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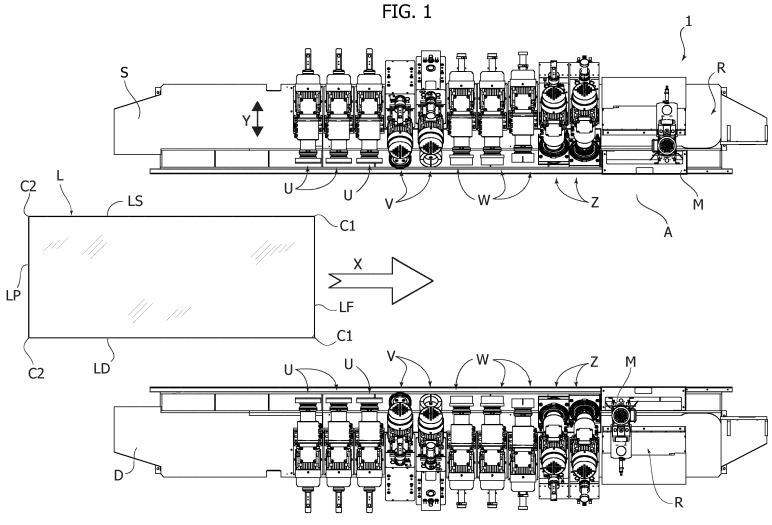
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Amended claims in accordance with Rule 137(2) EPC.

(54) BILATERAL MACHINE FOR MACHINING EDGES OF PLATES WITH INTEGRATED CORNER RADIUSING DEVICES

(57) In a bilateral machine (1) for machining the edges of plates (L) made of glass or stone there is included at least one radiusing device (R) for forming a radiused circular profile at one or more corners (C1, C2) of the plate (L) defined between two adjacent sides of the plate (L). Two radiusing devices (R) are preferably provided on the two banks (D, S) of the bilateral machine (1), downstream of tool units (U, V, W, Z) for machining the lateral edges of the plate (L). The radiusing devices (R) are configured and controlled for performing the radiusing operation of one or more corners (C1, C2) of the plate while the plate (L) advances through the work area (A) of the machine (1).

FIG. 1



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Description

[0001] The present invention relates to bilateral machines for machining edges of plates made of glass or stone and stone materials in general, of the type including a frame which comprises two banks each provided with a plurality of machining units and defining therebetween a machining area through which a plate to be machined is caused to advance, wherein the machining units on the two banks of the machine are adapted to perform a machining operation of the two lateral edges of the plate while the latter advances through the machining area.

[0002] The object of the present invention is that of providing a bilateral machine of the above indicated type which enables new functionalities and further types of machining operations to be integrated therein, with the advantage of greater productivity and flexibility of the plant and elimination of space and resources which otherwise would be required for providing machines dedicated to performing the above mentioned further machining operations.

[0003] In view of achieving this object, the invention provides a bilateral machine of the above indicated type, whose main feature lies in that within said machine there is included at least one radiusing device adapted to impart a circular radiused profile to the plate being machined at least at one corner defined between two adjacent sides of the plate.

[0004] In the present description and in the following claims, the expression "edge of the plate" is used to indicate anyone of the sides of the plate. In the typical case of a quadriangular plate, the expression "lateral edges of the plate" designates the two sides of the plate which are parallel to the direction of advancement of the plate along the machining area. Again in the typical case of a quadriangular plate, the expression "corner of the plate" designates anyone of the four corners which, in a plan view of the plate, are defined between the side edges and the front and rear edges of the plate.

[0005] It is also to be noted that each of the lateral edges of the plate may be a surface having two longitudinal arris or "corners". Naturally, the "corner" of each lateral edge is therefore a longitudinal arris (a line), which has nothing to do with the "corner" which, in a plan view of the plate, is defined between one lateral edge of the plate and the front edge or the rear edge of the plate.

[0006] In one embodiment, the machine according to the invention comprises two radiusing devices arranged on the above mentioned two banks of the machine and configured and controlled for performing simultaneously a radiusing operation of the two head corners of the plate in a first step and a radiusing operation of the two trailing corners of the plate in a second step, while the plate advances through the machining area of the bilateral machine.

[0007] Also in the case of this embodiment, each radiusing device comprises a tool unit including a grinding wheel-tool with vertical axis, which is displaceable in a coordinated manner both in the longitudinal horizontal direction of advancement of the plate and in a horizontal direction transverse relative to said longitudinal direction, so that said tool is able to follow with its axis a circular path, with respect to the advancing plate, around a vertical axis located inside the perimeter of the plate.

[0008] According to a first solution, the movements of the tool unit of each radiusing device along the longitudinal and transverse directions are operated by respective actuator devices controlled by an electronically controlled (CNC) unit, which can be programmed for coordinating said movements along said transverse and longitudinal directions so as to displace the axis of the tool along the desired curved path relative to the moving plate.

[0009] In the case of this solution, the abovementioned electronic control unit can be programmed both for setting the desired value of the radius of the radiused profile to be provided on the plate, and for compensating progressive wear of the tool due to repeated machining operations, by accordingly adjusting the radius of the circular path followed by the axis of the tool relative to the plate, as well as for adjusting the speed of the radiusing machining operation.

[0010] Also in the case of this first solution, it can be provided that the control unit retrieves (also in real time) data relating to the dimensions of the plate and the advancement speed thereof (for example on the basis of signals from sensor means provided in the bilateral machine for detecting passage of the front edge and/or the rear edge of the plate). The control unit is therefore able to control movement of the tool during the radiusing operation on the basis of geometrical and kinematic parameters of the machining operation.

[0011] In a second solution, each radiusing device comprises:

- a fixed support structure,
- a slide slidably mounted in said longitudinal direction above said support structure,
- first and second abutments for abutting engagement with the plate, said abutments being carried by said slide and being adapted to cooperate with the front edge and the rear edge of the plate respectively,
- each of said abutments being movable between a raised operative position and a lowered inoperative position,
- in such a way that during the radiusing operation of a front corner of the plate, said first abutment is in its raised position and the plate engages said first abutment with its front edge thereby causing advancement of said slide in the longitudinal direction together with the plate, due to the pushing action of the plate,
- said support structure being further provided with an actuator to positively control a displacement of said slide in the longitudinal direction,
- in such a way that during the radiusing operation of a rear corner of the plate, said second abutment is

in its raised position and the slide is pushed by said actuator so as to bring and hold said second abutment in engagement against the rear edge of the plate, thereby causing advancement of said slide in the longitudinal direction, together with the slide, due to the pushing action of said actuator.

[0012] Also in the case of this solution, preferably each radiusing device further comprises:

- a platform mounted so that it can float both in the longitudinal direction and in the transverse direction above said slide, said platform carrying a tool unit which on its turn carries said grinding wheel-tool having a vertical axis,
- a cam device, including a cam track and a cam-follower member carried respectively by said platform and by said slide, or vice versa, and

- auxiliary actuating means for activating a relative movement between said cam track and said cam-follower member while holding them in contact with each other,
- said cam track being configured to give rise to the desired movement of the tool with respect to the plate, during the joint advancement of the plate and the slide, in order to perform the radiusing operation.

[0013] In the case of a specific example, said cam track includes two symmetrical sections which are operative respectively during the radiusing operation of a front corner and during the radiusing operation of a rear corner of the plate and said auxiliary actuating means comprise a pair of actuating cylinders interposed between said slide and said platform and adapted to be selectively activated so that one of them is elongated and the other is shortened, or vice versa, for respectively generating the relative motion between each section of the cam track and the cam-follower member.

[0014] Preferably, said actuating cylinders are provided with manually adjustable flow regulators for adjusting the machining speed in the radiusing operation.

[0015] In one variant, the cam device is eliminated and the movements of the tool unit relative to slide 11 along direction X and along direction Y are operated by two respective actuators controlled by an electronic (CNC) control unit, which provides to coordinating these movements for obtaining the desired path of the axis of tool M relative to the moving plate.

[0016] Independently from what is the selected embodiment, the machine according to the invention is able to perform a complete grinding and radiusing machining of a plate, with a processing time lower for example with respect to that which is required by an electronically controlled machining centre adapted to perform these operations, and with optimal machining quality. The integration of a device adapted to perform radiusing of the corners of the plate within a bilateral machine enables saving of the space and resources necessary for providing machines dedicated to performing the radiusing operation only, subsequently to a conventional machining operation carried out by the bilateral machine. Therefore also dead times for transferring the plates from the bilateral machine to the machine performing the radiusing operation are also avoided, so that also productivity of the plant is improved.

[0017] The present invention is also directed to the machining method which can be carried out by the machine according to the invention.

[0018] Further features and advantages of the invention will become apparent from the following description with reference to the annexed drawings, given purely by way of non limiting example, in which:

- figure 1 is a diagrammatic plan view of a bilateral machine according to the invention,
- figure 2 is a perspective view of a glass plate with radiused corners, obtained by the machine of figure 1,
- figure 3 is a diagrammatic view of a corner of the plate, which shows the mode of operating of the tool forming part of the radiusing device integrated in the machine of figure 1,
- figure 4 is a plan view at an enlarged scale of a radiusing device according to an exemplary embodiment of the invention, and
- figures 5-10 show different operative conditions of a radiusing device according to the solution of figure 4.

[0019] In figure 1, reference L generally designates a glass plate blank, of a quadriangular shape, which is caused to advance horizontally in the machining area A defined between right and left lateral banks D, S constituting the frame of a bilateral machine 1. The two banks D, S have respective support structures each carrying a number of longitudinally aligned tool units U, V, W and Z including respective grinding wheel-tools for machining the two lateral edges LD, LS of the glass plate L, while this is caused to advance through the machining area A by a conveyor system of any known type (not shown) such as a belt conveyor system. As in the conventional art, each of the tool units U, V, W and Z on each bank of the machine is movable also in a transverse direction Y relative to the longitudinal direction X of advancement of plate L, with the aid of actuator means of known type.

[0020] According to the invention, in the two banks D, S of the bilateral machine 1, downstream of the tool units U, V, W, Z (with reference to the direction of advancement of the plate L) there are integrated two radiusing devices R configured and controlled for simultaneously performing the radiusing operation of the two head corners C1 of plate L in a first step, and the radiusing operation of the two trailing corners C2 of plate L in a second step. The result of this machining operation is a glass plate L having radiused corners C1', C2', as shown for example in figure 2.

[0021] By the expression "radiusing operation" the machining operation is meant by means of which each corner of the plate is given a rounded circular profile r1 (see figure 3). To this end, each radiusing device R comprises a grinding wheel-tool M having a vertical axis M1. According to the invention, while the plate L is advancing in direction X, tool M (see again figure 3) is moved relative to plate L both in direction X and direction Y with movements which are coordinated in such a way that the axis M1 of the tool M is moved, relative to the moving plate L, so that it follows a circular path R1 having a radius RR around a vertical axis C lying inside the perimeter of the plate L (see figure 3).

[0022] Naturally, the possibility is not excluded that a single radiusing device is provided only on one of the two banks of a machine. Also, it is not essential that the two radiusing devices are operated simultaneously, since it is absolutely possible that a radiused profile is formed only on one of the corners of the plate or only on some of the corners of the plate. Furthermore, it is advantageous that the radiusing devices are operated while the plate is moving, in order to obtain a minimum cycle time, but the possibility is not excluded that they are operated with the plate being in a stationary position.

[0023] In a first embodiment, not shown, the tool unit carrying the tool M is movable along directions X, Y with the aid of respective actuator devices (such as electric or pneumatic actuators) controlled by an electronic control unit (CNC). The electronic unit can be programmed for performing an interpolation of the movements along the X and Y directions so as to obtain the desired path of the tool M relative to plate L, while the plate is moving. This can be done both for machining the front corners of the plate, i.e. the corners located on the front side of the plate, with reference to the direction of advancement through the machine, and for performing the radiusing operation of the trailing corners of the plate.

[0024] This solution has the advantage of enabling a high operative flexibility. The electronic unit can indeed be programmed for setting the desired value of the ray of the rounded profile to be formed at a given corner of the plate. It is further possible to vary the control parameters so as to take into account the progressive wear of the grinding wheel-tool, by reducing the radial distance RR (figure 3) depending upon the reduction of the ray of the grinding wheel M. Furthermore, the electronic control (CNC) unit can also enable the speed of the radiusing operation to be adjusted.

[0025] Figures 4-10 relate to a second embodiment. With reference initially to figures 4, 5, each of the two radiusing devices R provided on the two banks of the machine includes a fixed supporting bench 10 on which the structure of a slide 11 is slidably mounted along direction X. The slide 11 extends transversally with respect to the supporting bench 10 both on its side facing towards the machining area A through which the plate L is moved, and on its opposite outer side. On the side facing towards the machining area A, the front of each slide 11 carries two abutments 13, 12 for engaging the plate (that are visible in figure 4) which are respectively for cooperation with the front edge LF and with the rear edge LP of the plate, in a way which will become clear in the following. These abutments 12, 13 are movable vertically, with the aid of actuators of any type, such as pneumatic cylinders (not shown), between a raised operative position and a lowered inoperative position, in which they do not interfere with the passing plate.

[0026] Figure 5 shows plate L in a position in which it has not yet come to engage the two radiusing devices R, which therefore are in a waiting condition. In this condition, the plate engaging abutments 12, 13 are both lowered.

[0027] During the radiusing operation of a front corner C1 of the plate L (figures 6, 7) the abutment 13 of each device R is in a raised position and the plate L engages said abutment 13 with its front edge LF thereby causing advancement of said slide 11 in the longitudinal direction X together with the plate L, simply due to the pushing action of the plate.

[0028] Each radiusing device R comprises a platform 14 mounted so that it can float both in the longitudinal direction X and in the transverse direction Y above said slide 11 (for instance with the aid of an arrangement including two superimposed guides arranged in a cross, not shown in the drawings). Platform 14 carries a tool unit 15 carrying on its turn said grinding wheel-tool M having a vertical axis.

[0029] The radiusing device R of the exemplary embodiment illustrated herein further comprises a cam device T, P, including a cam track T and a cam-follower member P (such as in form of a wheel having a vertical axis) respectively carried by said platform 14 and said slide 11 (or vice versa). Auxiliary actuating means Q1, Q2 are further provided for activating a relative movement between said cam track T and said cam-follower member P while keeping them in contact with each other, so as to give rise to the desired movement of tool M relative to plate L, during the joint advancement of the plate L and the slide 11, in order to carry out the radiusing operation.

[0030] In the illustrated example, said cam track T includes two symmetrical sections t1, t2 which are active respectively during the radiusing operation of a front corner C1 and during the radiusing operation of a rear corner C2 of the plate. The above mentioned auxiliary actuator means comprise a pair of actuating cylinders Q1, Q2 interposed between the above mentioned slide 11 and the above mentioned platform 14 and adapted to be activated selectively so that one is shortened and the other is extended, or vice versa, for respectively generating the relative movement of the cam-follower member P on section t1 and on section t2 of the cam track T.

[0031] Figure 6 shows the initial step of the radiusing operation of a front corner C1 of the plate. Starting from this condition, while slide 11 advances along direction X, being pushed by plate L, the auxiliary actuating means

Q1 and Q2 are activated so that one is extended and the other one is shortened in order to generate the relative movement between the section t1 of the cam track T and the cam-follower member P (figure 7) which generates the desired movement of tool M relative to plate L.

[0032] When the radiusing operation of the two front corners of the plate is terminated, the slide 11 is brought back to a position more upstream, by activating an actuating device (not shown in the drawings) such as a pneumatic cylinder, which is provided on structure 10 and is connected to slide 11. In this step, the abutments 12, 13 are in their lowered positions, so as to enable plate L to pass above them. When the trailing edge LP of the plate has passed beyond the radiusing devices (figure 8) slide 11 is moved again forwardly in the X direction by activating the above mentioned actuating device, so as to follow the plate until contact of the abutment 12 (which in the meantime has been raised) of each radiusing device R against the rear edge LP of the plate (see figure 9).

[0033] At this point the radiusing operation can be carried out due to that the auxiliary actuators Q1, Q2 are activated so that one of them is shortened and the other one is extended, while slide 11 continues to be positively pushed by the actuator associated thereto so that it moves together with plate L. Activation of the two auxiliary actuators Q1, Q2 causes relative movement between the cam track T and the cam-follower member P, with engagement of the latter on section t1 of the cam track T (figure 7). As a consequence, the tool M is moved relative to the moving plate thus performing the desired curved path.

[0034] As already indicated herein, the actuating cylinders can be provided with manually adjustable flow regulators for adjusting the speed of the machining operation.

[0035] Alternatively to the embodiment illustrated herein it is also possible to provide f a solution having the same arrangement of the slide 11 with abutments 12 and 13, and wherein the slide 11 is also pushed by plate L during the radiusing operation of the front corners of the plate, and is positively driven by an actuator so that it moves with the plate during radiusing operation of the rear corners. However, in this variant, the cam device is not used and the tool unit is operated for its movements along the X direction and along the Y direction relative to slide 11 by two respective actuators controlled by an electronic (CNC) control unit, which is adapted to coordinate these movements for obtaining the desired path of the axis of tool M relative to the moving plate.

[0036] 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. Bilateral machine (1) for machining edges of plates (L) made of glass or stone and stone materials in general, including a frame which includes two banks (D, S) each provided with a plurality of machining units (U, V, W, Z) and defining between them a machining area (A) through which a plate (L) to be machined is caused to advance, wherein the machining units (U, V, W, Z) on the two banks of the machine are adapted to machining of the two lateral edges (LD, LS) of the plate (L) while the latter advances through the machining area (A),
characterized in that within said machine (1) there is included at least one radiusing device (R) for imparting a circular radiused profile (r1) to the plate (L) at least at one corner (C1, C2) defined between two adjacent sides of the plate (L).

2. Bilateral machine according to claim 1, **characterized in that** it comprises two radiusing devices (R) arranged on the two aforementioned banks (D, S) of the machine and configured and controlled to perform simultaneously in a first phase the radiusing operation of the two head corners (C1) of the plate and in a second phase the radiusing operation of the two trailing corners (C2) of the plate, while the plate (L) advances through the machining area (A) of said bilateral machine.

3. Bilateral machine according to claim 1 or 2, **characterized in that** each radiusing device (R) comprises a tool unit including a grinding wheel-tool (M) with vertical axis (M1), which is displaceable in a coordinated manner both in the longitudinal horizontal direction (X) of the plate (L), and in a horizontal direction (Y) transverse to said longitudinal direction (X), in such a manner that said tool (M) is capable of following with its axis (M1), relative to the plate (L) which is advancing, a circular path (R1) around a vertical axis (C) located inside the perimeter of the plate (L).

4. Bilateral machine according to claim 3, **characterized in that** the movements of said tool unit (15) of the radiusing device (R) along the longitudinal and transverse directions (X, Y) are operated by respective actuating devices controlled by an electronic numerical control unit, programmable to coordinate the movements along said two directions (X, Y) so as to move the axis (M1) of the tool (M) according to the desired curved path with respect to the moving plate (L).

5. Bilateral machine according to claim 4, **characterized in that** said electronic control unit is programmable so as to enable adjustment of the desired value of the radius of the radiused profile to be obtained

at a given corner of the plate (L).

6. Bilateral machine according to claim 4, **characterized in that** said electronic unit is programmable to compensate for wear of the tool (M).

7. Bilateral machine according to claim 4, **characterized in that** said electronic unit is programmable to adjust the speed of execution of the radiusing operation.

8. Bilateral machine according to claim 4, **characterized in that** the electronic control unit is arranged to obtain data on the size of the plate and on the advancement speed thereof on the basis of signals from sensor means provided in the bilateral machine and adapted to detect passage of the front edge and/or the rear edge of the sheet, the control unit being thus able to control movement of the tool (M) during the radiusing operation on the basis of geometry and speed processing parameters.

9. Bilateral machine according to claim 3, **characterized in that** each radiusing device includes:

- a fixed support structure (10),
- a slide (11) slidably mounted in said longitudinal direction (X) above said support structure (10),
- first and second abutments (13, 12) for abutting engagement with the plate, carried by said slide (11) and intended to cooperate respectively with the front edge (LF) and with the rear edge (LP) of the plate (L),
- wherein each of said abutments (13, 12) is movable between a raised operative position and a lowered inoperative position,
- in such a way that during the radiusing operation of a front corner (C1) of the plate (L) said first abutment (13) is in its raised position and the plate (L) engages with its front edge (LF) said first abutment (13) causing the advancement of said slide (11) in the longitudinal direction (X) unitarily to the plate (L), simply as a result of the pushing action of the plate,
- said support structure (10) being provided with an actuator to positively control a displacement of said slide (11) in the longitudinal direction (X),
- in such a way that during the radiusing operation of a rear corner (C2) of the plate (L), said second abutment (12) is in its raised position and the slide (11) is pushed by said actuator so as to bring and maintain the second abutment (12) in engagement with the rear edge (LP) of the plate, thus causing the advancement of said slide (11) in the longitudinal direction (X), unitarily to the plate (L), due to the pushing action of said actuator.

10. Bilateral machine according to claim 9, **characterized in that** each radiusing device (R) further comprises:

- a platform (14) mounted so that it can float both in the longitudinal direction (X) and in the transverse direction (Y) above said slide (11), said platform carrying a tool unit (15) on its turn carrying said grinding wheel-tool (M) with vertical axis,
- a cam device (T, P), including a cam track (T) and a cam-follower member (P) carried respectively by said platform (14) and by said slide (11), or vice versa, and
- auxiliary actuating means (Q1, Q2) adapted to cause a relative movement between said cam track (T) and said cam-follower member (P) while holding them in contact with each other,
- said cam track (T) being configured to give rise to the desired movement of the tool (M) with respect to the plate (L), during the advancement of the plate (L) along with the slide (11), in order to perform the radiusing operation.

11. Bilateral machine according to claim 10, **characterized in that** said cam track (T) includes two symmetrical sections (t1, t2) which are operative respectively during the radiusing operation of a front corner (C1) and during the radiusing operation of a rear corner (C2) of the plate.

12. Bilateral machine according to claim 11, **characterized in that** said actuating means comprise a pair of auxiliary actuating cylinders (Q1, Q2) interposed between said slide (11) and said platform (14) and adapted to be selectively activated so that one of them is elongated and the other in shortening, or vice versa, to generate respectively the relative motion between each stroke (t1, t2) of the cam track (T) and the cam-follower member (P).

13. Bilateral machine according to claim 11, **characterized in that** said actuator cylinder (Q1, Q2) are provided with manually adjustable flow regulators for adjusting the speed of execution of the radiusing operation.

14. Bilateral machine according to claim 9, **characterized in that** the movements of the tool unit relative to the slide (11) along the longitudinal and transverse directions (X, Y) are driven by two respective actuators controlled by an electronic numerical control unit, which is programmed to coordinate these movements so as to achieve the desired path of the tool axis (M1) with respect to the moving plate.

15. Method for machining edges of plates (L) of glass or stone and stone materials in general, wherein a bi-

lateral machine is provided comprising a frame which includes two banks (D, S), each having a plurality of machining units (U, V, W, Z) and defining between them a machining area (A), wherein a plate to be worked (L) is caused to advance horizontally through said machining area (A) while said processing units (U, V, W, Z) perform a machining operation of the two lateral edges (LD, LS) of the plate (L),
characterized in that within said machine (1) there is included at least one radiusing device (R), so that while the plate (L) advances through said machining area (A) of the bilateral machine said radiusing device (R) engages at least one corner (C1, C2) defined between two adjacent sides of the plate (L) to impart a radiused circular profile (r1) to it.

Amended claims in accordance with Rule 137(2) EPC.

1. Bilateral machine (1) for machining edges of plates (L) made of glass or stone and stone materials in general, including a frame which includes two banks (D, S) each provided with a plurality of machining units (U, V, W, Z) and defining between them a machining area (A) through which a plate (L) to be machined is caused to advance, wherein the machining units (U, V, W, Z) on the two banks of the machine are adapted to machining of the two lateral edges (LD, LS) of the plate (L) while the latter advances through the machining area (A),
characterized in that within said machine (1) there is included at least one radiusing device (R) for imparting a circular radiused profile (r1) to the plate (L) at least at one corner (C1, C2) defined between two adjacent sides of the plate (L) in a plan view of the plate.

2. Bilateral machine according to claim 1, **characterized in that** it comprises two radiusing devices (R) arranged on the two aforementioned banks (D, S) of the machine and configured and controlled to perform simultaneously in a first phase the radiusing operation of the two head corners (C1) of the plate and in a second phase the radiusing operation of the two trailing corners (C2) of the plate, while the plate (L) advances through the machining area (A) of said bilateral machine.

3. Bilateral machine according to claim 1 or 2, **characterized in that** each radiusing device (R) comprises a tool unit including a grinding wheel-tool (M) with vertical axis (M1), which is displaceable in a coordinated manner both in the longitudinal horizontal direction (X) of the plate (L), and in a horizontal direction (Y) transverse to said longitudinal direction (X), in such a manner that said tool (M) is capable of following with its axis (M1), relative to the plate (L) which is advancing, a circular path (R1) around a vertical axis (C) located inside the perimeter of the plate (L).

4. Bilateral machine according to claim 3, **characterized in that** the movements of said tool unit (15) of the radiusing device (R) along the longitudinal and transverse directions (X, Y) are operated by respective actuating devices controlled by an electronic numerical control unit, programmable to coordinate the movements along said two directions (X, Y) so as to move the axis (M1) of the tool (M) according to the desired curved path with respect to the moving plate (L).

5. Bilateral machine according to claim 4, **characterized in that** said electronic control unit is programmable so as to enable adjustment of the desired value of the radius of the radiused profile to be obtained at a given corner of the plate (L).

6. Bilateral machine according to claim 4, **characterized in that** said electronic unit is programmable to compensate for wear of the tool (M).

7. Bilateral machine according to claim 4, **characterized in that** said electronic unit is programmable to adjust the speed of execution of the radiusing operation.

8. Bilateral machine according to claim 4, **characterized in that** the electronic control unit is arranged to obtain data on the size of the plate and on the advancement speed thereof on the basis of signals from sensor means provided in the bilateral machine and adapted to detect passage of the front edge and/or the rear edge of the sheet, the control unit being thus able to control movement of the tool (M) during the radiusing operation on the basis of geometry and speed processing parameters.

9. Bilateral machine according to claim 3, **characterized in that** each radiusing device includes:

- a fixed support structure (10),
- a slide (11) slidably mounted in said longitudinal direction (X) above said support structure (10),
- first and second abutments (13, 12) for abutting engagement with the plate, carried by said slide (11) and intended to cooperate respectively with the front edge (LF) and with the rear edge (LP) of the plate (L),
- wherein each of said abutments (13, 12) is movable between a raised operative position and a lowered inoperative position,
- in such a way that during the radiusing operation of a front corner (C1) of the plate (L) said

first abutment (13) is in its raised position and the plate (L) engages with its front edge (LF) said first abutment (13) causing the advancement of said slide (11) in the longitudinal direction (X) unitarily to the plate (L), simply as a result of the pushing action of the plate,
- said support structure (10) being provided with an actuator to positively control a displacement of said slide (11) in the longitudinal direction (X),
- in such a way that during the radiusing operation of a rear corner (C2) of the plate (L), said second abutment (12) is in its raised position and the slide (11) is pushed by said actuator so as to bring and maintain the second abutment (12) in engagement with the rear edge (LP) of the plate, thus causing the advancement of said slide (11) in the longitudinal direction (X), unitarily to the plate (L), due to the pushing action of said actuator.

10. Bilateral machine according to claim 9, **characterized in that** each radiusing device (R) further comprises:

- a platform (14) mounted so that it can float both in the longitudinal direction (X) and in the transverse direction (Y) above said slide (11), said platform carrying a tool unit (15) on its turn carrying said grinding wheel-tool (M) with vertical axis,
- a cam device (T, P), including a cam track (T) and a cam-follower member (P) carried respectively by said platform (14) and by said slide (11), or vice versa, and
- auxiliary actuating means (Q1, Q2) adapted to cause a relative movement between said cam track (T) and said cam-follower member (P) while holding them in contact with each other,
- said cam track (T) being configured to give rise to the desired movement of the tool (M) with respect to the plate (L), during the advancement of the plate (L) along with the slide (11), in order to perform the radiusing operation.

11. Bilateral machine according to claim 10, **characterized in that** said cam track (T) includes two symmetrical sections (t1, t2) which are operative respectively during the radiusing operation of a front corner (C1) and during the radiusing operation of a rear corner (C2) of the plate.

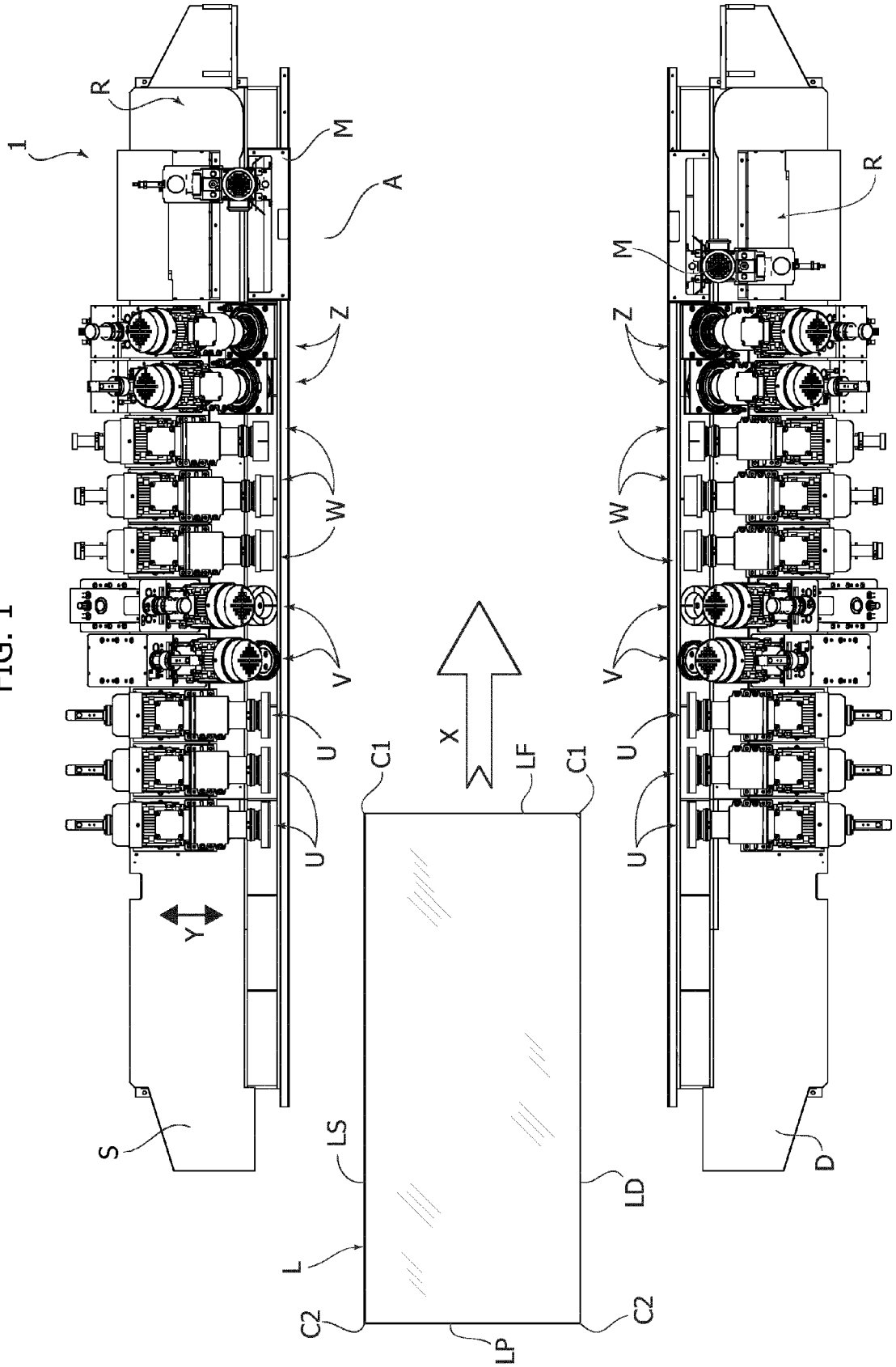
12. Bilateral machine according to claim 11, **characterized in that** said actuating means comprise a pair of auxiliary actuating cylinders (Q1, Q2) interposed between said slide (11) and said platform (14) and adapted to be selectively activated so that one of them is elongated and the other in shortening, or vice versa, to generate respectively the relative motion between each stroke (t1, t2) of the cam track (T) and the cam-follower member (P).

13. Bilateral machine according to claim 11, **characterized in that** said actuator cylinder (Q1, Q2) are provided with manually adjustable flow regulators for adjusting the speed of execution of the radiusing operation.

14. Bilateral machine according to claim 9, **characterized in that** the movements of the tool unit relative to the slide (11) along the longitudinal and transverse directions (X, Y) are driven by two respective actuators controlled by an electronic numerical control unit, which is programmed to coordinate these movements so as to achieve the desired path of the tool axis (M1) with respect to the moving plate.

15. Method for machining edges of plates (L) of glass or stone and stone materials in general, wherein a bilateral machine is provided comprising a frame which includes two banks (D, S), each having a plurality of machining units (U, V, W, Z) and defining between them a machining area (A), wherein a plate to be worked (L) is caused to advance horizontally through said machining area (A) while said processing units (U, V, W, Z) perform a machining operation of the two lateral edges (LD, LS) of the plate (L),
characterized in that within said machine (1) there is included at least one radiusing device (R), so that while the plate (L) advances through said machining area (A) of the bilateral machine said radiusing device (R) engages at least one corner (C1, C2) defined between two adjacent sides of the plate (L) in a plan view of the plate, to impart a radiused circular profile (r1) to it.

FIG. 1



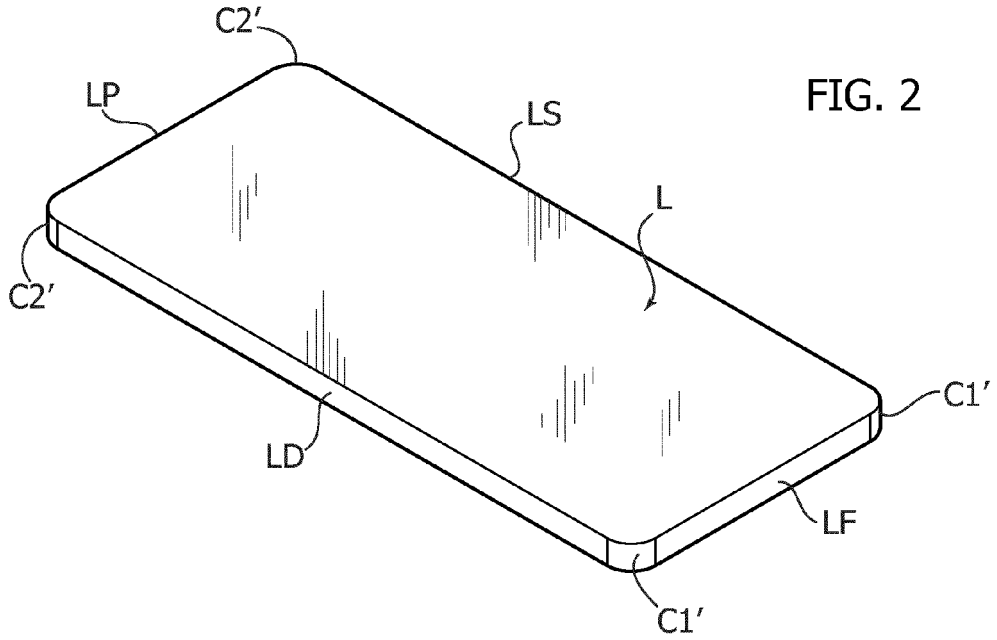


FIG. 2

FIG. 3

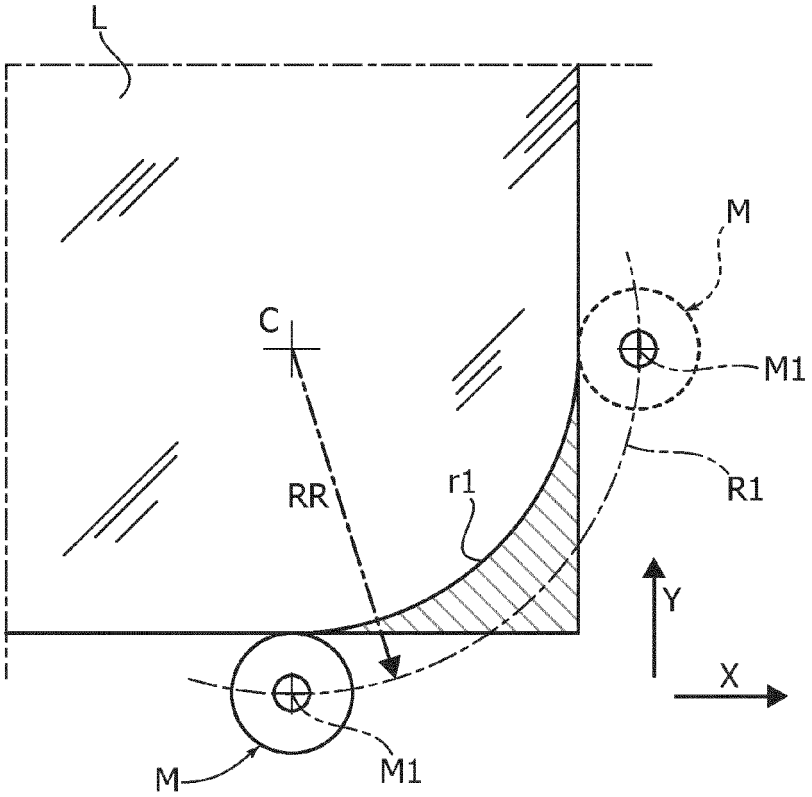


FIG. 4

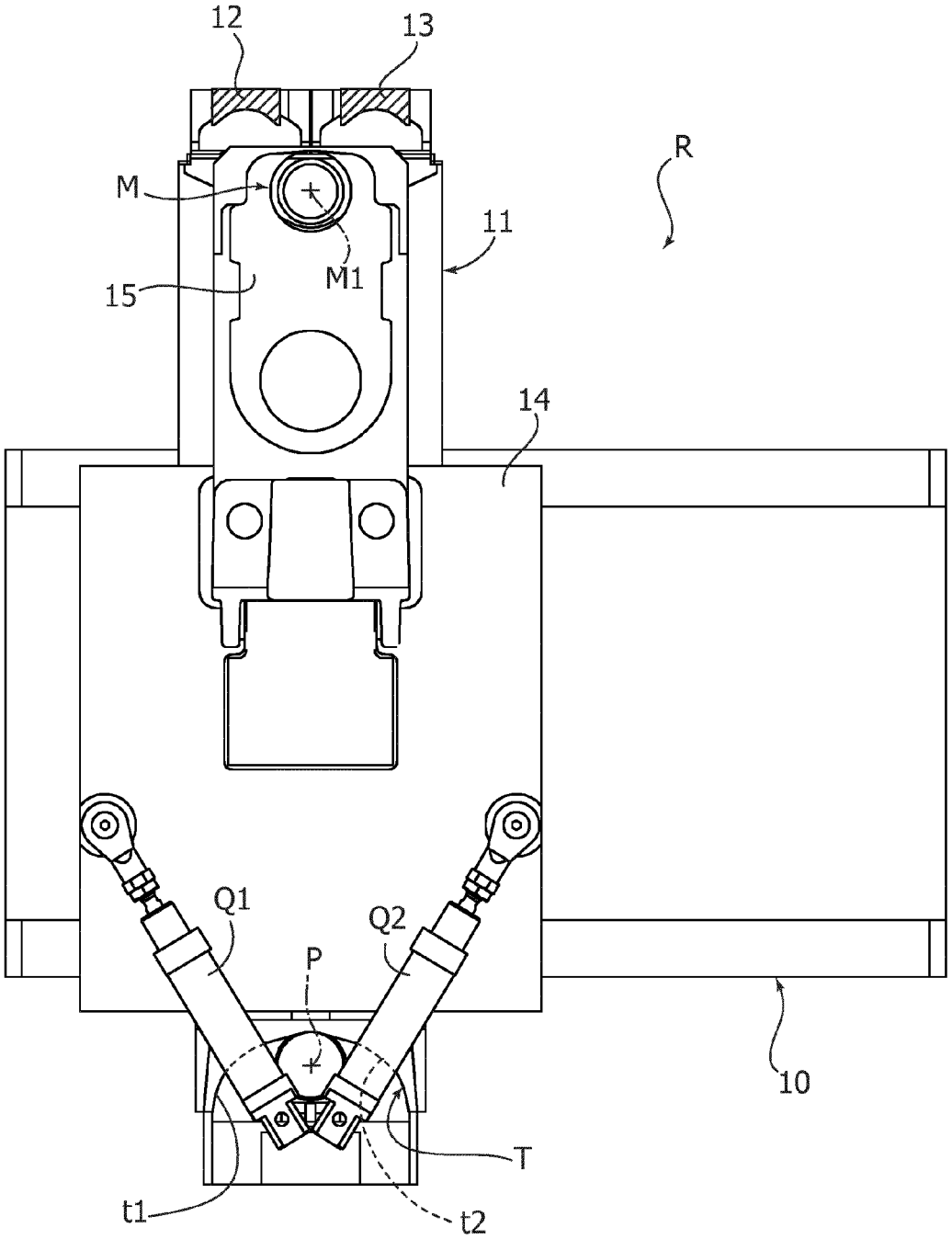


FIG. 6

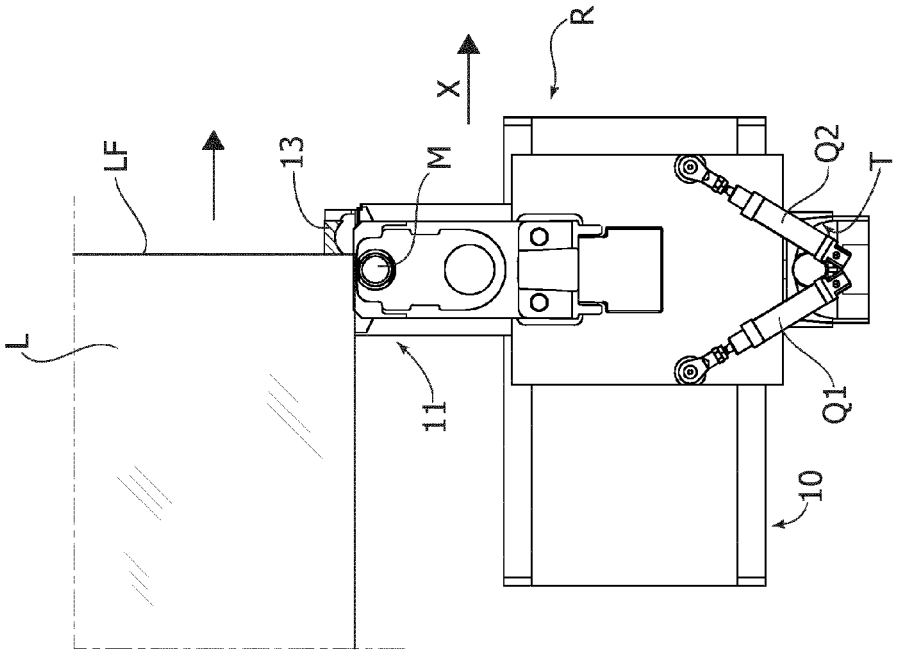


FIG. 5

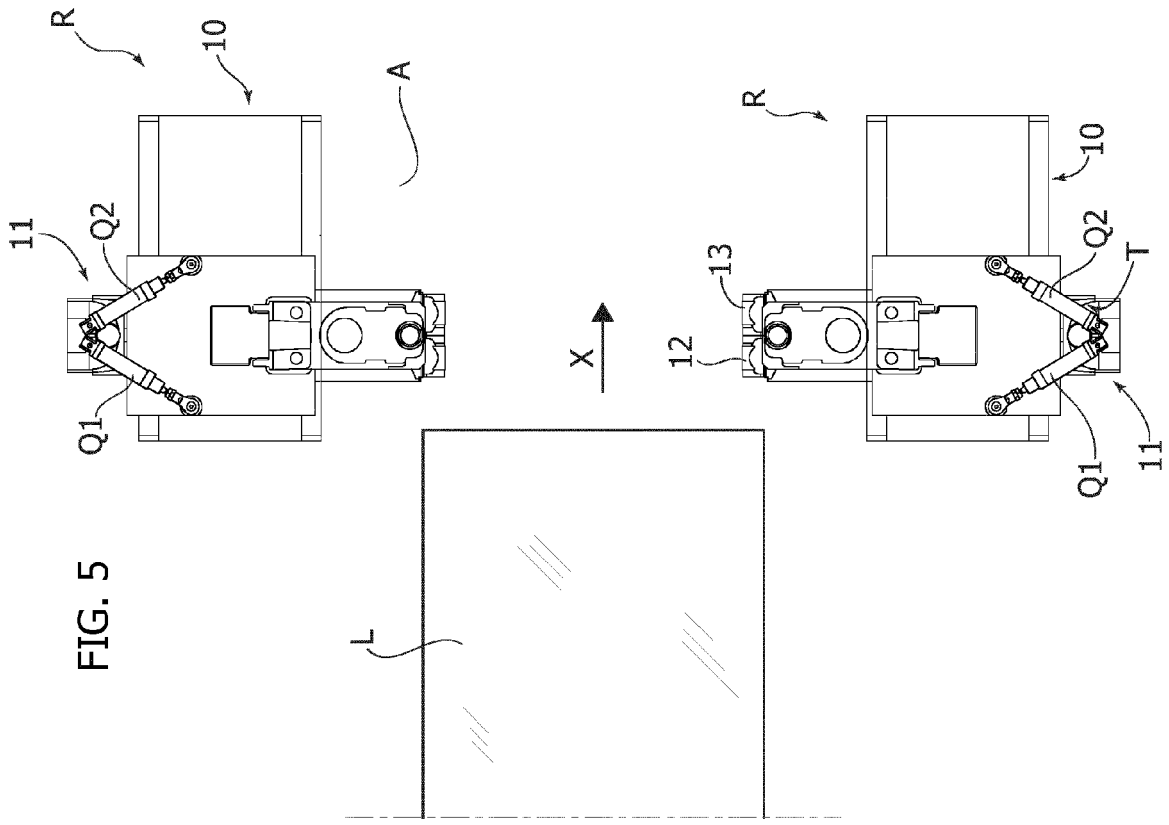


FIG. 8

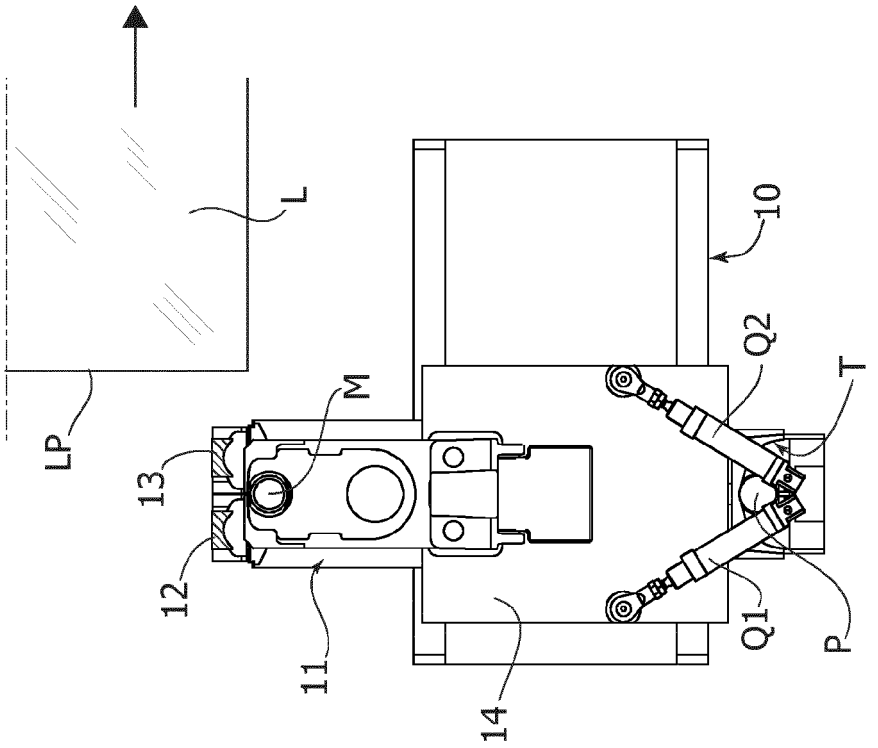


FIG. 7

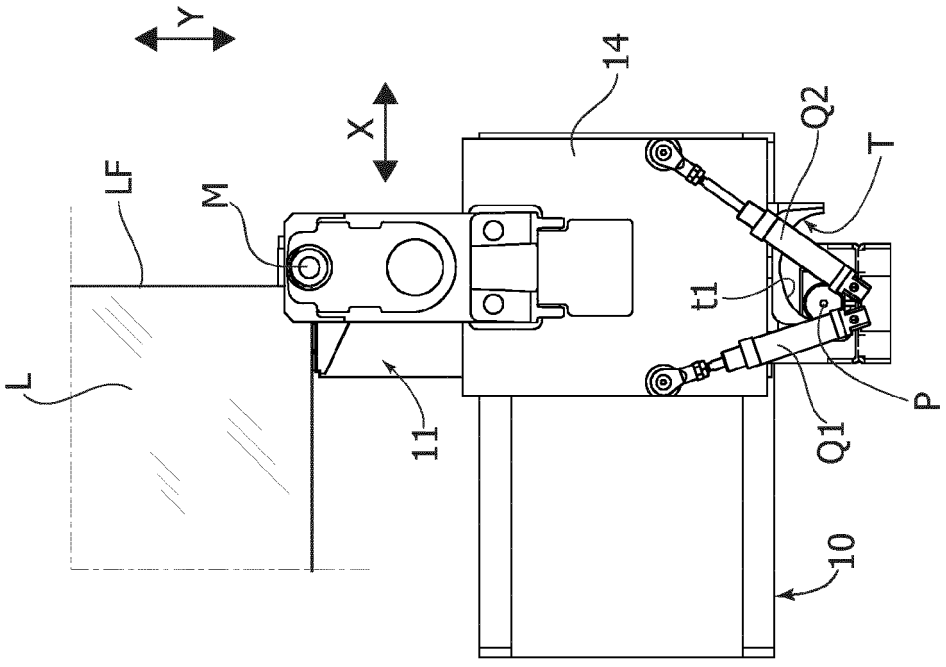


FIG. 10

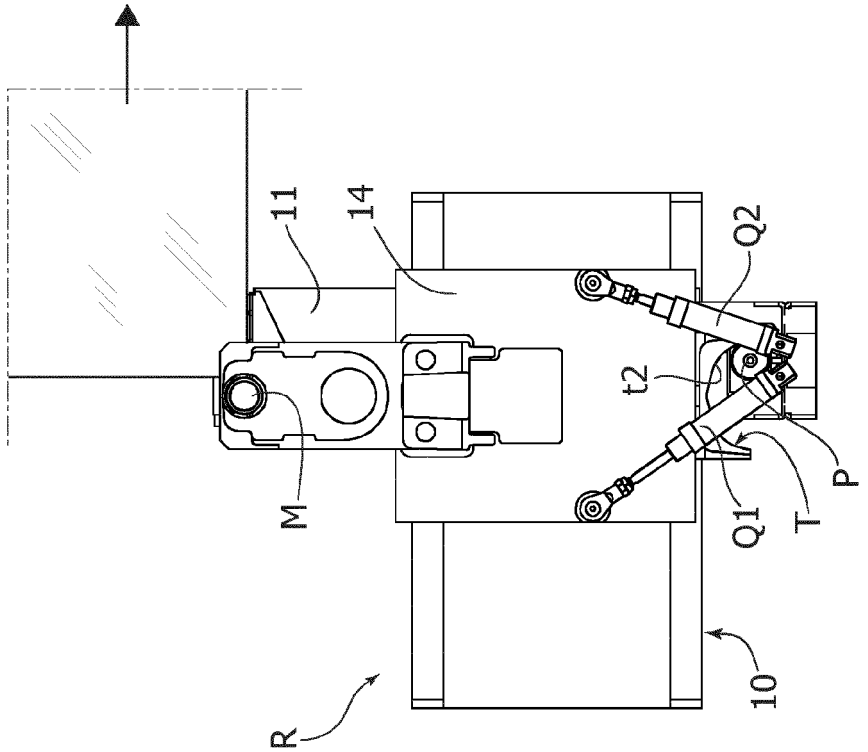
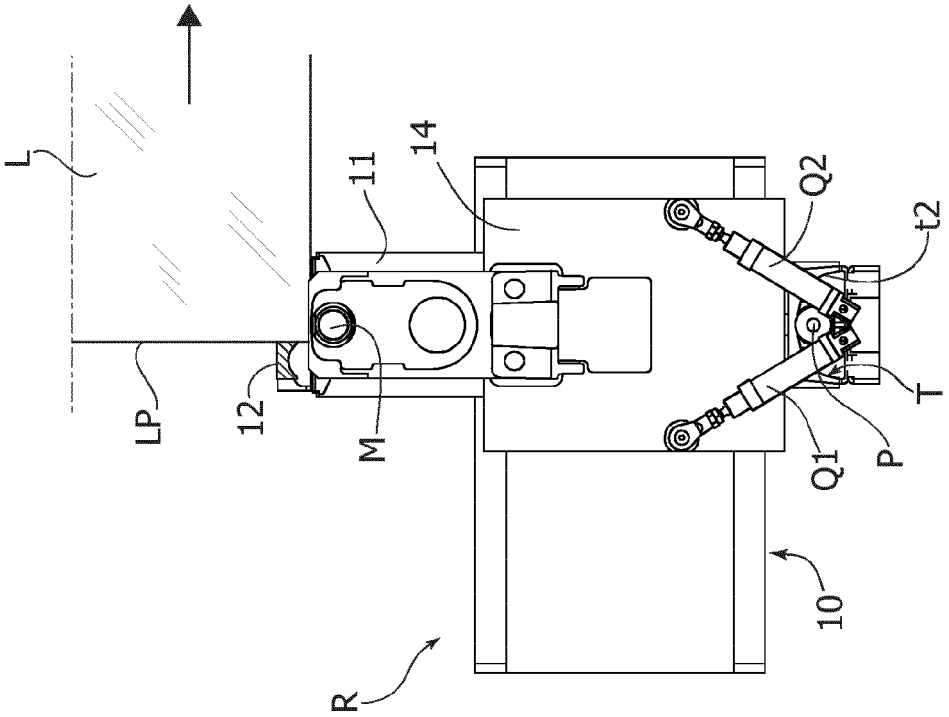


FIG. 9



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EUROPEAN SEARCH REPORT

Application Number
EP 15 18 6794

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	19 November 2015	Endres, Mirja

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