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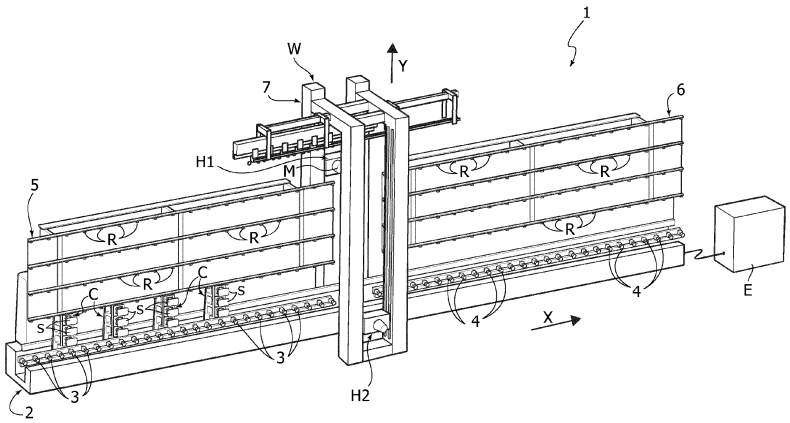
(54) Machine for working the peripheral edge of glass plates and for drilling these plates, and working method implemented by this machine

(57) In a machine for working the peripheral edge of glass plates (L), the plate to be worked advances in a substantially vertical position in a first horizontal direction X parallel to the plane of the plate (L) through a workstation (W) comprising a first working head (H1) and a second working head (H2), which are movable in a second substantially vertical direction Y and include motor-driven rotating spindles that can each be coupled to a grinding tool (M). Three or more suction-cup carriages (C), which are movable independently of one another in the direction X, carry a plurality of suction cups (S) that can be engaged on the plate, for feeding the glass plate in the first direction X. The first and second working heads (H1, H2) are set on opposite sides with respect to the plane of lie of the glass plate, and are prearranged for mounting on the respective motor-driven spindles, instead of the grinding tools, a first drilling tool (F1) and a second drilling tool (F2) that are designed to engage coaxially the glass plate on opposite sides for carrying out drilling operations on the glass plate. The suction-cup carriages are each provided with a single aligned vertical series of suction cups (S) and each have a maximum dimension in the longitudinal direction X that substantially does not exceed the dimension in the longitudinal direction X of each suction pad. When it is necessary to carry out a drilling operation in an area of the glass plate (L) occupied by a suction-cup carriage (C), the carriage (C) is brought into a different position on the plate (L) or into a position out of engagement with the plate (L), whilst the correct position of the plate is in any case ensured by at least two of the remaining suction-cup carriages (C).

FIG. 1



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Description

TEXT OF THE DESCRIPTION

[0001] The present invention relates to machines for working the peripheral edge of glass plates, of the type comprising:

- means for advancing one or more glass plates (L) to be worked, in a substantially vertical position, along a first horizontal direction X parallel to the plane of the plate through a working station comprising at least a first working head for working the plate, movable along a second substantially vertical direction Y, and including a motorized spindle which can be coupled with a grinding tool,
- at least three suction-cup carrying carriages movable independently from each other along said first direction X and carrying a plurality of suction-cups which can be engaged on the plate, for advancing the glass plate along the first direction X, while precisely defining the laying plane of the plate, and
- machine electronic control means for controlling said suction-cup carrying carriages and said first working head.

[0002] A machine of the type specified above is for example known from EP 2 039 464 B1. The present applicant has likewise produced and marketed machines for working the peripheral edge of glass plates that are also designed for carrying out drilling operations on glass plates. Drilling of a circular hole in a glass plate implies the use of two rotating drilling tools that engage coaxially the glass plate on opposite sides. In this case, it is consequently necessary to provide the machine with a first working head and a second working head that are movable in the vertical direction Y, the spindles of which are coupled to grinding tools when it is necessary to carry out grinding of the edges of the plate and to drilling tools if and when it is necessary to carry out drilling operations on the plate. These drilling operations are, however, prevented when the area in which it is necessary to carry out drilling is occupied by one of the aforesaid suction-cup carriages used for moving the plate in the longitudinal direction X. In such cases, it is necessary to carry out the drilling operations in a subsequent station, with consequent waste of time and space occupied by the plant.

[0003] The object of the present invention is to overcome the above problem in a simple and efficient way.

[0004] With a view to achieving the above object, the subject of the invention is a machine having all the characteristics referred to at the start of the present description and moreover **characterized in that:**

- said working station comprises a second working head movable along a direction parallel to said second direction Y and also including a motorized spindle which can be coupled with a grinding tool,
- the first and second working heads are arranged on opposite sides with respect to the laying plane of the glass plate, and are provided for mounting first and second drilling tools on the respective motorized spindles in replacement of the grinding tools, said drilling tools being adapted to coaxially engage the glass plate from opposite sides for carrying out drilling operations on the glass plate,
- the suction-cup carriages are each provided with a single aligned vertical series of suction-cups and each have a maximum dimension along the longitudinal direction X which substantially does not exceed the dimension in the longitudinal direction X of each suction-cup,
- said machine electronic control means are programmable so that when there is the need of performing a drilling operation at an area of the glass plate occupied by a suction-cup carrying carriage, said carriage is brought to a different position on the plate or in a position out of the engagement on the plate while the proper position of the plate is anyhow assured by at least two of the remaining suction-cup carriages.

[0005] The adoption of three or more suction-cup carriages that are movable independently of one another and each carry a single vertical row of suction cups, with the structure of each carriage that substantially does not exceed the overall dimensions in the horizontal direction of the suction cups, makes it possible to obtain a great flexibility of positioning of the carriages with respect to the glass plate and a consequent good possibility of always guaranteeing the right support and referencing in position of the glass plate even when it is necessary to displace a carriage to free an area of the plate in which a drilling operation is to be carried out. This arrangement likewise makes it easy to find the way to free the area in which it is necessary to carry out the drilling operation, without waste of time and without the various suction-cup carriages interfering with one another.

[0006] A further subject of the invention is the working method described above, according to what is specified in the annexed Claim 2.

[0007] Further characteristics and advantages of the invention will emerge from the ensuing description with reference to the annexed drawings, which are provided purely by way of non-limiting example and in which:

- Figure 1 is a perspective view of a machine according to the invention;
- Figure 2 is a view at an enlarged scale of a detail of Figure 1, which illustrates the machine during working of four single glass plates;
- Figure 3 is a variant of Figure 1, which illustrates a step in which a single glass plate of large dimensions is loaded on the machine;
- Figure 4 illustrates a detail of Figure 2 at an enlarged scale;

- Figure 5 is a front view of the machine of Figure 1;
- Figure 6 illustrates the detail of two rotating drilling tools, which engage coaxially on opposite sides a glass plate so as to follow a drilling operation; and
- Figure 7 is a top plan view of the machine of the invention.

[0008] The machine according to the invention is generally designated in the drawings by the reference number 1. According to the conventional technique, it comprises a fixed supporting structure 2 defining a line of movement extending in a longitudinal direction X, in which the glass plates to be worked are fed, keeping them in a quasi vertical plane. For the purpose, the line comprises two longitudinal arrays of motor-driven rollers 3, 4, extending in the longitudinal direction X upstream and downstream of a central workstation W. The glass plates to be worked come from the left-hand end (as viewed in the drawings) of the machine and rest with their bottom edge on the line of rollers 3. As indicated, the plates are slightly inclined with respect to the vertical plane in such a way that with their rear face (i.e., the one opposite to the one facing the observer in the figures) rest on arrays of wheels R, which can freely rotate about vertical axes and are carried by longitudinal bars forming part of a fixed frame 5. A similar frame 6, with wheels R for supporting the rear face of the worked plates, is set downstream of the workstation 4 (with reference to the direction of advance X of the plates).

[0009] Once again according to the conventional technique, advance of the plate L in the direction X is obtained by means of a plurality of suction-cup carriages C, equipped with suction cups S, which can be activated to engage the rear face of the plate L (i.e., the face opposite to the one facing the observer in the figures).

[0010] Each carriage C is autonomously mounted in a slidable way on a longitudinal guide C1 (Figure 7) of the fixed base structure 2 so as to be movable in the direction X independently of the other suction-cup carriages. According to a technique in itself known, each carriage C is provided with motor means that govern its movement in the direction X, for example in the form of a motor-driven pinion engaging a toothing. These constructional details are not illustrated herein either in so far as they are known and do not fall in themselves within the scope of the invention.

[0011] Each carriage C is provided with a plurality of suction-cup devices S that can translate in a direction orthogonal to the glass plate for engaging thereon or disengaging therefrom. The details regarding the suction-cup devices S, the means for governing translation of these devices in a direction orthogonal to the glass plate, and the means for communicating a negative pressure to the suction-cup devices are not illustrated herein either, in so far as they are in themselves of a known type and in so far as they do not fall, taken in themselves, within the scope of the present invention.

[0012] A characteristic that is instead peculiar to the present invention lies in the fact that the suction-cup carriages (which are at least three, and preferably four, in number) are each provided with a single aligned vertical series of suction cups S and have a structure that has a maximum dimension in the longitudinal direction X that substantially does not exceed the dimension in the longitudinal direction X of each suction pad S. The advantage deriving from this characteristic has already been mentioned above. It consists in the fact that, when all the carriages are used to engage a single glass plate, it is thus possible to obtain a considerable flexibility of positioning of the carriages with respect to the glass plate and always guarantee correct support and referencing in position of the glass plate even when it is necessary to displace a carriage to free an area of the plate in which a drilling operation is to be performed. This arrangement makes it in particular very easy to free the area in which it is necessary to carry out the drilling operation, without any waste of time and without the various suction-cup carriages interfering with one another.

[0013] During working of the edge of the glass plate, the plane of lie of the glass plate L is ensured by the suction cups S of the carriages C, and the precise position in the direction X of the plate L is likewise ensured by the position of the carriages C, the motor means of which are controlled in synchronism by an electronic control unit E associated to the machine (Figure 1).

[0014] According to the conventional technique, the workstation W comprises a fixed column structure 7, on which two working heads H1, H2 are mounted movable parallel to a substantially vertical direction Y (Figures 5 and 7), which each carry a motor-driven spindle. According to a technique in itself known, the spindle of each head can be coupled selectively to a grinding tool or to a drilling tool. Appearing in Figure 5, above the plate L, is a grinding tool M, whilst Figure 6 shows the detail at an enlarged scale of two drilling tools F1, F2. The two heads H1, H2 are provided on opposite sides with respect to the plane of lie of the plate to be worked in such a way that, when the drilling tools F1, F2 are mounted on the spindles of the heads H1, H2, they can engage the plate L coaxially on opposite sides, as illustrated in Figure 6. Once again, as may be seen in Figure 6, the drilling tools F1, F2 are in the form of cup tools and engage the plate L one after the other to carry out a drilling operation without any risk of breaking the glass plate, as is known to persons skilled in the branch.

[0015] Once again, according to the conventional technique, working of the longitudinal edges (parallel to X) of the plate is obtained by movement of the carriages C along X, and simultaneous control of the position in Y of the heads H1, H2 (which carry out grinding, one of the top edge and the other of the bottom edge, as may be seen in Figure 5). Working of the vertical edges of the plate is obtained by stopping the carriages C and moving one of the heads H1, H2 along Y. In this step, mounted on the spindles of the heads H1, H2 are the grinding tools M.

[0016] According to the known art, associated to the machine is an electronic control unit E that controls movement of the working heads H1, H2 in the direction Y, and movement of the suction-cup carriages C.

[0017] The adoption of at least three (in the case illustrated, four) suction-cup carriages obviously enables the advantage of being able to move a plurality of glass plates L of small dimensions simultaneously, as may be seen in Figure 2. However, the present invention gives rise to a further and important advantage in the case where the carriages C are all engaged on a single plate L of large dimensions (Figure 3). In relation to this aspect, it should be considered that in the case of the invention each suction-cup carriage C has a single vertical row of suction cups and has a structure that substantially does not exceed the overall dimensions in the direction X of the suction cups. This tall and narrow conformation of the carriages C makes it easy and convenient to reposition the carriages C with respect to the glass plate L when it is necessary to carry out a drilling operation in an area of the plate L occupied by a carriage C. In this case, in fact, the electronic control unit E temporarily brings said carriage into a different position of engagement on the plate, or into a position out of engagement of the plate, whilst the correct position of the plate is in any case ensured by means of at least two of the remaining suction-cup carriages C. Consequently, in the case of the invention, the provision of at least three carriages C and the narrow and tall conformation of the structure of these carriages makes it easy and simple to obtain optimal repositioning of the carriages C with respect to the plate L, whatever the area of the plate in which a drilling operation is to be carried out.

[0018] In view of the foregoing, it is evident that the machine according to the invention guarantees the possibility of carrying out both working of the edges of the glass plates and execution of drilling operations in plates of relatively large dimensions, whatever the area of the plate where the drilling is to be carried out. This avoids the drawback of current machines, which require provision downstream of the machine of dedicated drilling stations, with a consequent loss of productivity and greater space occupied in the plant.

[0019] Of course, without prejudice to the principle of the invention, the details of construction and the embodiments may vary widely with respect to what has been described and illustrated herein, without thereby departing from the scope of the present invention.

Claims

1. Machine for working the peripheral edge of glass plates (L), comprising:

- means for advancing one or more glass plates (L) to be worked in a substantially vertical position along a first horizontal direction X parallel to the plane of the plate (L) through a working station (W) comprising at least a first working head (H1) for working the plate (L), movable along a second substantially vertical direction Y, and including a motorized spindle which can be coupled with a grinding tool (M),
- at least three suction-cup carrying carriages (C) movable independently from each other along said first direction X and carrying a plurality of suction-cups (S) which can be engaged on the plate, for advancing the glass plate along the first direction X, while precisely defining the laying plane of the plate (L), and
- machine electronic control means for controlling said suction-cup carrying carriages and said first working head,

characterized in that:

- said working station (W) comprises a second working head (H2) movable along a direction parallel to said second direction Y and also including a motorized spindle which can be coupled with a grinding tool (M),
- the first and second working heads are arranged on opposite sides with respect to the laying plane of the glass plate, and are provided for mounting first and second drilling tools (F1, F2) on the respective motorized spindles in replacement of the grinding tools, said drilling tools being adapted to coaxially engage the glass plate from opposite sides for carrying out drilling operations on the glass plate,
- the suction-cup carriages are each provided with a single aligned vertical series of suction-cups (S) and each have a maximum dimension along the longitudinal direction X which substantially does not exceed the dimension in the longitudinal direction X of each suction-cup,
- said machine electronic control means are programmable so that when there is the need of performing a drilling operation at an area of the glass plate (L) occupied by a suction-cup carrying carriage (C), said carriage (C) is brought to a different position on the plate (L) or in a position out of the engagement on the plate (L) while the proper position of the plate is anyhow assured by at least two of the remaining suction-cup carriages (C).

2. Method for working the peripheral edge of glass plates (L), wherein:

- at least a glass plate (L) to be worked is caused to advance in a substantially vertical position along a first horizontal direction X parallel to the plane of the plate (L) through a working station (W) comprising at least a first working head (H1)

for working the plate (L), movable along a second substantially vertical direction (X), and including a motorized spindle which can be coupled with a grinding tool (M),

- at least three suction-cup carrying carriages (C) are arranged which are movable independently from each other along said first direction X and carrying a plurality of suction-cups (S) which can be engaged on the plate, for causing the glass plate to advance along the first direction X, while precisely defining the laying plane of the plate (L),

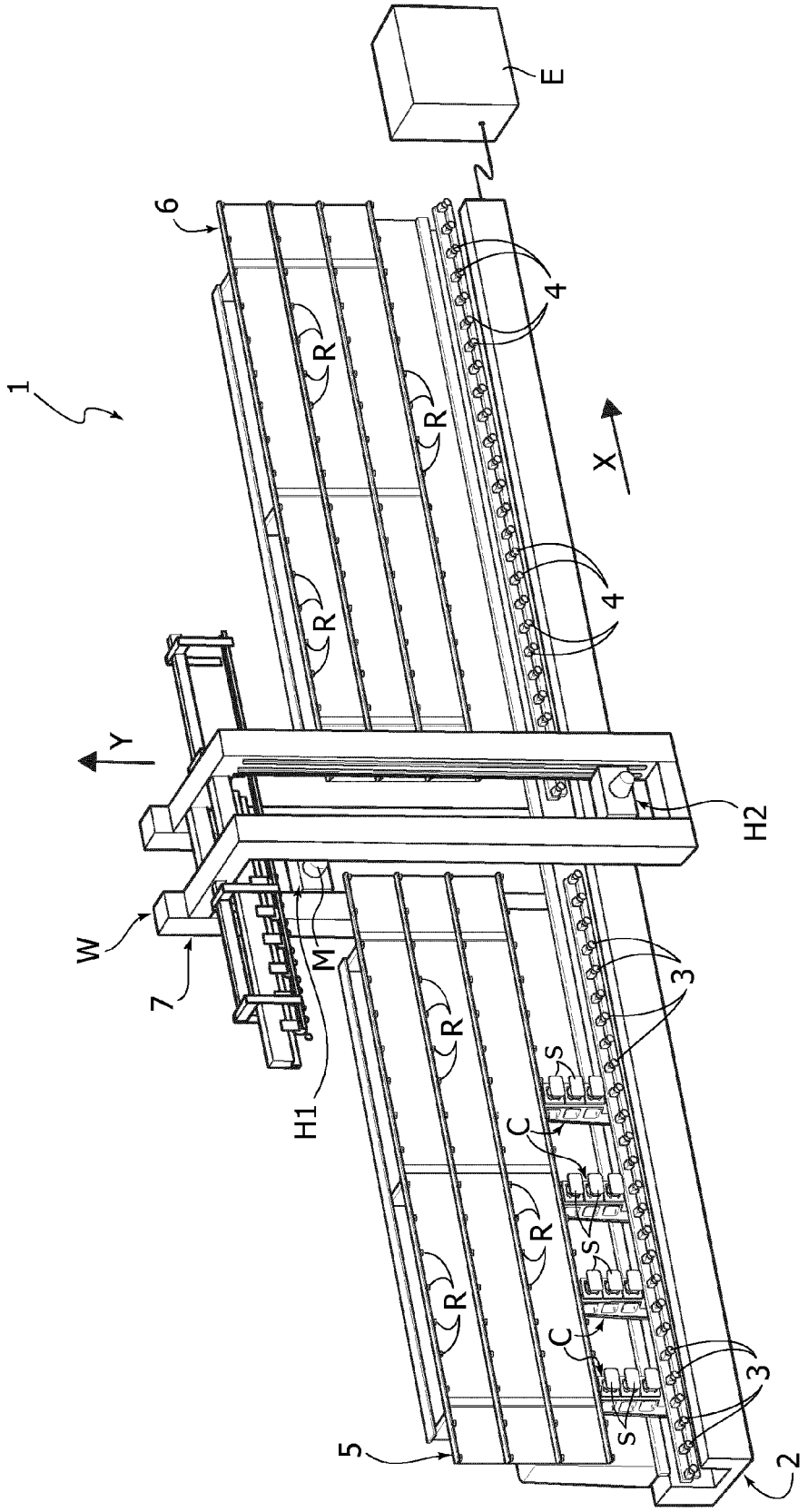
said method being **characterized in that:**

- said working station (W) is provided with a second working head (H2) movable along a direction parallel to said second direction Y and also including a motorized spindle which can be coupled with a grinding tool (M),
- the first and second working heads are arranged on opposite sides with respect to laying plane of the glass plate, and are provided for mounting first and second drilling tools (F1, F2) on the respective motorized spindles, in replacement of the grinding tools, said drilling tools being adapted to coaxially engage the glass plate from opposite sides for carrying out drilling operations on the glass plate,
- the suction-cup carriages are each provided with a single aligned vertical series of suction-cups (S) and each have a maximum dimension along the longitudinal direction (X) which substantially does not exceed the dimension along the longitudinal direction X of each suction-cup, and

in that when there is the need of carrying out a drilling operation at an area of the glass plate (L) occupied by a suction-cup carrying carriage (C), said carriage (C) is brought to a position different on the plate (L) or a position out of the engagement on the plate (L), while the proper position of the plate is anyhow assured by at least two of the remaining suction-cup carrying carriages (C).

The foregoing substantially as described and illustrated herein and for the purposes specified.

FIG. 1



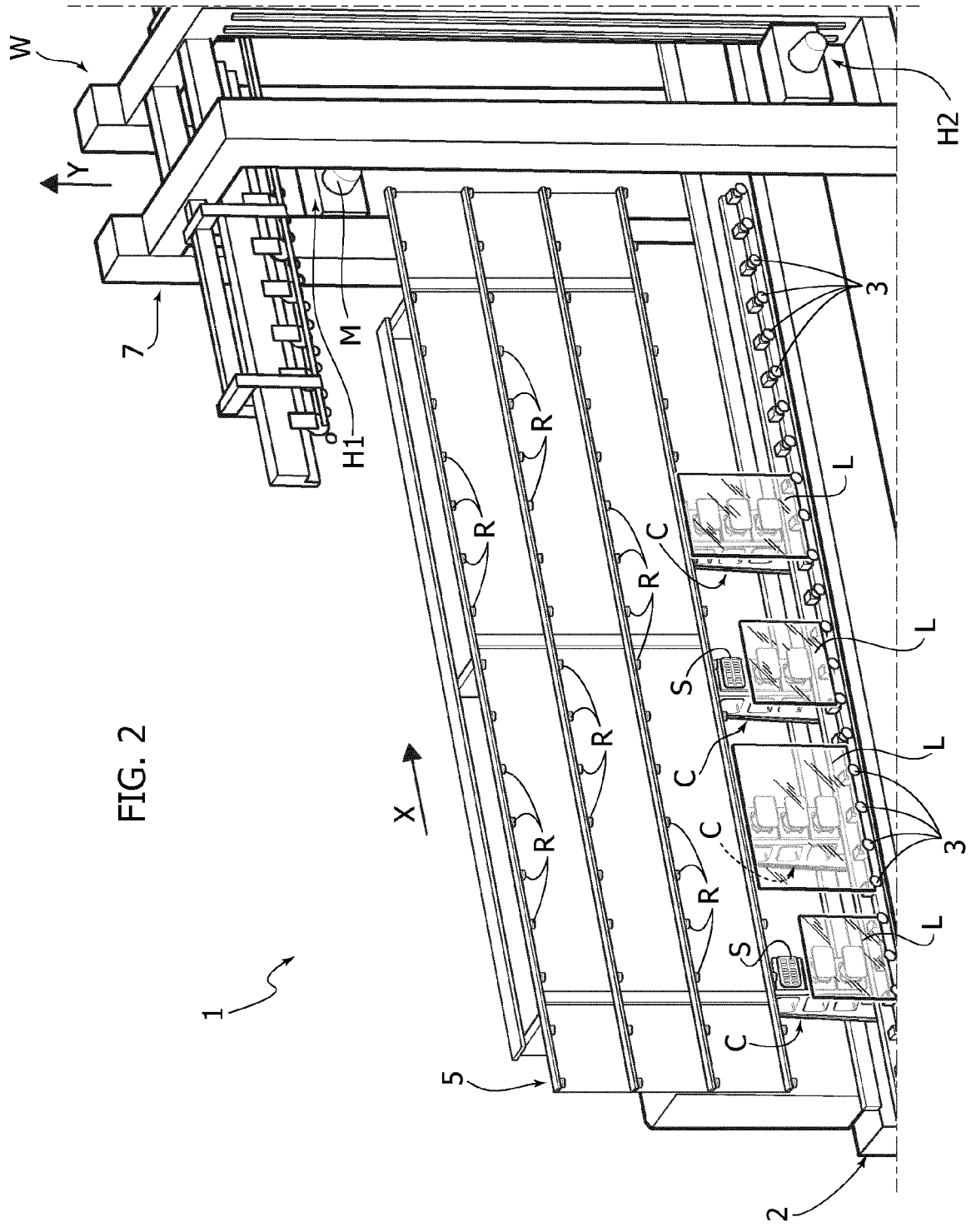


FIG. 2

FIG. 3

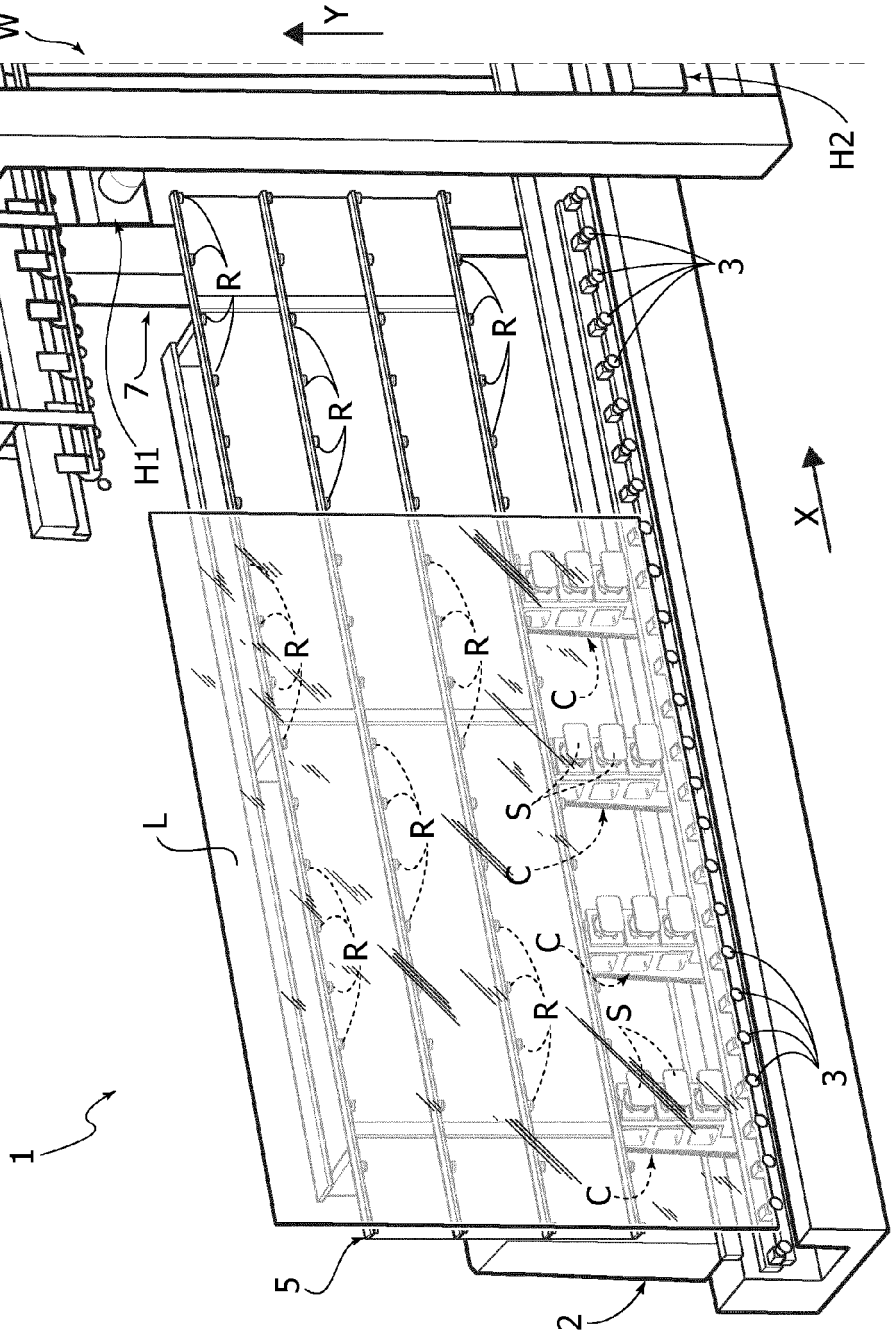


FIG. 4

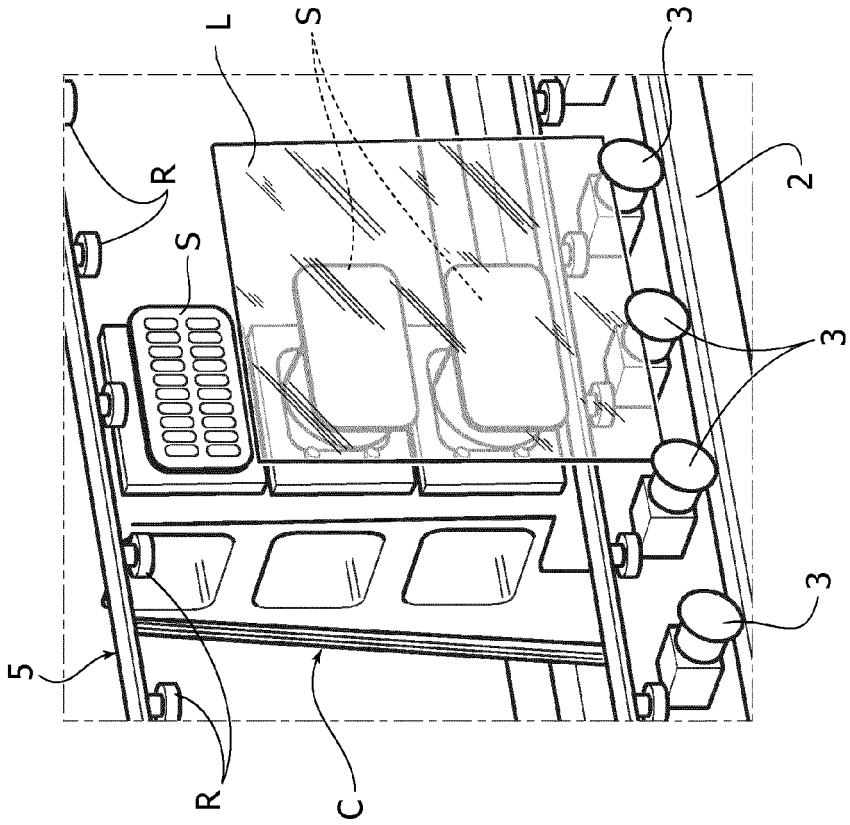


FIG. 5

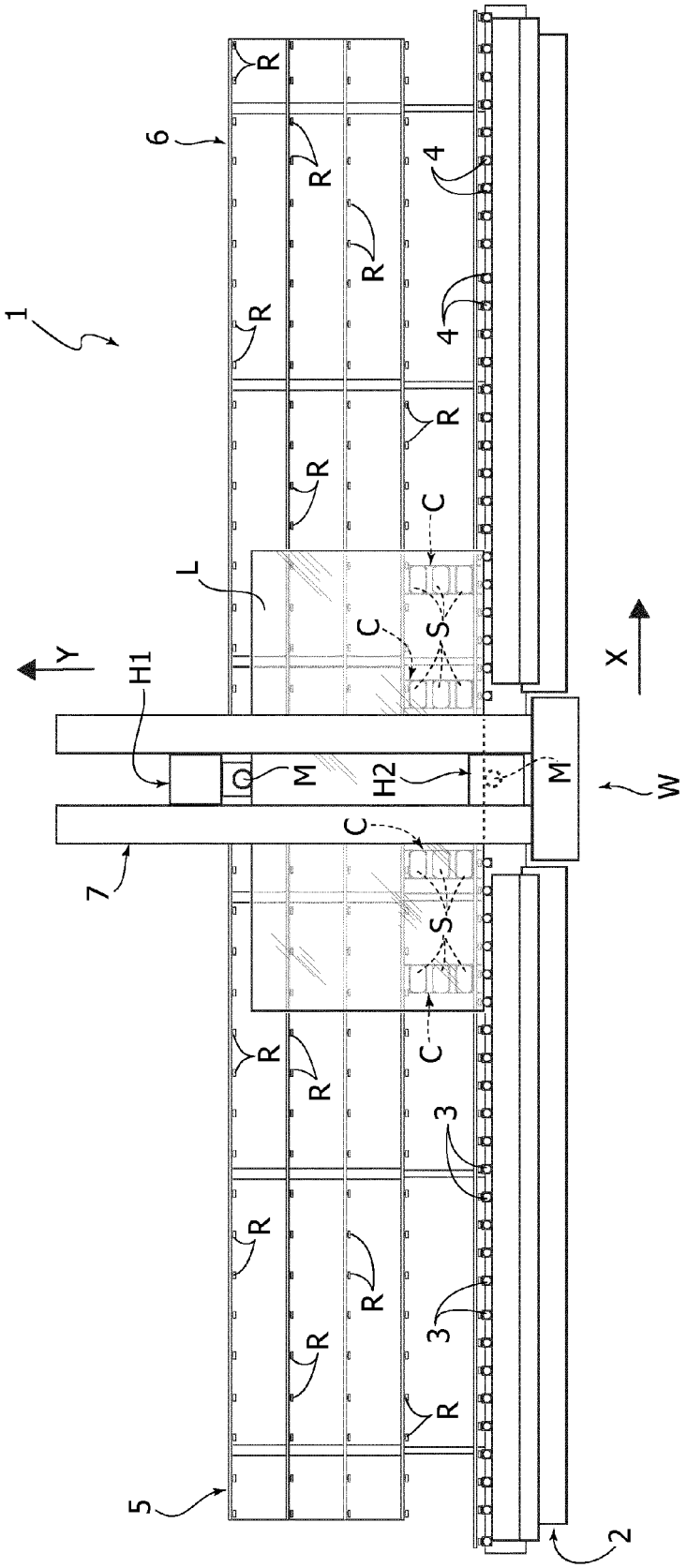


FIG. 6

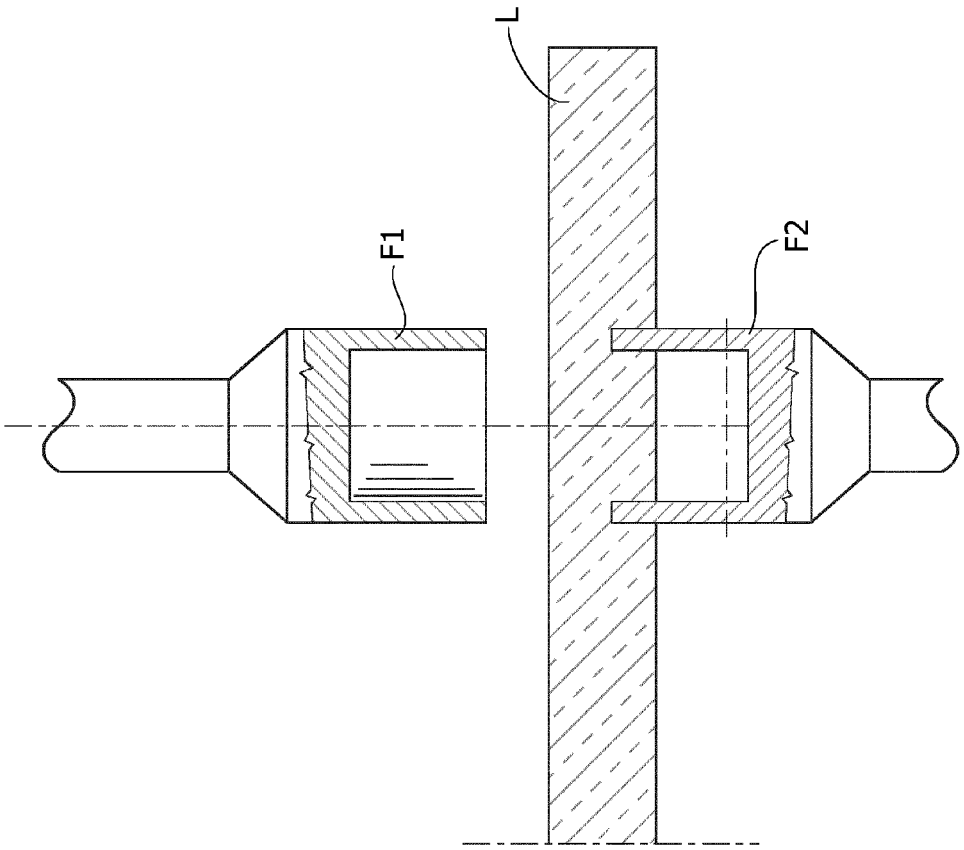
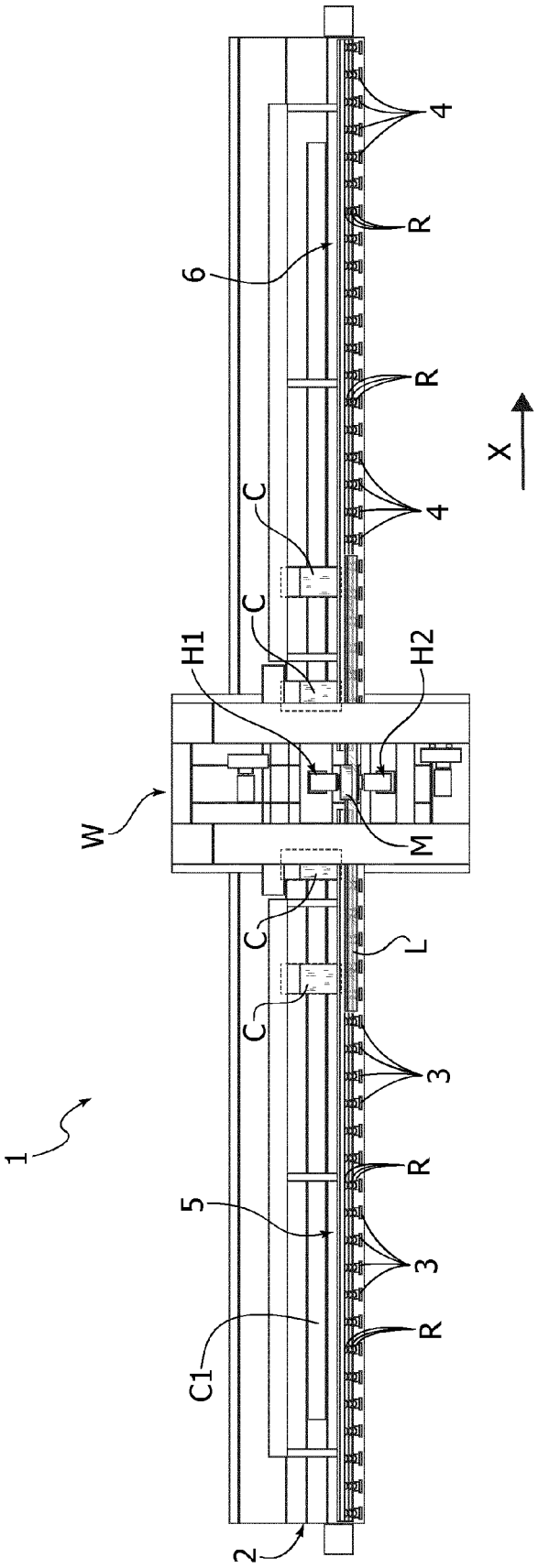


FIG. 7



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EUROPEAN SEARCH REPORT

Application Number
EP 13 18 7216

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,D	EP 2 039 464 A1 (FOR EL BASE DI VIANELLO FORTUN [IT] FOR EL BASE DI DAVANZO NADIA & [IT) 25 March 2009 (2009-03-25) * figures 2-9 * -----	1,2	INV. B24B9/10 B24B47/22 B28D1/14 B24B41/02
A	DE 202 18 341 U1 (TORGAUER MASCHB GMBH [DE]) 13 February 2003 (2003-02-13) * figures 1-6 * -----	1,2	
A	EP 2 189 400 A1 (C M B COSTRUZIONI MECCANICHE B [IT]) 26 May 2010 (2010-05-26) * paragraph [0015] - paragraph [0023]; figures 1-6 * * paragraph [0030] - paragraph [0044] * -----	1,2	

TECHNICAL FIELDS SEARCHED (IPC)

B24B
B28D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	20 December 2013	Kornmeier, Martin

CATEGORY OF CITED DOCUMENTS

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20-12-2013

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