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(54) MAKING MULTIPLE GLAZED UNITS INCLUDING THE STEP OF POSITIONING GLASS SHEETS IN PARALLEL PLANES

(71) We, SAINT-GOBAIN INDUSTRIES, a French body Corporate, of 62 Boulevard Victor Hugo, 92209 Neuilly Sur Seine, France, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a method of and device for making multiple glazed units including the step of positioning glass sheets in parallel planes. Such a method and device finds application in automatic manufacture of double panes.

An insulating double pane, or more generally a multiple pane, is formed of two or more glass sheets spaced and held together side-by-side by spacer joints which may be of plastics material. In order to make such a pane, for example a double pane (and the discussion which follows will be devoted to double panes, it being understood that the problem to which this invention is directed exists and is solved in the same way when the number of sheets of glass is greater than two) there is first of all deposited a strip forming the first spacer joint on the edges of a glass sheet, this first sheet provided with its strip is turned and there is applied a second sheet; the assembly of the two sheets is pressed to bring the double pane thus formed to the desired thickness and there is applied to the edges of said double pane a second plastics material. In an automatic manufacturing line for double panes such as described in French Patent 2,211,413 where the glass sheets are moved in the horizontal state and where the assembly of the two sheets is also carried out in the horizontal state, one of the two glass sheets being turned over and applied to the other using an assembly device formed by a fork which, holding the first sheet by suction members, lifts it and turns it by pivoting about a horizontal axis. At the moment of assembly when the spacer strip carried by one of the sheets comes into contact with the other the two glass sheets have to be practically parallel otherwise the portions of the strip which are close to the axis of pivoting have the tendency to spread and the crushing of said strip is not uniform for the whole perimeter of the pane, the portions of the strip being crushed to a greater extent as they are closer to the axis of pivoting. These effects are increased when the spacer strip is higher, or in other words when the layer of air defined by the strip is thicker. Such disadvantages are not always serious for strips of low height but they may prevent the formation of a good airtight seal for the air layer between the two sheets when the strip is thick.

In a configuration for the assembly line where the glass sheets are flat, it is possible to avoid these disadvantages by lengthening the branches of the assembly fork to increase the separation of the glass sheets from the axis of pivoting. Thus the sheet to be deposited traverses a circumference of greater radius and at the moment of contact the glass sheets are quite close to perfect parallelism.

However when, to restrict the bulk of the apparatus, the manufacturing line has another arrangement, such that the sheet carrying the strip always moves in the horizontal state whereas the other sheet is approximately vertical the quasi parallelism of the two glass sheets at the moment of assembly cannot be obtained by the same means. When the glass sheet which carries the spacer strip arrives in the horizontal state at a normal height of working, typically about 0·95 cm above a support surface and has to be brought to an approximately vertical position and applied on the other sheet, lengthening the branches of the fork then requires increasing the bulk and carrying out assembly of the two sheets at a height increased to the extent that the glass sheets are on their respective fork further from the axis of pivoting, whereas it is highly desirable that the assembly should be carried out at normal height so that the quality can be verified and the machines adjusted in consequence.

The invention is intended to avoid the disadvantages mentioned above without the bulk of the device for depositing one sheet on the other being increased and/or the pane made from the sheets being initially at a normal height for working but being in an inaccessible position after assembly.

According to one aspect of the invention there is provided a method of making multiple glazed units including the step of positioning glass sheets in parallel planes which step comprises mounting both sheets in predetermined positions on respective planar supports, rotating a first said support about a first axis parallel to the planes of both supports, the axis being adjacent the sheet mounted on the first support, and then rotating at least one of the supports about a second axis parallel to the first remote from the sheet mounted on the first support to position the sheets in parallel planes.

According to another aspect, there is provided a device for carrying out such a method comprising respective planar supports for each of the glass sheets, a first said support being mounted to move in rotation about a first axis adjacent the sheet which it supports, and parallel to the planes of the two supports, and at least one of said supports being mounted to move in rotation about a second axis remote from the sheet supported by the first support, said other axis being parallel to the first axis.

In a preferred embodiment the second axis about which rotation for the second stage of the positioning is carried out is further away from the sheet than the first axis and is situated at the intersection of two planes in which the two supports are found at the end of the first stage of positioning.

According to one embodiment a single support is rotatable and the other support is then a fixed "desk" and provided with means for supporting the sheet and an abutment for defining a predetermined position of the sheet.

The two supports may define an angle of 95° when they are at rest and after the first phase of rotation about the first axis they may be at 5°.

A device according to the invention will now be described by way of example with reference to the accompanying drawings, in which:

Figure 1 represents a view in perspective of a device according to the invention together with conveyor means for glass sheets;

Figure 2 is a section of means for adjusting the device as a function of the thickness of different sheets, first a face view (Figure 1A), then a profile (Figure 2B);

Figure 3 illustrates the different stages of transfer of a sheet to be positioned on the device of the invention;

Figure 4 is a schematic view in profile of the device illustrating the different phases of rotation;

Figure 5 is a schematic view in profile of the device illustrating the different phases of positioning the sheets together.

Figure 1 shows the assembly of a positioning device associated with a roller conveying table and a belt conveyor. The positioning device is in two parts and as shown in Figure 1 it comprises a movable part which carries out the positioning of one of the two sheets and a fixed part or assembly desk which carries the other, waiting, sheet against which comes to be applied the positioned sheet.

The movable part of the device is formed by elements for holding the glass sheet, means for pivoting the elements for holding the sheet, means for defining the position of the glass sheet on the holding elements and means for adjusting the device as a function of different thicknesses of the glass sheets.

The elements for holding the glass sheet comprise a fork-shaped support 1 comprising a transverse bar 2 provided with arms such as 3 and a series of suction nozzles such as 4 incorporated in the arms 3 of the fork and opening onto their upper faces. At the side of each suction nozzle 4 is arranged a touch member 5 which starts application of a vacuum to the nozzles when urged by the glass sheet. The means for pivoting the holding elements of the glass sheet comprises two axes 6 and 7 for pivoting and two jacks 8 and 9 driving the support 1 to pivot respectively about axes 6 and 7. The transverse bar 2 of the fork 1 is provided on its lower face with bearings 10 and pivots by the bearings about axis 6. The axis 6 is itself mounted in other bearings supported by two arms 11, each situated on a side of the support 1.

Each arm 11 is mounted free to pivot about the axis 7 carried by a bearing 12 fixed to the ground or to the framework of the assembly. A transverse member 13 connects the two arms 11 and renders them integral in pivoting. The jack 8 is connected on one side to an axis 14 carried by a bearing 15 fixed laterally on the transverse bar 2 in the same plane, but opposed to, arms 3 on the other side of the transverse member 13. The jack is connected on one side to an axis 16 carried by a bearing 17 fixed on the transverse member 13 and mounted on the other side to the ground or the framework of the assembly.

The reference means for the glass sheet comprise a lateral rank of guide rollers 18, parallel to arms 3 of the support 1, and a transverse rank of movable abutments 19 mounted on a rod 20 activated in rotation by means of a crank 21 connected to jack 22.

The means for adjusting the positioning device as a function of different thicknesses of glass sheets are spaced between the transverse bar 2 of the support 1 and the bearings 10 through which passes the axis 6 about which said support 1 pivots under the action of jack 8.

Figures 2A and 2B show the detail of the adjusting means. In these figures there are shown the transverse bar 2 of support 1, a section of arm 3, the bearings 10 in which turns the axis 6, and the summit of the arms 11 carrying the axis 6.

The adjusting means is formed by platform 23 carrying the transverse bar 2, movable in height along guiding sliders 24 by the bias of play of two superposed bevelled blocks 25 and 26, separated between said platform and the bearings 10. A threaded stem 27 provided with a crank 28 allows sliding one along the other of the inclined surfaces of the bevelled blocks 25 and 26, thus varying the space between the axis 6 and the support 1. The screw jacks 29 ensure fixing in the adjusted position.

The fixed part of the device also known as an assembly desk, shown in Figure 1 and of which certain elements are shown schematically in Figures 4 and 5, is formed by a fixed frame 60 slightly inclined to the vertical (in the example shown 5° to vertical) of which the surface is supplied with spherical rollers 30, by operation of catches 31 integral with the frame 60, by a train of cylindrical support rollers 32 and by a removable abutment 33. The level of the train of cylindrical rollers 32 is variable under the action of the jack 34 which pushes or draws a draw member 35 provided with a groove 36 of predetermined profile in which is engaged a stud 37 integral with said train of rollers 32.

The conveyor table shown in Figure 1 is shown schematically and indicated by B in Figure 3 and is a table of known type comprising a series of rollers 38 rotatable in bearings such as 39 carried by a frame 40. The frame 40 may be inclined a few degrees with respect to the horizontal plane, pivoting about the axis 41 carried by one of the sides of the frame 40 under the action of the jack 42 acting on the lower side. This table also comprises two perpendicular ranks of rollers 43 and 44 for defining the position of the glass sheet, the rank 43 perpendicular to the rollers 38 and the rank 44 at the end of the conveyor table B parallel to rollers 38.

The transfer conveyor C visible in Figure 1 and Figure 3 is inserted between the rollers 38 of the conveyor table B and the arms 3 of the support 1 of the movable part (A (r) in Fig. 3) of the depositing device. This conveyor C is formed by endless belts 45 turning on eccentric rotatable wheels 46. These belts are driven in rotation by a series of driver pulleys 47 under the action of motor 48. The belt conveyor C is variable in height by the operation of the eccentrics 46, controlled in movement (rising or falling) by the rods 49, cranks 50 and a rod 51 under the action of jack 52.

The functioning of the device will now be described with reference to the figures. A sheet of glass V_1 arrives in a quasi vertical position on the frame 60 in the direction of arrow E rolling on rollers 32 and advances up to the abutment 33. The rollers 32 are lowered (by 15 mm in this embodiment) and deposit the sheet V_1 on the catches 31. The sheet V_1 remains stationary on the frame 60. During this time, another sheet V_2 moves on the approximately horizontal part of the manufacturing line, receives a spacer band 61, arrives in the direction of arrow F on the conveyor table having rollers inclined at 2° to the horizontal and advances into abutment with the rank of rollers 44. This stage is shown in Figure 3*a*, in which are shown in profile the rollers 38 of the conveyor table in a plane inclined to the horizontal carrying a glass sheet V_2, an abutment roller 44 limiting advance of the glass sheet, the fork shaped support 1 of the movable part of the depositing device, the belt conveyor for transfer C with the eccentric pulleys 46 and the control rods. At the stage shown in Figure 3*b*, this conveyor table B has tilted to the horizontal under the action of jack 42; then as shown in Figure 3*c* the belt transfer conveyor C passes to a high position under the action of jack 52, it takes the glass sheet V_2 and sets it in motion, transfers the sheet V_2 to the movable part of the device, according to arrow G; the latter is guided in its movement by rollers 44 initially, then by rollers 18; the abutments 19 rise again into their active position and stop the sheet V_2. As shown in Figure 3*d*, the belt conveyor redescends, deposits the sheet V_2 on the fork 1, said sheet V_2 activates a certain number of touch members 5 which start the vacuum in suction nozzles 4 which are associated with them. The sheet V_2 is then firmly held and the abutments 19 are removed under the action of jack 22.

The movement of the movable part A (r) of the device will now be described with reference to Figures 4 and 5. Figure 4 shows the fork 1 supporting the glass sheet V_2, the jack 8 acting on the bearing 15 to drive the fork 1 in a pivoting movement about axis 6, the jack 9 acting on the arms 11 to pivot them about axis 7, the assembly desk inclined at 5° to the vertical, shown schematically, with carrying rollers 32 and the catches 31 carrying the sheet V_1 in the waiting position. Initially, as shown in Figure 4*a*, the jack 8 pivots the fork 1 carrying a sheet of glass V_2 about the axis 6 through an angle of 90°, said fork arriving at its end of path of travel intercepts a detector which interupts the action of the jack 8 and releases the following motion of pivoting. The latter is produced under the action of jack 9 about axis 7, over a radius which is much greater, increased by approximately the length of the arm 11 (about 60 cms in this example) through an angle of 5°.

As shown in Figure 5*a*, the movable part A (r) of the device applies the sheet V_2 provided with a spacer strip 61 on the sheet V_1 resting on the catches 31. As shown in Figure 5*b*, at the end of path of travel at fork 1 the vacuum in the nozzles 4 is interrupted and the fork starts its return rearwardly and the rollers 32 are relifted to the level of the catches 31. Then, as shown in Figure 5*c* the rollers 32 are again lifted (by 5 mm in this embodiment) and take in charge the two sheets V_1 V_2 which are joined together; the fork 1 terminates its return into horizontal position and the abutment 33 is removed. The rollers 32 are put in rotation under the action of motor means which are not shown in the Figures and transport the double pane V_1, V_2 to the following working station which is generally a press.

The device described may be used for forming multiple panes with glass of any thickness, the means for adjustment being provided for this purpose. The angle of deposition is in this case 95°, that is 90 plus 5°, but it may be different. It could be 180° if necessary, the deposition still be carried out by rotation about more than one axis. In the case of two axes, the deposition takes place in two stages: the first deposition will be through a large angle and carried out about an axis situated in the immediate neighbourhood of the glass sheet in order to reduce by the maximum the bulk of device; the second deposition will be through a smaller angle and will be carried out about another axis separated as far as possible from the glass sheet which has been subjected to the first stage; the axis of the second deposition being situated in the intersection of the plane of the glass sheet V_1 fixed on the assembly desk and the plane of the glass sheet V_2 which has already been subjected to the first stage.

In the embodiment described, the rotation through 95° is composed of two rotations through 90 and 5°. Other divisions are also possible but, to limit the bulk of the device as far as possible, it is always desirable to carry out the greatest part of the rotation about an axis situated very close to the glass sheet to be deposited, the last part following a radius which is much greater about an axis separated as far as possible from the sheets and not being more than a few degrees. On this distribution of angles of rotation depends the radius of rotation about the axis which is furthest away from the sheets and in all cases this axis is situated at the intersection of the plane of the assembly desk and the plane of the movable support after the latter has carried out the first part of the rotation.

There has been described above a device in which a single sheet is deposited against another which remains fixed. However it remains within the scope of the invention to provide a device in which two sheets are deposited, one towards the other, each being subjected to a rotation about different axes. Thus, each of the two sheets to be assembled may be placed on a support 1 in the shape of a fork. Each support will carry out the greatest part of its rotation about an axis 6 situated very close to the glass sheet, then the two supports will bring the two sheets V_1, V_2 into contact moving one towards the other through a small angle about a common axis 7 situated at the intersection of the planes of the two sheets V_1 and V_2 after they have been subjected to the first rotation.

Each of the supports A (r),

—on the one hand, will be provided with the same elements as those described previously that is: elements for holding the glass sheet, means for pivoting, means for defining the position of the sheet, means for adjustment as a function of the different thicknesses of the glass sheets and

—and on the other hand, will be associated with a table for conveying and a transfer conveyor for the sheets.

WHAT WE CLAIM IS:—

1. A method of making multiple glazed units including the step of positioning glass sheets in parallel planes, which step comprises mounting both sheets in predetermined positions on respective planar supports, rotating a first said support about a first axis parallel to the planes of both supports, the axis being adjacent the sheet mounted on the first support, and then rotating at least one of the supports about a second axis parallel to the first remote from the sheet mounted on the first support to position the sheets in parallel planes.

2. A method according to Claim 1, in which one of the glass sheets is provided

with a peripheral spacer strip and the sheets are positioned face to face separated and joined by the spacer strip to form a multiple pane.

3. A method of positioning glass sheets in parallel planes to form multiple glazed units, substantially as hereinbefore described with reference to the accompanying drawings.

4. A device for carrying out a method according to any preceding Claim, comprising respective planar supports for each of the glass sheets, a first said support being mounted to move in rotation about a first axis adjacent the sheet which it supports, and parallel to the planes of the two supports; and at least one of said supports being mounted to move in rotation about a second axis remote from the sheet supported by the first support, said other axis being parallel to the first axis.

5. A device according to Claim 4, in which the first support is mounted to rotate about said first and second axes, the first axis passing through bearings fixed directly on the support, the second axis being positioned at the ends of two arms mounted at their other ends on the first axis, and in which jacks are connected to the rotatable support to rotate the support about the first and second axes.

6. A device according to Claim 5, provided with a first jack connected to the rotatable support and to said arms to rotate the support about said first axis relatively to the arms, a second jack connected to said arms and to a fixed point to rotate the arms and support about the second axis, and a detector member arranged to stop operation of the first jack and start operation of the second jack when the rotatable support has reached a predetermined position on rotation about the first axis.

7. A device according to Claim 6, in which the second axis is in the planes of both supports at said predetermined position after rotation about the first axis.

8. A device according to Claim 7, in which the rotatable support is provided with means for adjusting its position relative to the first axis as a function of the thickness of the sheets to be positioned and means for holding the sheet which it supports in a predetermined position.

9. A device according to Claim 8, in which the means for adjustment as a function of the thickness of the sheets are positioned between the bearings of the first axis, and on the rotatable support, and comprise mounting members connected to the support which are movable relative to the first axis along sliders, the distance between the first axis and the mounting members being defined by at least one pair of blocks having respective inclined surfaces in contact with each other, the blocks being movable one with respect to the other so that the inclined surfaces can slide one along the other.

10. A device according to Claim 7 or 8, in which the means for holding the sheet are suction nozzles carried by the rotatable support and means activated by the sheet on the support for actuating application of a vacuum in the nozzles.

11. A device according to any one of Claims 8, 9 and 10, in which the rotatable support is provided with means for defining the position of the sheet thereon comprising a plurality of abutment members arranged in a line parallel to said axes and a line of rollers perpendicular to said axes.

12. A device according to any one of Claims 4 to 11, in which one support is rotatable and the other is formed by a fixed assembly provided with catches for supporting the sheet and an abutment for defining the position of the sheet thereon.

13. A device according to Claim 12, in which the supports form an angle of 95° with each other before rotation of the rotatable support.

14. A device according to Claim 13, in which the rotatable support is rotatable through 90° about the first axis and through 5° about the second axis.

15. A device for positioning glass sheets in parallel planes to form multiple glazed units substantially as hereinbefore described with reference to the accompanying drawings.

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1569668 COMPLETE SPECIFICATION

5 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

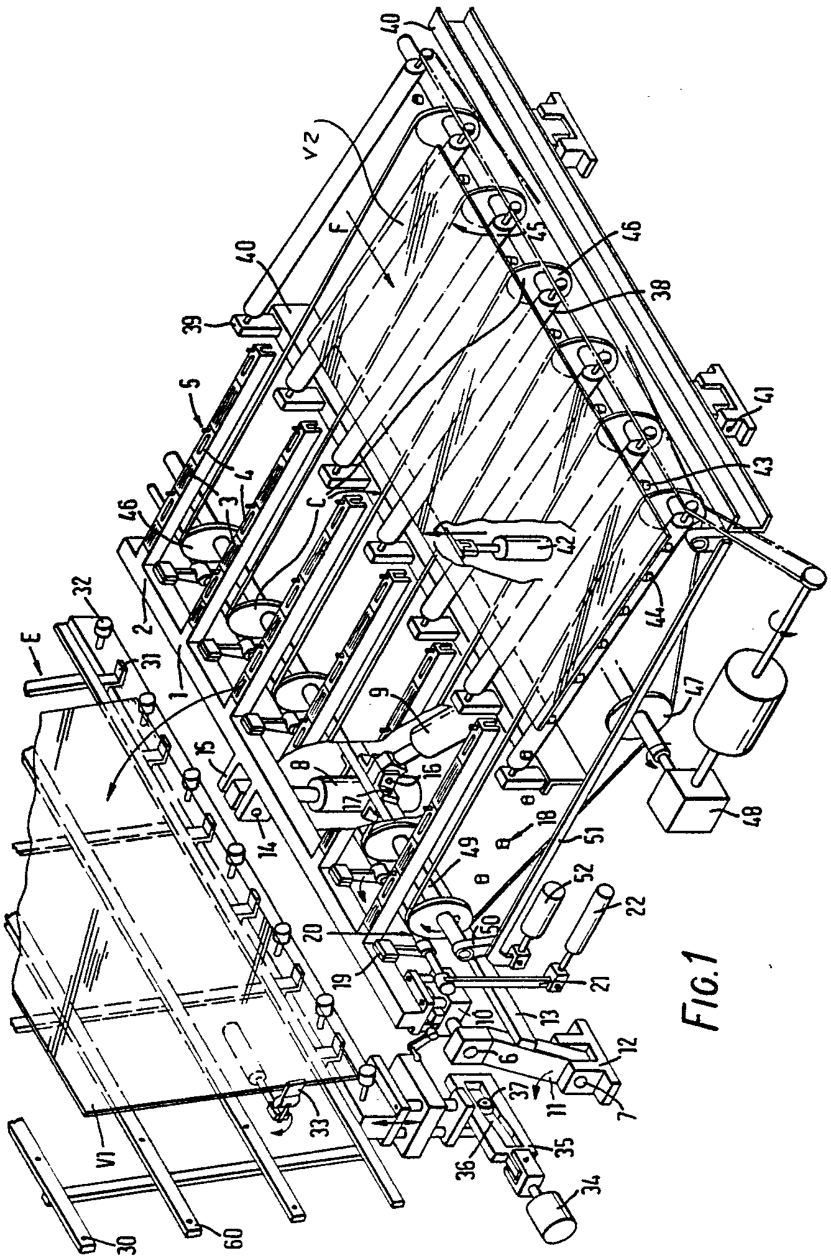

FIG.1

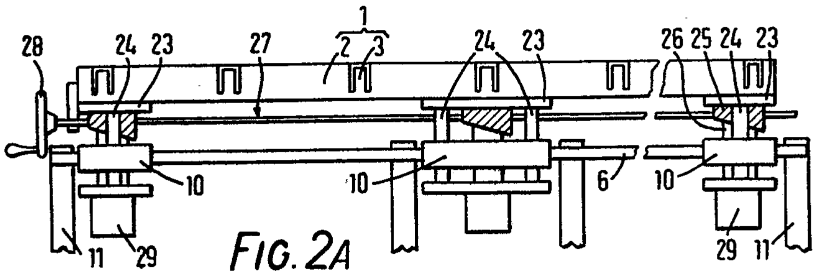
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FIG. 2A

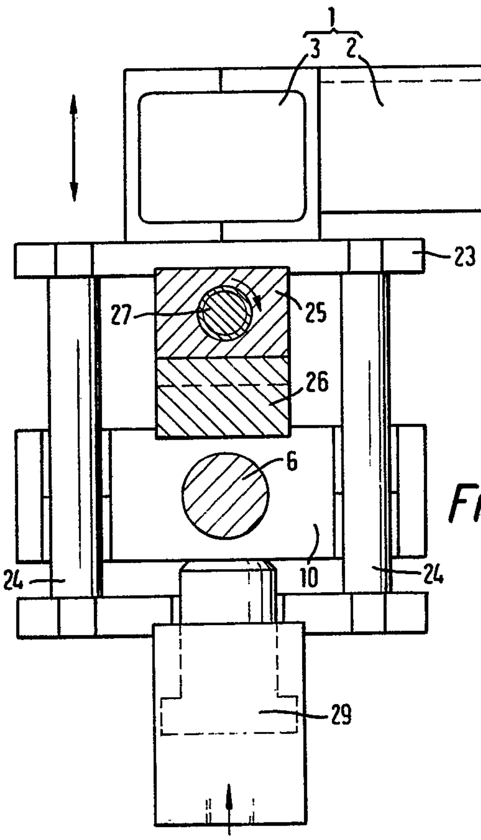
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FIG. 2B

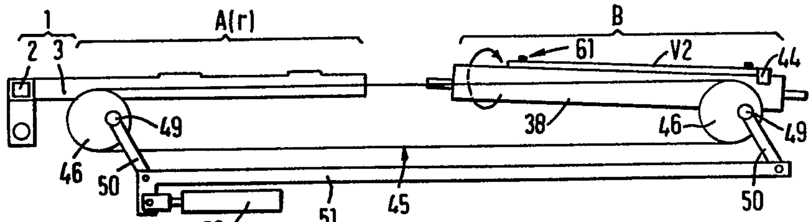

FIG. 3a

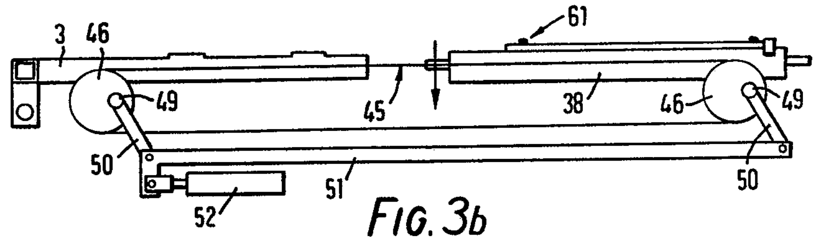

FIG. 3b

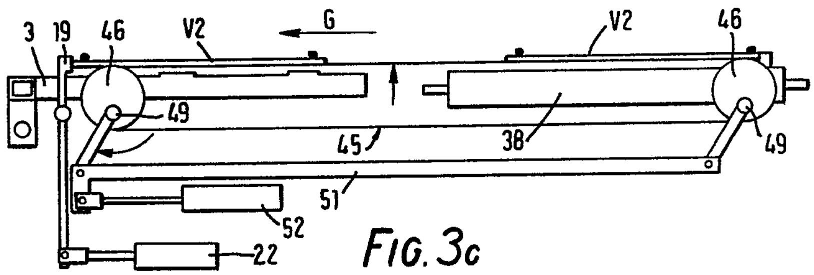

FIG. 3c

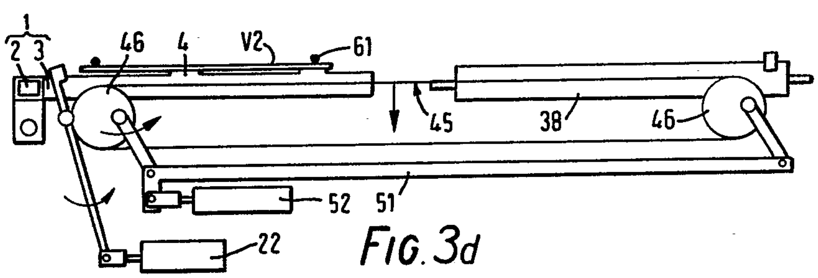

FIG. 3d

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5 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 4

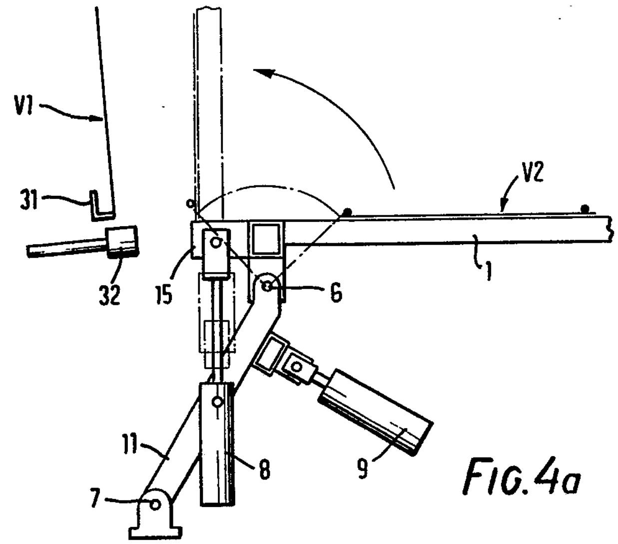
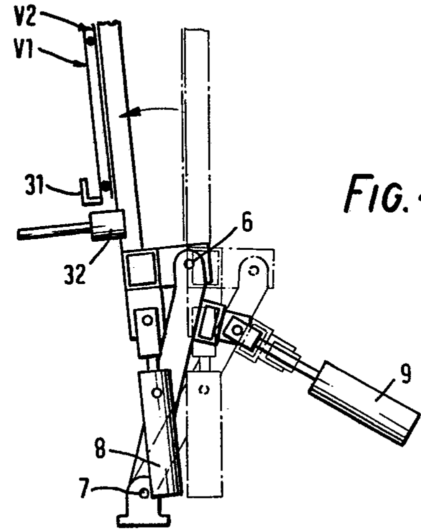


FIG. 4a

FIG. 4b



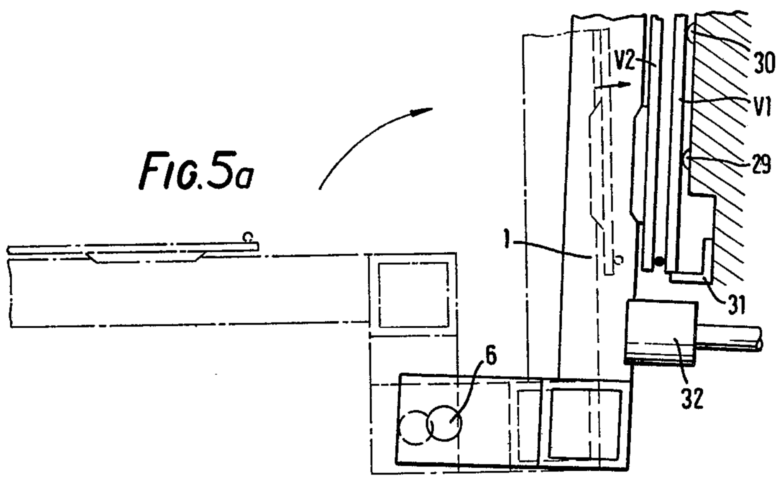


FIG.5a

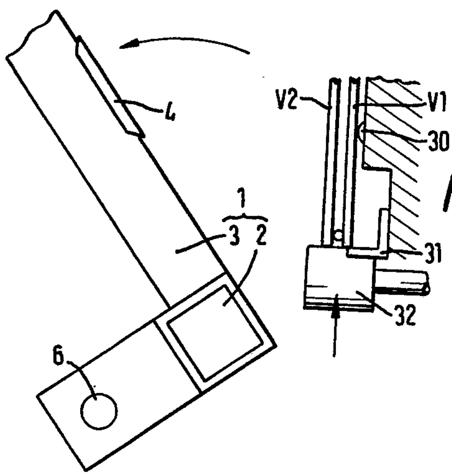


FIG.5b

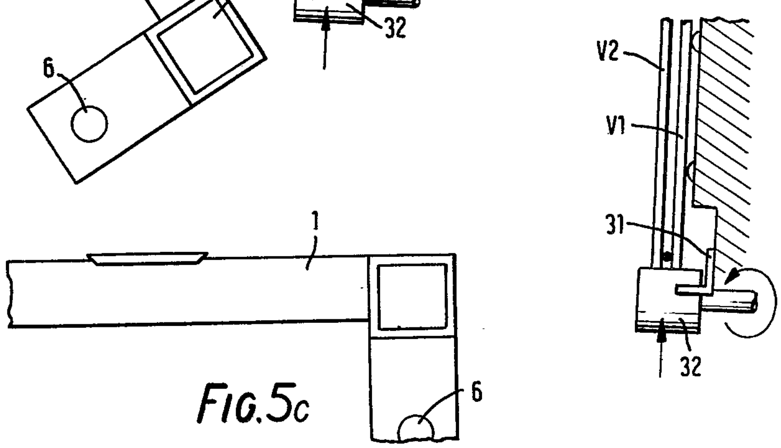


FIG.5c