

[54] **CONVEYING SHEET MATERIAL**
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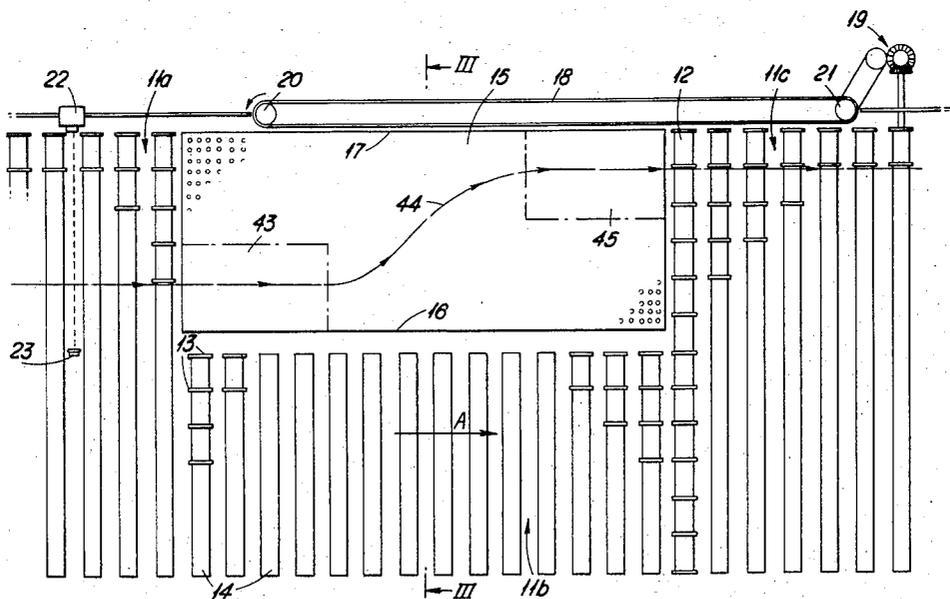
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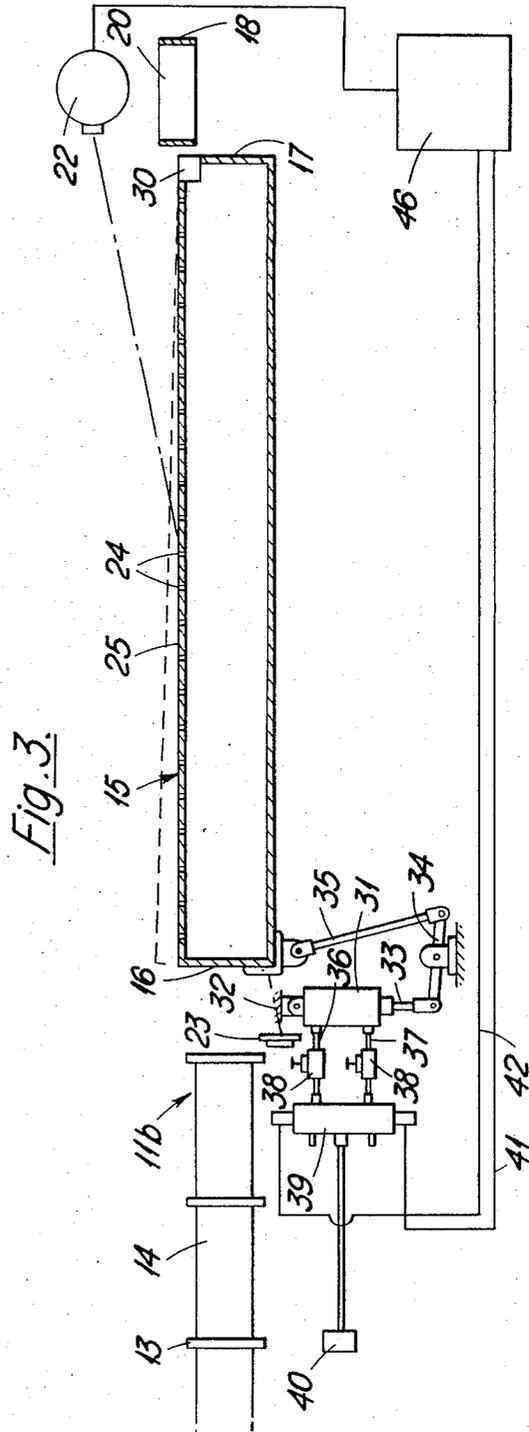
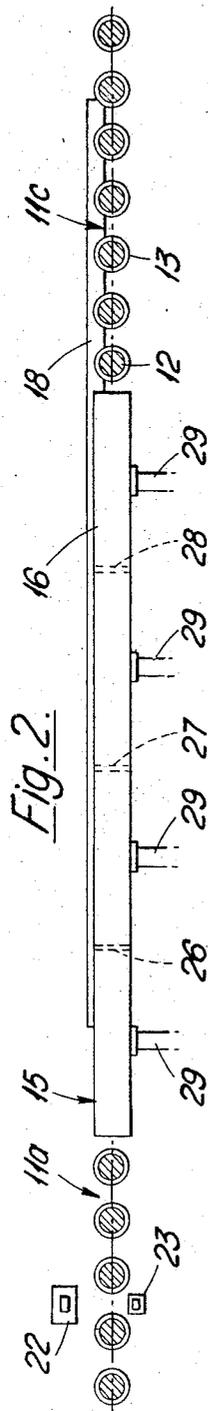
[57] **ABSTRACT**

Glass sheet material is conveyed along a path passing over an air box for providing a gas cushion. Tilting means is arranged to raise one edge of the air box so that the sheet is laterally displaced while moving over the air box. Datum means is provided at one side of the air box to arrest lateral movement of the sheet when it has reached a required position. Two similar tiltable air boxes may be provided side by side in the conveyor path so that two sheets may be moved apart in opposite directions.

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15 Claims, 6 Drawing Figures





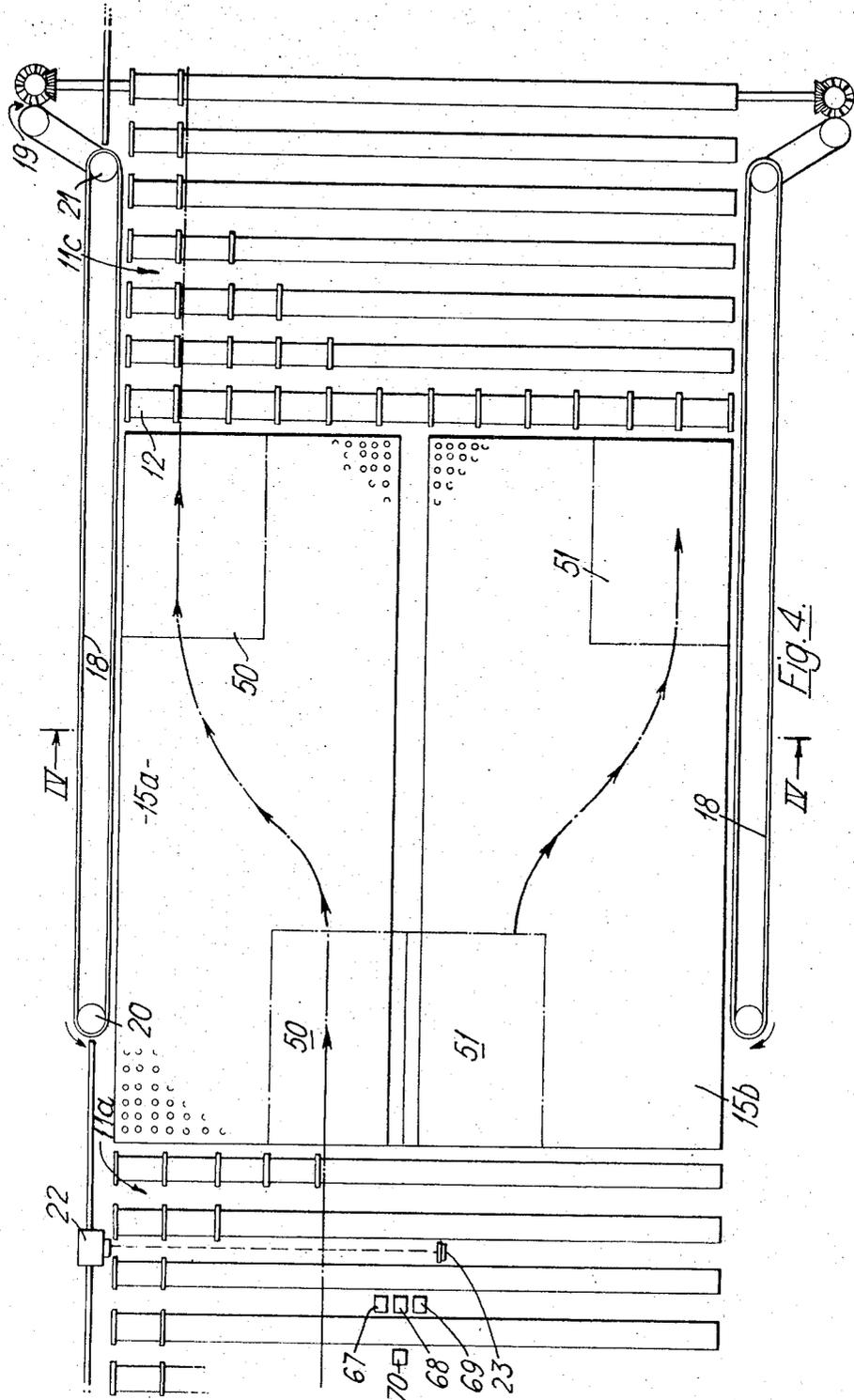


Fig. 4.

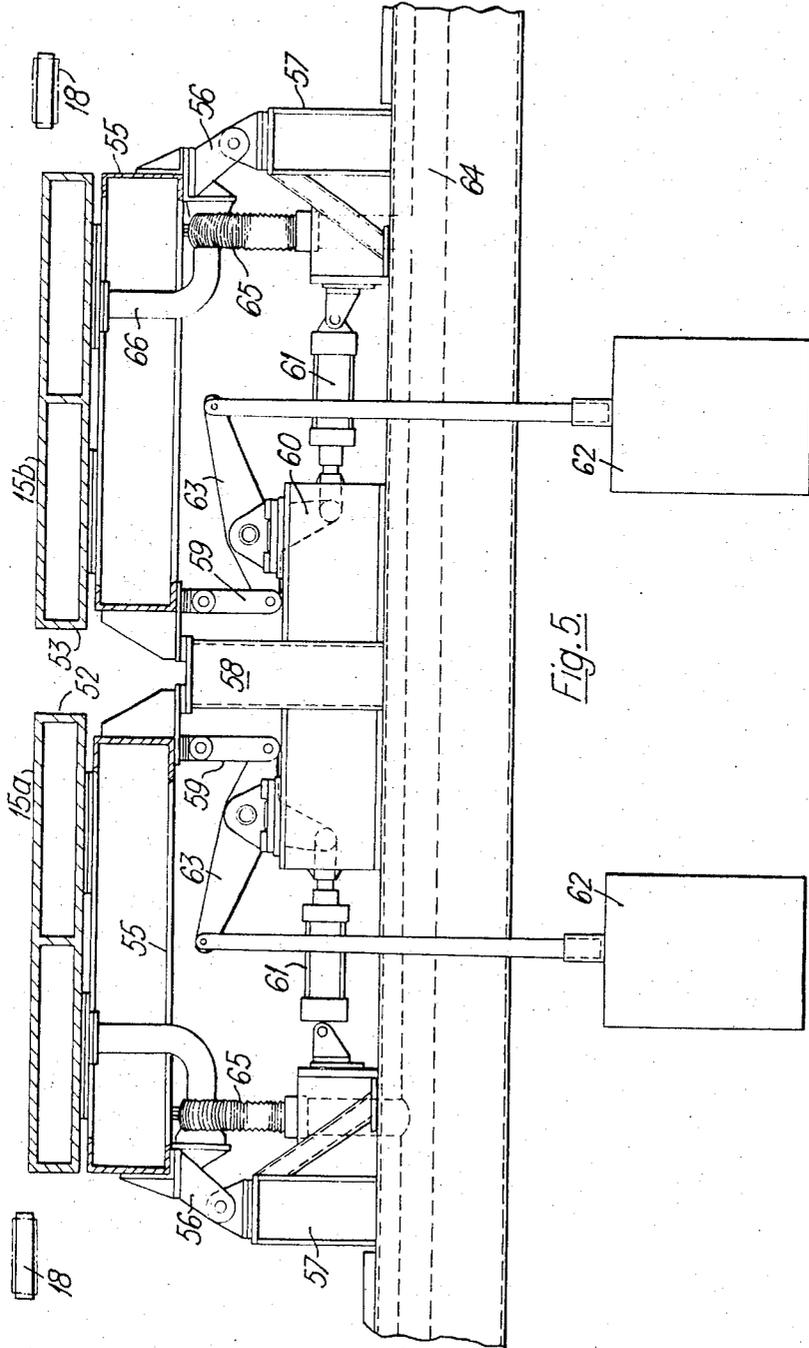
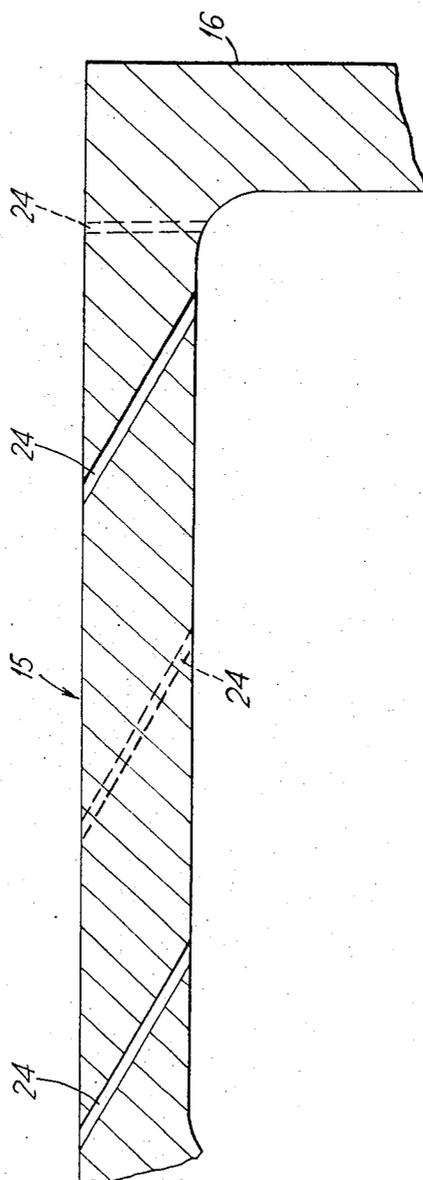


Fig. 5.

Fig. 6.



CONVEYING SHEET MATERIAL

BACKGROUND OF THE INVENTION

The invention relates to conveying sheet material and in particular to apparatus and methods for effecting a side-ways shift of a forwardly travelling sheet.

When handling sheet material, such as for example glass, it is commonly necessary to effect a lateral shift of the sheet member during the conveying operation. This may be necessary, for example, to separate laterally two adjacent sheet members travelling along a conveyor or to locate a succession of sheets against a common datum position at one side of the conveyor. This is for example useful when conveying a succession of sheets to a stacking station.

SUMMARY OF THE INVENTION

The present invention provides apparatus for effecting a sideways shift of a forwardly travelling sheet member, which apparatus comprises conveyor means for conveying a sheet member lying in a generally horizontal plane in a forward direction, support means provided in the conveying path and adapted to provide a gas cushion on which the sheet member can be supported when passing over the support means, means selectively operable to cause movement of the sheet member in a direction transverse to said forward direction while the member is supported on the gas cushion, and datum means to arrest lateral movement of, and thereby locate at a desired lateral position, said sheet member in said transverse direction.

Preferably said support means comprises a table having ducts therein for the emission of gas through a surface thereof to provide said gas cushion.

Preferably said means operable to cause transverse movement of the sheet member comprises tilting means to tilt said table in a direction transverse to said forward direction thereby to move said surface between a horizontal position substantially coplanar with the conveyor means and a position inclined to the horizontal.

In order that the sheet does not drop to a level below the plane of the conveyor, it is preferable for the tilting means to be arranged to raise the edge of the table remote from the datum means when it is desired to cause a lateral shift.

The datum means may conveniently comprise an endless driven element such as a belt, part of which extends parallel to said forward direction. In this way, the movement of the endless driven element assists in maintaining movement of the sheet member in the forward direction once the sheet member has engaged the datum means.

The conveyor may be adapted to convey a group of at least two sheet members side-by-side, part of the conveyor means extending alongside said support means so that it can convey a sheet member past the support means while another sheet member travels over the support means and is subjected to a lateral shift away from said part of the conveyor and is then returned to said conveyor means downstream of the support means at a desired separation in said transverse direction from the sheet member conveyed past the support means.

In some arrangements of the invention the support means comprises two separate gas cushion devices ar-

ranged side-by-side in the conveying path, each gas cushion device having a datum means on the side of the device remote from the other gas cushion device, whereby two sheets may be moved laterally apart simultaneously and in opposite directions, one sheet passing over each gas cushion.

The invention also provides a method of effecting a sideways shift of a forwardly travelling sheet member, comprising conveying the sheet member lying in a generally horizontal plane in a forward direction, providing a gas cushion beneath the sheet member being conveyed, moving the sheet member in a direction transverse to said forward direction while it is supported on the gas cushion, and arresting lateral movement of the sheet member thereby to locate it at a desired lateral position in said transverse direction. The method may be used to produce a desired separation between sheet members and comprise supplying gas through two separate tables lying side-by-side in a common horizontal plane to provide respective gas cushions, and tilting the tables in opposite directions to raise their inner edges, thereby to move two sheet members supported on the respective gas cushions outwardly in opposite directions transverse to said forward direction. Furthermore the method may be used for splitting a relatively large sheet into two smaller sheets and producing a desired separation between the two smaller sheets and comprise feeding a scored relatively large sheet over the two tables with the scoreline lying therebetween, and tilting the tables in opposite directions to snap the large sheet along the score line and thereby produce two smaller sheets which move outwardly on the respective gas cushions in opposite directions transverse to said forward direction.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a plan view of part of a conveyor;

FIG. 2 is a side view of the conveyor shown in FIG. 1;

FIG. 3 shows schematically an enlarged section on the line III—III in FIG. 1;

FIG. 4 is a plan view similar to FIG. 1 of an arrangement with twin air beds side-by-side;

FIG. 5 is a section on the line IV—IV in FIG. 4, and FIG. 6 is a section through part of an air bed, with a modified arrangement of air ducts.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

As can be seen in FIG. 1, a roller conveyor for conveying flat sheets lying in a horizontal plane consists of three successive conveyor sections 11a, 11b and 11c. The upstream section 11a and downstream section 11c are both similar and consist of a number of parallel driven rollers 12 extending across the full width of the conveying path. The rollers rotate about horizontal axes and are provided with a plurality of tyres 13 at spaced positions along their length. The middle section 11b has similar rollers 14 extending across half the conveyor. The other half of the conveyor consists of an air box 15 normally lying flat with its upper surface slightly below the upper peripheries of the tyres 13. In this way, a sheet supported on the air bed over the box 15 is normally substantially coplanar with sheets lying on the tyres 13. The inner edge 16 of the air box 15 is spaced slightly to one side of the centre line of the conveyor and both sides of the air box extend parallel to the di-

rection of travel of the glass which is indicated by the arrow A in FIG. 1. Extending along the major part of the side 17 of the air box adjacent the edge of the conveyor is a belt 18 driven around a closed loop by a gearing connection 19 to the driven rollers 12. The belt 18 rotates at its ends around vertical axes 20 and 21 so that the part of the belt immediately adjacent the edge 17 extends in a vertical plane and projects slightly above the upper surface of the air box 15. Situated on the upstream half of the conveyor preceding the air box 15 is an optical sheet detector comprising a light source and detector 22 and a reflector 23. The light source and detector 22 is positioned at one side of the conveyor above the rollers 12. The reflector 23 is positioned half-way across the conveyor below the level of the rollers 12. The light source directs light towards the reflector and if no glass sheet is present between them, light is reflected back to the detector giving a signal indicating the absence of a sheet. When the leading edge of an advancing sheet on that half of the conveyor passes between the source and reflector, no reflected beam is detected by the detector 22 and the change in signal is used to indicate the position of the sheet approaching the air box 15. As is shown in FIGS. 2 and 3, the air box consists of a rectangular hollow enclosure having a plurality of gas outlet passages 24 passing perpendicularly through the upper wall 25 of the air box. If preferred the gas outlet passages 24 may, however, be so inclined that gas emitted therethrough tends to urge a sheet supported on the gas cushion towards the datum belt 18, e.g., the passages may be at an angle of about 30° to the upper wall 25 of the air box. Such an arrangement is shown in FIG. 6 in which similar reference numerals are used. The interior of the box is subdivided into four sections by partitions 26, 27 and 28. Each section of the box is supplied with air under pressure through an inlet pipe 29. Air is fed into the box at a sufficient rate for the air jets escaping through the outlet passages 24 to provide a gas cushion to support a sheet passing over the upper surface of the air box. As shown in FIG. 3 the air box is pivotally mounted about a horizontal axis extending through the upper corners 30 of the box adjacent the edge 17. The lower surface of the inner edge 16 of the box is supported by a pneumatic jack device 31 so that the inner edge 16 may be raised to the position shown in dashed lines in FIG. 3 such that the inner edge 16 is raised above the level of the adjacent conveyor rollers while the outer edge 17 remains at the same level as the conveyor rollers. The jack device is arranged to tilt the box through an angle of 5° when actuated. The jack device 31 is mounted on a rigid support 32 and the piston rod 33 projecting from the jack device acts through a pivoted arm 34 to raise or lower a connecting rod 35 secured to the lower surface of the inner edge 16 of the box 15. The jack device 31 consists of a double acting piston and cylinder, the opposite ends of the cylinder having separate air inlet pipes 36 and 37. Each of these pipes incorporates a flow regulator 38. The two regulators 38 are connected to a main source of compressed air 40 through a solenoid valve 39. The solenoid valve 39 is connected via two control lines 41 and 42 through a time control unit 46 to the optical sheet detector 22.

In use, two glass sheets travel side-by-side along the upstream section 11a of the conveyor. These two sheets, which may have been formed by centre splitting of a larger sheet, will have a slight lateral separation al-

ready due to use of an earlier separating mechanism. This may for example be as described in commonly assigned co-pending Application Ser. No. 298,385, filed Oct. 17, 1972, for "CONVEYING APPARATUS". As the two sheets approach the middle section 11b of the conveyor, the sheet on the left hand half of the conveyor is detected by the optical detector 22 and an appropriate signal is fed to the control unit 46. The sheet on the left hand half of the conveyor passes onto the air bed as shown by the plate marked 43 in FIG. 1. The sheet on the right hand half of the conveyor continues on the rollers 14 past the air box 15. The control unit 46 provides an adjustable time delay so that the solenoid valve 39 and thereby the jack device 31, is operated when two-thirds of the sheet has passed onto the air box 15. The jack device then causes the air box to be tilted with its inner edge 16 moving upwards. As the air bed is tilted downwards towards the outside edge 17, the plate 43 slides downwards towards the edge 17 while its momentum continues to move it forwardly towards the downstream section 11c of the conveyor. The plate will pass along a path substantially as indicated by the line 44 in FIG. 3 until the plate lies against the belt 18 which provides a datum surface adjacent the edge of the air box 15. Although the lateral shift of the plate may not even along its length throughout the lateral shifting movement, when the plate reaches the position marked 45 in FIG. 3, its outer edge will lie against the belt 18 parallel with the direction of travel along the conveyor. The timing control unit 46 is so adjusted that the jack device 31 lowers the air box back to the original position before the leading edge of the glass plate leaves the air box 15. In this way, the sheet when leaving the air box passes smoothly onto the surface of the downstream section 11c of the conveyor. In the meantime, the sheet on the right hand side of the conveyor has also passed onto the downstream section 11c of the conveyor. The two sheets then continue to move together with a much greater lateral separation than was present on the upstream section of the conveyor. The sequence of events causing the lateral separation may be repeated for subsequent sheets arriving at the air bed.

The above described example is particularly suitable for providing a second stage of lateral separation in the process of cutting glass ribbon into separate sheets and providing the desired separation and alignment of sheets prior to arriving at a stacking station.

As the air bed provides very low friction to the sheet passing over it, the momentum of the sheet passing across it may be sufficient to carry it across the air bed and onto the downstream section of the conveyor. This movement can however be assisted by the driving movement of the datum conveyor belt 18. As previously mentioned, the gas ducts in the air box may be so inclined that the sheet is urged towards the datum belt 18 which can assist in holding the sheet against the belt.

It will be appreciated that the lateral separation is selectively controlled by actuation of the jack device 31. In order to reduce the length of the air bed to a minimum, it is desirable to raise the inner edge of the air bed as soon as possible and this can be controlled by adjustment of the timing control unit 46. If however the inner edge of the table is raised before approximately two-thirds of the glass plate has moved onto the table, loss of control of the plate may result.

Although the above example has been described as particularly suitable for providing good lateral separation between two similar sized plates cut by centre splitting a larger sheet, the invention is not limited to this and may be used for lateral shifting of other sheet material.

In the above example only one air box 15 is provided in the conveyor path. It is however desirable in some cases to provide two air boxes 15a and 15b side-by-side as shown in FIG. 4. In this case the air boxes extend across the full width of the conveyor so that two sheets 50, 51 may travel side-by-side along the conveyor, one sheet 50 passing over the air box 15a and the other sheet 51 passing over the air box 15b. Each air box has its own datum means in the form of the conveyor belt 18. The arrangement shown in FIG. 4 is the same as that described with reference to FIG. 1 except for the use of two air boxes rather than one. The two boxes 15a and 15b are separated along their inner edges 52 and 53 so that both inner edges may be raised simultaneously to tilt the air boxes and cause the two sheets 50 and 51 to move outwardly in opposite directions. The tilting mechanism, which may be operated by a signal from a single sheet detector located in front of one of the air boxes, is shown in more detail in FIG. 5. Each hollow box is mounted on a frame 55 having a pivot mounting 56 on a support 57. The inner edge of each frame 55 normally rests on a stop member 58 such that boxes lie in a common horizontal plane. Pivotaly connected to the inner edge of frame 55 is a push rod 59 connected via a bell crank lever mechanism 60 to a pneumatic jack 61. A counterweight 62 is connected on an arm 63 forming part of the lever mechanism 60 to counterbalance the weight of the air boxes. Both pneumatic jacks 61 are connected to a common pneumatic supply so that both jacks are operated simultaneously to raise or lower the inner edges of the air boxes. The angle of tilt is about 5°. Air to form the air cushion is supplied to both boxes through a common supply pipe 64, and flexible hoses 65 secured to pipes 66 adjacent the pivotal mounting 56.

In operation, a sheet of glass which has been scored along its centre line by a known form of scoring device schematically shown at 70, is fed centrally along the conveyor towards the air boxes which are lying horizontally. When the glass has passed onto the air boxes, with each half of the sheet lying over a respective one of the air boxes, the boxes are tilted and both halves move outwardly in opposite directions. Both halves move forwards on the air cushions and in controlled lateral positions due to the belts 18 as described with reference to FIG. 1. Normally the sheet is snapped along the scored centre line before reaching the air boxes so that the cut is formed between the two halves. The snapping may be effected by known snapping devices such as the rollers 67, 68 and 69 shown in FIG. 4. It is not however essential to open the cut before reaching the air boxes. The scored sheet may be fed over the air boxes so that the central score line lies over the space between the inner edges of the air boxes whereby when the boxes are tilted, the sheet is flexed about the score line so as to snap the glass and open up the cut along the score. The two smaller sheets so produced by splitting the relatively large sheet then move outwardly in opposite directions as previously described. In this way, the snapping and lateral separation

can both be effected by the use of the tilting air beds alone.

Instead of an optical detector as shown in FIG. 1 a mechanical device such as a spring loaded finger may be positioned in the path of the advancing glass to detect the leading and/or trailing edges of successive sheets.

I claim:

1. Apparatus for effecting a sideways shift of a forwardly travelling sheet member comprising conveyor means for conveying a sheet member lying in a generally horizontal plane in a forward direction, said conveyor means comprising upstream and downstream sections in the same horizontal plane, support means comprising a table provided in the conveying path, between the upstream and downstream conveyor sections, said table having two opposite edges extending along the conveyor path with pivotal mounting means adjacent one of said edges, said table further having ducts therein for the emission of gas through a surface thereof to provide a gas cushion on which the sheet member can be supported when passing over the table, lifting means, selectively operable to raise the other edge of the table and thereby tilt said table about said pivotal mounting means in a direction transverse to said forward direction between a horizontal position substantially coplanar with the conveyor means and a position inclined to the horizontal, for moving said sheet member in a direction transverse to said forward direction while the member is supported on the gas cushion, and datum means located adjacent said one edge of the table to arrest lateral movement and thereby locate at a desired lateral position said sheet member in said transverse direction, said apparatus further including means operable to advance the sheet, in a sideways shifted position, onto said downstream conveyor section.
2. Apparatus according to claim 1, wherein the ducts are inclined relative to said surface so that gas emitted therethrough tends to urge a sheet supported on the gas cushion towards the datum means.
3. Apparatus as claimed in claim 1, in which the tilting means is arranged to raise the edge of the table remote from the datum means.
4. Apparatus as claimed in claim 3, in which the tilting means includes a selectively operable jack device.
5. Apparatus as claimed in claim 4, in which the jack device comprises a pneumatic piston and cylinder controlled by an electrically operable control valve.
6. Apparatus according to claim 1, wherein said datum means extend parallel to said forward direction along one edge of the support means.
7. Apparatus according to claim 6, wherein said datum means comprise an endless driven element, such as a belt, part of which extends parallel to said forward direction.
8. Apparatus according to claim 1 comprising detector means located in advance of the support means and operative to detect the position of a sheet member as it travels forwardly towards said support means, and wherein the tilting means effective to cause transverse movement of the sheet member is arranged to receive an actuating signal from said detector means.
9. Apparatus according to claim 1 wherein said conveyor means extends upstream and downstream from said support means in said forward direction, whereby a sheet member can travel from the upstream conveyor

means on to said support means to be subjected to a lateral shift, and then from the support means onto the downstream conveyor means for continued travel in said forward direction.

10. Apparatus according to claim 9 for producing a desired separation between sheet members wherein said conveyor means is adapted to convey a group of at least two sheet members side-by-side, and a part of the conveyor means extends alongside said support means so that it can convey a sheet member past the support means while another sheet member travels over the support means and is subjected to a lateral shift away from said part of the conveyor to be returned to said conveyor means downstream of the support means at a desired separation in said transverse direction from the sheet member conveyed past the support means.

11. Apparatus according to claim 1, including a second table having ducts therein for the emission of gas to provide a gas cushion, the two tables lying side-by-side in a common horizontal plane, means being provided to raise the inner edges of the two tables so that both tables are tilted in opposite directions thereby to cause sheets on the respective tables to move outwardly in opposite directions to the respective datum means.

12. Apparatus according to claim 11 comprising scoring means adapted to score a relatively large sheet so as to designate two smaller sheets into which said large sheet can be split, the conveyor means being arranged to feed said scored large sheet over said two tables with the scoreline lying therebetween, so that the tables can be tilted to snap said large sheet into said smaller sheets and to cause the smaller sheets on the respective tables to move outwardly in opposite directions to the respective datum means.

13. A method of effecting a sideways shift of a forwardly travelling sheet member, comprising conveying the sheet member lying in a generally horizontal plane in a forward direction over a support table provided in the conveying path, passing gas through ducts in the table to provide a gas cushion beneath the sheet member being conveyed, selectively raising one edge of the table to tilt said table from a horizontal position to an inclined position to move the sheet member in a direction transverse to said forward direction while it is supported on the gas cushion, arresting lateral movement of the sheet member at the opposite edge of the table thereby to locate it at a desired lateral position in said transverse direction, returning the table to the horizontal position, and advancing the sheet member in a sideways shifted position onto a downstream conveyor in said generally horizontal plane.

wardly travelling sheet member, comprising conveying the sheet member lying in a generally horizontal plane in a forward direction over a support table provided in the conveying path, passing gas through ducts in the table to provide a gas cushion beneath the sheet member being conveyed, selectively raising one edge of the table to tilt said table from a horizontal position to an inclined position to move the sheet member in a direction transverse to said forward direction while it is supported on the gas cushion, arresting lateral movement of the sheet member at the opposite edge of the table thereby to locate it at a desired lateral position in said transverse direction, returning the table to the horizontal position, and advancing the sheet member in a sideways shifted position onto a downstream conveyor in said generally horizontal plane.

14. A method according to claim 13 for producing a desired separation between sheet members comprising supplying gas through two separate tables lying side-by-side in a common horizontal plane to provide respective gas cushions, and tilting the tables in opposite directions to raise their inner edges, thereby to move two sheet members and supported on the respective gas cushion outwardly in opposite directions transverse to said forward direction.

15. A method according to claim 14 for splitting a relatively large sheet into the two smaller sheets, and producing a desired separation between the two smaller sheets, comprising feeding a scored relatively large sheet over the two tables with the scoreline lying therebetween, and tilting the tables in opposite directions to snap the large sheet along the score line and thereby produce two smaller sheets which move outwardly on the respective gas cushions in opposite directions transverse to said forward direction.

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