(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 106 275 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
21.12.2016 Bulletin 2016/51

(21) Application number: **16174144.2**

(22) Date of filing: **13.06.2016**

(51) Int Cl.:
B27M 1/00 *(2006.01)* ***B26D 7/18*** *(2006.01)*
B26F 1/38 *(2006.01)* ***B24B 9/10*** *(2006.01)*

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
MA MD

(30) Priority: **16.06.2015 IT UB20151417**

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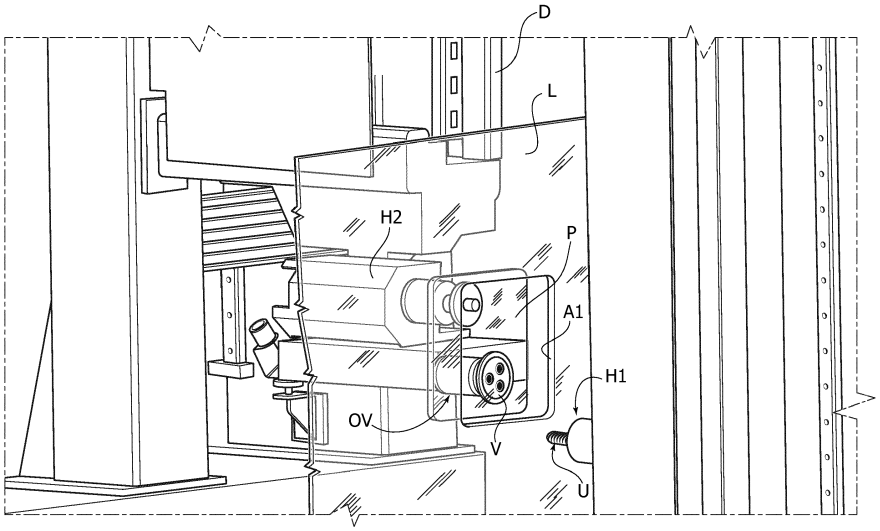
(54) MACHINE AND METHOD FOR PROCESSING PLATES

(57) A machine for processing plates, for example plates of glass, natural or synthetic stone material or slabs of wood or other suitable materials, comprises- a conveying device for advancing a plate (L) to be processed in a substantially vertical position along a first horizontal X direction, into and out from a processing station (W). The processing station (W) comprises at least a first plate machining head (H1) for machining the plate (L), movable along a second substantially vertical Y direction, and including a motorized spindle which can be coupled at least with a milling tool (U), which can be used to mill the plate (L) along a predetermined path, so as to form an opening (A1, A2) in the plate, with resulting removal of a portion of the plate (P) constituting a processing waste. The machine further comprises at least one suction-cup gripping member (V,S) for gripping said plate portion (P) constituting the processing waste, which can be activated by depression and is displaceable from a retracted position to an advanced position for engaging said plate portion (P) that must be removed as a result of said milling operation, before that the milling operation is terminated.

FIG. 4



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Description

Field of the invention

[0001] The present invention relates to machines for processing plates, for example plates of glass, plates of natural or synthetic stone material and slabs of wood or other materials suitable for the technology which is presented herein.

[0002] In particular, the invention relates to machines for processing plates, of the type comprising:

- a conveying device for advancing a plate to be processed in a substantially vertical position along a first horizontal X direction parallel to a general plane of the plate of glass, into and out from a processing station,
- said processing station comprising at least a first glass plate machining head, arranged on one side with respect to the general plane of the plate, said machining head being movable along a second substantially vertical Y direction, and including a motorized spindle having an axis directed along a third Z direction orthogonal to said first and second directions X,Y, said spindle being adapted to be coupled at least with a milling tool, which can be used to mill the glass plate along a predetermined path, so as to form an opening in the plate, said opening being spaced from a peripheral edge of the plate or extending from the peripheral edge of the plate, thus resulting in the removal of a portion over the plate constituting a processing waste, and
- electronic control means for controlling said machine, adapted to control said first machining head.

Prior art

[0003] Machines of the above indicated type have been produced and marketed since long by the Applicant. A machine of this type is also known for example from EP 2 039 464 B1. These machines have been used originally for performing drilling operations on the plates. To this end, they usually have a processing station comprising a first and second machining heads movable along the above mentioned substantially vertical Y direction, and arranged on opposite sides with respect to the general plane of the plate. The two machining heads have motorized spindles provided with drilling tools adapted to engage the plate from opposite sides, for performing a drilling operation trough the plate with no risk of damaging the plate. Machines of the above indicated type have been also used for machining the peripheral surface of the plates in order to remove the cutting edge originated from previous cutting operations. In more recent times, machines of this type have been further developed by providing automatic tool change on one or both the machining heads, in order to carry out different kinds of machining operations, such as grinding and polishing operations of the lateral surfaces of the plates, and, as indicated herein at the beginning, also milling operations, through which a portion of plate is removed in order to form an opening in the plate; the opening thus formed may be closed on its four sides, i.e. it may be entirely located inside the perimeter of the plate, or it may formed starting from a peripheral edge of the glass plate.

[0004] In the case of milling operations, the problem arises of eliminating the waste material generated by the machining operation. In the case of drilling operations, the machining waste material is typically let to fall down into a container provided at the bottom of the processing station. At present, the same is done also in the case of milling operations, but this poses a limit to the size of the opening which can be formed by the milling operation, because when the machining waste element has excessive dimensions it is not possible to let it fall down into the above mentioned container. For this reason, at present the technique is also adopted to interrupt the milling operation right before that the machining waste material becomes totally separated from the plate, so that an operator can remove the waste material by hand and subsequently start the plate machining process again. In some cases, the waste is divided in many portions, through smart programming of the strokes of the milling tool, thus ensuring that the portion which each time is removed from the plate always has dimensions sufficiently small to be able to fall into the waste container.

[0005] Obviously, the above described techniques are not considered to be satisfactory, since they impose limits to the milling operations which can be carried out and/or cause productivity losses due to the breaks in the processing cycle which are required for manually removing the processing waste materials and/or for dividing the waste in more parts, with resulting time losses.

Object of the invention

[0006] The object of the present invention is that of solving the above mentioned drawbacks, by proposing a new solution which can be advantageously used in machines of the above indicated type for removing the waste of the milling operations on the glass plates and which is not jeopardized by the limits which are proper of the known solutions.

Summary of the invention

[0007] In view of achieving this object, the invention applies to a machine having the features which have been indicated at the beginning of the present description and further characterized in that said machine comprises at least one suction-cup gripping member, for gripping said plate portion constituting the processing waste, said suction-cup gripping member being adapted to be activated by depression and being displaceable from a retracted position to an advanced position along a direction parallel to said Z third direction, for engaging said plate

portion constituting the processing waste that must be removed as a result of said milling operation, so as to hold said processing waste and prevent it from falling down after that the milling operation is completed.

[0008] Due to the above mentioned features, therefore, in the machine according to the invention the above mentioned gripping member is able to engage the processing waste, to remove it and then to hold it in a position spaced apart from the general plane of the plate, which does not interfere with the subsequent processing cycle of the plate. Therefore, with the invention, the processing waste materials originated from milling operations on the plate can be removed without involving any appreciable interruption in the processing cycle and with no limits to the dimensions of the processing waste materials. Once the gripping member has engaged and held a processing waste in a position spaced apart from the general plane of the glass plate, it is possible for an operator to pick up the waste material from the gripping member at the end of the processing cycle, or also during the processing cycle. It is not even excluded that the gripping member can be provided with an ability to move towards a position for automatic unloading of a previously taken processing waste.

[0009] In a first embodiment, said gripping member for gripping said plate portion constituting the processing waste is arranged at said processing station. Preferably, said gripping member provided at said processing station is movable along said second substantially vertical Y direction and said electronic means are programmed for carry out said milling operation so that in a last step of the machining operation the milling tool moves with respect to the plate only along said Y direction, so that during this last step the glass portion which must be removed can be held by said gripping member, since the plate does not move along the first direction X.

[0010] In the case that the machine is provided, in a way known per se, with first and second machining heads movable along said second substantially vertical Y direction on opposite sides of the plate, said gripping member for gripping said plate portion constituting the processing waste can be mounted at said processing station so as to be movable along said second substantially vertical Y direction independently with respect to said second machining head. Alternatively, the gripping member can be supported by said second machining head so that it is movable along said second Y direction together with said machining head.

[0011] In an alternative embodiment, the above mentioned gripping member is constituted by a suction-cup unit selected among the suction-cup units forming part of at least one suction-cup carrying carriage. In this case, the electronic control means of the machine are programmed to position said suction-cup carrying carriage with respect to the plate in such a way that said at least one selected suction-cup unit is engageable on said plate portion that must be removed as a result of said milling operation, keeping the at least one selected suction-cup unit completely within the perimeter of said plate portion. A solution is also foreseen in which one or more dedicated gripping members are provided on a dedicated suction-cup carriage, which is independent with respect to suction-cup carriages which are used for moving the glass plate.

[0012] The invention also provides a processing method which can be carried out by the machine according to the invention.

[0013] Further features and advantages of the invention will become apparent from the description which follows with reference to the annexed drawings, given purely by way of non-limiting example, in which:

- figure 1 is a perspective view of a machine according to the invention,
- figure 2 is a front view of the machine of figure 1,
- figures 3A-3F diagrammatically show the different steps of a milling operations which can be carried out for forming an opening in the glass plate which is entirely contained within the perimeter of the glass plate,
- figure 3G diagrammatically shows a glass plate at the end of a milling operation for forming an opening extending from a peripheral edge of the glass plate,
- figure 4 is a perspective view which shows a first exemplary embodiment of a gripping member for gripping a glass portion constituting the processing waste, and
- figure 5 is a perspective view which shows a second embodiment of the gripping member for gripping a plate portion constituting the processing waste.

[0014] The machine according to the invention is generally designated in the drawings by reference numeral 1. Purely by way of example, the drawings show the case of a machining operation carried out on a glass plate, while it must be understood that the machine can be used in general on plates of any type of material which is adapted to the technology discussed herein.

[0015] According to the conventional technique, the machine 1 comprises a fixed supporting structure 2 defining a processing line extending in a longitudinal direction X, along which the plates to be processed are caused to advance while being held in a substantially vertical plane. To this end, the machine comprises two longitudinal arrays of motorized rollers 3,4 (a view at an enlarged scale of a rollers 3 is visible in figure 5) extending along the longitudinal direction X, upstream and downstream of a central processing station W. The plates to be processed come from the left end (with reference to the drawings) of the machine and are supported at their lower edge on the line of rollers 3. As indicated, the plates are slightly inclined with respect to the vertical plane, so that with their rear face (i.e. the face opposite to that facing the viewer in the figures) they can rest on arrays of wheels R which are freely rotatable around vertical axes, these wheels being carried by longitudinal rods forming part of

a fixed frame 5. A similar frame 6, with wheels R for supporting the rear face of the machined plates, is arranged downstream of the processing station W (with reference to the direction of movement X of the plates).

[0016] Alternatively to rollers 3, 4, conveying belts or automated movable clamp members can be used as a device for conveying the plate in the X direction.

[0017] Also according to the conventional art, in the case of the illustrated example, the movement of the plate L in the X direction is further obtained by means of a plurality of suction-cup carriages C, provided with gripping members S which can be activated by depression and are movable from a retracted position to an advanced position for engaging the rear face of the plate L (that is the face opposite to that facing the viewer in the figures).

[0018] It is however to be noted, that the use of suction-cup carrying carriages is provided in the examples described herein, but does not represent an essential feature of the present invention. The conveying device which is used for advancing the plates along the direction Zx may simply comprise the above described motorized rollers and/or alternative devices, such as conveying belts and automated movable clamp members.

[0019] In the case of the embodiment described herein, each carriage C is independently slidably mounted on a longitudinal guide (not shown in the drawings) of the bottom fixed structure 2, so that it is movable in the X direction independently from the other suction-cup carrying carriages. According to a technique known per se, each carriage C is provided with motor means which drive its movement in the X direction, such as a motorized pinion in engagement with a rack. Also these details of construction are not illustrated herein, since they are known and do not fall within the scope of the invention. Also the details relating to the suction-cup gripping members S, the means for driving the movement of these suction-cup gripping members in a direction orthogonal to the glass plate, between a retracted position and an advanced position, and the means for communicating a depression to the suction-cup members are not illustrated herein, since they are known per se.

[0020] During the machining of a glass plate, the general plane of the glass plate L is defined by the suction-cup members S of the suction-cup carrying carriages C. The precise position of the plate L along the X direction is also defined by carriages C, whose motor means are controlled in synchronism by an electronic control unit E associated to the machine (figure 1).

[0021] Also according to the conventional art, the machining station W comprises a fixed column structure 7 on which two machining heads H1,H2 are mounted so as to be movable parallel to a substantially vertical direction Y, these machining heads each carrying a motorized spindle having an axis parallel to a third Z direction (figure 1) orthogonal to directions X and Y. According to a technique known per se, the spindle of each head can be coupled selectively with a machining tool (such as a grinding tool or a drilling tool, or a milling tool, or also a combined tool). As shown in figure 1, at the top of the vertical structure 7 there is provided a tool magazine carried by a rack which is movable horizontally along the direction X with respect to structure 7 to enable an automatic change of the tool carried by each machining head (H1, H2), according to a technique known per se. As clearly apparent, these details are shown herein purely by way of example, the general configuration of the machine being made in any known manner.

[0022] The two heads H1, H2 are provided on opposite sides with respect to the general plane of the plate to be machined, so that for example when on the spindles of the heads H1, H2 drilling tools are mounted, they can engage the plate L coaxially from opposite sides in order to properly carry out the drilling operation, according to a technique known per se.

[0023] Also according to the conventional art, the machining operations of the longitudinal edges (parallel to X) of the plate can be carried out by a movement of the carriages C along X, with simultaneous control of the position along Y of heads H1, H2 (which carry out simultaneously the grinding of the upper and lower edges of the plate). The machining of the vertical edges of the plate is carried out by stopping the carriages C and moving one of the heads H1, H2 along Y. In the case of machining operations of this type, on the spindles of heads H1, H2 grinding tools are mounted.

[0024] The movement of the machining heads H1, H2 in the Y direction, and the movement of the suction-cup carrying carriages C in the X direction are controlled by the electronic control unit E, according to any predetermined program.

[0025] Also according to the conventional art, the machine according to the invention is also used for carry out milling operations of the glass plate in order to form openings in the glass plate, of the type which is diagrammatically shown in figures 3A and 3G. To this end, only one of the two machining heads H1, H2 is used. In the case of the embodiment described herein, use is made in particular (but the choice could be different) of the machining head H1 which is located on the front part of the machine (with reference to figure 1) and which for this reason is also called the front machining head, so as to distinguish it from the machining head H2, which is called the rear machining head.

[0026] Figure 3A shows the case in which plate L has been subjected to a meaning operation in order to form an opening A therein which is closed on four sides, since it is entirely contained within the peripheral perimeter of the plate L. In order to form the opening A1, the plate L is moved along the X direction by the suction-cup carrying carriages C until it is positioned with respect to the vertical axis Y of movement of heads H1, H2 at the position shown in figure 3B. In this position the plate is subjected to a first drilling operation by which a hole F is obtained which is required for enabling subsequent engagement through the plate of a drilling tool. Once the drilling operation is performed (for example with the aid of both the machining

heads H1, H2) the motorized spindle of head H1 is provided with a milling tool U of the type visible at an enlarged scale in figure 4. The rotation of the milling tool U around its axis is then started while maintaining the front head H1 at a fixed position with respect to the vertical axis Y and simultaneously moving the glass plate L in the X direction, until forming the first side A of opening A1, as shown in figure 3C. In the subsequent step (figure 3D) the plate L is maintained at a fixed position with respect to the X direction, while the machining head H1 is moved upwardly along the Y direction (while rotation of tool U around its axis is always maintained active) so as to form the second side B of opening A1. Between segments A and B there is a radiused portion (which is obtained with a simultaneous movement along the X and Y directions). Figures 3E and 3F show forming the third and fourth sides, until reaching the final step in which the tool U returns to the starting position with a resulting total separation of the plate portion P constituting the machining waste. The third and fourth sides formed by the milling tool are designated in these figures by C and D.

[0027] Naturally, once the machining cycle shown in figures 3A, 3F is terminated, the plate portion P constituting the machining waste is no longer held and could therefore fall down by gravity. This is what actually happens in the machines made heretofore.

[0028] Figure 4 of the annexed drawings shows an important component of the machine according to the invention, according to a first embodiment. This figure shows the glass plate L at the end of a milling operation by which an opening A1 has been formed which is closed on four sides. Figure 4 also shows the plate portion P constituting the machining waste which is held in a position spaced apart from the general plane of the glass plate L by a suction-cup gripping member V comprising a suction-cup which can be activated by depression and which is carried by an associated support so as to be movable between a retracted position (shown in figure 4) and an advanced position, in a direction substantially orthogonal to the plane of the plate. In the illustrated example this suction-cup gripping member D is carried by the structure of the rear machining head H2 and is movable with it in the vertical direction Y along respective guides D.

[0029] The details of construction relating to the suction-cup member V, the means for communicating vacuum to the suction-cup and the means for moving the suction-cup in the direction orthogonal to the plate are not shown herein, since they can be made in any known way, for example in the same manner in which they are made for the suction-cups forming part of the suction-cup carrying carriages. On the other hand, the elimination of these details of construction from the drawings renders the latter simpler and easier to understand.

[0030] In the machine according to the invention, the suction-cup gripping member V is moved to its advanced position and is activated by vacuum for engaging the rear face (with reference to figure 4) of the plate portion P, before that the milling operation shown in figures 3A-3F is terminated, so as to hold the plate portion P and avoid that it falls when the milling operation is terminated. At that point, the suction-cup member V is brought back to its retracted position so that it removes the machining waste P and holds it at a position spaced from the general plane of the glass plate L, as shown in figure 4.

[0031] Due to this course of action, the machining waste P is therefore removed in a completely automated manner, thus enabling at the same time the machining cycle to be immediately continued once the meaning operation is terminated. When the machining waste P is in the position spaced from the plane of the plate which is shown in figure 4, where it is held by the suction-cup gripping member V, it is then possible to attend to removal of the machine waste without interfering with the machining cycle of the plate. For example, the plate portion P can be removed manually by an operator, or it can be provided that the gripping member V is brought to a position adjacent to a station for unloading the machining waste, where the waste can be automatically unloaded. The solution shown by way of example in figure 4 is particularly simple to provide, since the suction-cup member V is carried by the structure of the rear machining head H2, whereby the movement of the suction-cup member V along the vertical direction Y is obtained by the same means which are provided for the rear machining head H2. However, it is also possible to provide a suction-cup gripping member V constituting a separate unit with respect to the rear machining head H2 and movable along the Y direction on the same guides D2 of the rear machining head H2 or also on independent guides. Theoretically, it is also possible to provide a suction-cup gripping member V which can be moved both in the X direction and in the Y direction with respect to the structure of the machining station W, for obtaining maximum flexibility of operation. Naturally, furthermore, the suction-cup gripping member V can also be provided with more than one suction-cup V, or also more suction-cup members V can be provided which are movable independently from each other.

[0032] In one variant (not shown), the suction-cup for holding the waste is carried by a conical coupling element which can be coupled directly with the spindle of one of the two heads H1, H2. The advantage of this solution with respect to that described above lies in a lower cost of manufacture and also in a greater flexibility for what concerns the shape of the suction-cup. As a source of vacuum for activating the suction-cup, the vacuum pump of the main circuit of the machine can be used, by providing a solenoid valve for controlling supply of vacuum to the suction-cup. Alternatively, the system can be provided with a small pump on board the head which is able of generating vacuum by compressed air, due to the Venturi principle.

[0033] Also in the case of the embodiment of figure 4, the suction-cup gripping member V is able of moving along the direction Y, but is not able to move along the

X direction. Therefore, when the suction-cup gripping member V has gripped the plate portion P, before that the milling operation is terminated, is absolutely necessary that the remaining part of the milling operation does not imply a movement of the plate in the X direction. For this reason, with reference to figures 3A-3F, the machining cycle is carried out so that the last step of the operation involves forming a vertical portion of the opening perimeter.

[0034] In the case instead in which the opening to be formed in the glass plate L is an opening A2 extending starting from a peripheral edge of the glass plate (figure 3G), this means that a horizontal side A of the milling path is carried out firstly, after which the tool is removed from the glass plate and is then again engaged thereon for obtaining the second horizontal side B of the glass plate. The third vertical side is obtained lastly, after that the suction-cup V has engaged the rear face of the machining waste P.

[0035] According to an alternative embodiment, the present invention provides that as a gripping member for engaging and removing the machining waste at least a suction-cup unit S is used which is selected among the suction-cup units S forming part of one of the suction-cup carrying carriages C. Figure 5 shows one of the suction-cup carrying carriages C with the respective suction-cups S engaged on the rear face of a glass plate L. One of the suction-cups S is shown in its retracted position, with the machining waste P carried thereby and held in a plane spaced apart from the plane of the glass plate L, after in milling operation by which an opening A in the glass plate has been formed. This solution is obviously to be adopted only in the case in which the suction-cup carrying carriage C has one of its suction-cups S which can be contained completely inside a perimeter of the opening A1 which must be formed in the glass plate. However, in general, it is possible to provide a suction-cup carrying carriage dedicated solely to the above mentioned function, with a plurality of suction-cups of relatively small dimensions, which can be activated, singularly or in groups, for engaging the waste material whatever is its dimension and whatever is its position with respect to the glass plate. It would be also possible to provide a suction-cup carrying carriage of this type which is movable along the horizontal direction X and provided with one or more suction-cup members S which can be moved in the Y direction with respect to the carriage structure.

[0036] It can be also foreseen that each suction-cup unit S can pivot with respect to a pivot axis in order to find the more proper orientation in order to be contained inside the machining waste.

[0037] As it is clearly apparent, in the solution in which the machining waste is engaged by one or more suction-cup units carried by suction-cup carrying carriages, it is not necessary that the milling operation is programmed so that the last portion of the milling path is arranged along the substantially vertical Y direction, since the suction-cup carrying carriages are free to move in the X direction. The advantage is thus obtained that milling operations can be carried out along paths of any shape, for example also of circular shape. In the case of the first embodiment described herein, instead, a circular opening in the glass plate could be obtained by firstly forming a square opening contained within the desired circular perimeter and by than removing the square waste element in order to machine the edges of the square opening until the circular opening is obtained.

[0038] As it is clearly apparent from the foregoing description, due to the features which have been described herein, the invention enables the machining waste originated by a milling operation on a plate to be held and removed automatically, without the requiring interruptions in the machining cycle of a plate and therefore with great advantages for the productivity and without involving any limit on the dimensions of the machining waste which must be removed.

[0039] Naturally, while the principle of the invention remains the same, the details of construction and the embodiments may widely vary with respect to what has been described and illustrated purely by way of example, without departing from the scope of the present invention.

Claims

1. A machine for processing plates, for example plates of glass, natural or synthetic stone material or slabs of wood or other materials suitable for the present technology, comprising:

- a conveying device (3, 4; C) for advancing a plate (L) to be processed in a substantially vertical position along a first horizontal X direction parallel to a general plane of the plate (L), into and out from a processing station (W),
- said processing station (W) comprising at least a first plate machining head (H1) for machining the plate (L), said head being arranged on one side with respect to the general plane of the plate (L), said machining head (H1) being movable along a second substantially vertical Y direction, and including a motorized spindle having an axis directed according to a third Z direction orthogonal to said first and second directions X, Y, said spindle being adapted to be coupled at least with a milling tool (U), which can be used to mill the plate (L) along a predetermined path, so as to form an opening (A1, A2) in the plate said opening being spaced from a peripheral edge of the plate (L), or extending from a peripheral edge of the plate (L), thus resulting in the removal of a portion of the plate (P) constituting a processing waste, and
- electronic control means (E) for controlling said machine, adapted to control said first plate ma-

chining head (H1),

characterized in that said machine comprises at least one suction-cup gripping member (V, S) for gripping said plate portion (P) constituting the processing waste, said suction-cup gripping member (V, S) being adapted to be activated by depression and being displaceable from a retracted position to an advanced position along a direction parallel to said Z third direction, for engaging said plate portion (P) constituting the processing waste that must be removed as a result of said milling operation, so as to hold said processing waste (P) and prevent it from falling down after that the milling operation is completed ,
said gripping member (V, S) being displaceable back to its retracted position so as to remove the processing waste (P) and hold it in a position spaced apart from the general plane of the plate (L), after that the milling operation is terminated.

2. Machine according to claim 1, **characterized in that** said suction-cup gripping member (V) for gripping said plate portion (P) constituting the processing waste is provided at said processing station (W).

3. Machine according to claim 2, **characterized in that** said suction-cup gripping member (V) for gripping said plate portion (P) constituting the processing waste is provided at said processing station (W) and is movable along said second substantially vertical Y direction, said electronic control means (E) being programmed to perform said milling operation in such a way that in the final machining stage, a milling tool (U) moves relative to the plate only along said Y direction, so that during this last stage the plate portion (P) that must be removed can be held by said gripping member (S), **in that** the plate (L) is not moved in the first direction X.

4. Machine according to claim 3, **characterized in that** said gripping member (V) and said first machining head (H1) are arranged on opposite sides of the general plane of the plate.

5. Machine according to claim 4, **characterized in that** said processing station (W) is provided with a second machining head (H2) movable along said second substantially vertical Y direction on the side of the general plane of the plate opposite to that of the first machining head (H1), said second machining head (H2) being provided with a motorized spindle having an axis directed along said third Z direction and adapted to be coupled with one or more machining tools, and **in that** said gripping member (V) for gripping said plate portion (P) constituting the processing waste is mounted movable at said processing station (W) along said second substantially vertical Y direction independently from said second machining head (H2), either along guides which said gripping member has in common with said second machining head (H2), or along separate guides.

6. Machine according to claim 4, **characterized in that** said processing station (W) is provided with a second machining head (H2) movable along said second substantially vertical Y direction on the side of the general plane of said plate opposite to that of the first machining head (H1), said second machining head (H2) being provided with a motorized spindle having an axis directed along said third Z direction and adapted to be coupled with one or more machining tools, and **in that** said gripping member (V) for gripping said plate portion (P) constituting the processing waste is supported by, or is otherwise associated with, said second machining head (H2), whereby said gripping member can move along said substantially vertical second Y direction together with the second machining head (H2).

7. Machine according to claim 6, **characterized in that** said gripping member (V) for gripping said plate portion (P) constituting the processing waste is adapted to be coupled with the spindle of the second machining head (H2).

8. Machine according to claim 1, **characterized in that** it comprises at least one suction-cup carrying carriage (C) movable in said first direction X under the control of said electronic control means (E) and carrying a plurality of suction-cup units (S) adapted to be activated by depression and engageable on the plate (L) to support and/or moving the plate (L) along said first direction X while it is machined at said processing station (W), while precisely defining a lying plane for said plate (L),
in that said suction-cup gripping member for gripping said plate portion (P) constituting the processing waste is constituted by at least one suction-cup unit (S) selected from the suction-cup units (S) forming part of said at least one suction-cup carrying carriage (C) which is movable in the first direction X, and
in that said electronic control means (E) are programmed to position said suction-cup carrying carriage (C) with respect to the plate (L) in such a way that said at least one selected suction cup unit (S) is engageable on said plate portion (P) that must be removed as a result of said milling operation, keeping the at least one selected suction-cup unit (S) completely within the perimeter of said plate portion (P).

9. Machine according to claim 8, **characterized in that** said suction-cup carrying carriage (C) which carries said at least one gripping member is solely dedicated to the function of carrying said gripping member.

10. A method for processing plates (L), for example plates of glass, natural or synthetic stone material, slabs of wood or other materials suitable for the present technology, in which:

at least one plate (L) to be processed is advanced through a processing station (W) in a substantially vertical position along a first horizontal X direction parallel to a general plane of the plate (L),

- said processing station (W) comprising at least a first plate machining head (H1) for machining the plate (L), said head being arranged on one side with respect to the general plane of the plate (L), said machining head (H1) being movable along a second substantially vertical Y direction, and including a motorized spindle having an axis directed according to a third Z direction orthogonal to said first and second directions X, Y, said spindle being adapted to be coupled at least with a milling tool, which can be used to mill the plate (L) along a predetermined path, so as to form an opening (A1, A2) in the plate said opening being spaced from a peripheral edge of the plate (L), or extending from the peripheral edge of the plate (L), thus resulting in the removal of a portion of the plate (P) constituting a processing waste, and

said method being **characterized in that** at least one suction-cup gripping member (V, S) is provided for gripping said plate portion (P) constituting the processing waste, said suction-cup gripping member being adapted to be activated by depression and being displaceable from a retracted position to an advanced position along a direction parallel to said Z third direction and **in that** said gripping member (V, S) is brought to its advanced position and is activated by depression for engaging said plate portion (P) constituting the processing waste that must be removed as a result of said milling operation, so as to hold the processing waste (P) and prevent it from falling down after that the milling operation is completed, said gripping member (V, S) being displaced back to its retracted position so as to remove the processing waste (P) and hold it in a position spaced apart from the general plane of the plate (L), after that the milling operation is terminated .

11. Method according to claim 10, **characterized in that** said gripping member (V) is arranged at said processing station (W) and is movable along said second substantially vertical Y direction, and **in that** said milling operation is performed in such a way that in the final machining stage, a milling tool moves relative to the plate only along said Y direction, so that during this last stage the plate portion (P) that must be removed can be held by said gripping member (S), **in that** the plate is not moved in the first direction X.

12. Method according to claim 8, **characterized in that** at least one suction-cup carrying carriage (C) is provided, which is movable in said first direction X and carrying a plurality of suction-cup units (S) adapted to be actuated by depression and engageable on the plate, to support and/or moving the plate (L) along said first direction X while it is machined at said processing station (W), while precisely defining a lying plane for said plate (L),
in that said suction-cup gripping member for gripping said plate portion (P) constituting the processing waste is constituted by at least one suction-cup unit (S) selected from the suction-cup units (S) forming part of said at least one suction-cup carrying carriage (C) which is movable in the first direction X, and **in that** said suction-cup carrying carriage (C) is positioned with respect to the plate (L) in such a way that said at least one selected suction-cup unit (S) is engaged on said plate portion (P) that must be removed as a result of said milling operation, keeping the at least one selected suction-cup unit (S) completely within the perimeter of said plate portion (P).

FIG. 1

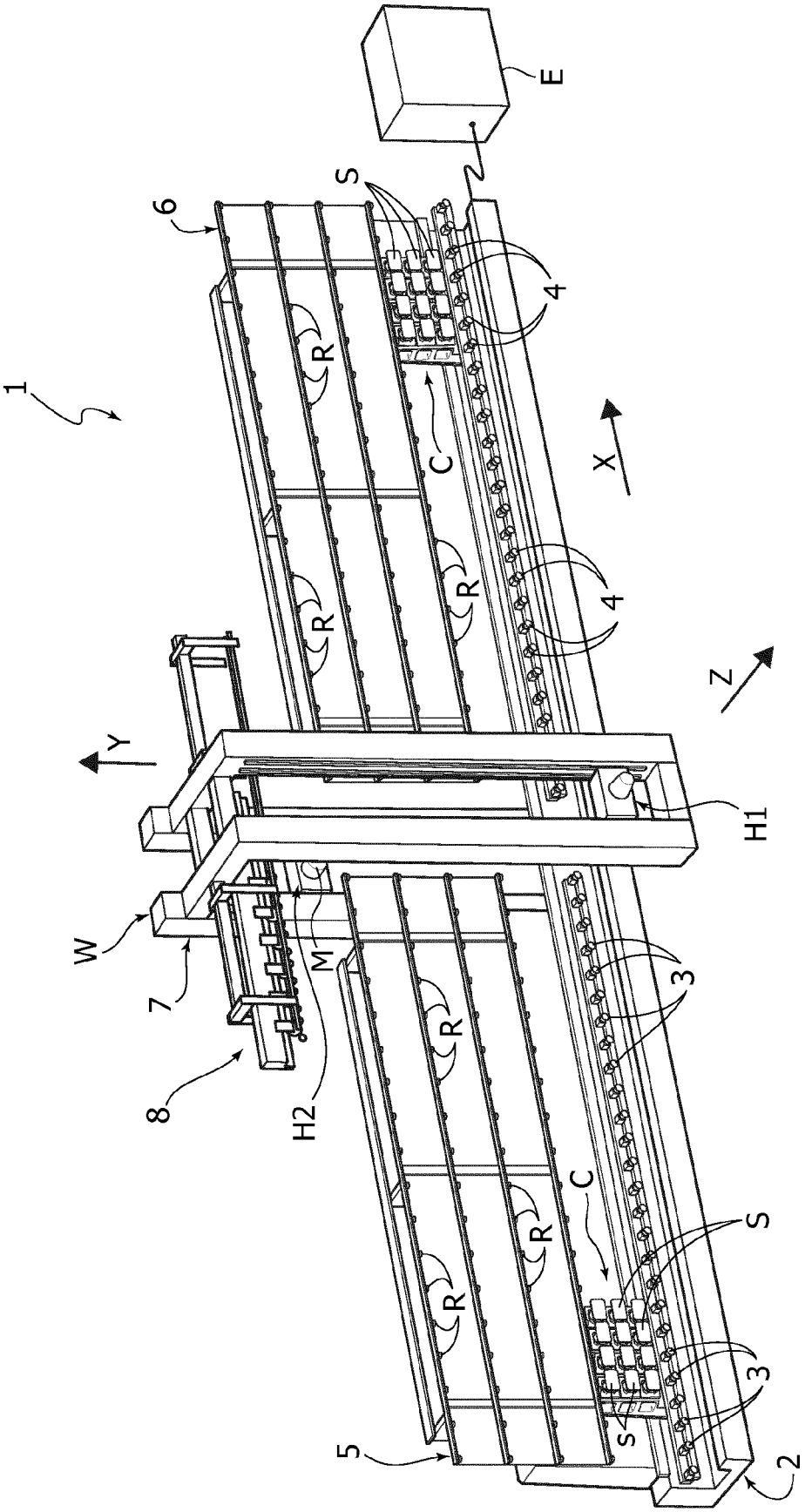


FIG. 2

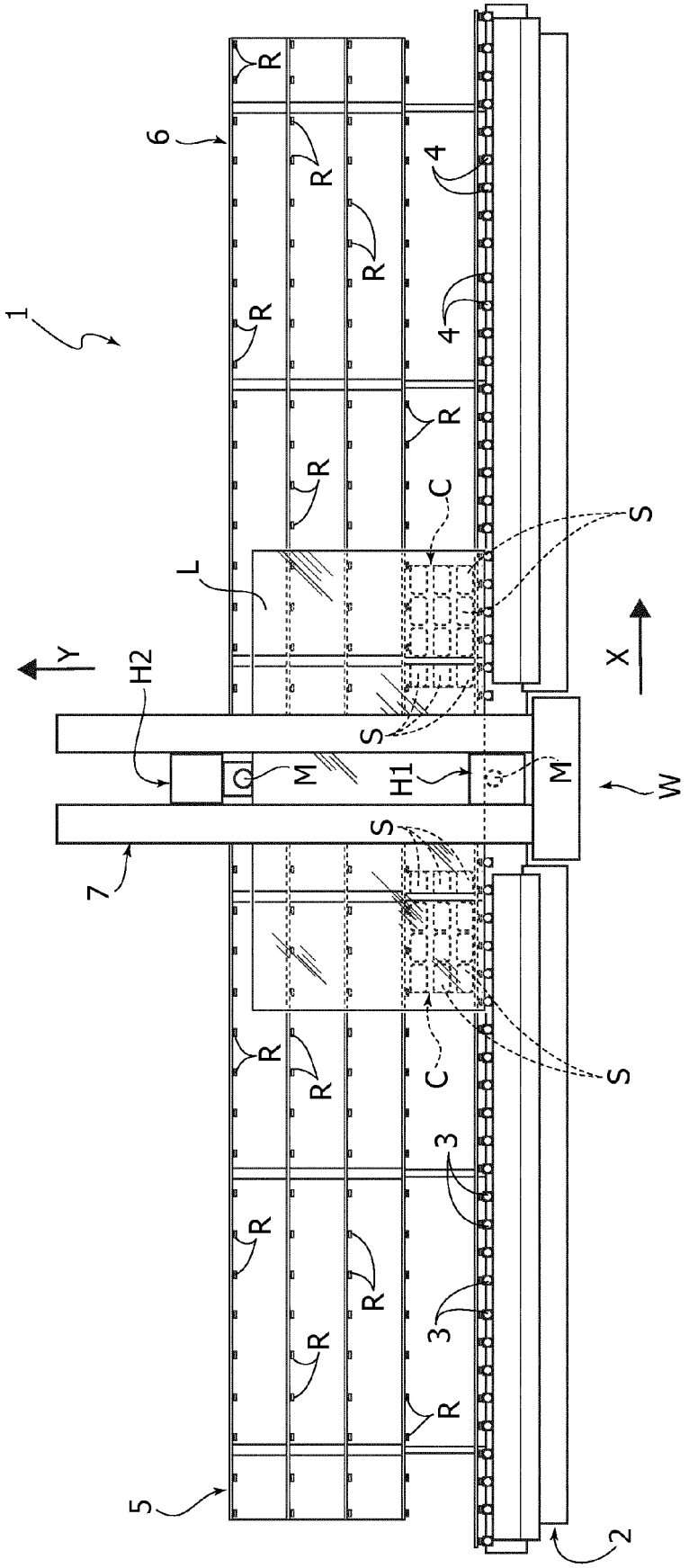


FIG. 3A

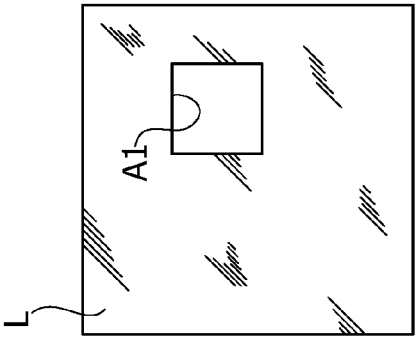


FIG. 3B

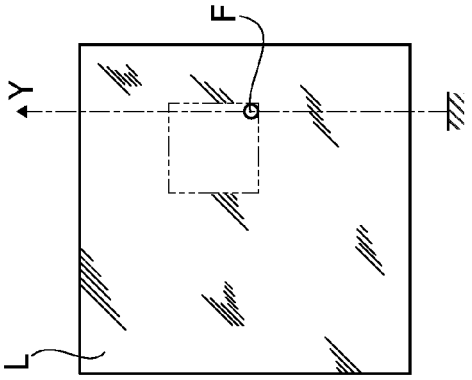


FIG. 3C

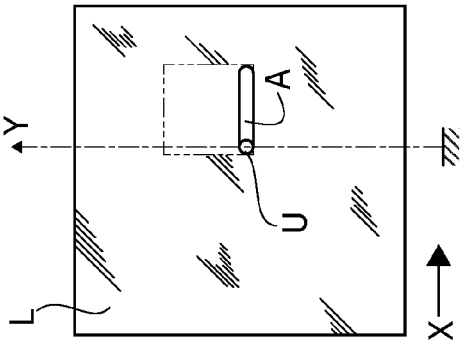


FIG. 3D

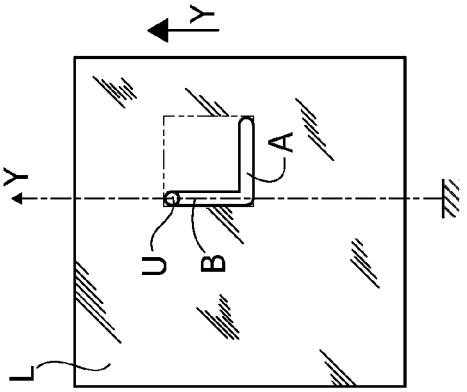


FIG. 3E

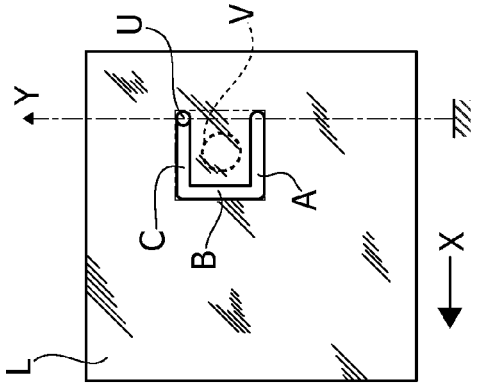


FIG. 3F

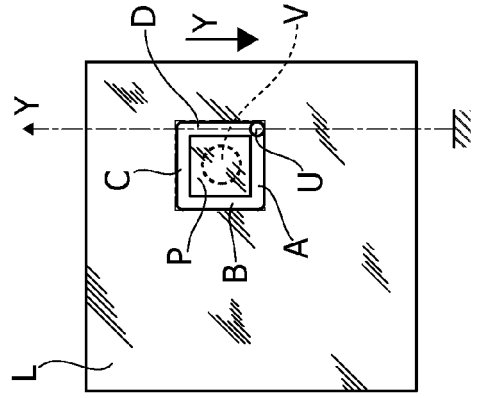


FIG. 3G

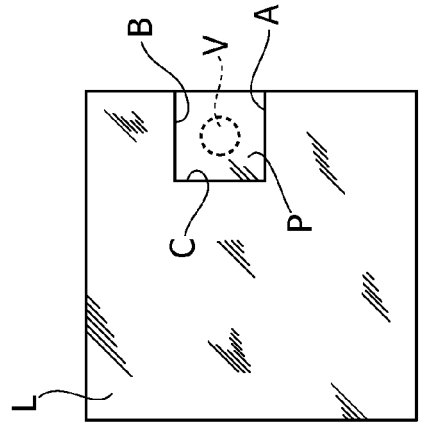


FIG. 4

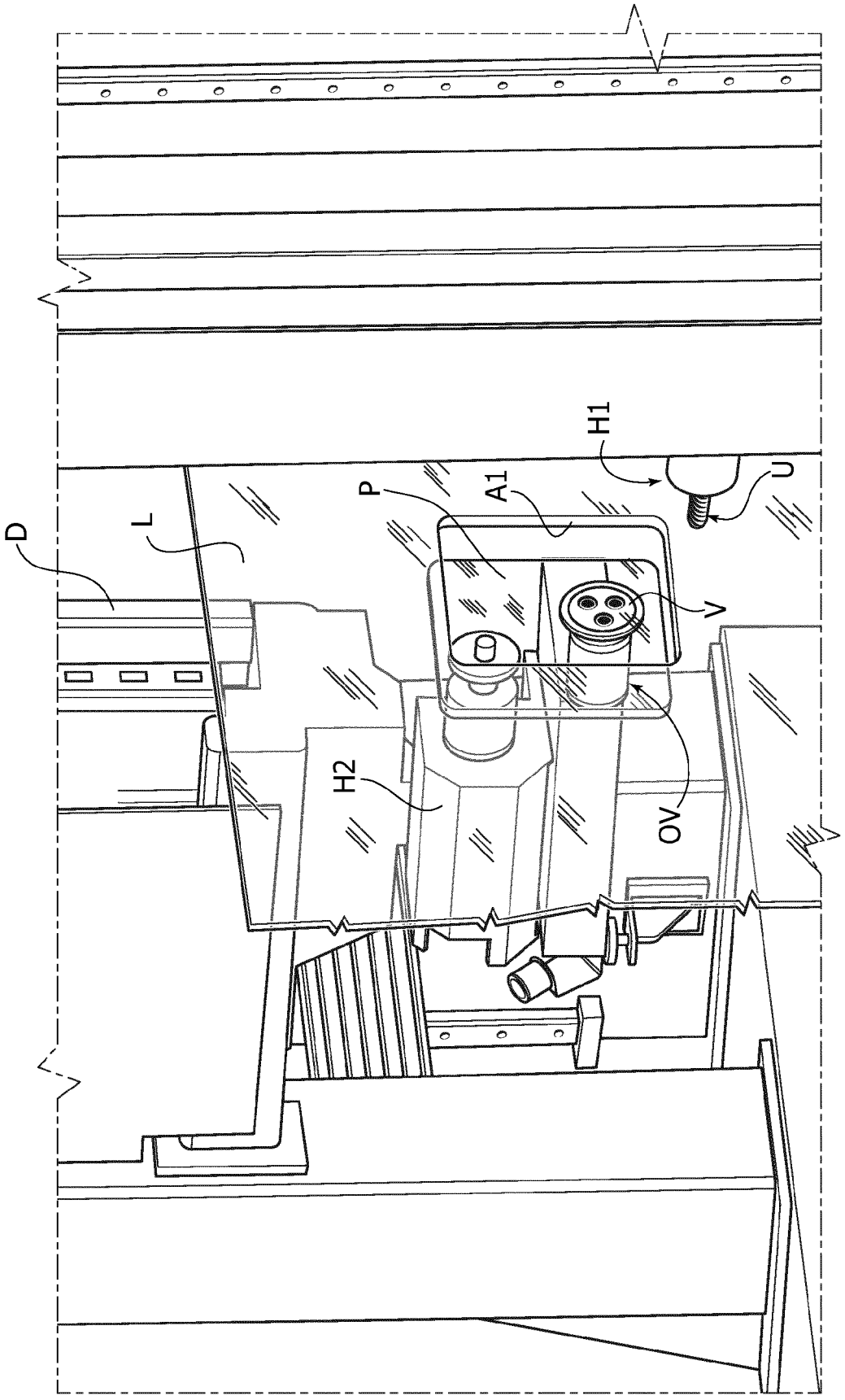
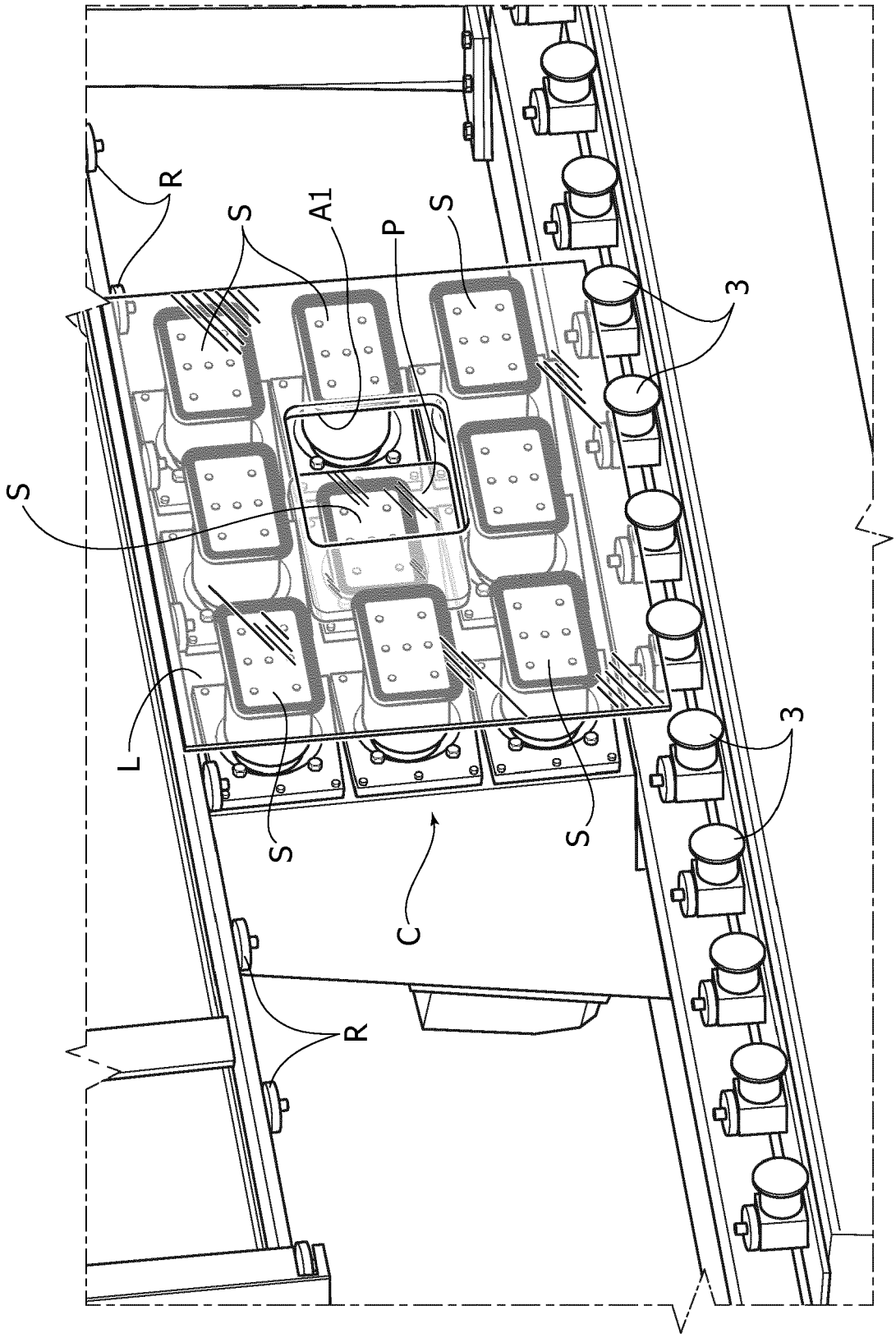


FIG. 5



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EUROPEAN SEARCH REPORT

Application Number
EP 16 17 4144

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	EP 2 719 501 A1 (BIESSE SPA [IT]) 16 April 2014 (2014-04-16) * the whole document * -----	1-12	INV. B27M1/00 B26D7/18 B26F1/38
A	US 2010/011927 A1 (LEE JAE-PIL [KR] ET AL) 21 January 2010 (2010-01-21) * the whole document * -----	1-12	B24B9/10

TECHNICAL FIELDS SEARCHED (IPC)

B27M
B26D
B26F
B24B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	2 November 2016	Antolí Jover, Jordi

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