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

(11) **EP 3 800 006 A1**

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
07.04.2021 Bulletin 2021/14

(21) Application number: **19835345.0**

(22) Date of filing: **05.10.2019**

(51) Int Cl.:
B24B 9/10 *(2006.01)* ***B24B 41/053*** *(2006.01)*

(86) International application number:
PCT/JP2019/039416

(87) International publication number:
WO 2021/024501 (11.02.2021 Gazette 2021/06)

(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
Designated Validation States:
KH MA MD TN

(30) Priority: **04.08.2019 JP 2019143432**

(71) Applicant: **Bando Kiko Co., Ltd**
Tokushima-shi, Tokushima 770-0871 (JP)

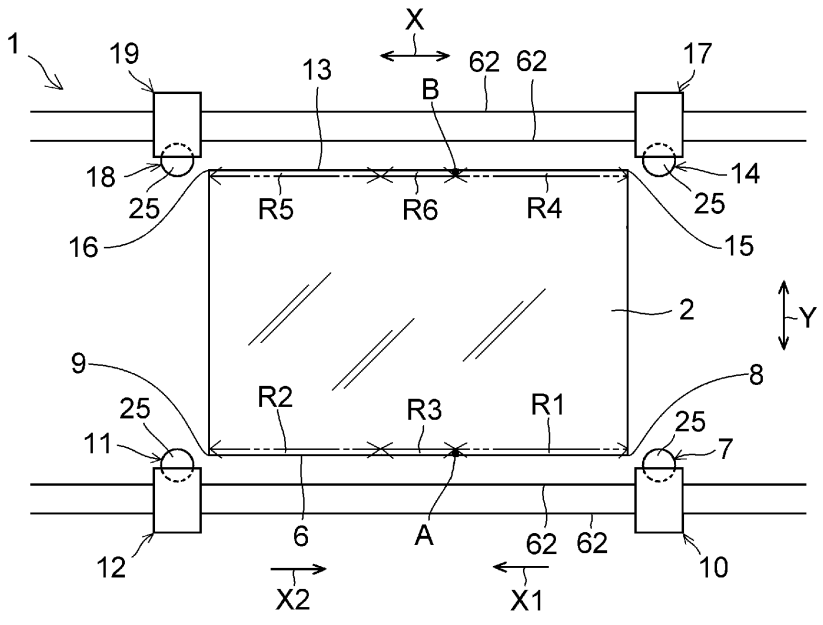
(72) Inventor: **BANDO, Kazuaki**
Tokushima-shi
Tokushima 770-0871 (JP)

(74) Representative: **J A Kemp LLP**
14 South Square
Gray's Inn
London WC1R 5JJ (GB)

(54) GLASS PLATE PROCESSING DEVICE

(57) A glass-plate working apparatus 1 is comprised of a working head 7 for working an end face in a region R1 of an end face 6 of a glass plate 2; a moving means 10 for moving the working head 7 in an X direction along the end face in the region R1 of the glass plate 2; a working head 11 for working an end face in regions R2 and R3 of the end face 6 of the glass plate 2; and a moving means 12 for moving the working head 11 in the X direction along the end face in the regions R2 and R3 of the glass plate 2.

FIG.3



EP 3 800 006 A1

Description

TECHNICAL FIELD

[0001] The present invention relates to a glass-plate working apparatus for grinding or polishing, or both grinding and polishing (hereinafter, working) an end face on one side of a glass plate or end faces on both sides of a glass plate, e.g., a rectangular glass plate, for automobile use, liquid crystal panel use for such as liquid crystal television, solar cell use, furniture use, architectural use, and the like.

BACKGROUND ART

[0002] Conventionally, the grinding of a glass plate, for example, is carried out by a grinding apparatus disposed on a transport passage of glass plates.

PRIOR ART DOCUMENTS

PATENT DOCUMENTS

[0003] Patent Document 1: JP-A-2013-169622

SUMMARY OF THE INVENTION

PROBLEMS THAT THE INVENTION IS TO SOLVE

[0004] Incidentally, the grinding of glass plates is conventionally carried out by a grinding apparatus disposed on a transport passage of glass plates, so that it takes time and the glass plate working efficiency as a whole is poor.

[0005] The present invention has been devised in view of the above-described aspects, and its object is to provide a glass-plate working apparatus in which the efficiency of working with respect to the end face of the glass plate is excellent, and which makes it possible to shorten the working time required therefor and is high in productivity.

MEANS FOR SOLVING THE PROBLEMS

[0006] A glass-plate working apparatus in accordance with the present invention comprises: at least one first working head means for working an end face in one region of a glass plate; a first moving means for moving the at least one first working head means along the end face in the one region of the glass plate; at least one second working head means for working an end face in another region of the glass plate; and a second moving means for moving the at least one second working head means along the end face in the other region of the glass plate.

[0007] According to the glass-plate working apparatus in accordance with the present invention, since there are provided the at least one first working head means for working the end face in the one region of the glass plate; the first moving means for moving the at least one first working head means along the end face in the one region of the glass plate; the at least one second working head means for working the end face in the other region of the glass plate; and the second moving means for moving the at least one second working head means along the end face in the other region of the glass plate, the working of the end face of the glass plate can be effected by the first working head means and the second working head means. Therefore, the efficiency of working with respect to the end face of the glass plate is high, and the working time of the operations can be shortened, making it possible to carry out glass plate working with high productivity.

[0008] With the glass-plate working apparatus in accordance with the present invention, in a preferred embodiment, the first moving means is adapted to move the at least one first working head means along the end face in the one region of the glass plate to cause the at least one first working head means to work the end face in the one region of the glass plate, and the second moving means is adapted to move the at least one second working head means along the end face in the other region of the glass plate to cause the at least one second working head means to work the end face in the other region of the glass plate. Therefore, it is possible to shorten the time for working the end face including the one region and the other region of the glass plate, thereby making it possible to efficiently carry out the working of the end face of the glass plate.

[0009] In another embodiment of the glass-plate working apparatus in accordance with the present invention, each of the first moving means and the second moving means is adapted to move each of the at least one first working head means and the at least one second working head means such that the at least one first working head means and the at least one second working head means approach each other or move away from each other. Therefore, it is possible to shorten the working time with respect to the end face of the glass plate.

[0010] In still another embodiment of the glass-plate working apparatus in accordance with the present invention, the at least one first working head means has at least one grinding wheel or at least one polishing wheel, or at least one grinding wheel and at least one polishing wheel, and the at least one second working head means has at least one grinding wheel or at least one polishing wheel, or at least one grinding wheel and at least one polishing wheel. Therefore, for example, in a case where the at least one first working head means has the at least one grinding wheel and the at least one polishing wheel, and the at least one second working head means has the at least one grinding wheel and the at least one polishing wheel, the operation ranging from grinding to polishing can be performed continuously with respect to the end face including the one region and the other region of the glass plate, and the working time can be shortened,

thereby making it possible to efficiently effect working for the end face of the glass plate.

[0011] In a further embodiment of the glass-plate working apparatus in accordance with the present invention, the first working head means is constituted by a plurality of first working head means, and the second working head means is constituted by a plurality of second working head means. Therefore, since working (grinding or polishing, or both grinding and polishing) with respect to the end face of the glass plate can be effected by the plurality of first working head means and the plurality of second working head means, respectively, the working time with respect to the end face including the one region and the other region of the glass plate can be made even shorter, and a glass-plate working apparatus with high productivity can be obtained.

ADVANTAGES OF THE INVENTION

[0012] According to the present invention, it is possible to provide a glass-plate working apparatus in which the efficiency of working with respect to the end face of the glass plate is excellent, and which makes it possible to shorten the working time required therefor and is high in productivity.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013]

Fig. 1 is an explanatory plane view of an embodiment of the invention;
Fig. 2 is an explanatory right side view of the embodiment shown in Fig. 1;
Fig. 3 is a diagram for explaining the operation of the embodiment shown in Fig. 1;
Fig. 4 is a diagram for explaining the operation of the embodiment shown in Fig. 1;
Fig. 5 is a diagram for explaining the operation of the embodiment shown in Fig. 1;
Fig. 6 is a diagram for explaining the operation of the embodiment shown in Fig. 1;
Fig. 7 is a diagram for explaining the operation of another variation of the embodiment shown in Fig. 1;
Fig. 8 is a diagram for explaining the operation of the other variation of the embodiment shown in Fig. 1;
Fig. 9 is a diagram for explaining the operation of the other variation of the embodiment shown in Fig. 1; and
Fig. 10 is a diagram for explaining the operation of the other variation of the embodiment shown in Fig. 1.

MODE FOR CARRYING OUT THE INVENTION

[0014] Next, a more detailed description will be given of the present invention on the basis of a preferred embodiment illustrated in the drawings. It should be noted that the present invention is not limited to the embodiment.

[EMBODIMENT]

[0015] In Figs. 1 to 10, a glass-plate working apparatus 1 in accordance with this embodiment is comprised of: a base 3; a supporting table 4 which is provided on the base 3 and supports, in this embodiment, a rectangular flat plate-shaped glass plate 2; a transporting means 5 which is provided on the base 3 and transports the glass plate 2 within a plane parallel to a surface of the glass plate 2, i.e., in this embodiment in an X direction which is one direction within an horizontal plane and a direction in which the glass plate 2 is transported; a working head 7 which serves as a working head means for working an end face in a region R1 as one region of an end face 6 of the glass plate 2 (the region R1 being a region from one end 8 of the end face 6 of the glass plate 2 to a working point A on the end face 6 side of the glass plate 2 in the X direction), i.e., in this embodiment for grinding the end face in the region R1 of the glass plate 2; a moving means 10 for moving the working head 7 in the X direction along the end face in the region R1 of the glass plate 2; a working head 11 which, in the same way as the working head 7, serves as a working head means for working an end face in a region R2 as another region of the end face 6 of the glass plate 2 (the region R2 being a region from another end 9 of the end face 6 of the glass plate 2 to a vicinity of a central portion on the end face 6 side of the glass plate 2 in the X direction) and a region R3 (the region R3 being a remaining region obtained by subtracting the regions R1 and R2 from the entire region of the end face 6 of the glass plate 2), i.e., in this embodiment for grinding the end face in the regions R2 and R3 of the glass plate 2; a moving means 12 for moving the working head 11 in the X direction along the end face in the regions R2 and R3 of the glass plate 2; a working head 14 which serves as a working head means for working an end face in a region R4 as one region of another end face 13 of the glass plate 2 opposing the end face 6 of the glass plate 2 in another direction intersecting the one direction within the horizontal plane, i.e., in this embodiment in a Y direction perpendicular to the X direction (the region R4 being a region from one end 15 of the end face 13 of the glass plate 2 to a working point B on the end face 13 side of the glass plate 2 in the X direction), i.e., in this embodiment for grinding the end face in the region R4 of the glass plate 2; a moving means 17 for moving the working head 14 in the X direction along the end face in the region R4; a working head 18 which, in the same way as the working head 14, serves as a working head means for working an end face in a region R5 as another region of the end face 13 of the glass plate 2 (the region R5 being a region from another end 16 of the end face 13 of the glass plate 2 to a vicinity of a central portion on the end face 13 side of the glass plate 2 in the X direction) and a region R6 (the region R6 being a re-

maining region obtained by subtracting the regions R4 and R5 from the entire region of the end face 13 of the glass plate 2), i.e., in this embodiment for grinding the end face in the regions R5 and R6 of the glass plate 2; and a moving means 19 for moving the working head 18 in the X direction along the regions R5 and R6.

[0016] The supporting table 4 includes a pair of sucker devices 40 each having a rectangular sucker which sucks and fixes the glass plate 2 from a reverse surface side of the glass plate 2 and extends in the X direction, as well as a supporting table body 41 which is provided on the base 3 and on an upper end of which the pair of sucker devices 40 are disposed. The supporting table 4 is adapted to support the glass plate 2 by sucking and fixing the glass plate 2, which has been transported by the transporting means 5, by means of the pair of sucker devices 40 at a working position with respect to the glass plate 2.

[0017] The transporting means 5 includes a sucker device 50 having a rectangular sucker which sucks and fixes an unworked glass plate 2, which is carried in from an upstream side 100 of the glass plate 2, from the reverse surface side of the glass plate 2 and extends in the X direction; a supporting stand 51 on an upper end of which the sucker device 50 is disposed and which supports the glass plate 2; a traveling table 52 on which the supporting stand 51 is disposed and which is linearly movable (reciprocatable) in the X direction; a pair of guide rails 53 which are disposed on the base 3 and guide and support the traveling table 52 linearly movably (reciprocatably) in the X direction; and a driving means 54 for linearly moving (reciprocating) the traveling table 52 in the X direction along the guide rails 53.

[0018] The driving means 54 includes a rack 55 which is disposed on the base 3 and extends in the X direction in parallel therewith; a pinion gear 56 meshing with the rack 55; and a servo motor 57 which has an output rotating shaft (motor shaft) with the pinion gear 56 fitted at one end thereof and is mounted on the traveling table 52. Concerning the glass plate 2 sucked and fixed by means of the sucker device 50, the transporting means 5 is adapted to carry in the unworked glass plate 2 from the upstream side 100 of the glass plate 2 onto the supporting table 4 and meanwhile to carry out a worked glass plate 2 from the supporting table 4 to a downstream side 200 by moving (reciprocating) the traveling table 52 in the X direction through the rotation of the pinion gear 56 by the operation of the servo motor 57 of the driving means 54 and through the meshing of the pinion gear 56 with the rack 55.

[0019] The respective ones of the working heads 7, 11, 14, and 18 are formed similarly to one another, and the respective ones of the moving means 10, 12, 17, and 19 are formed similarly to one another. Therefore, a detailed description will be given hereafter of the working head 7 and the moving means 10, while, as for the working heads 11, 14, and 18 and the moving means 12, 17, and 19, the same reference numerals will be given in the drawings, as required, and a detailed description thereof will be omitted.

[0020] The working head 7 includes a grinding wheel 25 for working the end face in the region R1 of the glass plate 2, i.e., in this embodiment for grinding the end face in the region R1 of the glass plate 2; a spindle motor 26 having an output rotating shaft (motor shaft) on one end of which the grinding wheel 25 is mounted; a slide body 27 on which the spindle motor 26 is mounted and which is capable of raising and lowering the spindle motor 26 in a Z direction which is a vertical direction; a pair of guide rails 28 for guiding and supporting the slide body 27 liftably movably (reciprocatably) in the Z direction; a ball screw nut (not shown) mounted on the slide body 27 and a ball screw 29 engaged threadedly with the ball screw nut; and a raising/lowering servo motor 30 which is coupled to the ball screw 29 and effects the raising and lowering movement (reciprocating movement) of the slide body 27 in the Z direction along the pair of guide rails 28.

[0021] The moving means 10 includes a traveling table 60 which is linearly movable (reciprocatable) in the X direction; a pair of guide rails 62 which are disposed on the base 3 and guide and support the traveling table 60 linearly movably (reciprocatably) in the X direction; a driving means 63 for linearly moving (reciprocating) the traveling table 60 in the X direction along the guide rails 62; and a cutting amount adjusting means 64 for adjusting a cutting amount (grinding amount) in the Y direction of the grinding wheel 25 of the working head 7 with respect to the end face 6 of the glass plate 2 by linearly moving (reciprocating) the grinding head 7 in the Y direction.

[0022] The driving means 63 includes a rack 70 which is disposed on the base 3 and extends in the X direction in parallel therewith; a pinion gear 71 meshing with the rack 70; and a servo motor 72 which has an output rotating shaft (motor shaft) with the pinion gear 71 fitted at one end thereof and is mounted on the traveling table 60. The moving means 10 is adapted to linearly move (reciprocate) the traveling table 60 in the X direction through the rotation of the pinion gear 71 by the operation of the servo motor 72 of the driving means 63 and through the meshing of the pinion gear 71 with the rack 70.

[0023] The cutting amount adjusting means 64 includes a moving stand 75 on which the working head 7 is mounted and which is supported on the traveling table 60 linearly movably (reciprocatably) in the Y direction; a pair of guide rails 76 for guiding and supporting the moving stand 75 linearly movably (reciprocatably) in the Y direction; a ball screw nut (not shown) mounted on the moving stand 75 and a ball screw 77 engaged threadedly with the ball screw nut; and a servo motor 78 which is coupled to the ball screw 77 and linearly moves (reciprocates) the moving stand 75 in the Y direction along the pair of guide rails 76. The moving means 10 is adapted to adjust the cutting amount (grinding amount) in the Y direction of the grinding wheel 25 of the grinding head 7 with respect to the end face 6 of the glass plate 2 by moving the moving stand 75 in the Y direction by means

of the ball screw 77 by the operation of the servo motor 78 of the cutting amount adjusting means 64.

[0024] The moving means 10 and 12 are adapted to move their respective working heads 7 and 11 in such a manner as to cause the working heads 7 and 11 to approach each other or move away from each other by simultaneously starting the respective grinding operation of the grinding wheels 25 of the working heads 7 and 11 under numerical control (NC).

[0025] In the same way as the moving means 10 and 12, the moving means 17 and 19 are adapted to move their respective working heads 14 and 18 in such a manner as to cause the working heads 14 and 18 to approach each other or move away from each other by simultaneously starting the respective grinding operation of the grinding wheels 25 of the working heads 14 and 18 under numerical control.

[0026] In addition, the moving means 10, 12, 17, and 19 may be adapted to move their respective working heads 7, 11, 14, and 18 in such a manner as to cause the working heads 7 and 11 and the working heads 14 and 18 to approach each other or move away from each other, respectively, by simultaneously starting the respective grinding operation of the grinding wheels 25 of the working heads 7, 11, 14, and 18 under numerical control.

[0027] The respective moving speeds in the X direction of the working heads 7 and 11 may be mutually different or identical. Further, the respective moving speeds in the X direction of the working heads 14 and 18 may be mutually different or identical. Furthermore, the respective moving speeds in the X direction of the working heads 7, 11, 14, and 18 may be mutually different or identical.

[0028] On the side of the working heads 7 and 11, the pair of guide rails 62 on that side of the working heads 7 and 11 are used in common for the working heads 7 and 11 and, on the side of the working heads 14 and 18 as well, the pair of guide rails 62 on that side of the working heads 14 and 18 are used in common for the working heads 14 and 18.

[0029] Referring to Figs. 3 to 6, a description will be given of an embodiment of the method of working the glass plate 2 by the glass-plate working apparatus 1 in accordance with the above-described embodiment.

[0030] As shown in Fig. 3, in the working of both end faces 6 and 13 of the rectangular flat plate-shaped glass plate 2, the glass plate 2 carried in from the upstream side 100 is sucked and fixed by means of the sucker device 50 and is transported onto the supporting table 4 by the transporting means 5, and the unworked glass plate 2 transported by the transporting means 5 is sucked and fixed at the working position for the glass plate 2 by means of the pair of sucker devices 40.

[0031] Next, as shown in Figs. 3 and 4, with respect to the glass plate 2 sucked and fixed at the working position for the glass plate 2 by means of the pair of sucker devices 40, the working head 7, whose cutting amount (grinding amount) of the end face 6 of the glass plate 2 has been adjusted in advance, is moved by the moving means 10 in an X1 direction, which is one direction of the X direction parallel to a direction directed from the one end 8 to the other end 9 of the end face 6 of the glass plate 2 along the end face in the region R1 of the glass plate 2, so as to cause the grinding wheel 25 of the working head 7 to grind the end face in the region R1 of the glass plate 2. During the movement in the X1 direction of the working head 7 by the moving means 10, the working head 11, whose cutting amount (grinding amount) of the end face 6 of the glass plate 2 has been adjusted in advance, is moved by the moving means 12 in an X2 direction, which is another direction of the X direction parallel to a direction directed from the other end 9 to the one end 8 of the end face 6 of the glass plate 2 along the end face in the regions R2 and R3 of the glass plate 2, so as to cause the grinding wheel 25 of the working head 11 to grind the end face in the region R2 of the glass plate 2. Meanwhile, the working head 14, whose cutting amount (grinding amount) of the end face 13 of the glass plate 2 has been adjusted in advance, is moved by the moving means 17 in the same way as the moving means 10 in the X1 direction from the one end 15 of the end face 13 of the glass plate 2 along the end face in the region R4, so as to cause the grinding wheel 25 of the working head 14 to grind the end face in the region R4 of the glass plate 2. During the movement in the X1 direction of the working head 14 by the moving means 17, the working head 18, whose cutting amount (grinding amount) of the end face 13 of the glass plate 2 has been adjusted in advance, is moved by the moving means 19 in the same way as the moving means 12 in the X2 direction from the other end 16 of the end face 13 of the glass plate 2 along the end face in the regions R5 and R6 of the glass plate 2, so as to cause the grinding wheel 25 of the working head 18 to grind the end face in the region R5 of the glass plate 2.

[0032] As shown in Fig. 5, after the grinding of the region R1 and the region R2 of the glass plate 2 and the region R4 and the region R5 of the glass plate 2, the working head 7 is moved from the working point A of the glass plate 2 in the X2 direction by the moving means 10, and during the movement of the working head 7 in the X2 direction by the moving means 10, the working head 11 is further moved by the moving means 12 in the X2 direction from the vicinity of the central portion on the end face 6 side of the glass plate 2 along the end face in the region R3 of the glass plate 2, so as to cause the grinding wheel 25 of the working head 11 to grind the end face in the region R3 of the glass plate 2. Meanwhile, the working head 14 is moved from the working point B of the glass plate 2 in the X2 direction by the moving means 17, and during the movement of the working head 14 in the X2 direction by the moving means 17, the working head 18 is further moved by the moving means 19 in the X2 direction from the vicinity of the central portion on the end face 13 side of the glass plate 2 along the end face in the region R6 of the glass plate 2, so as to cause the grinding wheel 25 of the working head 18 to grind the

end face in the region R6 of the glass plate 2.

[0033] As shown in Fig. 6, after the grinding of the end face in the regions R1, R2, and R3 of the glass plate 2 by the moving means 10 and 12, the working head 7 is further moved in the X2 direction by the moving means 10, and during the movement of the working head 7 in the X2 direction by the moving means 10, the working head 11 is moved from the working point A of the glass plate 2 in the X1 direction by the moving means 12, to thereby return the working heads 7 and 11 to the positions shown in Fig. 6 by the moving means 10 and 12, respectively. Meanwhile, after the grinding of the end face in the regions R4, R5, and R6 of the glass plate 2 by the moving means 17 and 19, the working head 14 is further moved in the X2 direction by the moving means 17, and during the movement of the working head 14 in the X2 direction by the moving means 17, the working head 18 is moved from the working point B of the glass plate 2 in the X1 direction by the moving means 19, to thereby return the working heads 14 and 19 to the positions shown in Fig. 6 by the moving means 17 and 19, respectively.

[0034] After the return of the working heads 7, 11, 14, and 19, the glass plate 2, whose both end faces 6 and 13 (the respective end faces in the regions R1, R2, and R3 and the regions R4, R5, and R6) have been ground, is carried out by the transporting means 5 from the supporting table 4 to the downstream side 200 while being sucked and fixed by means of the sucker device 50.

[0035] The moving means 10 allows the end face in the region R1 of the glass plate 2 to be ground by the grinding wheel 25 of the working head 7, while the moving means 12 allows the end face in the respective regions R2 and R3 of the glass plate 2 to be ground by the grinding wheel 25 of the working head 11, to thereby effect the grinding of the end face 6 of the glass plate 2. Meanwhile, the moving means 17 allows the end face in the region R4 of the glass plate 2 to be ground by the grinding wheel 25 of the working head 14, while the moving means 19 allows the end face in the respective regions R5 and R6 of the glass plate 2 to be ground by the grinding wheel 25 of the working head 18, to thereby effect the grinding of the end face 13 of the glass plate 2.

[0036] In this embodiment, in the grinding of the end face in each of the region R1 of the glass plate 2 by the grinding wheel 25 of the working head 7 and the region R2 of the glass plate 2 by the grinding wheel 25 of the working head 11, the moving means 10 and the moving means 12 are respectively adapted to move the working head 7 in the X1 direction along the end face in the region R1 of the glass plate 2 and move the working head 11 in the X2 direction along the end face in the region R2 of the glass plate 2, respectively, so as to cause the working head 7 and the working head 11 to approach each other.

[0037] In this embodiment, in the grinding of the end face in each of the region R4 of the glass plate 2 by the grinding wheel 25 of the working head 14 and the region R5 of the glass plate 2 by the grinding wheel 25 of the working head 18, the moving means 17 and the moving means 19 are respectively adapted to move the working head 14 in the X1 direction along the end face in the region R4 of the glass plate 2 and move the working head 18 in the X2 direction along the end face in the region R5 of the glass plate 2, respectively, so as to cause the working head 14 and the working head 18 to approach each other.

[0038] In this embodiment, the moving means 10 is adapted to move the working head 7 in the X1 direction along the end face in the region R1 of the glass plate 2 to thereby cause the grinding wheel 25 of the working head 7 to grind the end face in the region R1 of the glass plate 2, while the moving means 12 is adapted to move the working head 11 in the X2 direction along the end face in the regions R2 and R3 of the glass plate 2 to thereby cause the grinding wheel 25 of the working head 11 to grind the end face in the respective regions R2 and R3 of the glass plate 2, so as to effect the grinding of the end face 6 of the glass plate 2. Meanwhile, the moving means 17 is adapted to move the working head 14 in the X1 direction along the end face in the region R4 of the glass plate 2 to thereby cause the grinding wheel 25 of the working head 14 to grind the end face in the region R4 of the glass plate 2, while the moving means 19 is adapted to move the working head 18 in the X2 direction along the end face in the regions R5 and R6 of the glass plate 2 to thereby cause the grinding wheel 25 of the working head 18 to grind the end face in the respective regions R5 and R6 of the glass plate 2, so as to effect the grinding of the end face 13 of the glass plate 2. On the other hand, the following arrangement may be adopted in substitution for this arrangement. As shown in Figs. 7 to 10, the moving means 10 is adapted to move the working head 7 from the working point A of the glass plate 2 in the X2 direction along the end face in the region R1 of the glass plate 2 to thereby cause the grinding wheel 25 of the working head 7 to grind the end face in the region R1 of the glass plate 2, while the moving means 12 is adapted to move the working head 11 from the working point A of the glass plate 2 in the X1 direction along the end face in the regions R3 and R2 of the glass plate 2 to thereby cause the grinding wheel 25 of the working head 11 to grind the end face in the regions R3 and R2 of the glass plate 2, so as to effect the grinding of the end face 6 of the glass plate 2. Meanwhile, the moving means 17 is adapted to move the working head 14 from the working point B of the glass plate 2 in the X2 direction along the end face in the region R4 of the glass plate 2 to thereby cause the grinding wheel 25 of the working head 14 to grind the end face in the region R4 of the glass plate 2, while the moving means 19 is adapted to move the working head 18 from the working point B of the glass plate 2 in the X1 direction along the end face in the regions R6 and R5 of the glass plate 2 to thereby cause the grinding wheel 25 of the working head 18 to grind the end face in the regions R6 and R5 of the glass plate 2, so as to effect the grinding of the end face 13 of the glass plate 2.

[0039] Referring to Figs. 7 to 10, a description will be given of another embodiment of the method of working the glass plate 2 by the glass-plate working apparatus 1 in accordance with the above-described embodiment.

[0040] As shown in Figs. 7 and 8, with respect to the glass plate 2 sucked and fixed at the working position for the glass plate 2 by means of the pair of sucker devices 40, the working head 7 is moved by the moving means 10 from the one end 8 of the end face 6 of the glass plate 2 to the working point A of the glass plate 2 in a state of noncontact with the end face in the region R1 of the glass plate 2, and during the movement of the working head 7 in the X1 direction from the one end 8 of the end face 6 of the glass plate 2 to the working point A of the glass plate 2 by the moving means 10, the working head 11 is moved by the moving means 12 from the other end 9 of the end face 6 of the glass plate 2 to the vicinity of the central portion on the end face 6 side of the glass plate 2 in a state of noncontact with the end face in the regions R2 and R3 of the glass plate 2. Meanwhile, the working head 14 is moved by the moving means 17 in the same way as the moving means 10 from the one end 15 of the end face 13 of the glass plate 2 to the working point B of the glass plate 2 in a state of noncontact with the end face in the region R4 of the glass plate 2, and during the movement of the working head 14 in the X1 direction from the one end 15 of the end face 13 of the glass plate 2 to the working point B of the glass plate 2 by the moving means 17, the working head 18 is moved by the moving means 19 in the same way as the moving means 12 from the other end 16 of the end face 13 of the glass plate 2 to the vicinity of the central portion on the end face 13 side of the glass plate 2 in a state of noncontact with the end face in the regions R5 and R6 of the glass plate 2.

[0041] As shown in Fig. 8, after the movement of the working heads 7 and 11, by using the moving means 10, the moving stand 75 of the moving means 10 is moved in the Y direction by operating the servo motor 78 of the cutting amount adjusting means 64 of the moving means 10 so as to cause the grinding wheel 25 of the working head 7 to be brought into contact with the glass plate 2 and grind the vicinity of the working point A of the glass plate 2. Meanwhile, after the movement of the working heads 14 and 18, by using the moving means 17, the moving stand 75 of the moving means 17 is moved in the Y direction by operating the servo motor 78 of the cutting amount adjusting means 64 of the moving means 17 so as to cause the grinding wheel 25 of the working head 14 to be brought into contact with the glass plate 2 and grind the vicinity of the working point B of the glass plate 2.

[0042] As shown in Fig. 9, after the grinding of the vicinity of the working point A of the glass plate 2 by the working head 7, the grinding wheel 25 of the working head 7 is moved by the moving means 10 in the X2 direction from the working point A of the glass plate 2 along the end face in the region R1 of the glass plate 2 in a state of contact with the glass plate 2, to thereby grind a part of the end face in the region R1 by the grinding wheel 25 of the working head 7. During the movement of the working head 7 in the X2 direction by the moving means 10, by using the moving means 12, the moving stand 75 of the moving means 12 is moved in the Y direction by operating the servo motor 78 of the cutting amount adjusting means 64 of the moving means 12 so as to cause the grinding wheel 25 of the working head 11 to be brought into contact with the working point A of the glass plate 2. Meanwhile, after the grinding of the vicinity of the working point B of the glass plate 2 by the working head 14, the grinding wheel 25 of the working head 14 is moved by the moving means 17 in the X2 direction from the working point B of the glass plate 2 along the end face in the region R4 of the glass plate 2 in a state of contact with the glass plate 2, to thereby grind a part of the end face in the region R4 by the grinding wheel 25 of the working head 14. During the movement of the working head 14 in the X2 direction by the moving means 17, by using the moving means 19, the moving stand 75 of the moving means 19 is moved in the Y direction by operating the servo motor 78 of the cutting amount adjusting means 64 of the moving means 19 so as to cause the grinding wheel 25 of the working head 18 to be brought into contact with the working point B of the glass plate 2.

[0043] As shown in Figs. 9 and 10, the working head 7 is further moved in the X2 direction along the end face in the region R1 of the glass plate 2 by the moving means 10, so as to cause the grinding wheel 25 of the working head 7 to grind the end face in the remaining region of the region R1 of the glass plate 2. During the movement of the working head 7 in the X2 direction by the moving means 10, the working head 11 is moved by the moving means 12 in the X1 direction from the working point A of the glass plate 2 along the end face in the regions R3 and R2 of the glass plate 2, so as to cause the grinding wheel 25 of the working head 11 to grind the end face in the regions R2 and R3 of the glass plate 2, and the working heads 7 and 11 are respectively returned to the positions shown in Fig. 10 by the moving means 10 and 12. Meanwhile, the working head 14 is further moved in the X2 direction along the end face in the region R4 of the glass plate 2 by the moving means 17, so as to cause the grinding wheel 25 of the working head 14 to grind the end face in the remaining region of the region R4 of the glass plate 2. During the movement of the working head 14 in the X2 direction by the moving means 17, the working head 18 is moved by the moving means 19 in the X1 direction from the working point B of the glass plate 2 along the end face in the regions R6 and R5 of the glass plate 2, so as to cause the grinding wheel 25 of the working head 18 to grind the end face in the regions R5 and R6 of the glass plate 2, and the working heads 14 and 18 are respectively returned to the positions shown in Fig. 10 by the moving means 17 and 19.

[0044] After the return of the working heads 7, 11, 14, and 19, the glass plate 2, whose both end faces 6 and 13 have been ground, is transported and carried out by

the transporting means 5 from the supporting table 4 to the downstream side 200 while being sucked and fixed by means of the sucker device 50.

[0045] The glass-plate working apparatus 1 in accordance with this embodiment is comprised of: the base 3; the supporting table 4 which is provided on the base 3 and supports the glass plate 2; the transporting means 5 which is provided on the base 3 and transports the glass plate 2 in the X direction; the working head 7 for grinding the end face in the region R1 of one end face 6 of the glass plate 2; the moving means 10 for moving the working head 7 in the X direction along the end face in the region R1 of the glass plate 2; the working head 11 for grinding the end face in the regions R2 and R3 of the glass plate 2; the moving means 12 for moving the working head 11 in the X direction along the end face in the regions R2 and R3 of the glass plate 2; the working head 14 for grinding the end face in the region R4 of the glass plate 2; the moving means 17 for moving the working head 14 in the X direction along the end face in the region R4 of the glass plate 2; the working head 18 for grinding the end face in the regions R5 and R6 of the glass plate 2; and the moving means 19 for moving the working head 18 in the X direction along the end face in the regions R5 and R6 of the glass plate 2. Therefore, since the working of the end face in the respective regions R1, R2, and R3 of the glass plate 2 can be effected by the working head 7 and the working head 11, and the working of the end face in the respective regions R4, R5, and R6 of the glass plate 2 can be effected by the working head 14 and the working head 18, the efficiency of working with respect to the end faces of the glass plate is high, and the working time of these operations can be shortened, thereby making it possible to carry out glass plate working with high productivity.

[0046] In the embodiment of the method of working the glass plate 2 by the glass-plate working apparatus 1 in accordance with this embodiment shown in Figs. 3 to 6, the following arrangement may be adopted. After the grinding of the end face in the region R1 of the glass plate 2 by the working head 7, the moving stand 75 of the moving means 10 is moved in the Y direction by operating the servo motor 78 of the cutting amount adjusting means 64 of the moving means 10, so as to move the grinding wheel 25 of the working head 7 away from the end face 6 of the glass plate 2. Subsequently, by operating the servo motor 72 of the driving means 63 of the moving means 10, the grinding wheel 25 of the working head 7 is moved in the X2 direction from the working point A of the glass plate 2 in a state of noncontact with the end face in the region R1 of the glass plate 2. Meanwhile, after the grinding of the end face in the region R4 of the glass plate 2 by the working head 14, the moving stand 75 of the moving means 17 is moved in the Y direction by operating the servo motor 78 of the cutting amount adjusting means 64 of the moving means 17, so as to move the grinding wheel 25 of the working head 14 away from the end face 13 of the glass plate 2. Subsequently, by operating the servo motor 72 of the driving means 63 of the moving means 17, the grinding wheel 25 of the working head 14 is moved in the X2 direction from the working point B of the glass plate 2 in a state of noncontact with the end face in the region R4 of the glass plate 2. In addition, an arrangement may be provided such that the respective grinding wheels 25 of the working heads 7 and 14 are not moved away from the end face 6 and the end face 13, respectively, of the glass plate 2, and are moved in the X2 direction by operating the respective servo motors 72 of the moving means 10 and 17.

[0047] In the embodiment of the method of working the glass plate 2 by the glass-plate working apparatus 1 in accordance with this embodiment shown in Figs. 3 to 6, the following arrangement may be adopted. After the grinding of the end face in the regions R2 and R3 of the glass plate 2 by the working head 11, the moving stand 75 of the moving means 12 is moved in the Y direction by operating the servo motor 78 of the cutting amount adjusting means 64 of the moving means 12, so as to move the grinding wheel 25 of the working head 11 away from the end face 6 of the glass plate 2. Subsequently, by operating the servo motor 72 of the driving means 63 of the moving means 12, the grinding wheel 25 of the working head 11 is moved in the X1 direction from the working point A of the glass plate 2 in a state of noncontact with the end face in the regions R3 and R2 of the glass plate 2. Meanwhile, after the grinding of the end face in the regions R5 and R6 of the glass plate 2 by the working head 18, the moving stand 75 of the moving means 19 is moved in the Y direction by operating the servo motor 78 of the cutting amount adjusting means 64 of the moving means 19, so as to move the grinding wheel 25 of the working head 18 away from the end face 13 of the glass plate 2. Subsequently, by operating the servo motor 72 of the driving means 63 of the moving means 19, the grinding wheel 25 of the working head 18 is moved in the X1 direction from the working point B of the glass plate 2 in a state of noncontact with the end face in the regions R6 and R5 of the glass plate 2. In addition, an arrangement may be provided such that the respective grinding wheels 25 of the working heads 11 and 18 are not moved away from the end face 6 and the end face 13, respectively, of the glass plate 2, and are moved in the X1 direction by operating the respective servo motors 72 of the moving means 12 and 19.

[0048] In this embodiment, after the grinding of both end faces 6 and 13 (the respective end faces in the regions R1, R2, and R3 and the regions R4, R5, and R6) of the glass plate 2, polishing may be performed with respect to both end faces 6 and 13 of the glass plate 2 in a separate process (online or offline) on the downstream side 200 of the glass-plate working apparatus 1 in accordance with this embodiment.

[0049] In addition, in the case where polishing is performed with respect to both end faces 6 and 13 of the glass plate 2 in the separate process, polishing may be performed with respect to both end faces 6 and 13 of the

glass plate 2 by another working head having a polishing wheel, and the other working head may be comprised of a similar arrangement to those of the moving means 10, 12, 17, and 19 and the working heads 7, 11, 14, and 18 in accordance with this embodiment.

[0050] In this embodiment, each of the working heads 7, 11, 14, and 18 has the grinding wheel 25, and in the case where polishing is performed with respect to both end faces 6 and 13 of the glass plate 2, each of the working heads 7, 11, 14, and 18 may have a polishing wheel in substitution for the grinding wheel 25.

[0051] In this embodiment, each of the working heads 7, 11, 14, and 18 has the grinding wheel 25, and in the case where grinding and polishing are consecutively performed with respect to both end faces 6 and 13 of the glass plate 2, each of the working heads 7, 11, 14, and 18 may further have a polishing wheel in addition to the grinding wheel 25. In this case, since each of the working heads 7, 11, 14, and 18 is provided with the grinding wheel 25 and the polishing wheel, it is unnecessary to perform polishing with respect to both end faces 6 and 13 of the glass plate 2 in the separate process (online or offline), and the operation ranging from grinding to polishing can be performed continuously with respect to both end faces 6 and 13 of the glass plate 2, thereby making it possible to shorten the working time in grinding and polishing.

[0052] Each of the working heads 7, 11, 14, and 18 has the grinding wheel 25 or the polishing wheel, or the grinding wheel 25 and the polishing wheel. However, by combining these grinding wheel(s) 25 and the polishing wheel(s), each of the working heads 7, 11, 14, and 18 may have, for example, the grinding wheel 25 and a plurality of polishing wheels, or a plurality of grinding wheels 25 and a polishing wheel, or a plurality of grinding wheels 25 and a plurality of polishing wheels.

[0053] Furthermore, each of the working heads 7, 11, 14, and 18 may be comprised of pluralities of working heads 7, 11, 14, and 18. According to the glass-plate working apparatus 1 having such pluralities of working heads 7, 11, 14, and 18, grinding or polishing, or both grinding and polishing, can be performed with respect to both end faces 6 and 13 of the glass plate 2 by the pluralities of working heads 7, 11, 14, and 18, the working time with respect to both end faces 6 and 13 of the glass plate 2 can be made even shorter, and the glass-plate working apparatus 1 with high productivity can be obtained.

[0054] Each of the pluralities of working heads 7, 11, 14, and 18 may have any one of at least one grinding wheel 25 or at least one polishing wheel, or at least one grinding wheel 25 and at least one polishing wheel.

[0055] In this embodiment, each of the moving means 10, 12, 17, and 19 and the working heads 7, 11, 14, and 18 may be numerically controlled independently, or each of the moving means 10, 12, 17, and 19 and the working heads 7, 11, 14, and 18 may be numerically controlled synchronously.

[0056] In this embodiment, as each of the moving means 10, 12, 17, and 19 and the working heads 7, 11, 14, and 18 is numerically controlled independently or synchronously, both end faces 6 and 13 of the glass plate 2 may be ground respectively continuously.

[0057] In this embodiment, although each of both end faces 6 and 13 of the glass plate 2 is adapted to be ground, working may be provided for either one end face between both end faces 6 and 13 of the glass plate 2 .

[0058] In this embodiment, each of the working heads 7 and 11 effects working of the end face in the respective regions R1, R2 and R3 of the glass plate 2 by moving in the X direction along the end face in the region R1 and the regions R2 and R3 of the glass plate 2, while each of the working heads 14 and 18 effects working of the end face in the respective regions R3, R4, and R6 of the glass plate 2 by moving in the X direction along the end face in the region R4 and the regions R5 and R6 of the glass plate 2. However, an arrangement may be provided such that, as the servo motors 72 of the driving means 63 of the moving means 10, 12, 17, and 19 and the servo motors 78 of the cutting amount adjusting means 64 are numerically controlled synchronously, the respective ones of the working heads 7, 11, 14, and 18 may be moved in the X direction and the Y direction (made to undergo XY plane coordinate movement) along the end face in the regions R1, R2, and R3 and the regions R4, R5, and R6 of the glass plate 2 so as to effect working of both end faces 6 and 13 of the glass plate 2, e.g., working of curves with respect to both end faces 6 and 13 of the glass plate 2.

[0059] In this embodiment, although the working point A of the glass plate 2 is provided on the one end 8 side of the glass plate 2, the working point A may be provided on the other end 9 side of the glass plate 2, or the vicinity of a central portion on the end face 6 side of the glass plate 2, or a central portion in the X direction of the end face 6 of the glass plate 2 (this central portion being located between the one end 8 and the other end 9 of the end face 6 of the glass plate 2 in the X direction). In addition, although the working point B of the glass plate 2 is provided on the one end 15 side of the glass plate 2, in the same way as the working point A, the working point B may be provided on the other end 16 side of the glass plate 2, or the vicinity of a central portion on the end face 13 side of the glass plate 2, or a central portion in the X direction of the end face 13 of the glass plate 2 (this central portion being located between the one end 15 and the other end 16 of the end face 13 of the glass plate 2 in the X direction). In each case, it is possible to shorten the working time of the grinding or polishing, or both grinding and polishing, of the glass plate 2.

[0060] In this embodiment, the glass plate 2 has a rectangular flat plate shape, and the glass plate 2 may alternatively have any shape among an elliptical shape, a circular shape, a polygonal shape, a square shape, a quadrilateral shape, and the like.

[0061] In this embodiment, as the servo motor 72 of

the driving means 63 for moving the traveling table 60 in the X direction and the servo motor 78 of the cutting amount adjusting means 64 for moving the moving stand 75 in the Y direction are numerically controlled, the working heads 7, 11, 14, and 18 are also capable of effecting corner cutting (cornering) of four corners of the glass plate 2 (the one end 8 and the other end 9 of the end face 6 of the glass plate 2 and the one end 15 and the other end 16 of the end face 13 of the glass plate 2).

[0062] In this embodiment, the working heads 7, 11, 14, and 18 may effect chamfering of the glass plate 2 together with the working of both end faces 6 and 13 of the glass plate 2, or may effect chamfering together with corner cutting of four corners of the glass plate 2.

[0063] In this embodiment, the driving means 54 of the transporting means 5 includes the rack 55 which is disposed on the base 3 and extends in the X direction in parallel therewith; the pinion gear 56 meshing with the rack 55; and the servo motor 57 which has the output rotating shaft (motor shaft) with the pinion gear 56 fitted at one end thereof and is mounted on the traveling table 52. Alternatively, however, the driving means 54 may include a ball screw nut, a ball screw engaged threadedly with the ball screw nut, and a servo motor which is coupled to the ball screw, in which case the transporting means 5 is capable of transporting the glass plate 2 more precisely with respect to the supporting table 4.

[0064] In this embodiment, the driving means 63 of each of the moving means 10, 12, 17, and 19 includes the rack 70 which is disposed on the traveling table 60 and extends in the X direction in parallel therewith; the pinion gear 71 meshing with the rack 70; and the servo motor 72 which has the output rotating shaft (motor shaft) with the pinion gear 71 fitted at one end thereof and is mounted on the traveling table 60. Alternatively, however, the driving means 63 may include a ball screw nut, a ball screw engaged threadedly with the ball screw nut, and a servo motor which is coupled to the ball screw, in which case each of the moving means 10, 12, 17, and 19 is capable of effecting working more precisely by each of the working heads 7, 11, 14, and 18 in the working of the glass plate 2.

[0065] In this embodiment, in the working of the end face 6 of the glass plate 2, an arrangement may be provided such that, as the servo motors 72 of the driving means 63 of the moving means 10 and 12 and the servo motors 78 of the cutting amount adjusting means 64 are numerically controlled synchronously, the end face in the region R1 of the glass plate 2 and the end face in the respective regions R2 and R3 of the glass plate 2 are simultaneously worked. In the working of the end face 13 of the glass plate 2, an arrangement may be provided such that, as the servo motors 72 of the driving means 63 of the moving means 17 and 19 and the servo motors 78 of the cutting amount adjusting means 64 are numerically controlled synchronously, the end face in the region R4 of the glass plate 2 and the end face in the respective regions R5 and R6 of the glass plate 2 are simultaneously worked.

DESCRIPTION OF REFERENCE NUMERALS

[0066]

1:	glass-plate working apparatus
2:	glass plate
3:	base
4:	supporting table
7, 11, 14, 18:	working head
10, 12, 17, 19:	moving means
62:	guide rail

Claims

1. A glass-plate working apparatus comprising:

at least one first working head means for effecting grinding or polishing, or both grinding and polishing, of an end face in one region of a glass plate;
a first moving means for moving said at least one first working head means along the end face in the one region of the glass plate;
at least one second working head means for effecting grinding or polishing, or both grinding and polishing, of an end face in another region of the glass plate; and
a second moving means for moving said at least one second working head means along the end face in the other region of the glass plate.

2. The glass-plate working apparatus according to claim 1, wherein said first moving means is adapted to move said at least one first working head means along the end face in the one region of the glass plate to cause said at least one first working head means to work the end face in the one region of the glass plate, and said second moving means is adapted to move said at least one second working head means along the end face in the other region of the glass plate to cause said at least one second working head means to work the end face in the other region of the glass plate.

3. The glass-plate working apparatus according to claim 1 or 2, wherein each of said first moving means and said second moving means is adapted to move each of said at least one first working head means and said at least one second working head means such that said at least one first working head means and said at least one second working head means approach each other or move away from each other.

4. The glass-plate working apparatus according to any one of claims 1 to 3, wherein said at least one first

working head means has at least one grinding wheel or at least one polishing wheel, or at least one grinding wheel and at least one polishing wheel, and said at least one second working head means has at least one grinding wheel or at least one polishing wheel, or at least one grinding wheel and at least one polishing wheel.

5. The glass-plate working apparatus according to any one of claims 1 to 4, wherein said first working head means is constituted by a plurality of first working head means, and said second working head means is constituted by a plurality of second working head means.

FIG.1

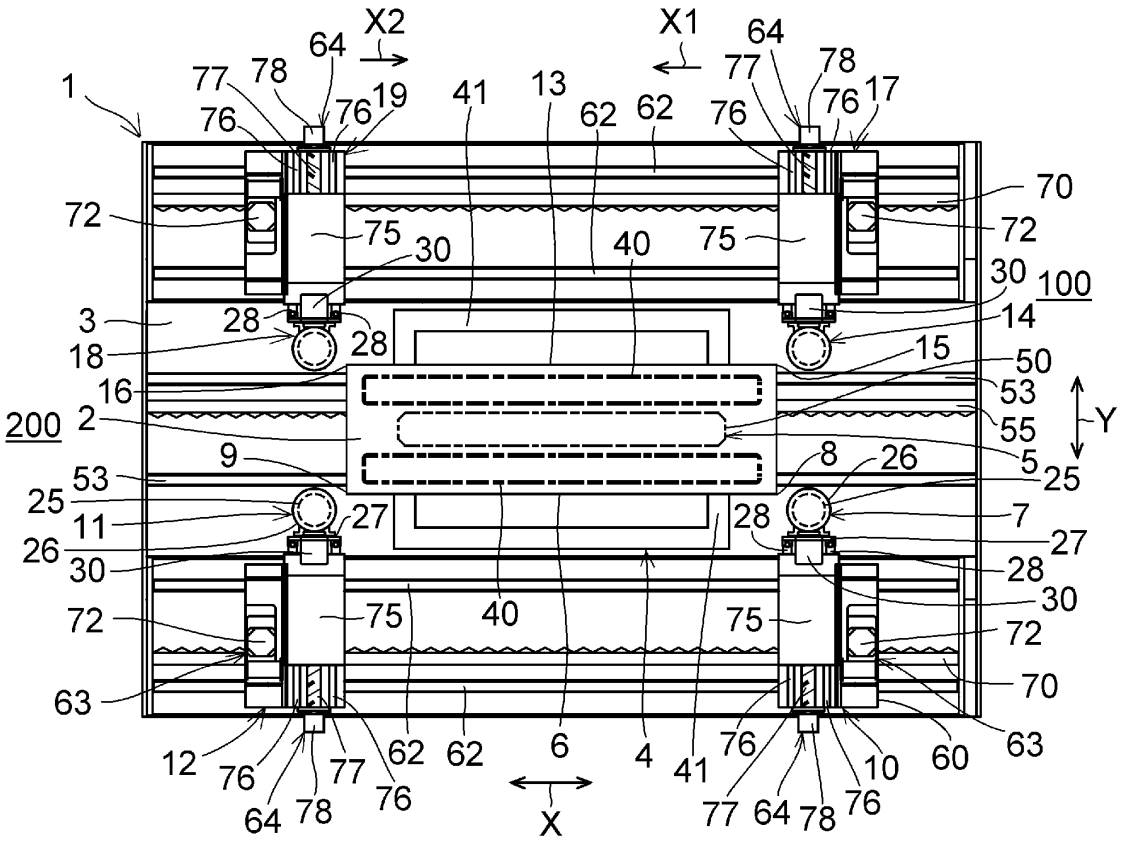

X2
X1
64
77
78
1
76
19
41
13
62
62
17
72
75
30
40
70
100
3
28
14
18
15
50
16
53
Y
200
2
55
9
8
26
25
53
27
7
11
26
30
63
12
6
4
10
60
X

FIG.2

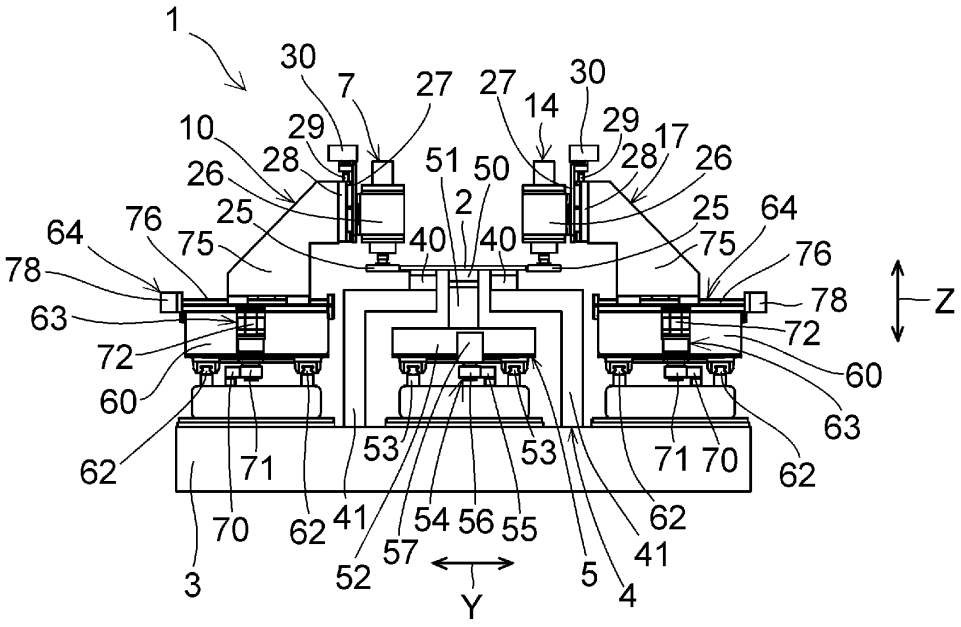

1
30
7
27
14
29
10
28
17
26
51
50
2
25
64
76
75
40
78
63
Z
72
60
62
71
53
70
41
54
56
55
57
52
5
4
Y

FIG.3

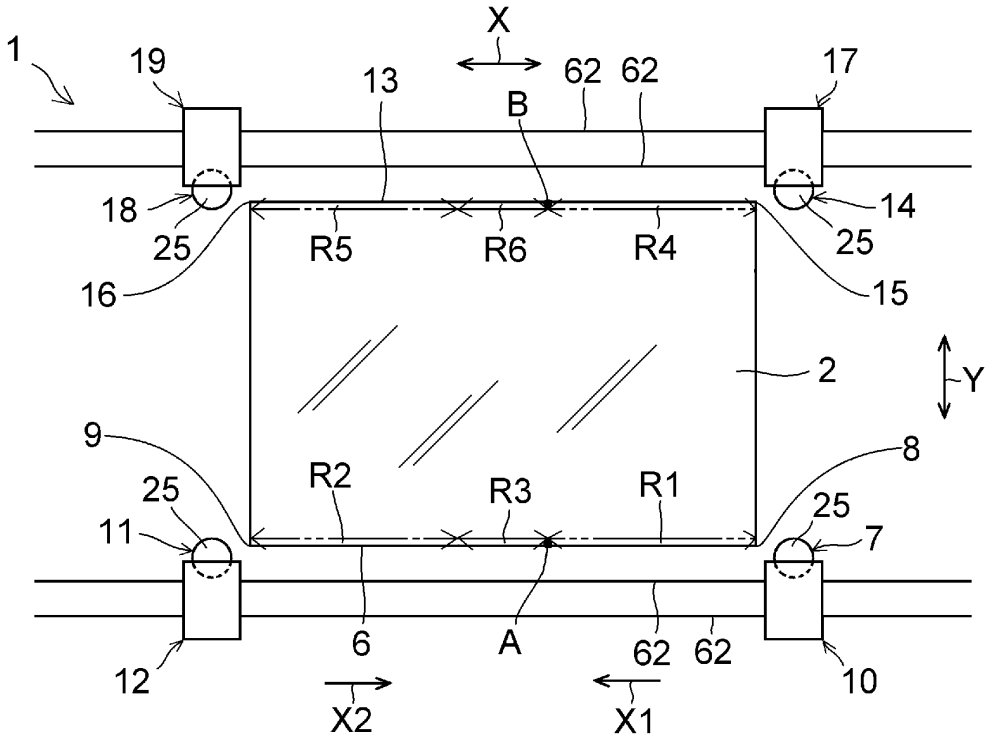

1
19
X
13
62 62
17
B
18
25
R5
R6
R4
25
14
16
15
2
Y
9
8
25
R2
R3
R1
25
11
7
6
A
62 62
12
10
X2
X1

FIG.4

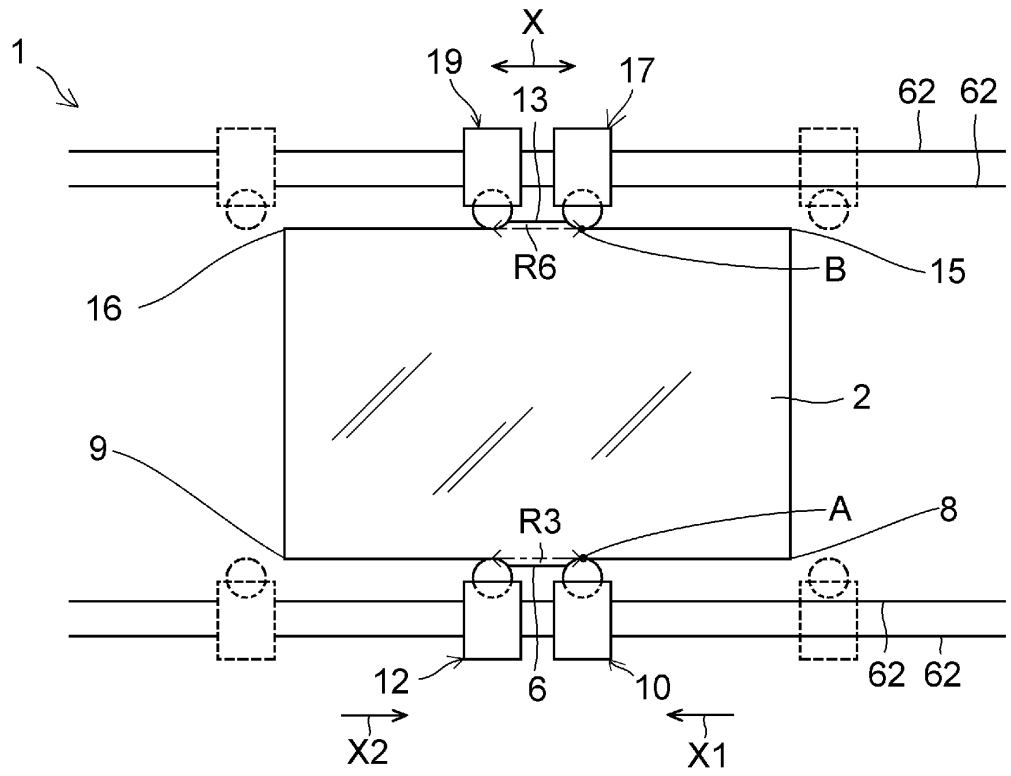

1
X
19
17
13
62 62
R6
B
15
16
2
9
R3
A
8
12
6
10
62 62
X2
X1

FIG.5

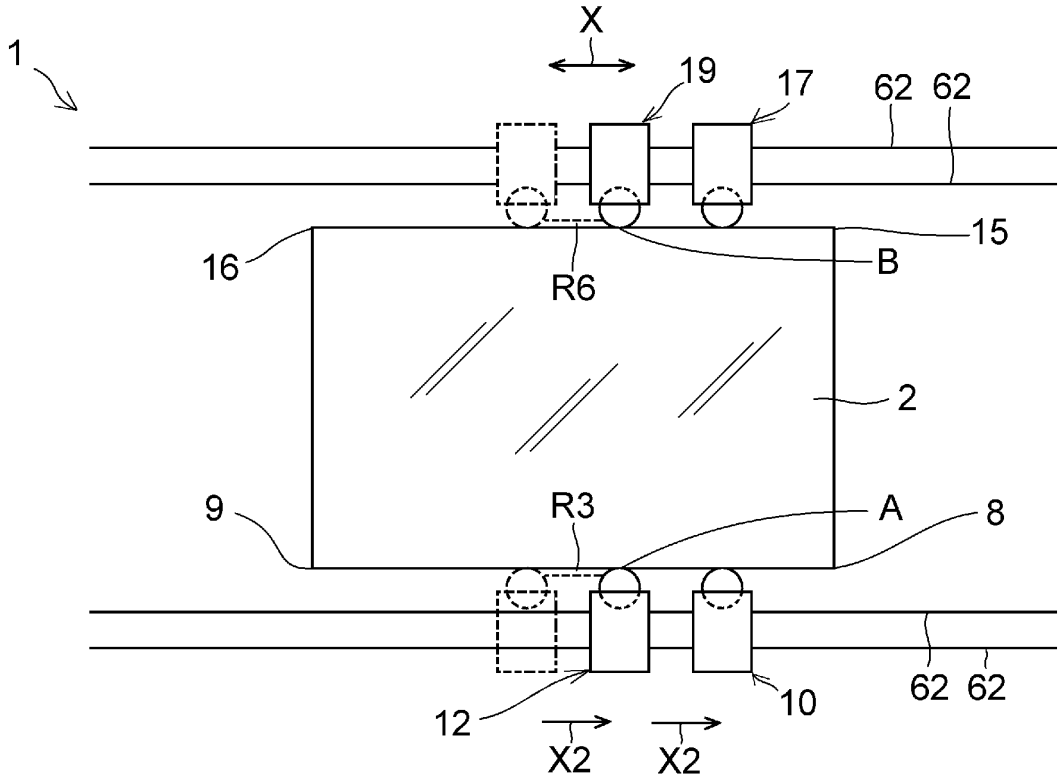

X
1
19
17
62
62
16
R6
B
15
2
9
R3
A
8
12
10
62
62
X2
X2

FIG.6

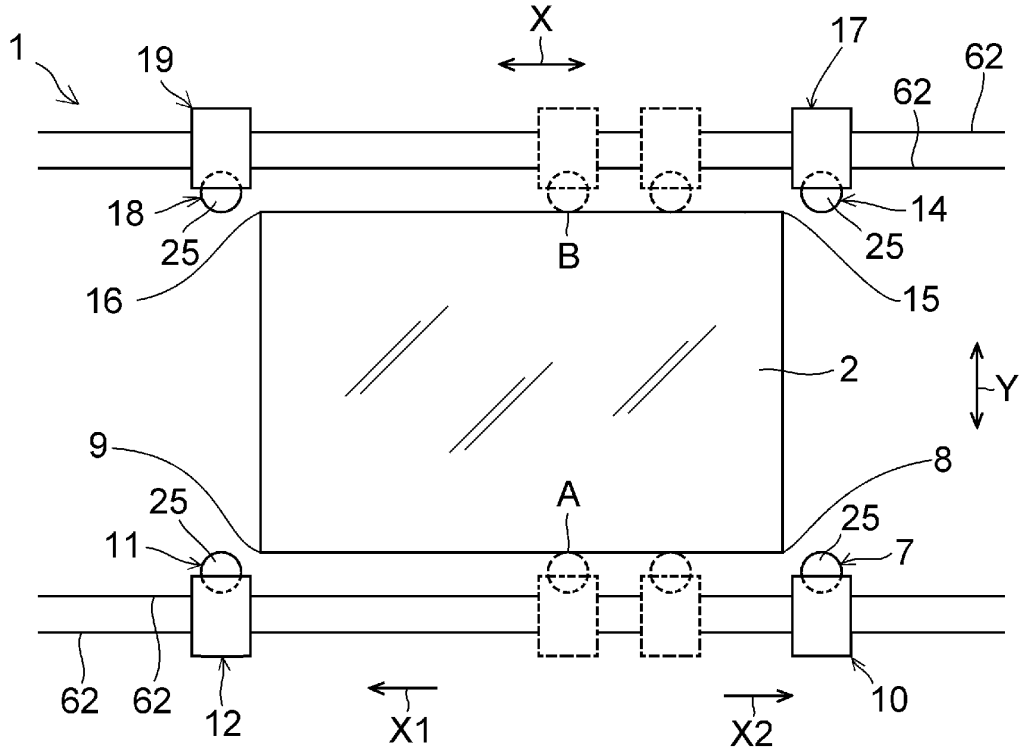

X
1
19
17
62
62
18
25
B
14
25
16
15
2
Y
9
8
25
A
25
11
7
62
62
12
X1
X2
10

FIG.7

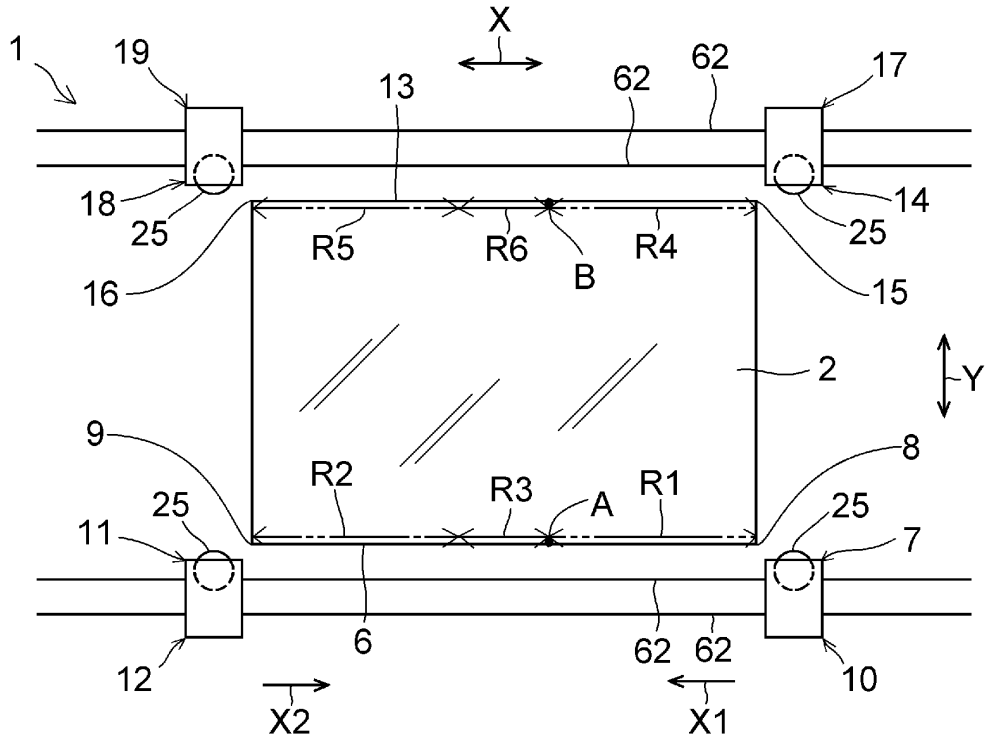

X
1
19
13
62
62
17
18
25
14
25
R5
R6
B
R4
16
15
2
Y
9
8
R2
R3
A
R1
25
25
11
7
6
62
62
12
10
X2
X1

FIG.8

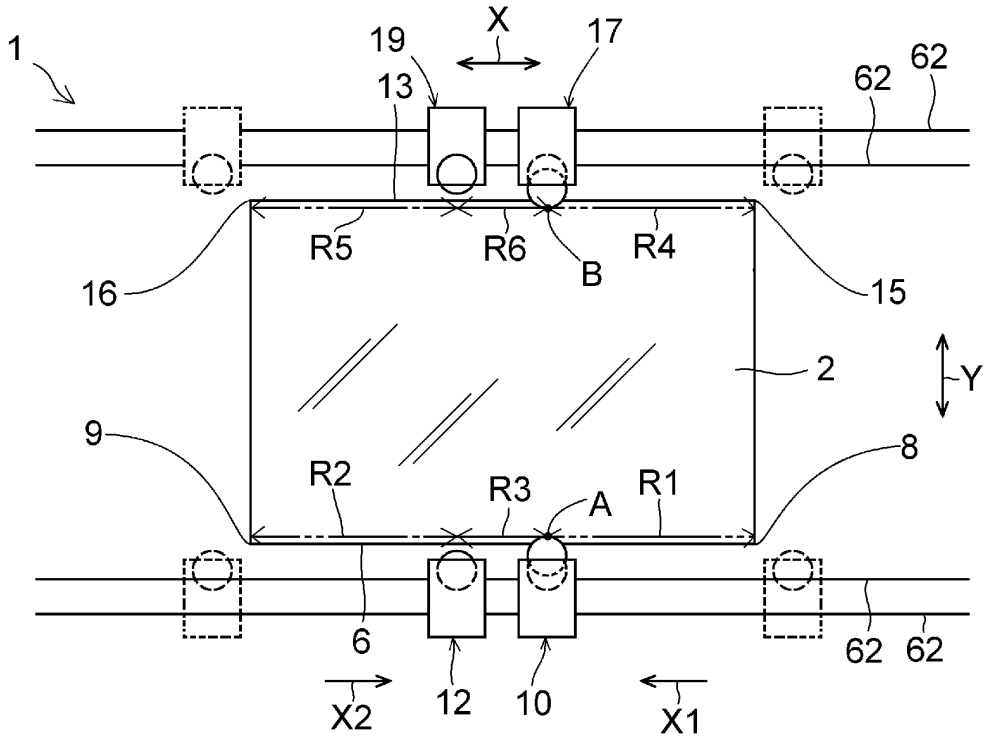

X
1
19
17
13
62
62
R5
R6
B
R4
16
15
2
Y
9
8
R2
R3
A
R1
6
62
62
12
10
X2
X1

FIG.9

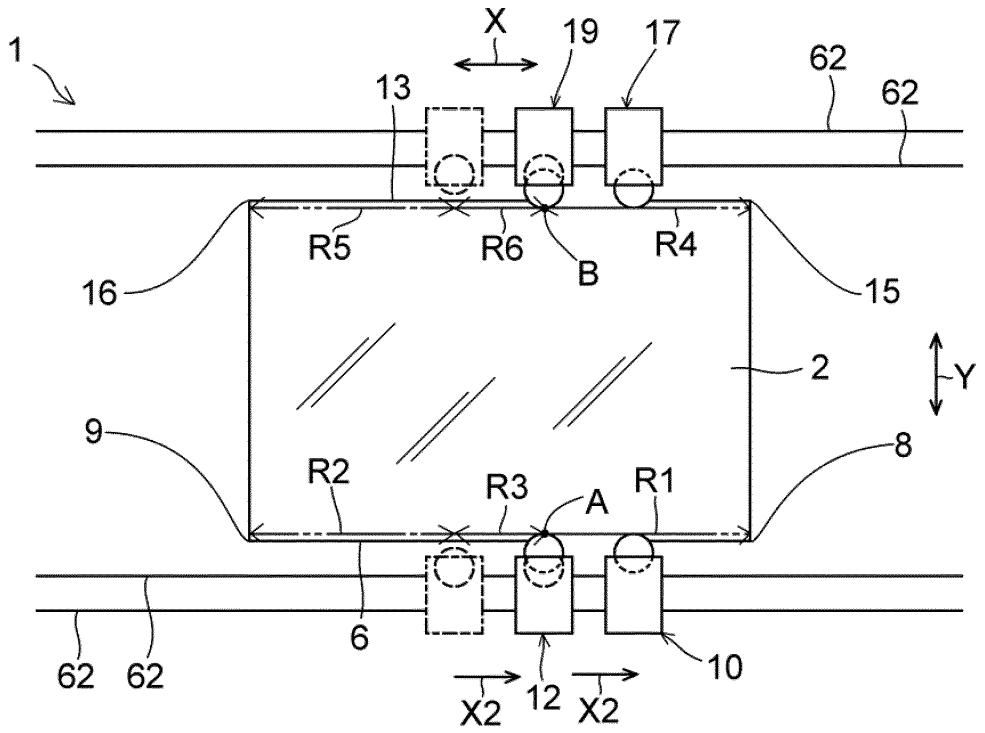
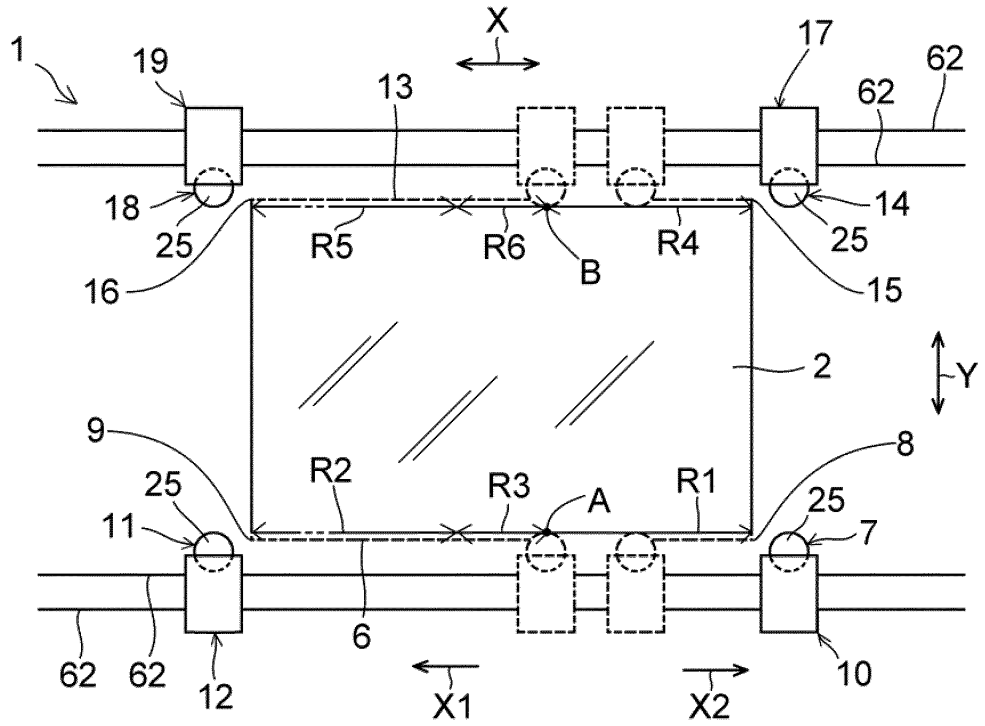

1
X
19
17
62
62
13
R5
R6
B
R4
16
15
2
Y
9
8
R2
R3
A
R1
6
62
62
10
X2
12
X2

FIG.10


1
X
19
17
62
62
13
18
25
R5
R6
B
R4
25
14
16
15
2
Y
9
8
25
R2
R3
A
R1
25
11
7
6
62
62
12
X1
X2
10

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2019/039416

A. CLASSIFICATION OF SUBJECT MATTER
Int. Cl. B24B9/10(2006.01)i, B24B41/053(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int. Cl. B24B1/00-1/04, B24B9/00-19/28, B24B41/053

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Published examined utility model applications of Japan 1922-1996
Published unexamined utility model applications of Japan 1971-2019
Registered utility model specifications of Japan 1996-2019
Published registered utility model applications of Japan 1994-2019

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	JP 2018-24072 A (ASAHI GLASS CO., LTD.) 15 February 2018, paragraphs [0042], [0043], [0049], [0057]-[0074], [0117], fig. 4-7 & CN 107363693 A & KR 10-2018-0018332 A	1-5 5
X Y	JP 2012-187642 A (ASAHI GLASS CO., LTD.) 04 October 2012, paragraphs [0039], [0043], [0044], fig. 1, 3 & CN 102672571 A & KR 10-2012-0102549 A	1-5 5
X Y	WO 2012/060158 A1 (ASAHI GLASS CO., LTD.) 10 May 2012, paragraphs [0023], [0028]-[0030], [0075], fig. 2, 7 & CN 103201072 A & KR 10-2013-0139961 A	1-4 5

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
10.12.2019	17.12.2019
Name and mailing address of the ISA/ Japan Patent Office 3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2019/039416

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	JP 11-123643 A (NOMURA MACHINE TOOL WORKS) 11 May 1999, paragraphs [0026], [0040], fig. 3, 22 (Family: none)	1-4 5
A	KR 10-1128516 B1 (KIM DONG WON) 02 April 2012, entire text, all drawings (Family: none)	1-5
A	JP 7-276205 A (BANDO KIKO CO.) 24 October 1995, entire text, all drawings (Family: none)	1-5

Form PCT/ISA/210 (continuation of second sheet) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 2013169622 A **[0003]**