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

(11) **EP 2 460 971 A2**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
06.06.2012 Bulletin 2012/23

(51) Int Cl.:
E06B 3/673 *(2006.01)* ***B65G 49/06*** *(2006.01)*

(21) Application number: **11190269.8**

(22) Date of filing: **23.11.2011**

(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

(30) Priority: **03.12.2010 IT TV20100156**

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(54) **Method for sealing the perimetric groove of an insulating glazing**

(57) An automatic machine and automatic method for the sealing of the perimetric rim of the insulating pane wherein the innovative peculiarity is constituted by the method of adaptation of the system for conveying and supporting panels of insulating pane, the adaptation being actuated both as a function of the total thickness of the panels and as a function of the staggering between the outermost glass sheets that make up the panel of insulating pane, with the objective of supporting and conveying the insulating pane during and after the sealing of its perimetric rim, without the sealant coming into contact with parts other than the glass sheets and the spacer frame.

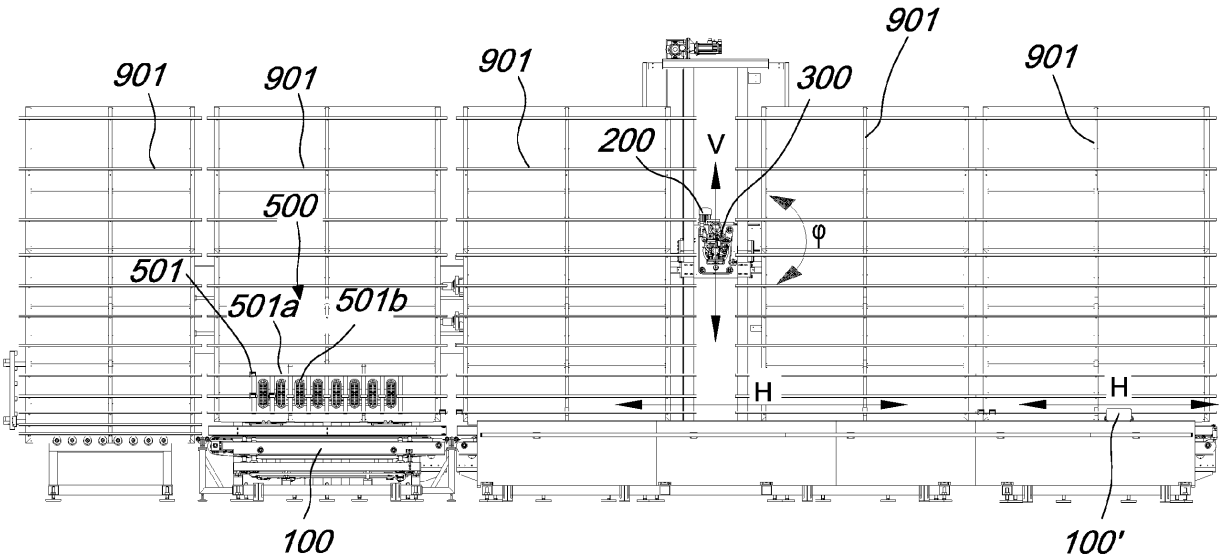

Fig. 2

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Description

[0001] The present invention relates to an automatic machine and an automatic method for the sealing of the perimetric rim of an insulating pane.

[0002] Nowadays it is known to perform, as illustrated in Figures 1A-1F, the depositing of the rigid spacer frame 3 or of the flexible spacer profile 5, prespread with sealant 6 and/or adhesive 6', onto a glass sheet 2, so that the assembly can then be coupled with a second glass sheet 2' and sealed along all of the outer peripheral region so as to constitute what is called the insulating pane 1. The operation can likewise be a multiple operation for obtaining the insulating pane 1 constituted by three glass sheets 2, 2', 2" and two frames 3, 3' or spacer profiles 5, 5', or indeed n sheets 2, 2', 2,", 2'", etc. and n-1 frames 3, 3', 3", etc. or spacer profiles 5, 5', 5", etc. The operation can likewise concern glass sheets 2M, 2'm with different sizes while still belonging to the same insulating pane so as to obtain a staggering between their edges, which is necessary for coupling with a particular type of window or door frame, i.e. the type that constitutes what is called continuous panes or what is called structural panes. And it is particularly, though not exclusively, for these types of offset insulating panes that the invention is remarkably innovative.

[0003] For better comprehension of the configuration of the glass sheet, not so much in its possible use in isolation but above all in its use together with other components, in particular the rigid frame 3 or the flexible spacer profile 5 for forming what is called the insulating pane 1, hereinbelow a brief description is given of some concepts regarding the semi-processed products, i.e. the glass sheet 2 and the frame or the spacer profile 3, 5 and the final product, i.e. the insulating pane 1, assuming the subsequent use of the insulating pane, i.e. as a component of the window or door frame, is known. In order to rationalize the description it is easier to begin with the final product and proceed to break it down into its constituent elements.

[0004] The insulating pane 1 is constituted by the composition of two or more glass sheets 2, 2', 2,", 2"', etc., which are separated by one or more spacer frames 3, 3', 3", etc., which are generally made of inorganic material like aluminum or stainless steel or an inorganic/organic mixture, the latter generally being PVC (polyvinyl chloride, but other substances are possible), are generally hollow and microperforated on the face directed inward, the spacer frames containing, in the hollow part thereof, hygroscopic material 4, and being provided with a butyl sealant 6 on the side faces (constituting what is called the first sealing) and the chamber (or chambers), delimited by the glass sheets 2, 2', 2,", 2"', etc. and by the spacer frame (frames) 3, 3', 3", etc., capable of containing air or gas 8 or mixtures of gas 8 that give the insulating pane special properties, for example thermal insulation and/or soundproofing. Recently the use has also become widespread of the spacer profile 5, which is basically rectangular in cross-section and optionally contains two receptacles on its flanks which are destined for the butyl sealant 6, made of expanded synthetic organic material (for the purposes of non-limiting example, silicone and EPDM) that embeds the hygroscopic material 4 in its mass.

[0005] The joint between glass sheets 2, 2', 2,", 2"', etc. and spacer frame (frames) 3, 3', 3", etc. or 5, 5', 5", etc. is achieved by means of two levels of sealing, the function of the first 6 being to achieve a hermetic seal and initial bond between these components and affecting the lateral surfaces of the frame and the portions of the adjacent panes, which has already been mentioned (butyl sealant), the function of the second 7 being to achieve definitive cohesion between the components and mechanical strength of the joint between them and affecting the space constituted by the outer surface of the spacer frame 3, 5 and by the faces of the glass sheets up to the rim thereof (see Figures 1A-1F). In a spacer profile 5 made of expanded synthetic material, the first level of sealing is substituted (in this event the hermetic function is removed) or it can be supplemented by an adhesive, for example acrylic, already spread on the lateral faces of the spacer profile, 6', and covered by a removable protective film (see Figures 1A-1F).

[0006] The glass sheets 2, 2', 2", etc. utilized in the makeup of the insulating pane 1 can have different shapes as a function of the use thereof; for example the outer sheet (i.e. outer with respect to the building) can be normal or reflective or selective (in order to limit thermal contribution during the summer months) or layered / armored (for anti-intrusion / antivandal applications) or layered / tempered (for security applications) or combined (for example reflecting and layered in order to obtain a combination of properties), the inner sheet (i.e. inner with respect to the building) can be normal or low-emission (in order to limit the dispersion of heat during the winter months) or layered / tempered (for security applications) or combined (for example low-emission and layered in order to obtain a combination of properties). In particular, and for this situation the present patent application offers further advantages with respect to the known art, the outer glass sheet 2M (and optionally also one or more intermediate sheets) can be bigger than the inner sheet (or sheets) 2'm for the entire extension of the perimeter or only on one side or on some sides (see Figures 1A-1F).

[0007] From the foregoing simple summary it is already clear that a production line for obtaining the insulating pane 1 product necessitates many types of processes in a cascade, and that in particular it comprises the process of second sealing which is addressed in the present application, not only in situations wherein all the glass sheets 2, 2', 2", etc. are aligned at the perimeter but also in the case where the glass sheets 2M, 2'm, are coupled not aligned but staggered at least on one of the sides, in particular on the lower side 1a. In detail the present invention solves the problem of keeping the peripheral

zone, intended for the second sealing, free from all contact with the elements for support and entrainment of the insulating pane 1 (a situation already forming part of the known art but requiring support and entrainment elements that are complex and thus expensive), and this by means of support devices that are simple and therefore economical and adapted to support heavy weights and moreover solve the problem of unloading the insulating pane 1 even if, in particular, it is very big and considerably heavy.

[0008] The process steps for producing the insulating pane 1, each needing a corresponding special machine to be arranged in series with the other, complementary machines, are, for the purposes of non-limiting example and at the same time not all necessary, the following:

EDGING on the peripheral face of the glass in order to remove any coatings in order to permit the bond of the primary sealant 6 and the secondary sealant 7 and maintain it over time;

BEVELING of the sharp edges of the glass, both to eliminate the edge defects introduced with the cutting operation, and to reduce the risks of injury in subsequent manipulations both of the glass sheets 2, 2', 2,", 2"', etc. and of the insulating pane 1;

WASHING of the individual sheets, with alternation between inner glass sheet / intermediate glass sheets, if any / outer glass sheet (the orientation being as defined earlier);

APPLICATION OF THE SPACER FRAME: the spacer frame 3 built previously, filled with hygroscopic material 4 and spread onto the lateral faces with a thermoplastic (butyl) sealant 6 the function of which is to seal, on machines outside the production line of the insulating pane 1, is applied onto one of the sheets of glass that make up the insulating pane 1 in a special station in the production line of the insulating pane 1; alternatively a continuous strip of spacer profile 5 is unwound from a reel and applied onto one of the two glass sheets until it forms a closed frame, directly made as it adheres to the glass sheet 2, after removal of the protective film, and on the same production line as the insulating pane 1;

MATING AND PRESSING of the sheets/frame (frames) assembly;

FILLING WITH GAS of the chamber (chambers) thus obtained, for example performed in the same machine that performs the functions in the previous paragraph, or in a subsequent machine, as shown in the figures showing the complete structure of the production line of the insulating pane 1;

SECOND SEALING of the assembled components: glass sheets 2, 2', 2", 2"', etc., spacer frame 3, 3', 3", etc., 5, 5', 5", etc., at the perimeter. A special case of this step is where the glass sheets are not aligned but staggered. An even more unusual case is where it is necessary, in addition to sealing the perimetric rim in order to mechanically join the components and in order to give a seal to the joint between the spacer frame 3 and the glass sheets 2, 2', to also spread sealant (second sealant) onto the flat face of the bigger glass sheet 2M which extends beyond the alignment with the smaller glass sheet 2'm. This is necessary for achieving a uniform aesthetic appearance of the outer sheet, which is the bigger one 2M, since starting from the position where the spacer frame 3, 5 is located, up to the perimetric rim of the glass sheet 2M, the distribution of the sealant, which is visible due to the transparency of the sheet of glass, is without discontinuities. The operation of distributing the sealant on the flat inner face of the larger glass sheet 2M is referred to in the jargon by makers of insulating panes as "troweling". Another function of troweling is to prepare the insulating pane 1 for subsequent installation, since it is already prepared with a base sealant.

[0009] The process steps listed above can be performed by the corresponding machine, automatically or semi-automatically or, for some operations, manually.

[0010] The search for prior art patents filed in the same field and describing machines and methods for executing the second sealing yields inventions wherein the sealant product is distributed in proximity to the spacer profile 3, for the purpose of mechanically joining it with the glass sheets 2, 2' and up to the alignment with the rim of the smaller glass sheet 2'm and for constituting a seal barrier against humidity which must not penetrate inside the insulating pane 1 and against the buffer gas 8 which must not escape from inside the insulating pane 1, where the means of support and entrainment acting on the lower horizontal side 1a of the insulating pane 1 are complex and therefore expensive since they are provided, for the sealing of the universal range of situations described previously, with at least three adjustment motions; or if reduced to two the one on the operator side is of necessity transverse to the plane of the insulating pane 1 for adaptation to the different thicknesses of the glass sheets 2, 2', 2,", 2"', etc. and of the spacer frame (frames) 3, 3', 3", etc., 5, 5', 5", etc., ultimately to the overall thickness of the insulating pane 1, and thus in any case more complex to achieve. In any case and above all, in terms of unresolved problems, none of these devices enables the opening of the insulating pane 1 by means of gripping below its lower horizontal side 1a after the sealing.

[0011] The search, in a field that is moreover very crowded, has yielded many patent titles, of which only the most significant are listed here:

EP 0 549 556 B1 (revoked on May 9, 2000), with Austrian priority AT 2557/91 of December 23, 1991 and American equivalent US 5,280,832 for a device, in the name of Peter Lisec, relating to the method of transport of the insulating pane 1, in a machine for the automatic sealing of the perimetric rim of the insulating pane, in particular where the glass sheets

2, 2' have different sizes, and whose sides and, consequently, edges are not aligned. The invention is not intended to implement other objectives.

[0012] EP 1 157 184 B2 (in force), with German priority DE 19909638 of March 5, 1999, for a device, in the name of Lenhardt Maschinenbau GmbH, relating to the method of transport of the insulating pane 1, in a machine for the automatic sealing of the perimetric rim of the insulating pane, in particular where the glass sheets 2, 2' have different sizes, and whose sides and, consequently, edges are not aligned. The invention is not intended to implement other objectives.

[0013] The aim of the present invention is to provide a device that enables the support and transport of the insulating pane 1 before, during and after the sealing of its perimetric rim both if the two or more glass sheets 2, 2', 2,", 2"', etc. are aligned, and if one or more of them is (are) staggered with respect to the remaining ones, and all these cases being feasible by means of only two simple adjustment motions, each one acting independently of the other on one of the two parts of which each conveyor is constituted.

[0014] Within this aim, an object of the invention is to provide a device that enables the support and transport of insulating panes 1 that are particularly heavy, the possible cases thereof extending, as in the generalized description in the foregoing paragraphs, to include types such as those using glass sheets of high thickness (such as laminated glass or armored glass or thick glass in general) or of large size (up to what is called "jumbo" size, that is to say 6000 mm in length, or even longer, and 3210 mm in height).

[0015] Another object of the invention is to make it possible to unload the insulating pane 1, once the sealing of its perimetric rim is completed, by means of gripping under its lower horizontal side 1a.

[0016] Further characteristics and advantages of the present invention will become better apparent from the following detailed description of a preferred but not exclusive embodiment thereof, illustrated by way of non-limiting example in the accompanying drawings, wherein:

Figures 1A-1F are schematic views of the peripheral portion of the insulating pane 1 in a series of non-limiting examples of possible combinations: Figure 1A normal; Figure 1B triple glazing unit with inner glass with low-emission coating; Figure 1C outer glass with selective coating and offset with respect to the inner glass with low-emission coating; Figure 1D outer glass tempered and inner glass with low-emission coating; Figure 1E outer glass layered and offset with respect to the inner glass with low-emission coating; Figure 1F outer glass layered and offset with respect to the remaining two sheets of glass of which the inner sheet is with low-emission coating. In Figures 1A, 1B, 1C and 1E the rigid frame 3 is shown, which is made of metal profile (typically aluminum or stainless steel or a stainless steel/plastic composite), hollow and filled with hygroscopic material 4, while in Figures 1D and 1F the flexible type frame 5 is shown, which incorporates the hygroscopic material 4 in its mass, but, for the purposes of the description, the solution shown for the frame is irrelevant. The two types of sealant used are highlighted: shown in black is the butyl sealant 6 the function of which it is to act as the initial bond between the components and as a seal (first sealing), whereas for a flexible frame an acrylic adhesive 6' is used instead (indicated but not actually shown since it has a thickness of just a few μm) or the combination of both acrylic sealant 6' and butyl sealant 6 applied between the lateral surfaces of the frame and the glass sheets, as can be seen in Figures 1D and 1F; shown cross-hatched is the polysulfuric or polyurethane or silicone sealant 7, the function of which is to provide mechanical strength (second sealing), applied between the outer surface of the frame and the faces of the glass sheets up to the rim of the smaller glass sheet 2'm (for glass sheets which are offset). The inside/outside orientation is visually indicated with icons showing the sun (outside) and a radiator (inside). From these figures it can be seen that the insulating pane 1 can have multiple shapes and that the machines for applying the second sealing must be both special and versatile, for example in order to seal the insulating pane 1 made up of two glass sheets as well as the pane made up of three glass sheets, and also the one with staggered glass sheets, and the pane made up of three or more than three glass sheets of which one or more are larger and therefore offset with respect to the remaining glass sheets. From all figures it can be easily deduced that the joint, when it has just been sealed, deployed along the lower horizontal side 1a of the insulating pane 1, involves problems not only relating to support and entrainment but also to lifting for unloading the insulating pane 1 from the sealing machine, which is the last machine in the production line of the insulating pane 1 described earlier, and this is due to the fact that the sealant 7 is doughy and gummy (the technical term "thixotropic" combines these two characteristics) from the moment of its extrusion up until the complete catalysis which occurs in a period that can vary from two to six hours.

Figures 2, 3, 4 are views of the machine that comprises the subject matter of the present invention respectively in the main views thereof (front elevation view, with identification of the horizontal axis H (actuated both by the conveyors of the assembly type 100, the subject matter of the present application, and by the slider carrying the suction cup (suction cups) 100' of the known type), the vertical axis V (assembly 200 of the known type) and the rotation axis φ (assembly 300 of the known type); the refer-

ence numeral 901 refers to the planes (referred to below as pseudo-vertical) which are slightly inclined with respect to the vertical plane of lateral sliding of the insulating pane 1 while it is supported in a lower region by the conveyors 100 that are the subject matter of the present application; end elevation view of the assembly: vertical track V with vertical slider (assembly 200 of the known type), rotation axis φ (assembly 300 of the known type) and with the unloading means 14 shown in the position in which the insulating pane 1, held along its lower horizontal side 1a, is already in the position removed from the automatic sealing machine and with arrangement along the lateral resting surface 902 of the unloading means 14; plan view, with identification of the electrical switchboard 11, the control desk 12, the safety devices 13 and the unloading means 14).

Figures 5 and 6 are views of the conditions at the end of the production cycle of the insulating pane 1 for a pane 1 of large size, so that its gripping is possible below its lower horizontal side 1a. Access by the unloading means 14 is now practicable by lowering the conveyor 100 upstream of the area provided with the group of suction cups 500 and optionally (if present) the one downstream.

Figures 7 and 8 are views of the conditions at the end of the production cycle of the insulating pane 1, for a pane 1 of medium/small size, i.e. such as to not protrude sufficiently from both sides of the conveyor 100 provided with the group of suction cups 500, so that it is possible to grip it below its lower horizontal side 1a towards the ends as in the previous case. Access by the unloading means 14 is made practicable by the activation of one (501) or more (501, 501a, 501b, etc.) suction cups of the group of suction cups 500 and lowering of the conveyor 100 below them.

Figures 9 and 10 are respectively views of a detail and of a variation of the situation in Figures 7 and 8, the variation consisting in the pivoting of the group of suction cups 500 that is adapted to modify the arrangement of the insulating pane 1 from the position where it is coplanar with the sliding surface 901 to the position where it is coplanar with the resting surface 902 of the (known) unloading means 14. In the side view also the option is shown where the group of suction cups 500 are deployed at several heights in order to hold the bigger sheets.

Figures 11a, 11b, 12a and 12b are views of the method of supporting the insulating pane 1 at its lower horizontal side 1a in the position with glass sheets 2, 2', 2,", 2"', etc. aligned on that side 1a, and the mechanisms for adapting to the extent of the overall thickness of the insulating pane 1.

Figures 13a, 13b, 14a and 14b are views of the methods of supporting the insulating pane 1 at its lower horizontal side 1a in the position with glass sheets 2, 2', 2,", 2"' etc. offset on that side 1a, and the mechanisms for adapting both to the extent of the staggering, and to the extent of the overall thickness of the insulating pane 1.

Figures 15 and 16 are views, only for the case of an insulating pane 1 with glass sheets aligned along the lower side 1a, of the methods of supporting the intermediate glass sheets in the step of waiting for unloading, to be employed in cases wherein the spacer frames are coupled to the glass sheets by means of first sealant of the butyl type and therefore the intermediate glass sheets are subjected to downward sliding due to the force of gravity.

Figures 17 and 18 are views, for the case of an insulating pane 1 with glass sheets unaligned or aligned along the lower side 1a, of the methods of supporting the intermediate glass sheets both in the step of transport and in the step of waiting for unloading, to be employed in cases wherein the spacer frames are coupled to the glass sheets by means of first sealant 6 of the butyl type and therefore the intermediate glass sheets are subjected to downward sliding due to the force of gravity.

Figures 19a, 19b, 19c and 19d are respectively views of the insulating pane 1 in its different shapes: rectangular, polygonal, curved, mixed. For the rectangular shape, the lower horizontal side 1a is indicated as the main side, since it is addressed by the subject matter of the present application, the remaining sides being indicated with the reference numerals 1b, 1c and 1d. The sequence of operations for the sealing machine as described and shown in the description and in the drawings, in the sealing steps, is as follows: side 1b, corner 1b/1c, side 1c, corner 1c/1d, side 1d, corner 1d/1a, side 1a, corner 1a/1b.

Figure 20 is a view of an example of installation of the device 100 and of the automatic sealing machine 1000 in the production line of the insulating pane 1 (elevation view) and does not include: electrical/electronic switchboard, control desk and protection devices.

Figure 21 is a view of an example of installation of the device 100 and of the automatic sealing machine 1000 in the production line of the insulating pane 1 (plan view) and includes: electrical/electronic switchboard 11, control desk 12 and protection devices, indicated generically with 13 whether they are of the mechanical shield type or optical barrier type or laser barrier type or electrosensitive mat type etc., since particular attention is devoted, in addition to the functional, qualitative, productive and peculiar aspects of the content of this invention, to accident prevention aspects as well. In particular, with reference to accident prevention the present invention has a number of peculiarities which are described in more detail below.

Figures 22 and 23 are views of enlargements of the details of Figures 12b and 14b and a final summing-up of the inventive concept which consists in the ad-

justment of the elements 108, 158 for supporting the insulating pane 1 only along planes with vertical arrangement (or rather pseudo-vertical as defined elsewhere in the description), paired with one of the possible types of supporting elements. The lower contouring of the supporting elements 108 is, for example, shown as mating with two rails on which to slide and with a simple entrainment chain 107; the lower contouring of the supporting elements 158 is, for example, shown as mating with three rails on which to slide and with a double entrainment chain 157 (rails and chains are not shown in the figures).

[0017] The following products: insulating pane 1, glass sheet 2, 2', 2,", 2"', etc., spacer frame 3, 3', 3", etc., 5, 5', 5", etc. and further components thereof are identified with single digit numbering. In particular, for distinguishing the various possible shapes of the insulating pane 1, 1 indicates the most common situation (rectangular), with 1' indicating the polygonal shape, 1" the curvilinear shape, and 1"' the mixed shape.

[0018] The components interfaced with the automatic sealing machine are identified with two-digit numbering.

[0019] The main components of the new device 100 are identified with three-digit numbers starting from 101 for the part of the conveyor opposite to the operator and 151 for the part of the conveyor on the operator side.

[0020] The machines belonging to the production line of the insulating pane 1 are identified with four-digit reference numbers.

[0021] We now come to the detailed description of an embodiment of the invention.

[0022] In order to better describe an embodiment of the invention, and one that comprises all the equivalents, reference is made in particular to Figures 9 to 14 for the concepts relating to the construction of the device and to all the other Figures for the description of the operation of the device. However, it is assumed that everything partially shown or not shown in Figures 2, 3, 4 regarding the sealing part is known, and therefore does not require a detailed description (since it forms part of the state of the art), since both the prior art described earlier and the knowledge of the technician skilled in the art do not necessitate any explanation for the construction of those parts relating to the automatic sealing machine.

[0023] A preferred embodiment of the invention is the one that is described below, and for better comprehension it is recommended to follow the Figures in parallel, in particular Figures 11 to 14, relating to the inventive concept explained in claim 1.

[0024] The following preliminary remarks should be kept in mind regarding the planes of arrangement and the orientations: when we speak of "vertical" we mean slightly inclined with respect to the vertical (also called pseudo-vertical); in fact the transport of the insulating pane 1 occurs on conveyors wherein the resting surface 901 acting on the face of the glass sheet 2 opposite to the operator is inclined by approximately 6 degrees with respect to the vertical plane (in compliance with a safety aspect of transport, as required by regulations deriving from the machine directive), and wherein the resting/supporting surface acting on the lower horizontal side 1a of the insulating pane 1 (constituted by the conveyor 100, the main subject matter of the present application) has a plane of arrangement inclined by around 6 degrees with respect to the horizontal plane; thus when we speak of "horizontal" we mean slightly inclined with respect to the horizontal (also called pseudo-horizontal).

[0025] The insulating pane 1 coming from the preceding machine that has performed the coupling and pressing of its components: glass sheets 2, 2', 2,", 2"', etc. and spacer frame (frames) 3, 3', 3", etc., 5, 5', 5", etc. coated on its flanks with the first butyl sealant 6, or possibly from the same or another machine that has also performed the filling thereof with gas, arrives at the automatic sealing machine 1000, a machine that is known for the second sealing of the perimetric rim, where it is placed in a waiting stage.

[0026] Control of the position of the insulating pane 1, in particular its initial positioning, is essential for the correct operation of the sealing process actuated by the known part of the head 300, through the known nozzle 400 both in the rectangular version and in the contoured version, for the subsequent coordination of the horizontal movements of the insulating pane 1 along the conveyors 100 actuated by at least one movable suction cup belonging to the slider 100' by means of the synchronous motor 102' (not shown since it is known) and the vertical movements of the head 300 which is moved, using the vertical slider 200, by the synchronous motor 202 (not shown since it is known). For an insulating pane 1 with a rectangular shape, a sensor (known) detects the position of the margin of the pane and, by means of the logic of the PLC (programmable logic controller), gives the information, which is needed to follow the rectangular perimeter of the insulating pane, respectively to the actuations of the horizontal motion of the insulating pane 1 and the vertical motion of the head 200. For an insulating pane 1 with a contoured shape, i. e. other than rectangular, information about its shape is input electronically with known techniques, and in addition to the actuations described earlier, acting on synchronous motors 102' and 202, actuation of the synchronous motor 302 (not shown since it is known) is also brought into play, so that the three known motions: horizontal of the insulating pane 1, vertical of the head 200, rotary of the head 300, are electrically/electronically linked to follow the shape of the perimeter of the insulating pane 1.

[0027] Once working of the first vertical side 1b of the insulating pane 1 is finished, the entire head 300 performs a rotation (of 90° for the rectangular sheet in this first description), by way of the action of the synchronous motor 302 and of the associated known mechanical transmission. In the known art, this is only a transitory step during which the corresponding feed valve is closed more or less in advance, and opened more or less with delay,

possibly pulse-controlled, possibly controlled by modulation of the flow, so as to dose the sealant at the perimetric corner joint.

[0028] It can immediately be seen that in the step of sealing the first corner connecting the first vertical side 1b with the first upper horizontal side 1c, the synchronously actuated horizontal axis H and vertical axis V are also electrically/electronically coordinated for correct filling of the corner, particularly but not exclusively if that corner is connected by means of a radius of curvature and particularly but not exclusively for the finishing of the troweling (not the troweling described earlier on the inner face of the glass sheets 2M, but the troweling on the corner between the continuous sides) which is done by a special spatula working transversely to the plane 901 of the insulating pane 1, adapted to delimit the volume to be filled in proximity to the corner. This coordination is handled by the process computer contained in the electrical/electronic switchboard 11 and it is interfaced with the user by means of the command desk 12 for parameterization of the constants involved in the process.

[0029] For the subsequent steps for the sides 1c, 1d and 1a and the corners 1c/1d, 1d/1a and 1a/1b the sequences described are repeated, except that, alternately, the insulating pane 1 moves horizontally while the head 200 remains stationary (this is the case for sealing the second horizontal side 1c), and then the insulating pane 1 remains stationary and the head 200 moves vertically (this is the case for sealing the second vertical side 1d).

[0030] Once all four of the sides 1b, 1c, 1d, 1a and the corners 1b/1c, 1c/1d, 1d/1a of the insulating pane 1 with rectangular shape have been completed, the sealing of the fourth corner 1a/1b and also the corresponding troweling can be done simply by actuating a horizontal movement of the insulating pane 1 up to its separation from the devices for sealing and troweling which in the meantime have retreated transversely with respect to the insulating pane 1 that is to say the plane 901 and the continuation towards the station for unloading the finished product.

[0031] Obviously all the movements associated with the steps of the cycle are mutually interlocked, by means of a logic that is parallel and always active, so as to prevent, during the process, conditions of mutual interference between actuator elements and material being worked on.

[0032] We come now to the details of the mechanisms that make up the devices forming the inventive part of the machine, and for practical purposes we shall subdivide the assembly 100, the function of which in the sealing step was described earlier, into its rear 101 and front 151 parts (with reference to the position of the operator who is facing the sealing machine 1000, as noted earlier) and we shall first analyze the case where the glass sheets 2, 2', 2,", 2"', etc. are aligned at the lower horizontal side 1a of the insulating pane 1.

[0033] The rear conveyor 101 is provided with two motions, one, synchronous, actuated (together with the synchronous movement of the pane actuated by the known suction cup slider 100') at the end of the movement of the insulating pane 1 along the horizontal axis H, and one, for adjustment, actuated in order to locate the position of the elements 108 for supporting the glass sheet 2, which are deployed on the endless chain 107 for transport, at the exact height required for the process of sealing the lower perimetric rim 1a of the insulating pane 1. Respectively the first motion is actuated by the synchronous motor 102 by means of the kinematic chain: reduction gear 103, transmission 103a, cardan shaft 104, shaft 105, pinion 106, 106a (not shown since it is the idle return pinion, as are the various pinions of which at least one is on a slide for tensioning the chain 107), chain 107; the second motion is actuated by the synchronous motor (the advantage of the synchronous motor is knowing the absolute position so as to simplify the identification of the position of the actuated element) 112 through the kinematic transmission: reduction gear 113, pinion 114, chain 115, pinion 116, ball volute 117, ball screw 118 (it goes without saying that the actuated part can either be the volute or the screw), whereas the vertical guiding of the semi-conveyor 101 is achieved by means of pins 119 and bushings 120.

[0034] The function of the rear conveyor 101 is to modify the position of the lower edge of the glass sheet 2 and thus, in the case examined first, of the glass sheets 2, 2', 2,", 2"', etc. (together with the activation of the front conveyor 151), which are aligned at the lower horizontal side 1a of the insulating pane 1, it remains in the zero position (or, if this is clearer, the lower stroke limit position).

[0035] As regards the front conveyor 151, the description exactly follows that of the rear conveyor 101, but simply adding the value 50 to the earlier numbering, which is easy to understand when looking at Figures 11 to 14. With regard to these figures, it should be noted that the numbering schemes used in the description are not all present since the corresponding details are hidden in some views. It is easy however to identify the corresponding details (that is to say those having the same functions) simply by adding or subtracting the value 50 to/from the indication given in the text.

[0036] A simplified and more logical variation is that, for the synchronous motion of moving the insulating pane 1 along the horizontal axis H, the chains 107, 157 are actuated by a single motor 102 instead of two motors 102, 152, and by a single reduction gear 103 instead of two reduction gears 103, 153, and in this variation using, after the single motor and single reduction gear, a transmission, the gear transmission 103a which also has the function of driving the two cardan shafts 104 and 154 in its output. The figures show this second situation, which is the most convenient.

[0037] From a conjunctive analysis of the methods of adjusting the rear 101 and front 151 conveyors, respectively for glass sheets 2, 2', 2,", 2"', etc. that are aligned or staggered at the lower perimetric rim 1a of the insu-

lating pane 1, the cases that can arise are as follows.

[0038] ALIGNED GLASS SHEETS: the conveyor 101 remains in the lower stroke limit position; the conveyor 151 adjusts its position in terms of height only in order to mate with the position of the outer edge of the glass sheet 2' or 2" or 2''' etc. on the operator side, the position of which changes as a function of the total thickness of the insulating pane 1 (see the enlarged details of Figures 11b, 12b and Figure 22).

[0039] OFFSET GLASS SHEETS: the conveyor 101 adjusts its position in height so as to mate with the position of the outer edge of the glass sheet 2 (which in this case, with reference to Figures 1C, 1E, 1F, becomes 2'm) on the side opposite to the operator; the conveyor 151 adjusts its position in height only in order to mate with the position of the outer edge of the glass sheet 2' or 2" or 2''' etc. on the operator side (which in this case, with reference to Figures 1C, 1E, 1F, becomes 2M), the position of which changes as a function of the total thickness of the insulating pane 1 (see enlarged details of Figures 13b and 14b and Figure 23).

[0040] A common characteristic of the two conveyors 101, 151 is that of carrying, on the extrados of the chain 107, 157, a series of inserts 108, 158, deployed at intervals in the direction of the axis H, the upper surface of which forms an acute angle with the sliding plane 901 of the insulating pane 1 (as can be seen in the details in Figures 12b, 13b, 14b and in Figures 22, 23). The function of these inserts is to limit contact with the outer edge (outer with respect to the insulating pane 1) of the glass sheets 2, 2', 2,", 2"', etc. and, since they are deformable, to adjust to any irregularities of the lower edge of the glass sheets 2, 2', 2,", 2"', etc., and to form a contact of the soft type in order to prevent the glass from cracking. This is essentially useful for glass sheets that are particularly heavy or particularly large (and therefore also heavy) and constitutes the preferred embodiment of the invention.

[0041] Variations which come under the same inventive concept are in any case constituted both by inserts the upper surface of which forms a right angle instead of an acute angle with the sliding plane 901 of the insulating pane 1, and by conveyors wherein the link chains 107, 157 are substituted by transmission belts, preferably of the toothed type, the extradoses of which can form both acute angles with the sliding plane 901 of the insulating pane 1, and right angles. For a right angle however, the problem of dirtying of the inserts 108, 158 by the sealant 7 re-emerges, and most of the known art suffers from this drawback.

[0042] We come now to the description of the validity of this invention with regard to the advantages obtained in the operations to unload the insulating pane 1.

[0043] Figures 5 and 6 for one type of insulating pane 1, and Figures 7 and 8 for another type of insulating pane 1, speak for themselves, but they are still described for identifying a possible variation of Figures 5, 6, as well as the different use of the conveyors 100 with respect to the sealing operation.

- CASE WHERE THE INSULATING PANE 1 IS LONGER THAN THE CONVEYOR 100 BELOW. In this case it is possible to obtain the space below the lower side 1a of the insulating pane 1 in order to introduce gripping means 14, both by means of raising the conveyor below (this is done by acting on the motors 112, 162 so that the lifting of the semi-conveyors 101, 151 is identical) and thus with a grip in any overhanging area at the side of the conveyor 100, and also by means of lowering the lateral conveyors (if this type of conveyor is present on both sides) and thus with a grip on the overhanging areas of the insulating pane 1 above the lateral conveyors 100.
- Case where the insulating pane 1 is shorter than the conveyor 100 below. In this case the supporting system 500 comes into play, which is adapted to hold the insulating pane 1 before the conveyor 100 below is lowered. This supporting system is constituted by an assembly of suction cups 501, 501a, 501b, etc. (or optionally by a single suction cup) which are kept overhanging by means of rails 502 on which wheels 503 run which are integral with a trolley 504 to which the suction cups are attached, the trolley being moved transversely to the plane 901 of arrangement of the insulating pane 1 by means of a pneumatic actuator 505. Once the conveyor 100 has been lowered, the unloading means 14 begin to interact with the lower horizontal side 1a in a position of stability with respect to the center of gravity of the insulating pane 1.

[0044] A variation for facilitating unloading operations using the means 14 is constituted by the presence of a fulcrum 506 on which the rails 502 are pivoted which, by means of the pneumatic actuator 507, modify the arrangement of the assembly of suction cups 500 from being parallel to the plane 901 of arrangement of the insulating pane 1 to being parallel to the plane 902 of arrangement of the unloading means 14 (Figure 10).

[0045] A further variation is constituted by the duplication (or multiplication) of the assembly of suction cups 500 in the vertical (pseudo-vertical) direction so as to ensure the insulating pane 1 is stably fixed when its vertical extension is important (Figure 10).

[0046] As noted earlier in this operation the conveyor 100 is managed in a manner different from the one conducted in the sealing step. Specifically, both parts 101, 151 of the conveyor 100 are raised or lowered synchronously in the same stroke, since the insulating pane 1, being the one just sealed, is in relation to the lower edge thereof 1a which is to be worked on, simply for obtaining a space for access by the unloading means 14, either at its end parts or at its intermediate part.

[0047] At this point it should be noted that depending on the type of insulating pane 1, the situation can arise

wherein the intermediate glass sheet 2' or the intermediate glass sheets 2', 2", etc. are not supported by the elements of the conveyor 100. So a distinction must be made between the case where the spacer frame is of the 5, 5', etc. type as in Figures 1D and 1F, where the acrylic sealant 6' constitutes a stable joint between the suspended sheet (or the suspended sheets) and the adjacent spacer frames 5, 5', etc., and the case where the spacer frame is of the 3, 3', etc. type, where the joint with the glass sheets 2, 2', 2", etc. is not stable because it is made using butyl sealant 6 consisting of thermoplastic material and thus subject to viscous sliding (creeping) until the secondary sealant 7 catalyzes and thus achieves its elastomeric characteristics. In the first case the intermediate glass sheets are not affected by the phenomenon of viscous sliding (creeping) and therefore no additional mechanisms are needed. But in the second case, during the waiting time before the coupling with the unloading means 14, especially if this time is not negligible, the intermediate sheet or sheets are subject to downward viscous sliding, since the elements 101, 151 only interact with the end glass sheets. In order to overcome this drawback, special retractable supports 551a, 551b, etc. are positioned against the lower horizontal side 2'a, 2"a, 2"'a, etc. of the intermediate sheet or intermediate sheets during the step of waiting for the unloading, with an action that is effective until the intervention of the supports of the unloading means 14 which have the same function. During the sealing step, the intermediate glass sheets 2', 2,", 2"', etc., with the spacer frame of the 3, 3', etc. type, undergo a lowering that is slight but still acceptable since the time during which these sheets remain suspended is limited and since this slight lowering is then corrected thanks to the action of the retractable supports of the 551a, 551b, etc. type. Alternatively and more effectively, and in addition to the retractable supports 552a, 552b which are now height-adjustable, one or more intermediate chains 553 of the type of the end chains 107, 157 can be deployed at the one or more intermediate sheets for their support also during the sealing step. In this solution the chain or chains, as well as being provided with motions like those described for the chains 107, 157 (both of movement along the H axis and of adjustment along the pseudo-vertical plane, like the stationary supports 552a, 552b), are provided with a further adjustment motion which is transversal with respect to the plane 901 of arrangement of the insulating pane 1 so as to be placed in the region of the two planes parallel to the plane 901 arranged at the end faces of the intermediate sheet or sheets 2', 2", etc. These options for supporting the intermediate sheet or sheets, not being considered inventive, are not claimed but included here to constitute state of the art. It is obvious that Figure 18 is merely for the purposes of example, the actual mechanisms being rather complex since they would in reality interact with positions interfering with those associated with the actuations of the semi-conveyors 101, 151 and therefore they must occupy interlocked regions to prevent interference.

[0048] As indicated in the comments on Figure 21, the accident prevention aspect is nowadays of primary importance, even a priority over the functionality and productivity of the machine. From this point of view the invention under discussion is in an advantageous position with respect to the state of the art for the following fundamental reasons: the devices for supporting the insulating pane 1 below the lower horizontal side 1a, although they are provided with the necessary adjustment motions for mating with the edges 1f and 1r of the lower horizontal side 1a (see Figures 22 and 23), do not have discontinuities in the direction transversal to the plane 901 and therefore the insulating pane 1 cannot be inserted between the semi-conveyors 101 and 151 that make up the conveyor 100; the load constituted by the insulating pane 1, which is of large size and great thickness and therefore massive, can be easily supported by the conveyor 100 because it has a rigid structure, all overhanging solutions of the shelf type (a situation that is widespread in the known art) being avoided; the monolithic constitution of the semi-conveyors 101, 151 (made possible by the solution recited in claim 1) and the adoption of actuators 112, 162 of the synchronous type enable a positioning of the elements 108, 158 that is reliably mated with the edges 1f and 1r of the end sheets of the insulating pane 1; the shape of the supporting elements 108, 158 enables the use and the easy substitution of inserts of hardness adapted to the fragility of the glass. These are all elements that, in addition to improving the safety factor, also considerably improve the functionality and maintainability aspects.

[0049] In case of the improbable but not impossible situation wherein the semi-conveyor 151 should develop play with respect to the edge If (for example due to an incorrect manual command, or anomalies in the transmission of data, etc.), fall prevention guards can be activated in any case, where the activation thereof is based on the checking, performed by the process computer, of the position of the vertical passing through the center of gravity of the insulating pane 1, whether it falls inside the line 1r or not (in fact if it falls inside, and under conditions of play between the line If and the supporting elements 158, then the insulating pane 1 would be unstable, crashing to the floor towards the operator). The process computer is capable of determining the position of the center of gravity of the insulating pane 1 since the associated inputs comprise all the information relating to the components of the insulating pane 1, i.e. dimensions and thicknesses of the glass sheets (2, 2', 2", 2"', etc.) or (2M, 2'm, 2"m, 2"'m, etc.) or (2M, 2'M, 2"m, 2"'m, etc.) or (2M, 2'M, 2"M, 2"'m, etc.) or other combinations, and of the spacer frames (3, 3', 3", etc.) or (5, 5', 5", etc.).

[0050] The present invention is susceptible of numerous variations of embodiment (with respect to what can be gleaned from the pictures, the details of which are evident and self-explanatory) all of which are within the scope of equivalence with the inventive concept, for example the mechanical solutions for the motions for mov-

ing and for adjusting the parts 101 and 151 constituting the conveyor 100, the inserts 108, 158 for supporting the insulating pane 1, the means 100' for synchronous horizontal entrainment of the insulating pane 1, the means for synchronous vertical movement of the head 200 containing the extrusion nozzle 400, the means for rotation of the head 300 containing the extrusion nozzle 400, the device for the troweling, etc., the actuation means which can be electrical, electrical/electronic, pneumatic, hydraulic and/or combined, etc., the control means which can be electronic or fluidic and/or combined, etc.

[0051] A variation of the known part of the invention, which however basically resides only in software and thus uses the variations of the known devices for the sealing part, is the variation constituted by the logical combination of the actuations, respectively: horizontal translation of the insulating pane 1 by means of the synchronous motors 102 and 102'; vertical translation of the head 200 by means of the synchronous motor 202; rotation of the head 300 by means of the synchronous motor 302; control of the obturator of the nozzle 400 so as to enable sealing on an insulating pane 1' having a shape other than rectangular in that it is regularly or irregularly polygonal or on an insulating pane 1" having a shape other than rectangular in that it is curvilinear or on an insulating pane 1"' having a shape other than rectangular in that it contains both rectilinear and curvilinear parts.

[0052] In order to achieve this, in completion of what was described earlier, the electric actuators of the four motors, two, 102 and 102', for actuation of the horizontal axis, one, 202, for actuation of the vertical axis; respectively moving the insulating pane 1 and the head 200, and one, 302, for rotation of the head 300 are concatenated by means of an electrical axis (digital control).

[0053] The constructional details can be substituted with others that are technically equivalent. The materials and the dimensions can be any according to requirements, in particular deriving from the dimensions (length and height) and/or from the shape of the glass sheets 2, 2', 2", etc. constituting the insulating pane 1.

[0054] The foregoing description and the associated figures refer to an automatic sealing machine 1000, including the innovative devices 100 for the conveyance of the insulating pane 1 and the innovative devices 500 placed at the end of the line for producing the insulating pane 1, and, with respect to the sealing machine, the origin machines (coupling machine and press, optionally filled with gas, etc.) are located to the right; it is easy to imagine a description and associated figures for deployments that are reversed or in some way different, for example including change of the direction of operation of the line.

[0055] In general the described sequence of sides to be sealed i.e.: vertical side 1b first, upper horizontal side 1c second, vertical side 1d third, lower horizontal side 1a fourth, can be varied according to the overall requirements of the production line of the insulating pane, of optimization of the cycle time, of alternation of the staggered sides with the nonstaggered sides, etc. However, a different sequence does not involve modifications of the inventive concept, but only implies a modification in the software and possibly a minor intervention in the hardware.

[0056] It goes without saying that the industrial application is sure to succeed since machines for automatic execution of the second sealing have seen extensive development in the last decade, so much so that the holder of the present application has already placed at least three hundred of them on the market, but these automatic sealing machines show complications or limitations when the sizes and weights of the insulating pane are particularly pronounced, and/or when the glass sheets 2, 2', 2", 2"' are staggered with respect to each other, both in the conveying of the insulating pane 1 during transport and sealing and in the unloading thereof. These complications mean either resorting to particularly complex conveyor means or, worse, the impossibility of sealing certain shapes of insulating pane 1. In parallel with the spread of automatic machines, development has been seen in the field of "continuous panes" and of "structural panes" where, not only for improved appearance but especially for structural reasons the dimensions, the thicknesses and therefore the weights have become considerable, but the fleet of automatic sealing machines represented by the state of the art has not kept pace with this parallel development of the final product.

[0057] What is more, the ever-increasing attention paid to accident prevention has ensured that the handling of panes of considerable size and weight has become an activity that is subjected to major considerations in terms of risk analysis. Therefore every solution that resolves this aspect with a configuration already inherent in the machine itself (the unloading of heavy and cumbersome insulating panes 1) is considered to be of primary importance in the comparison of the various types of machines, leading to competitive advantages of considerable significance.

[0058] The installation of the present invention in the double-glazing production line is shown in Figures 20 and 21 (elevation and plan views), as a clear confirmation of the assured success in industrial application, in view of today's consolidated but ever-evolving distribution of such lines.

[0059] The disclosures in Italian Patent Application No. TV2010A000156 from which this application claims priority are incorporated herein by reference.

[0060] Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly, such reference signs do not have any limiting effect on the interpretation of each element identified by way of example by such reference signs.

Claims

1. A machine for the automatic sealing of the perimetric cavity of the insulating pane (1) constituted by at least two glass sheets (2, 2', 2", 2"', etc.) of rectangular shape or different from rectangular shape and at least one spacer frame (3, 3', 3", etc., 5, 5', 5", etc.) located in proximity to the perimeter at a finite distance from the edge of said sheets or of the smaller sheet, where the glass sheets can be aligned or staggered on one or more or all of the perimetric sides and the thickness both of each glass sheet (2, 2', 2", 2"', etc.) and of each spacer frame (3, 3', 3", etc., 5, 5', 5", etc.) and therefore the total thickness of the insulating pane (1) can vary from one insulating pane to another insulating pane, said machine being constituted by at least one conveyor (100) having the function of supporting and conveying (together with the suction cup slider (100')) the insulating pane (1) during the sealing cycle and by a slider (200) running on vertical guides containing the sealing head (300), said sealing head (300) being provided with a rotary motion so that the sealing nozzle (400) orientates itself in an arrangement tangential to the perimeter of the insulating pane (1) and fed by one or more volumetric dosers for two-component or one-component sealant the flow of which is controlled as a function of the dimensions of the cavity of the perimetric edge comprised between the glass sheets (2, 2', 2", 2"', etc.) and the spacer frame (3, 3', 3", etc., 5, 5', 5", etc.) and of the relative speed between nozzle (400) and the perimeter of the insulating pane (1) so as to fill the cavity up to the outermost edge of the smaller glass sheet or of the glass sheets if they are aligned, **characterized in that** the conveyor (100) used for supporting and conveying (optionally together with the suction cup slider (100')) the insulating pane (1) is divided into two parts, the rear part (101) supporting and entraining the outer glass sheet (2) opposite to the operator and being constituted by an endless transmission chain (107), for example of the roller chain type, the arrangement of which is on a plane parallel to the plane of arrangement (901) of the insulating pane (1), carrying inserts (108) which interact with the lower outer edge (2a) of the sheet (2) and form an acute angle with the plane of arrangement (901) of said sheet and are limited in extension, being matched with the fixed position of the lower edge (2a) of the glass sheet (2), the front part (151) supporting and entraining the outer glass sheet (2' or 2" or 2"', etc.) on the operator side and being constituted by an endless transmission chain (107), for example of the roller chain type, the arrangement of which is on a plane parallel to the plane of arrangement (901) of the insulating pane (1), carrying inserts (158) which interact with the lower outer edge of the sheet (2' or 2" or 2"', etc.) and form an acute angle with the plane (901) of arrangement of said sheet and extend so as to cover the entire field of total thickness of the insulating pane (1), and **in that** each of said parts (101, 151) is provided with independent adjusting motion along the vertical (pseudo-vertical) direction belonging to a vertical (pseudo-vertical) plane parallel to the plane (901) of arrangement of the insulating pane (1).

2. The automatic machine according to claim 1, **characterized in that** the adjustment along the vertical plane (pseudo-vertical) of the parts (101, 151) of the conveyor (100) is used to obtain a space below the lower horizontal side (1a) of the insulating pane (1) between said side (1a) and the conveyor (100), adapted to the engagement of the unloading means (14).

3. The automatic machine according to claim 2, **characterized in that** one or more suction cups [(501, 501a, 501b, etc.) of the at least one group (500)] hold the rear face of the glass sheet (2) while the parts (101, 108, 151, 158) of the conveyor (100) detach and move away from the lower horizontal side (1a) of the insulating pane (1) by the action of the actuators (112, 162).

4. The automatic machine, according to claim 3, **characterized in that** the one or more suction cups (501, 501a, 501b, etc.) of the at least one group (500) that is integral with the slider (504) running on wheels (503) along rails (502), are equipped with motion for approaching/moving away from the glass sheet (2), actuated by means of the pneumatic cylinder (505), transversally to the plane (901) of arrangement of said glass sheet (2).

5. The automatic machine according to claims 2 to 4, **characterized in that** the one or more suction cups (501, 501a, 501b, etc.) of the at least one group (500) are pivoted on a fulcrum corresponding to the pin (506), so as to adapt the inclination of the pseudo-vertical arrangement of the insulating pane (1) from the condition of stability with respect to the sliding surface (901) thereof to the condition of stability with respect to the resting surface (902) of the unloading means (14), by means of the pneumatic actuator (507).

6. The automatic machine according to one or more of the preceding claims, **characterized in that** as a function of the size of the insulating pane (1) the conveyor (100) which is lowered for the engagement of the unloading means (14) is the conveyor below the group of suction cups (500).

7. The automatic machine according to one or more of the preceding claims, **characterized in that** as a function of the size of the insulating pane (1) the con-

veyors (100) which are lowered or lifted for the engagement of the unloading means (14) are the conveyors adjacent to the conveyor located at the group of suction cups (500).

8. The automatic machine according to claim 1, **characterized in that** the process controller locates the position of the center of gravity of the insulating pane (1) as constituted by the progression of the glass sheets (2, 2', 2", 2"', etc.) or (2M, 2'm, 2"m, 2"'m, etc.) or (2M, 2'M, 2"m, 2"'m, etc.) or (2M, 2'M, 2"M, 2"'m, etc.) or other combinations and of the spacer frames (3, 3', 3", etc.) or (5, 5', 5", etc.) and therefore as a function of the shapes, sizes, thicknesses, specific weights of these components; and verifies that its vertical projection falls, with respect to the line (1r) of intersection of the plane (901) of arrangement of the rear face of the insulating pane (1) with the group of support elements (108), internally or externally, with the purpose of managing the safety logic (which for example proceeds to activate adapted devices for protection against falling) for all panes that might be unstable, that is to say in the event said vertical projection should fall, with respect to the line (1r) of intersection of the plane (901) with the group of support elements (108), externally, and if the semi-conveyor (101) should be lifted or the conveyor (151) should be lowered in conditions such as to not observe the matching of the positions provided in order to support the insulating pane (1) under both of the outermost glass sheets by means of the elements (108, 158); where it is possible for such lifting and lowering to be activated by manual command or failure of the transmission and feedback means or anomalies in data transmission or anomalies or errors in the software.

9. A method for the automatic sealing of the perimetric cavity of the insulating pane (1) constituted by at least two glass sheets (2, 2', 2", 2"', etc.) of rectangular shape or different from rectangular shape and at least one spacer frame (3, 3', 3", etc., 5, 5', 5' ' , etc.) located in proximity to the perimeter at a finite distance from the edge of said sheets or of the smaller sheet, where it is possible for the glass sheets to be aligned or staggered on one or more or all of the perimetric sides and particularly on the lower horizontal side (1a), and where the thickness both of each glass sheet (2, 2', 2", 2"', etc.) and of each spacer frame (3, 3', 3", etc., 5, 5', 5", etc.) and therefore the total thickness of the insulating pane (1) can vary from one insulating pane to another insulating pane, the extrusion of the two-component or one-component sealant through the nozzle (400) being dosed as a function of the size of the cavity to be filled and of the relative speed between nozzle (400) and perimeter of the insulating pane (1), **characterized in that** the outer edges or the entire thickness or part of the thickness of the outermost sheets of the insulating pane (1) are supported, in any position whatsoever thereof, by means (101, 151, 108, 158) that can move together with the insulating pane (1) in the direction of conveyance thereof and are each adjustable, independently of each other, in the vertical (pseudo-vertical) direction belonging to a vertical (pseudo-vertical) plane parallel to the plane (901) of arrangement of the insulating pane (1).

10. The method according to claim 9, **characterized in that** a space between the lower horizontal side (1a) of the insulating pane (1), on part or all of said side, and the conveyor means (101, 151, 108, 158) can be obtained by means of lowering said conveyor means (101, 151, 108, 158) while the insulating pane (1) is held and supported in its end of cycle position, so as to allow for the introduction of means (14) for the unloading of the insulating pane (1).

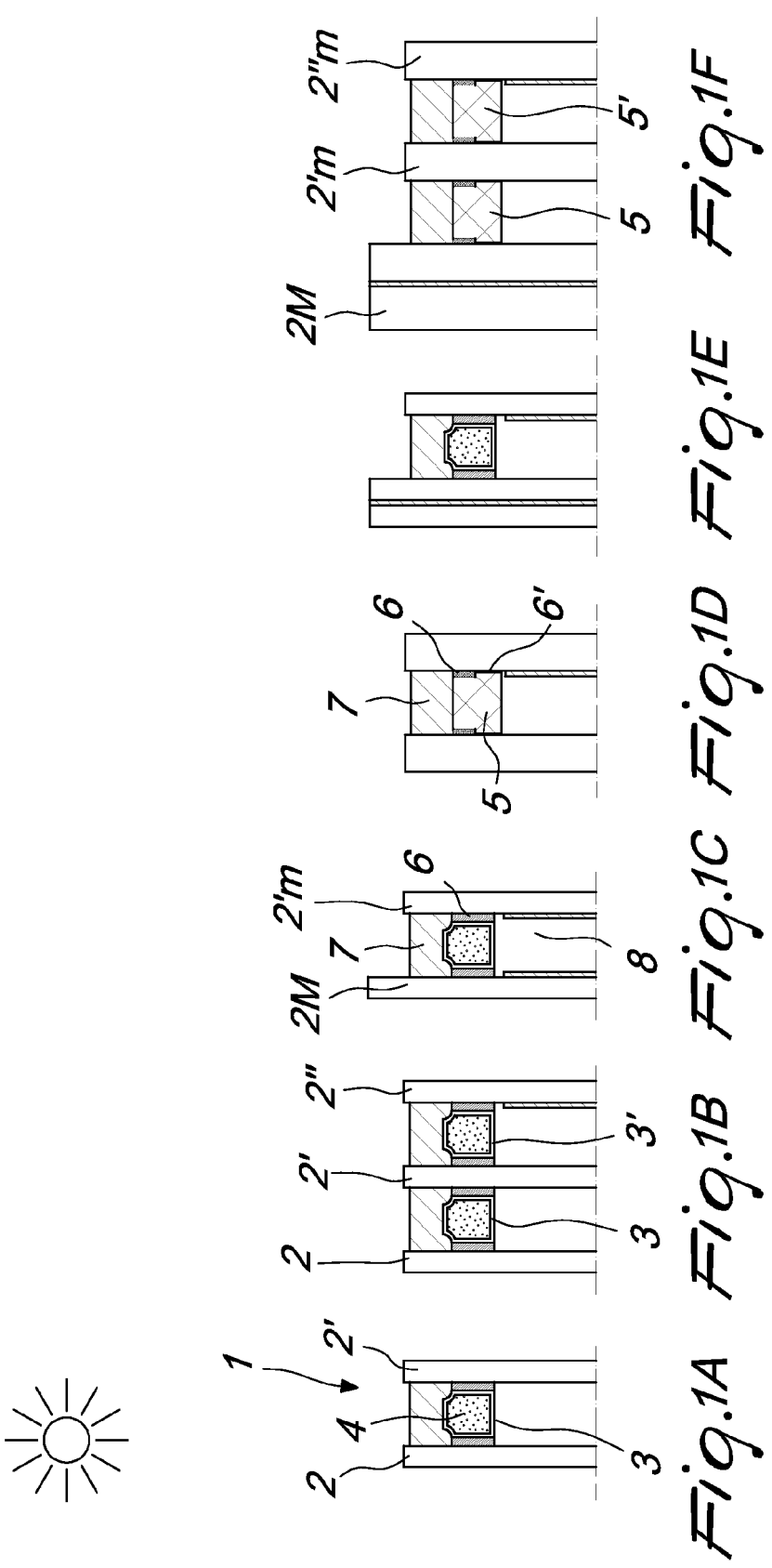

Fig.1A Fig.1B Fig.1C Fig.1D Fig.1E Fig.1F

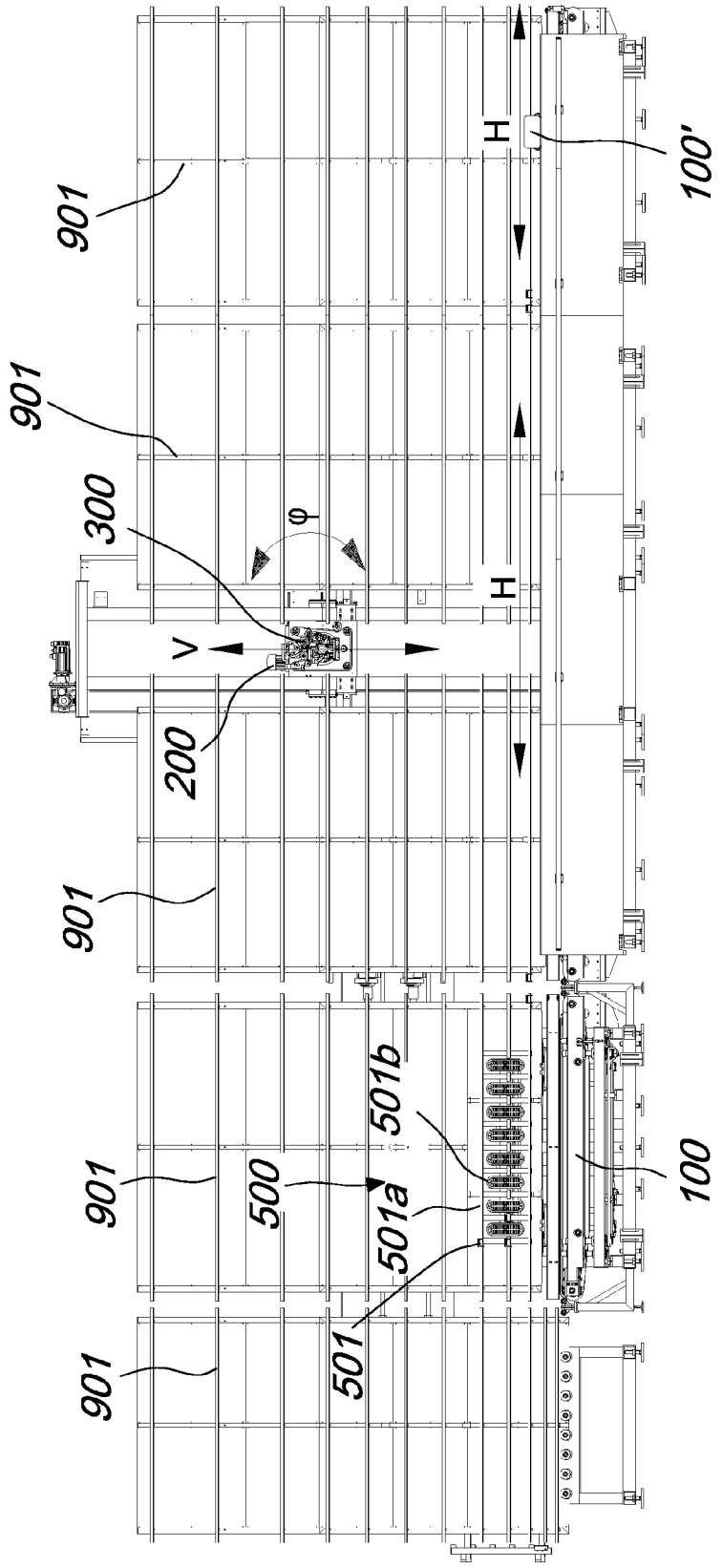

Fig. 2

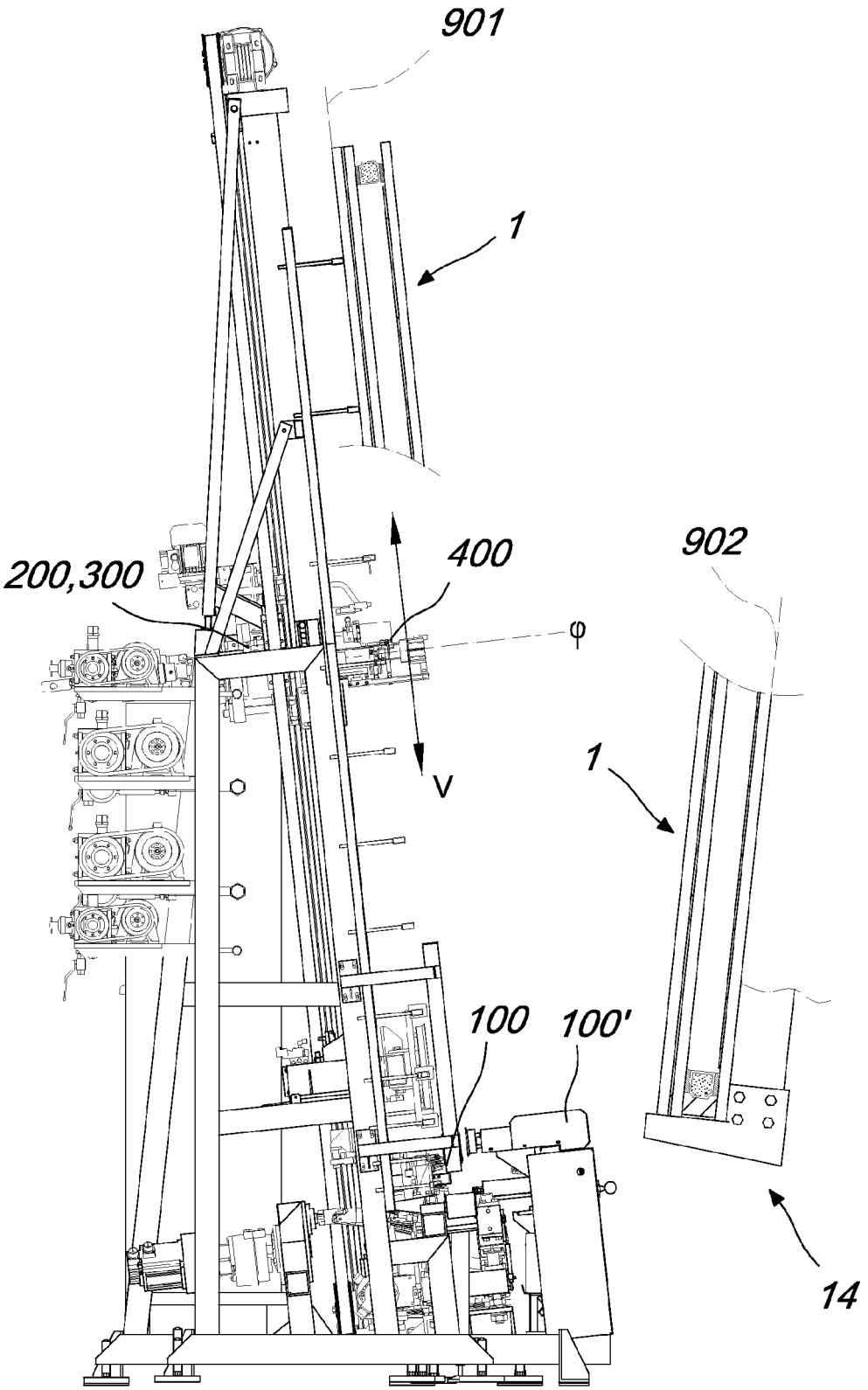

Fig. 3

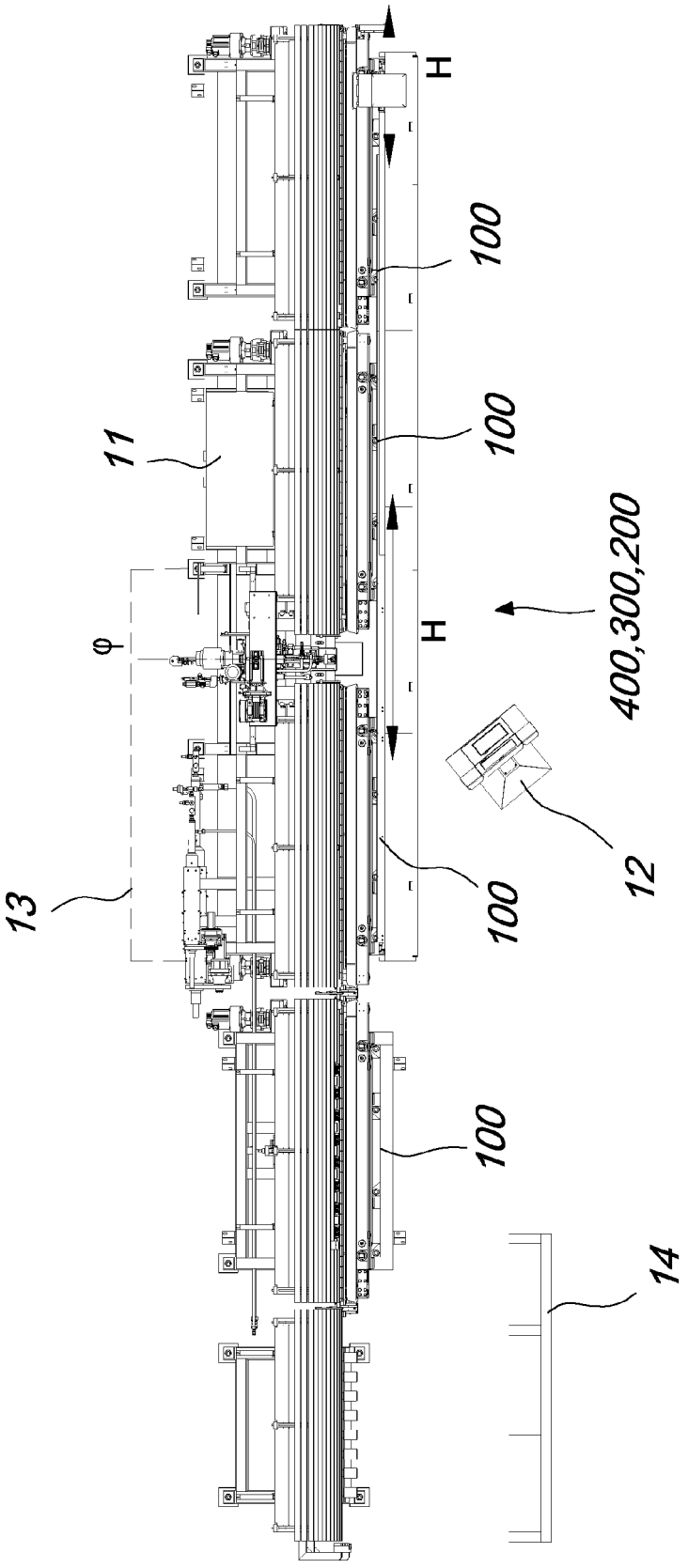

Fig. 4

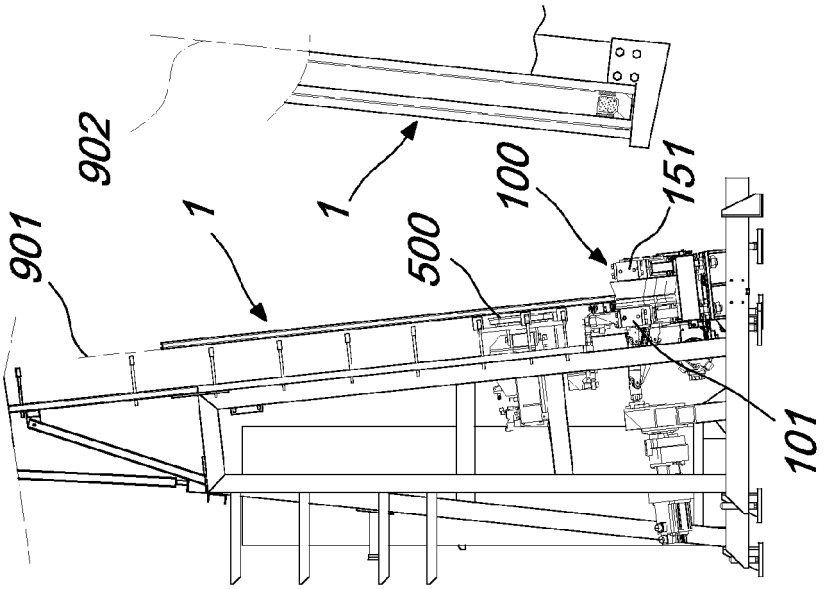

Fig. 6

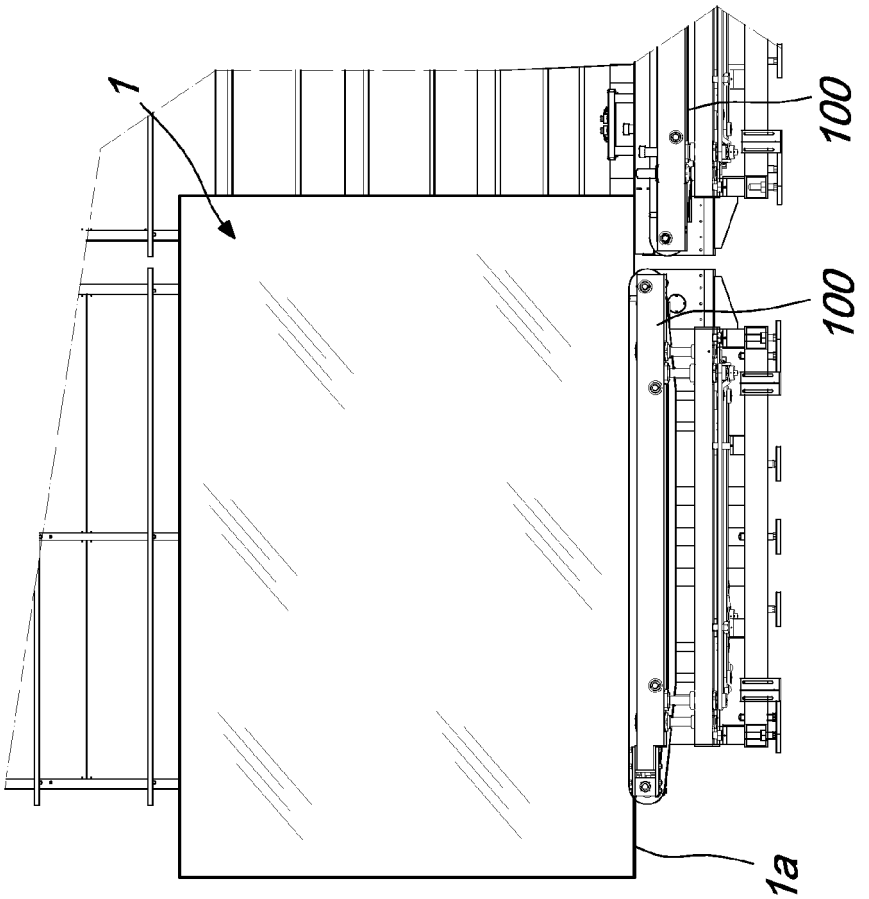

Fig. 5

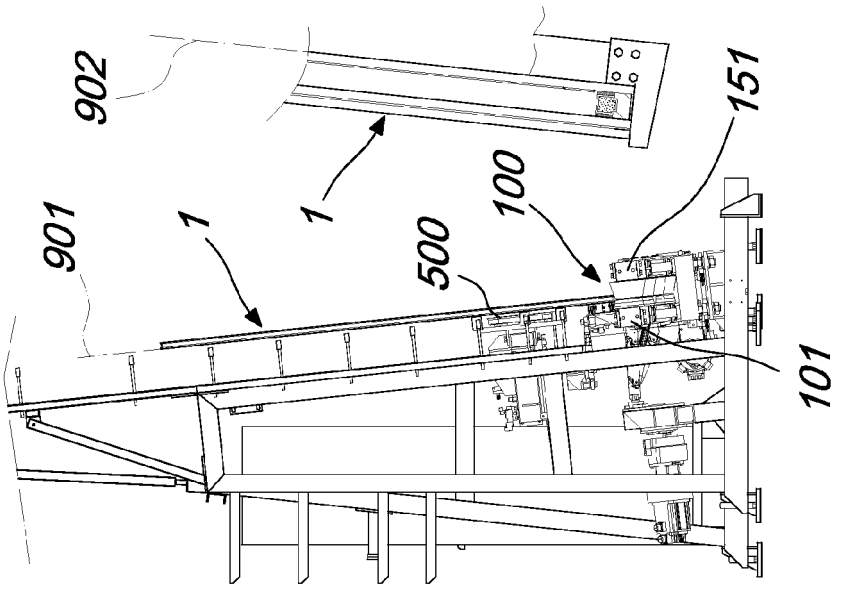

Fig. 8

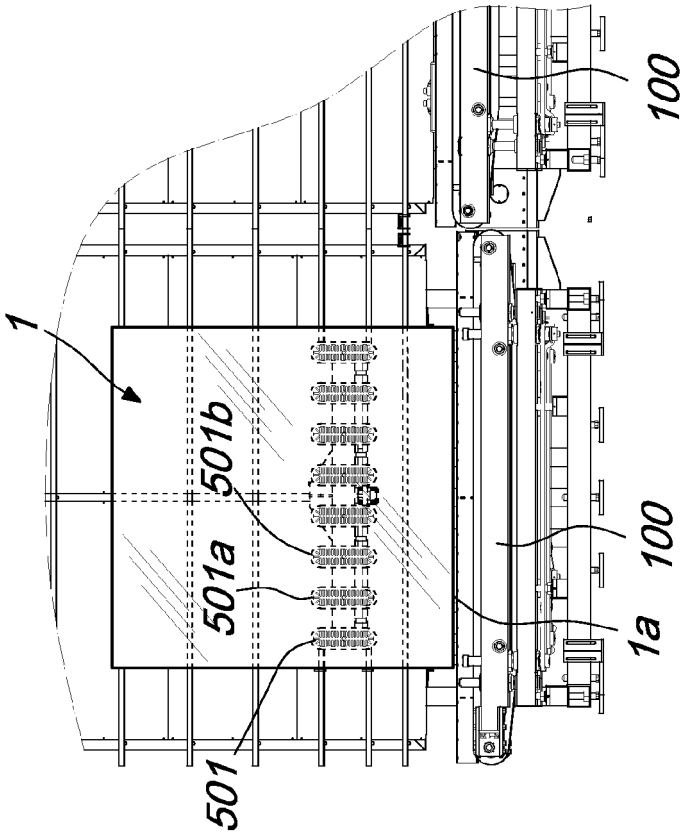

Fig. 7

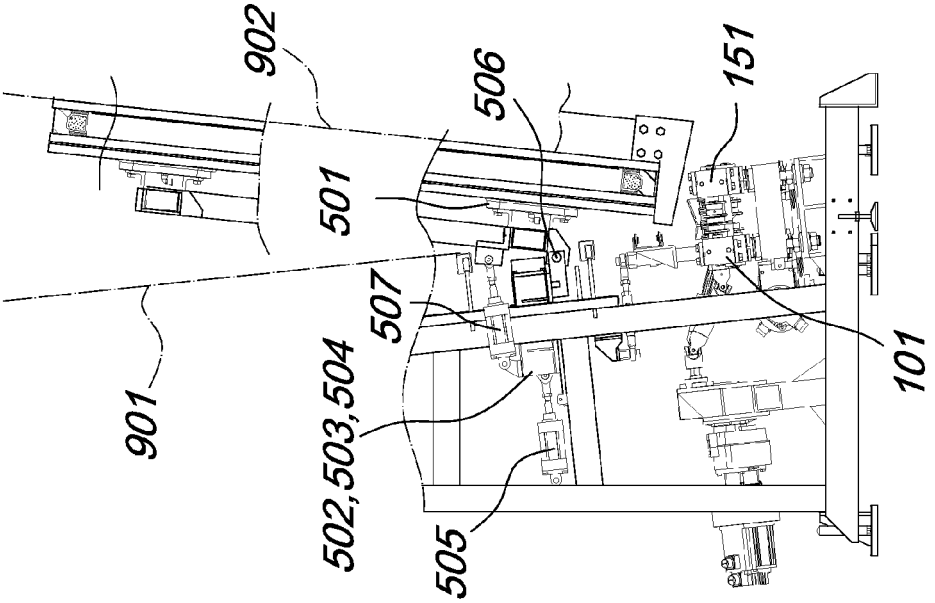
902
506
151
501
507
101
901
502,503,504
505

Fig. 10

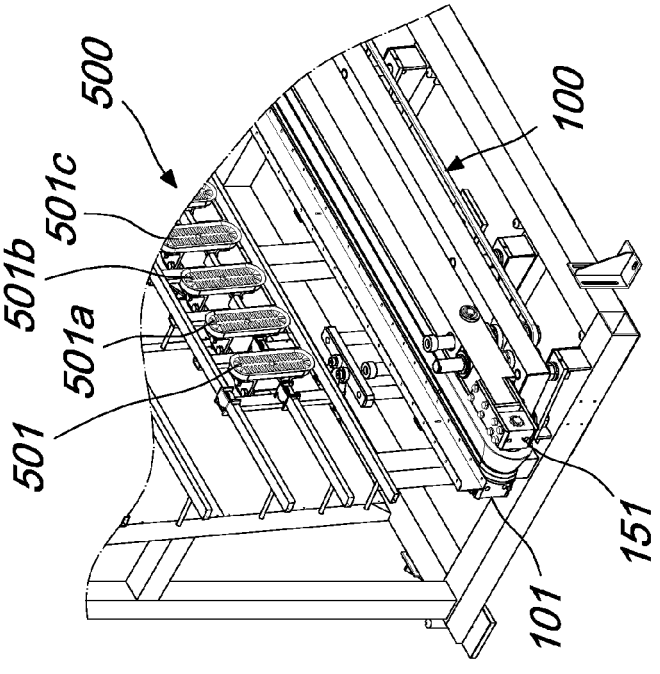
500
100
501c
501b
501a
501
151
101

Fig. 9

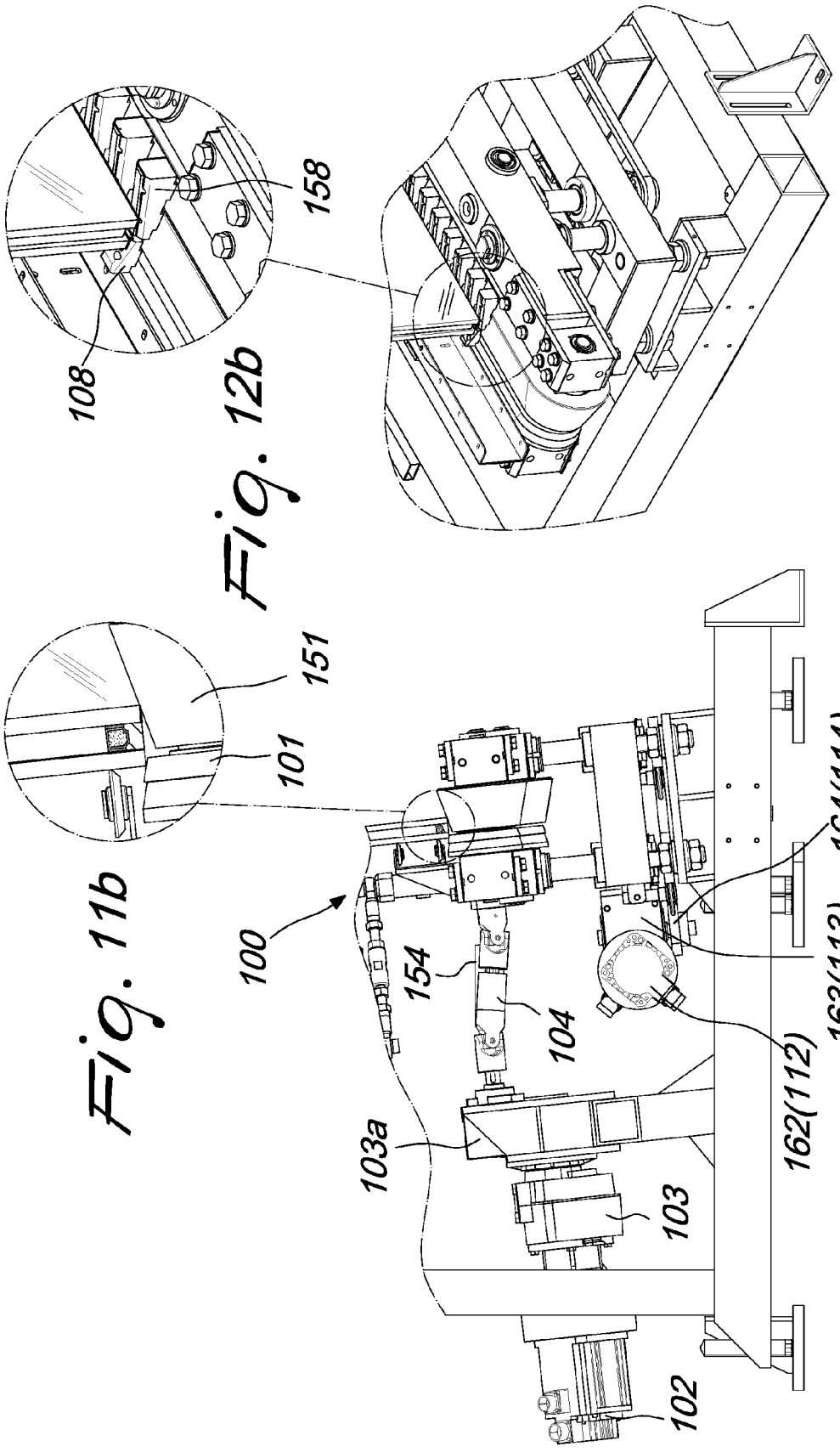

Fig. 11a

Fig. 11b

Fig. 12b

Fig. 12a

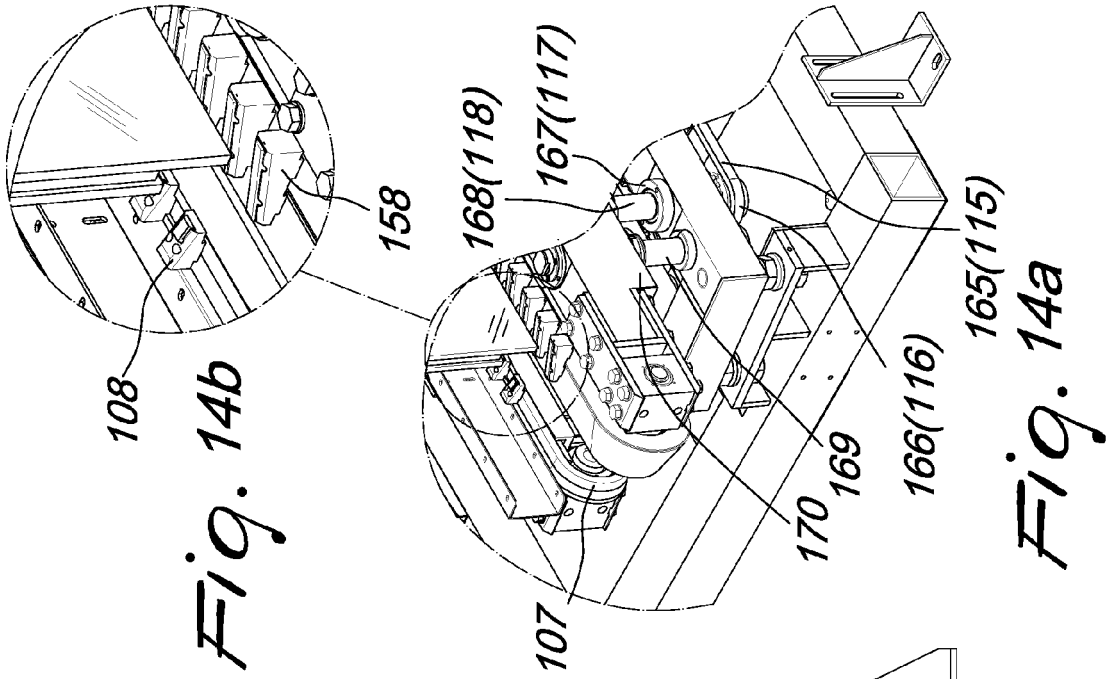

Fig. 14b

Fig. 14a

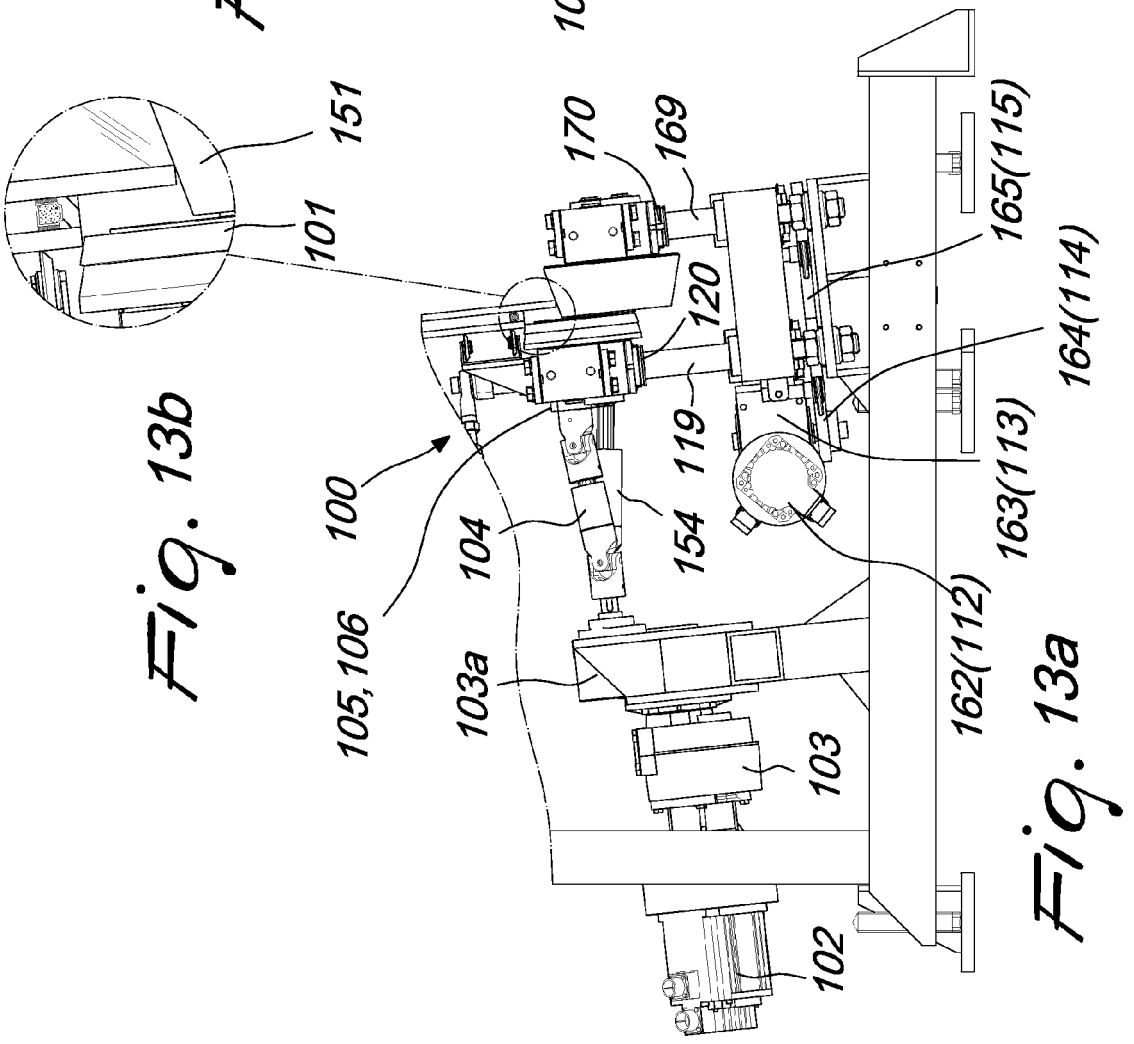

Fig. 13b

Fig. 13a

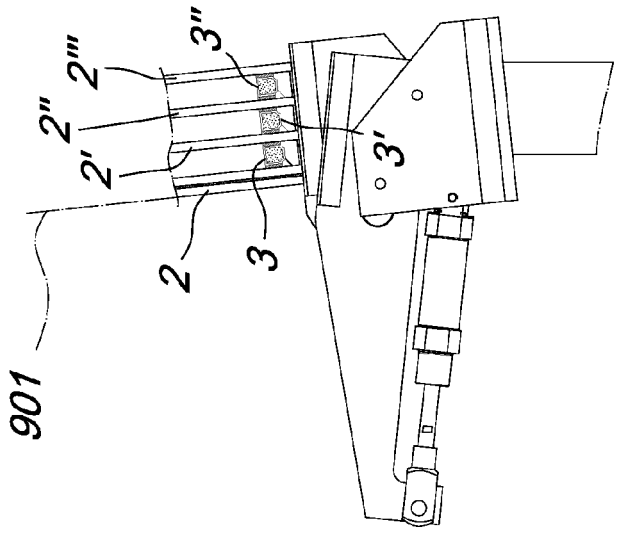

Fig. 16

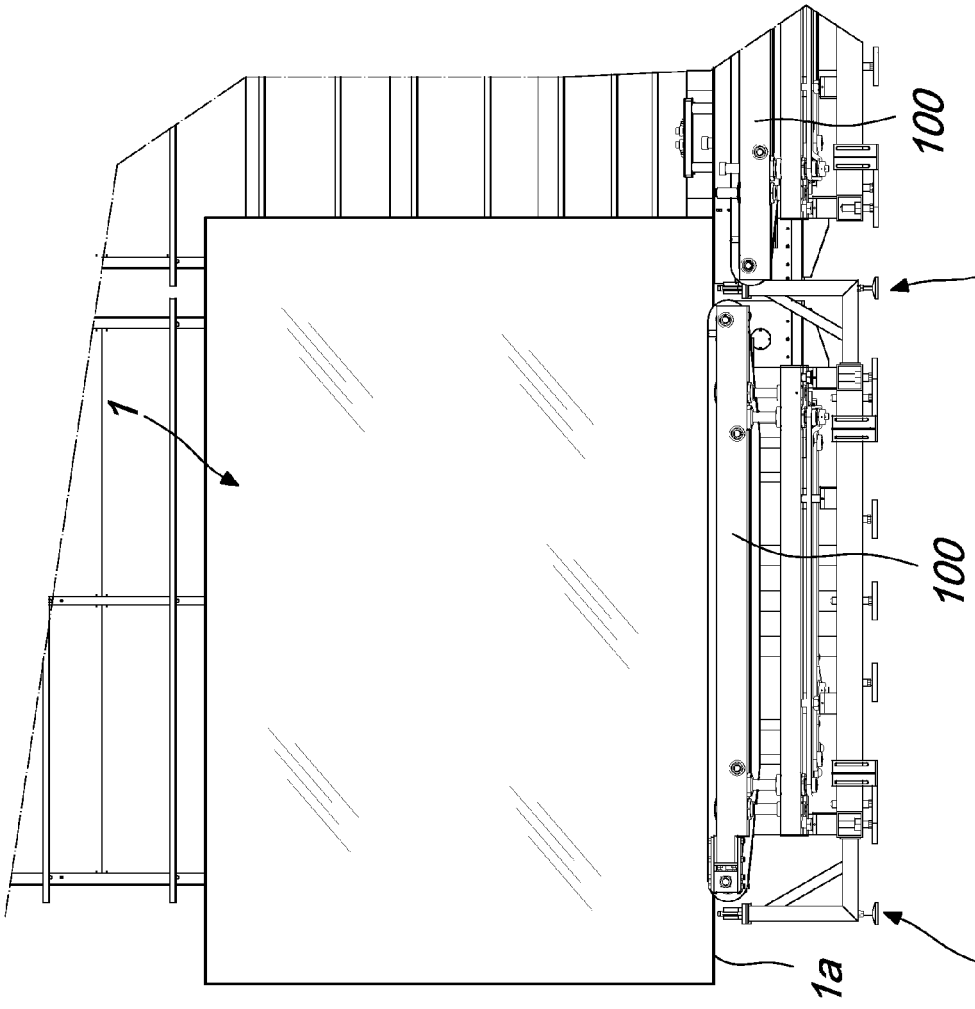

Fig. 15

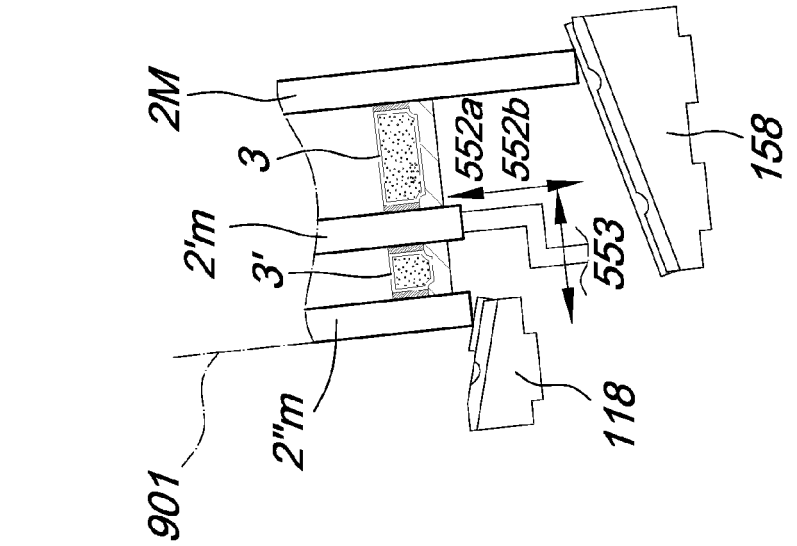

Fig. 18

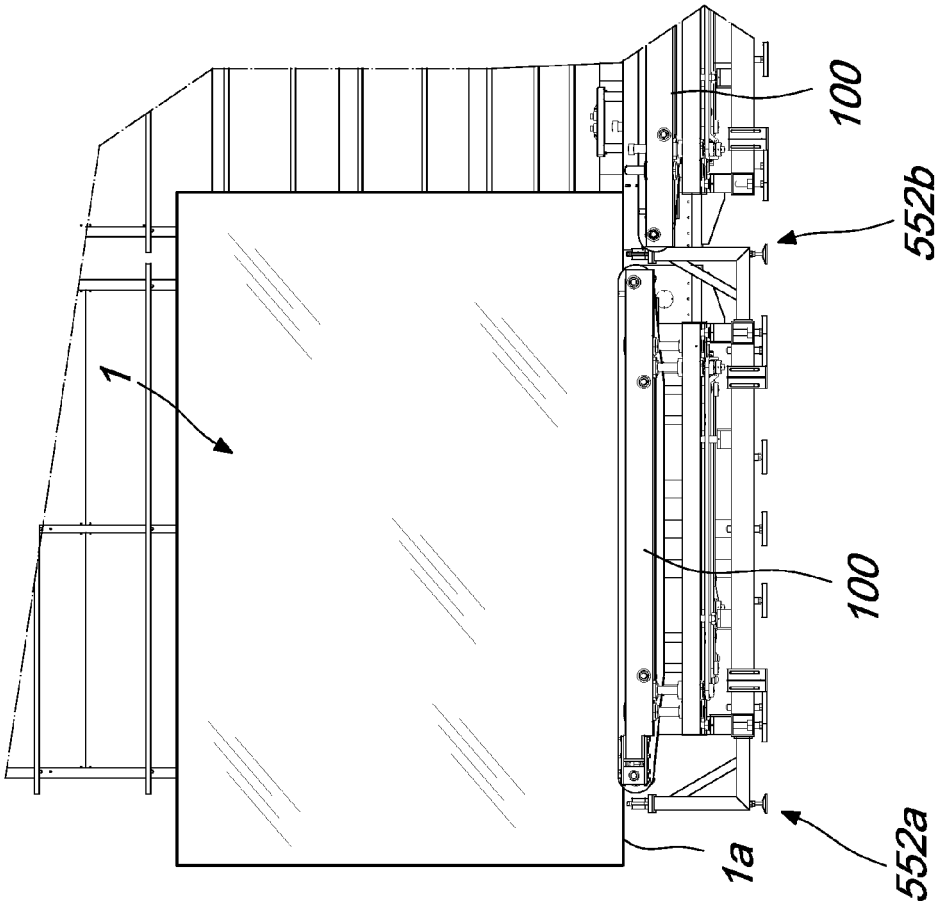

Fig. 17

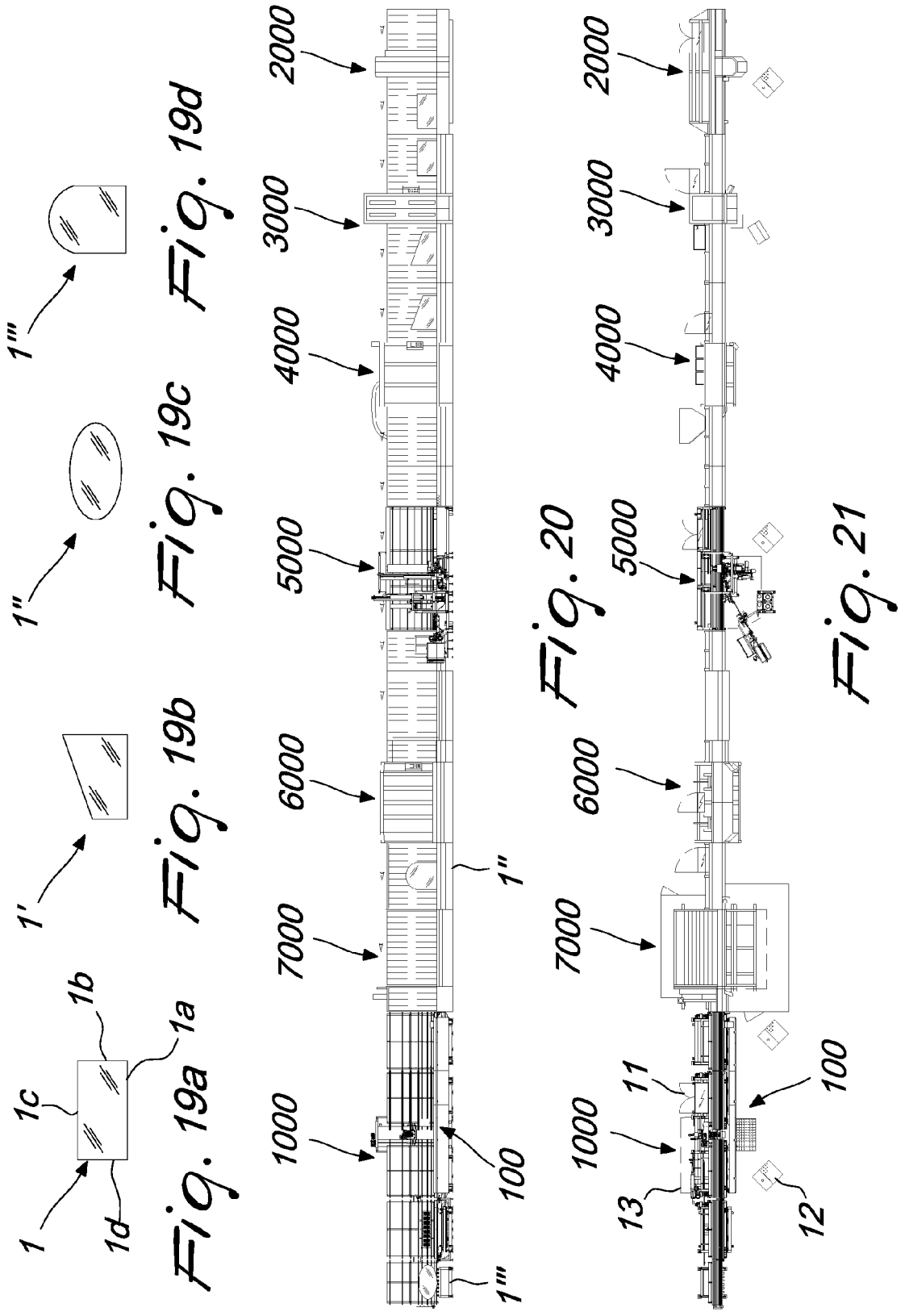

Fig. 19a Fig. 19b Fig. 19c Fig. 19d

Fig. 20

Fig. 21

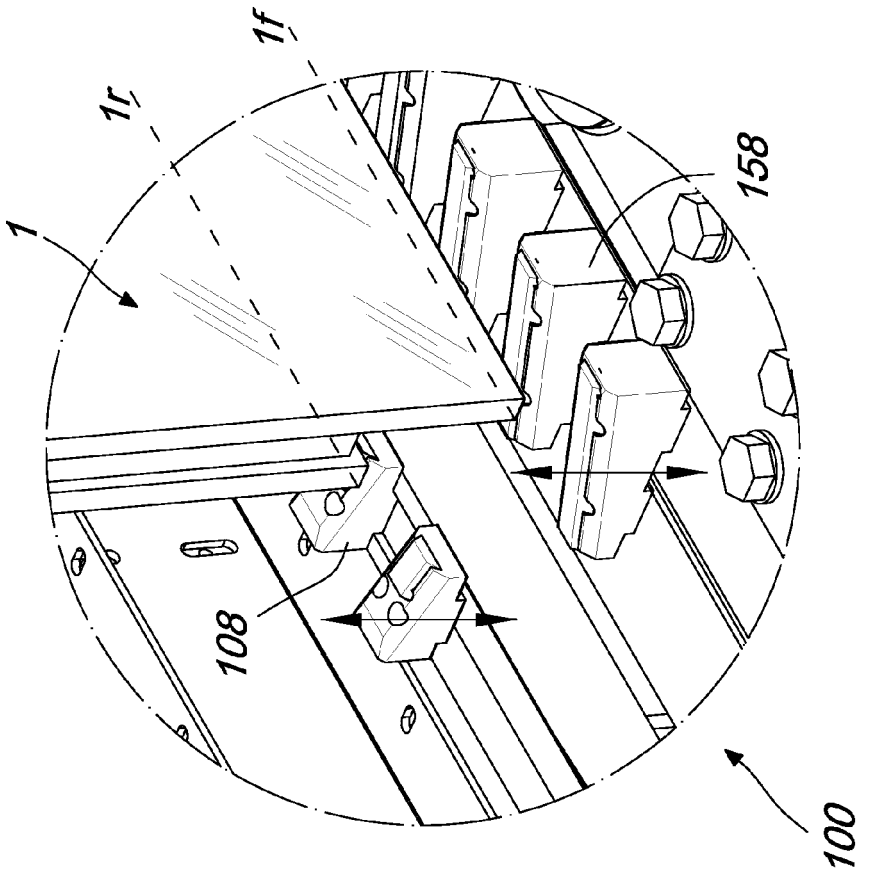

Fig. 23

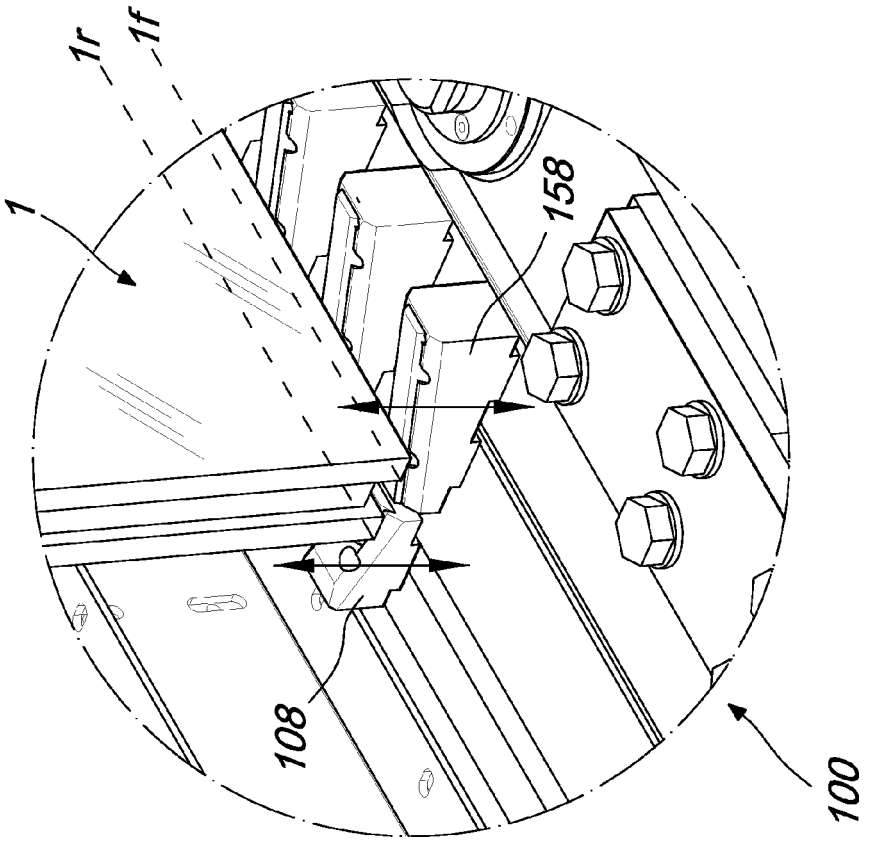

Fig. 22

REFERENCES CITED IN THE DESCRIPTION

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