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(54) **SUBSTRATE PROCESSING METHOD**

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(52) **U.S. Cl.**

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(57) **ABSTRACT**

A substrate processing method including: a disassembly process of disassembling a temporary batch lot by dividing substrates into a first set and a second set such that two substrates facing each other among substrates constituting the temporary batch lot form different sets and moving the first set and the second set relative to each other in a direction orthogonal to an arrangement direction of the substrates; a half-rotation process of orienting the substrates constituting the second set in a direction opposite to the one direction by half-rotating the second set; and a rearrangement process of combining the first set and the second set to generate a batch lot such that the substrates oriented in the one direction and the substrates oriented in the opposite direction are alternately arranged.

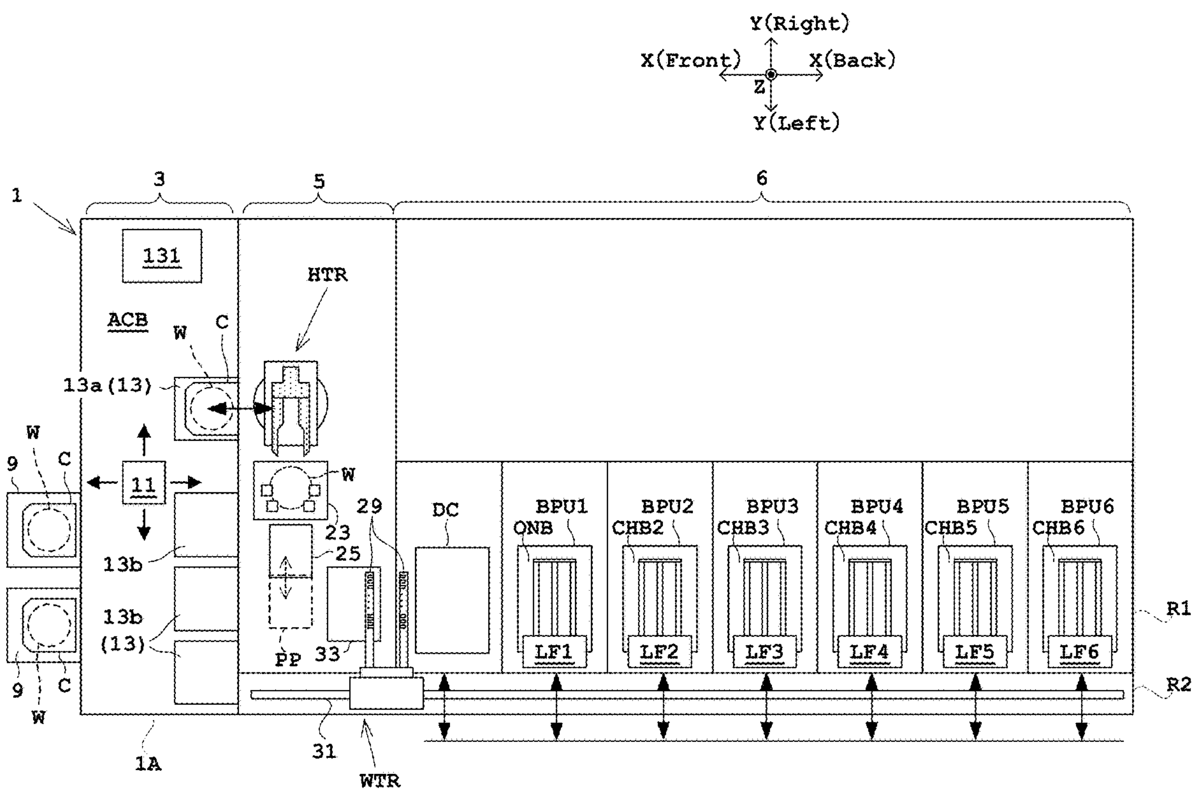
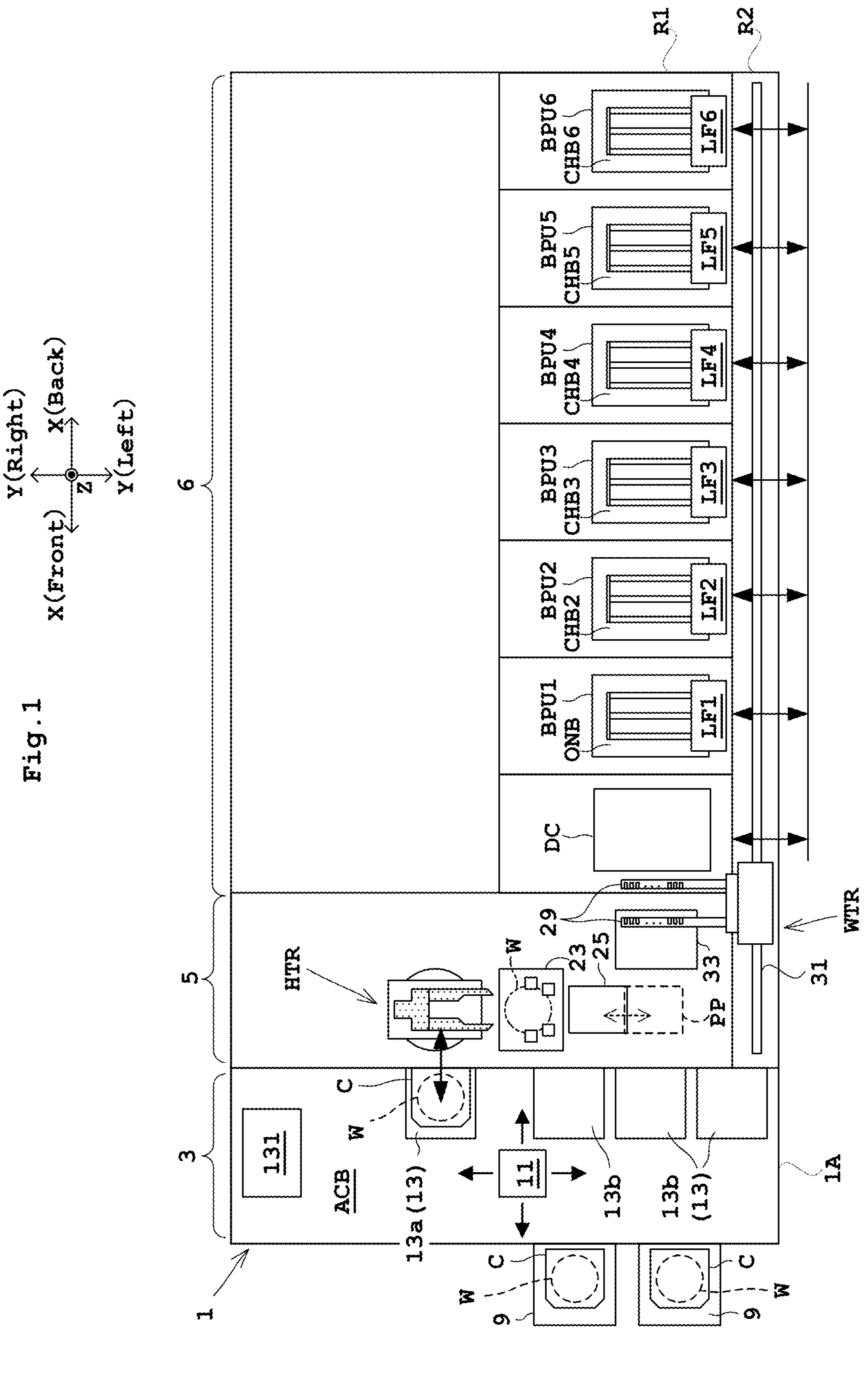


Fig.1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X(Front)
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R2
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LF5
BPU4
CHB4
LF4
BPU3
CHB3
LF3
BPU2
CHB2
LF2
BPU1
ONB
LF1
DC
HTR
W
23
25
29
33
PP
31
WTR
C
W
131
ACB
11
13a(13)
13b
13b
(13)
1A
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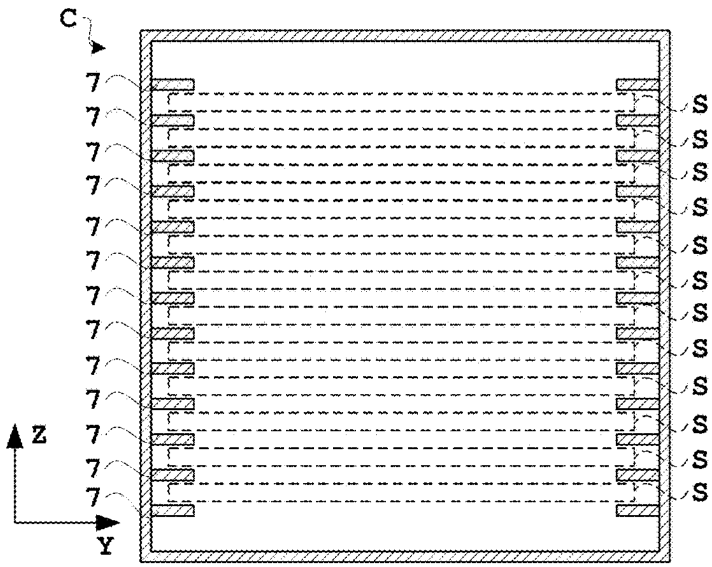
C
W
9
C
W
9

Fig.2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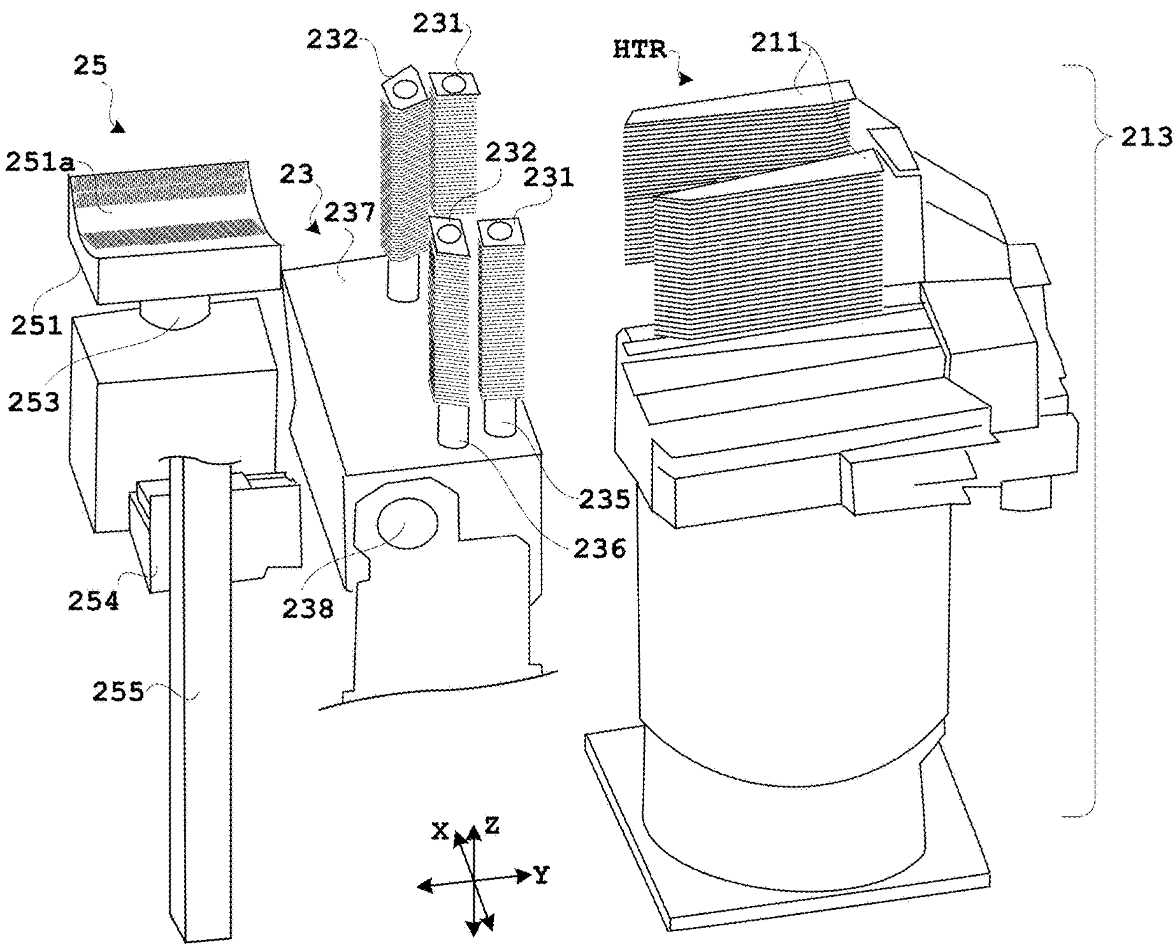
Z
Y

Fig.3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Y

Fig.4

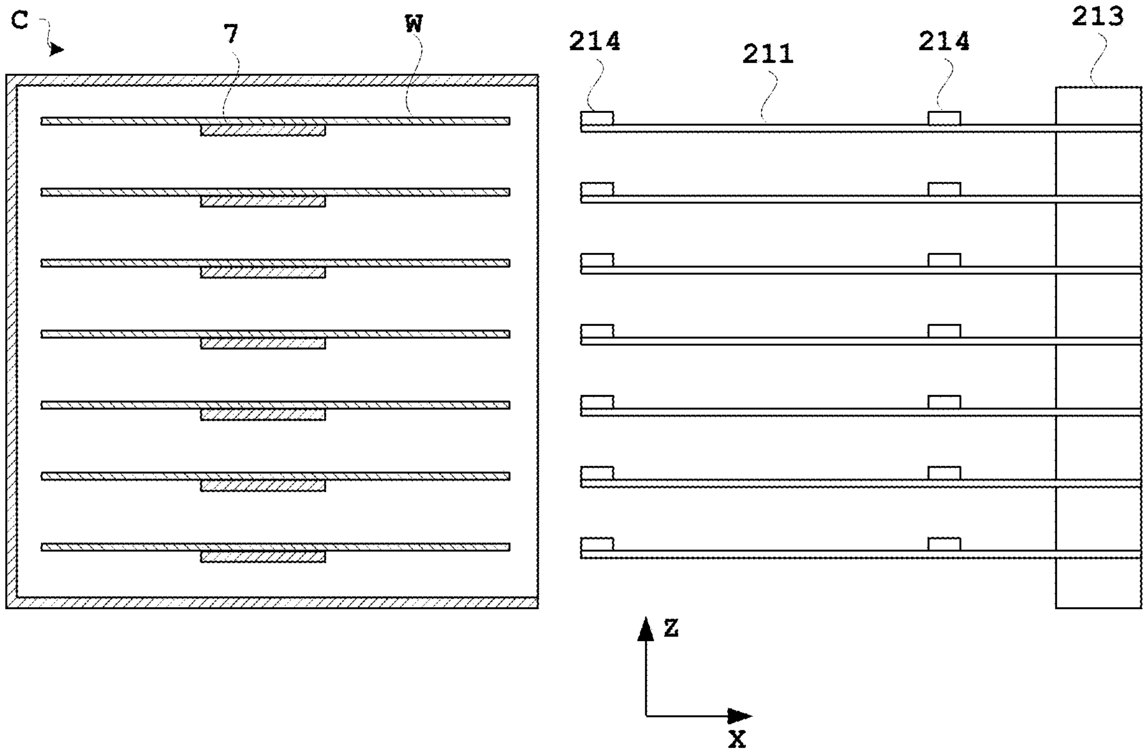
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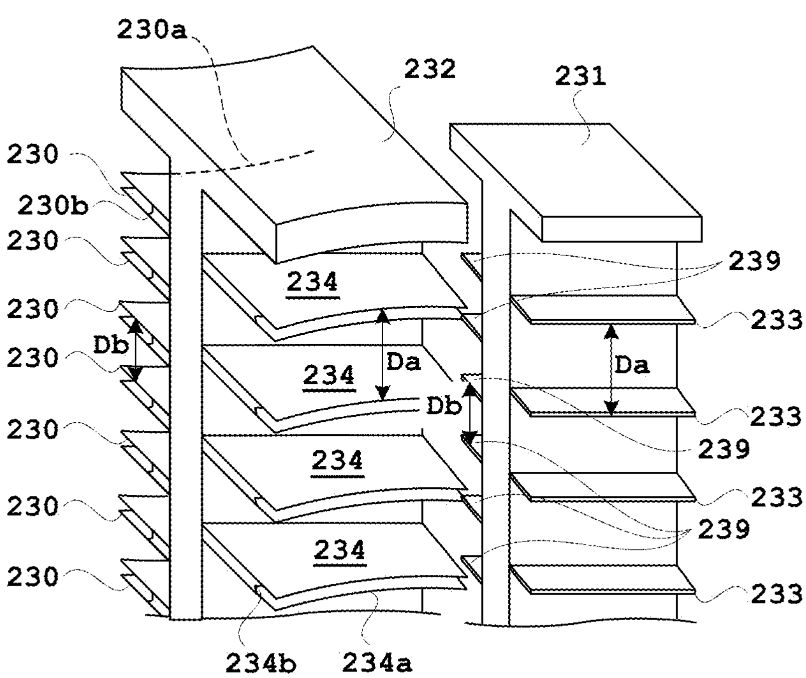
Fig.5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233
234b
234a

Fig. 6

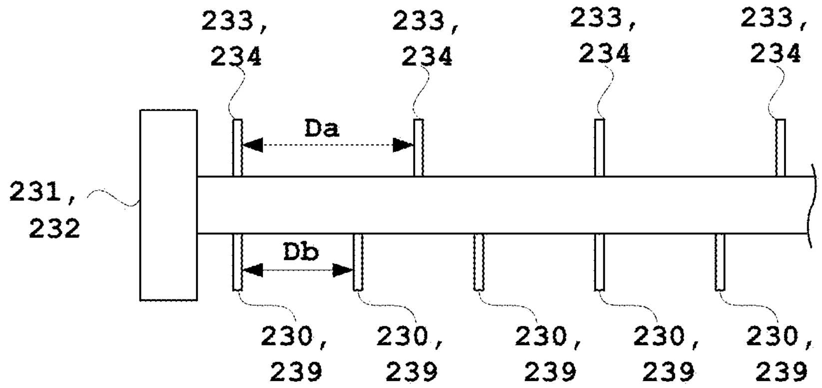


Fig. 7A

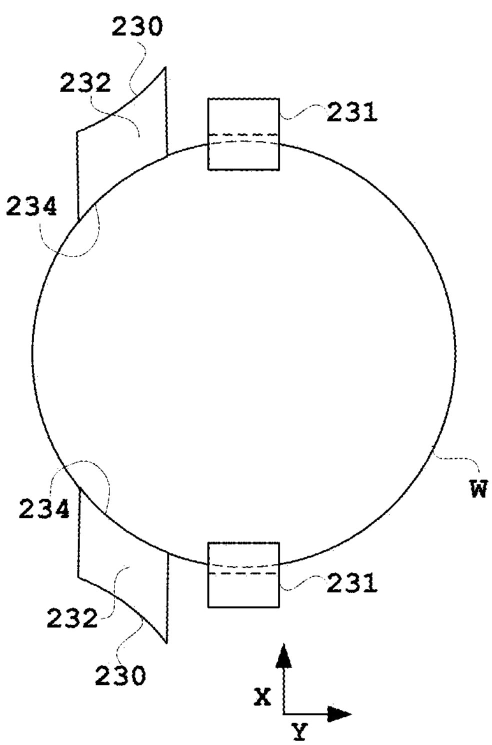


Fig. 7B

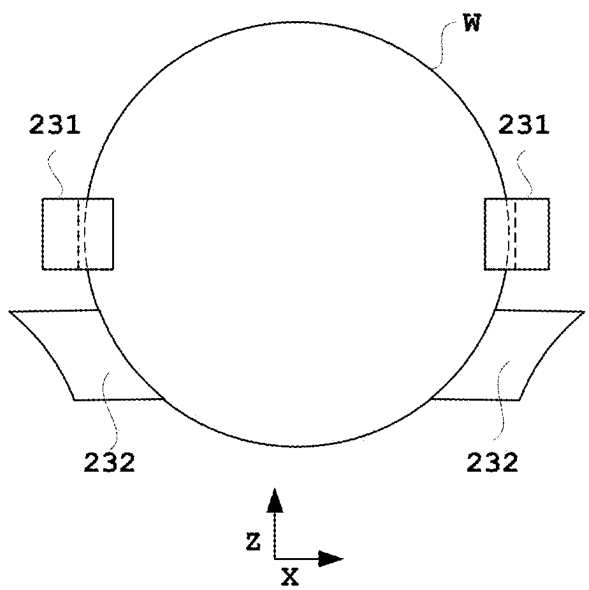


Fig. 8

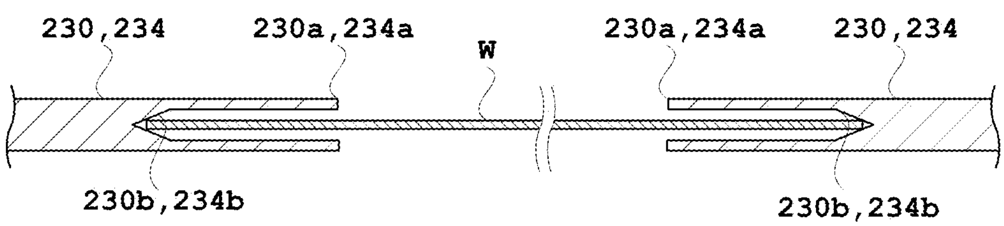


Fig.9

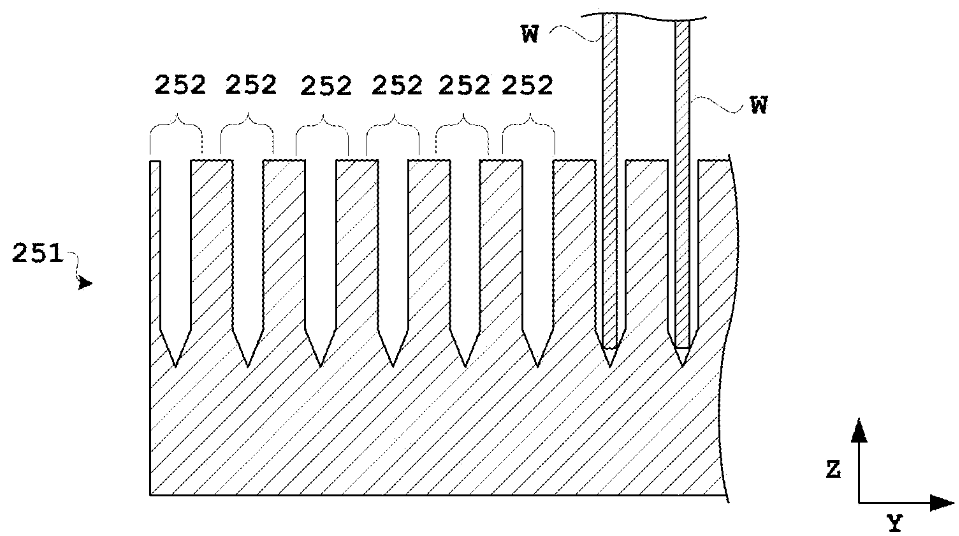


Fig.10

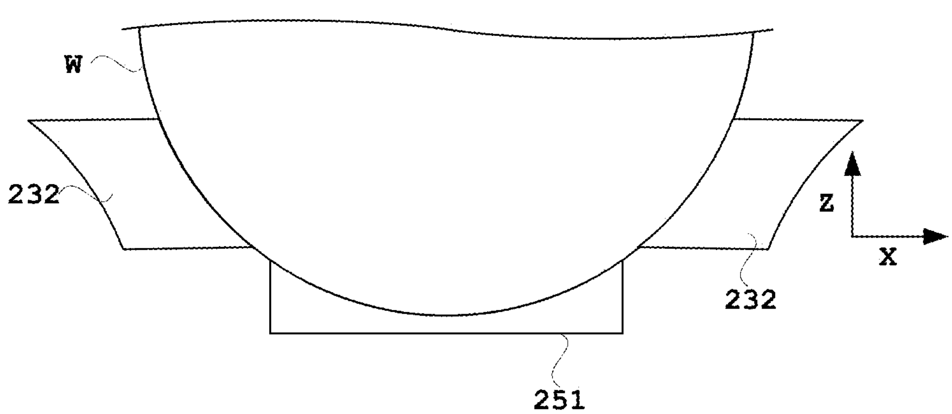


Fig.11A

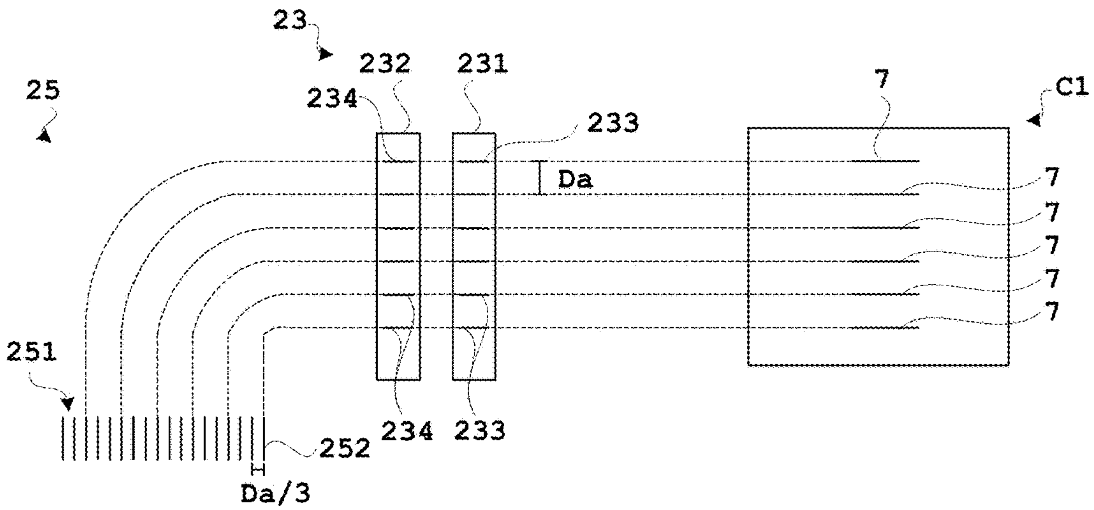


Fig.11B

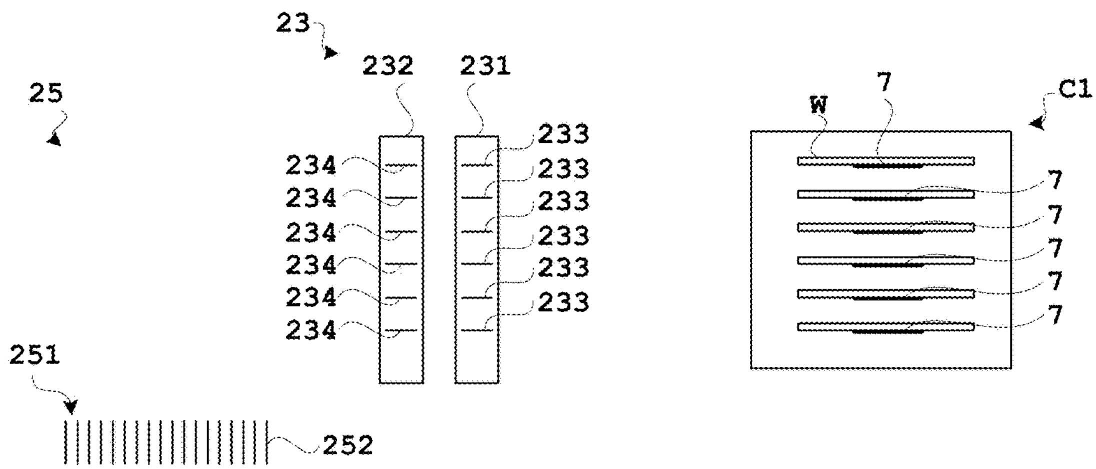


Fig.11C

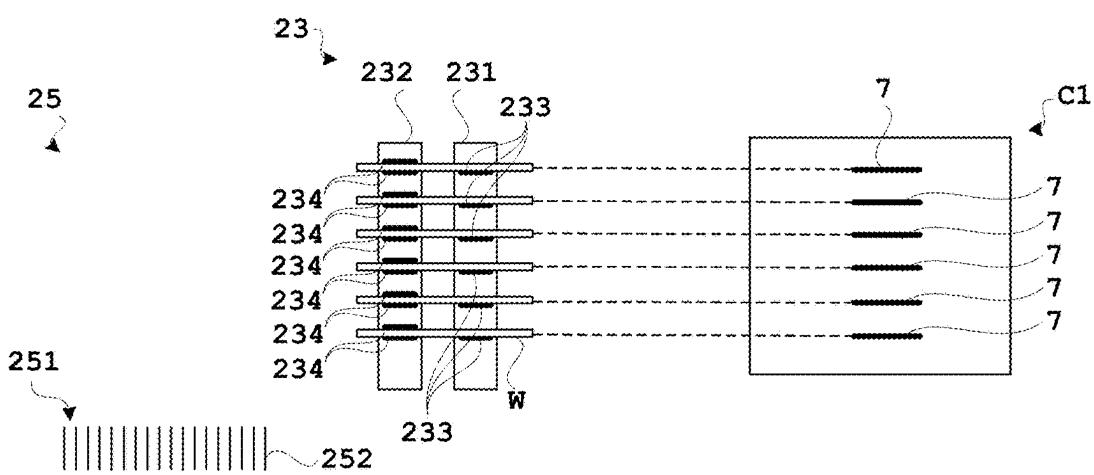


Fig.11D

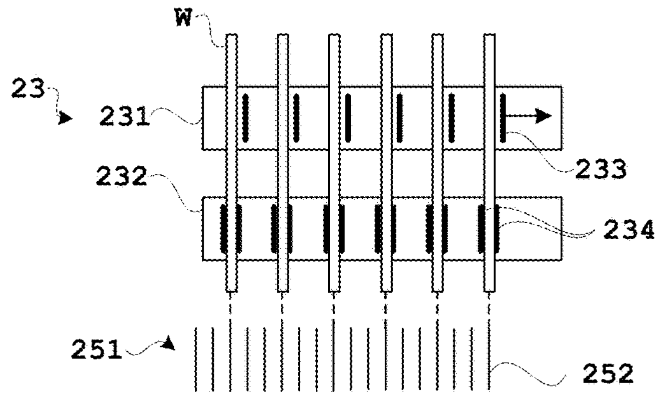


Fig.11E

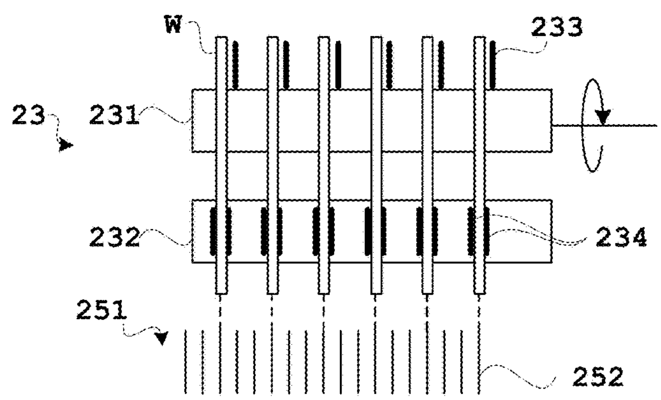


Fig.11F

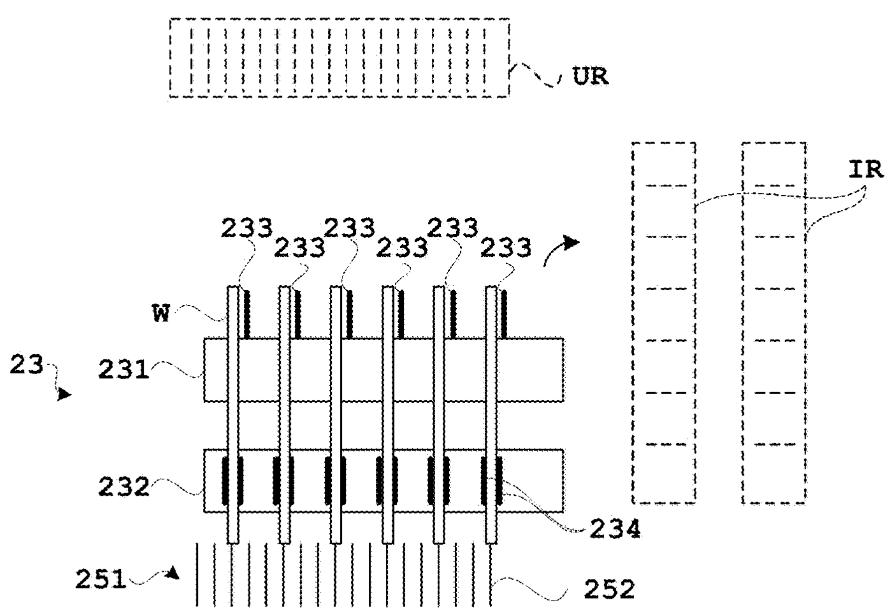


Fig.11G

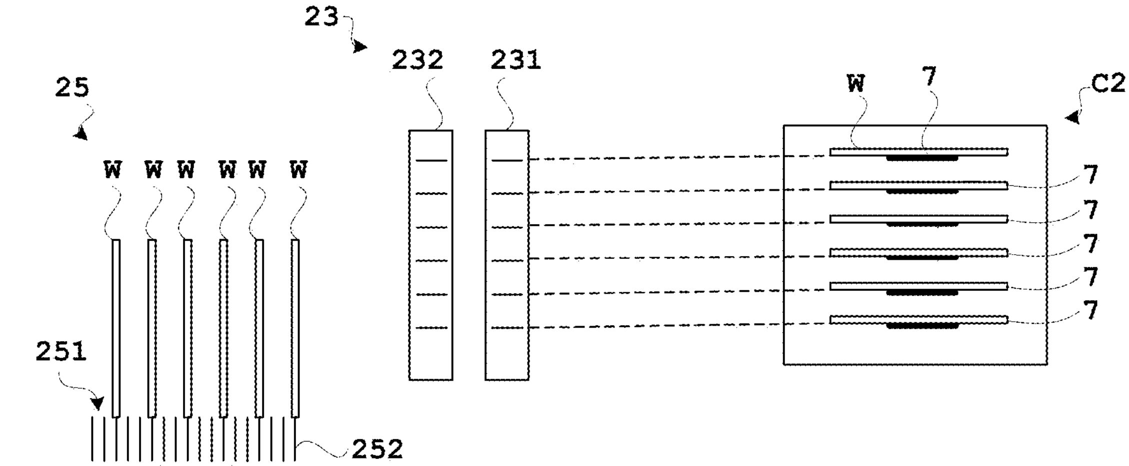


Fig.11H

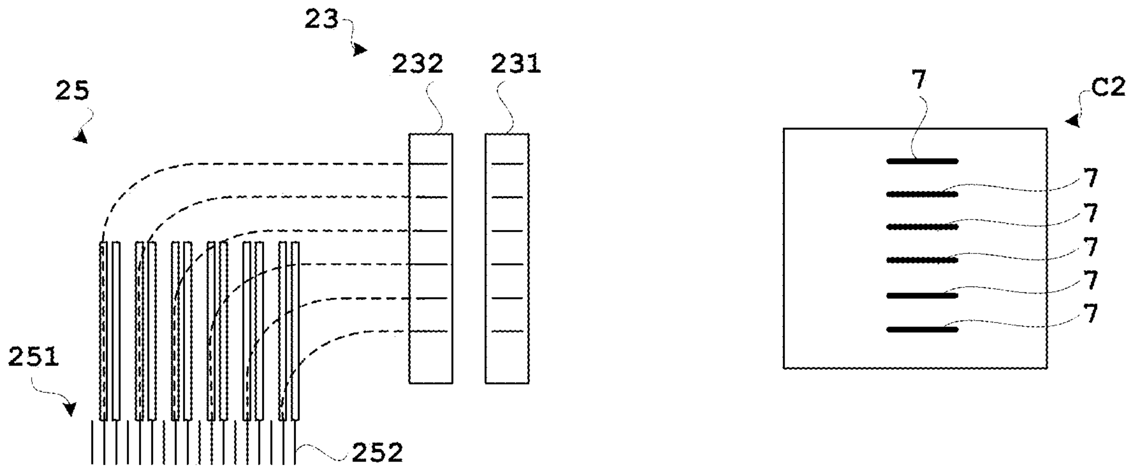


Fig.11I

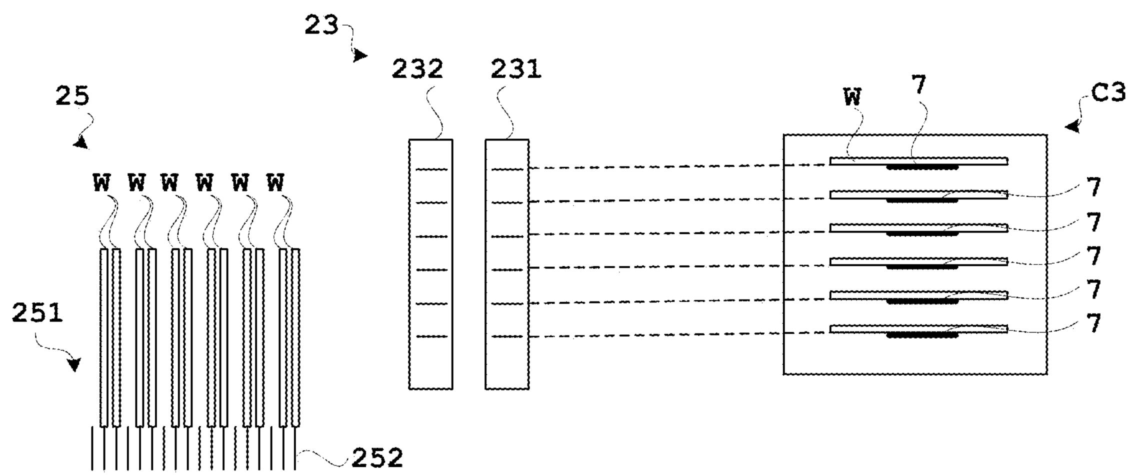


Fig.11J

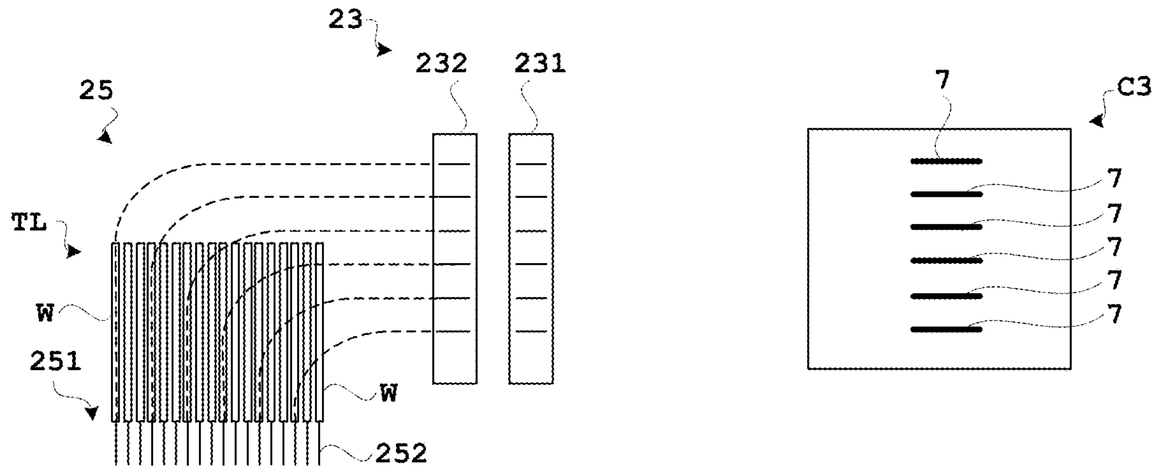


Fig.12

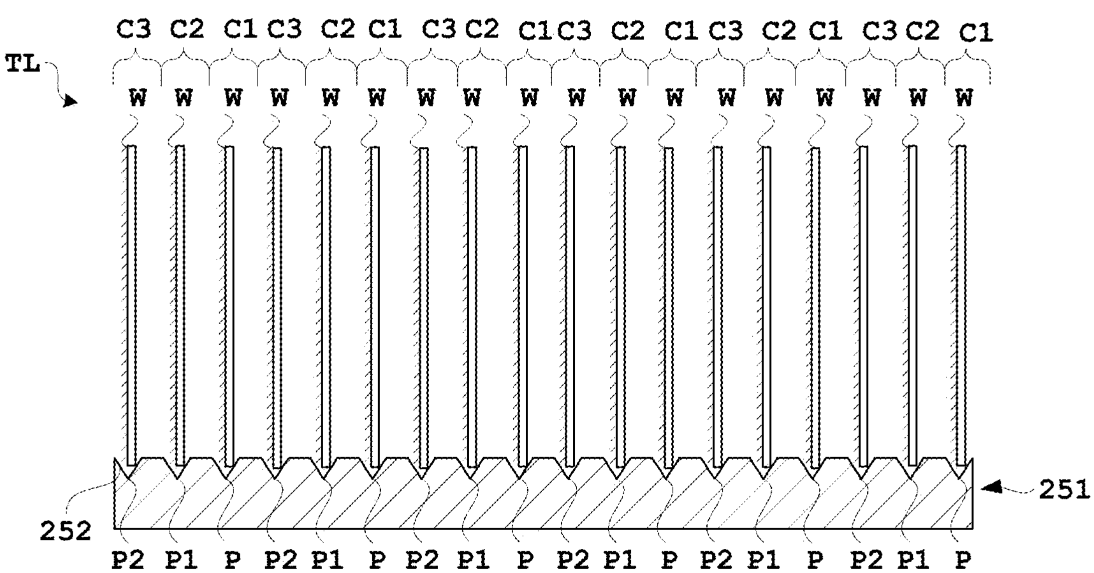


Fig.13

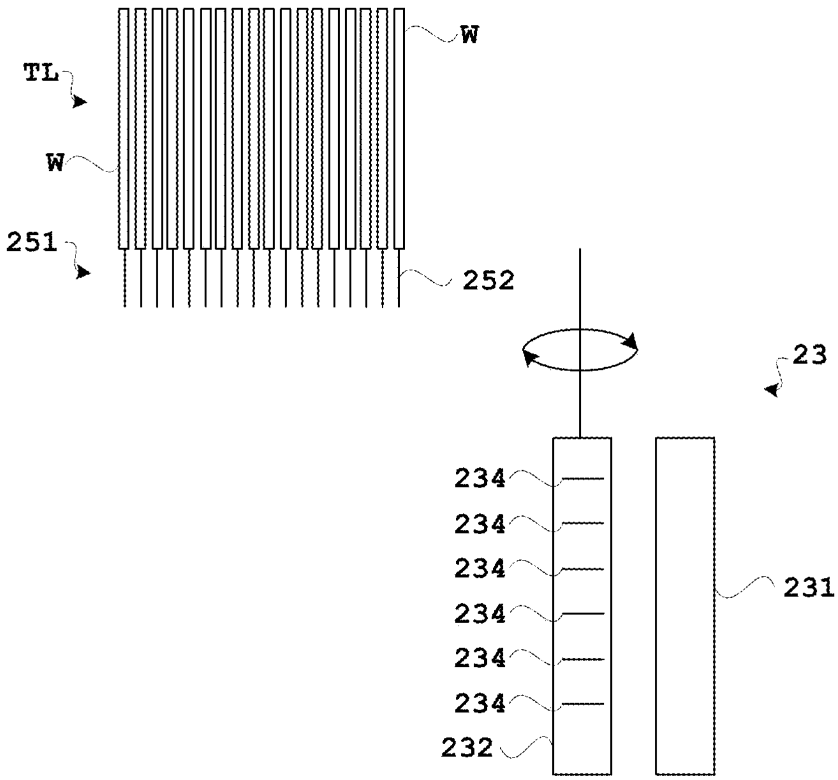


Fig.14A

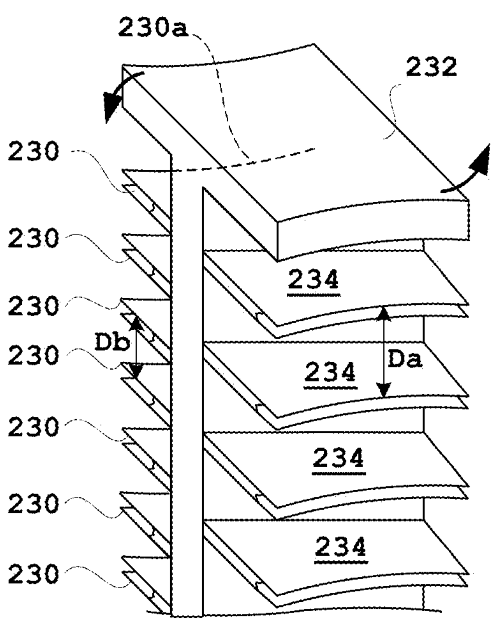


Fig.14B

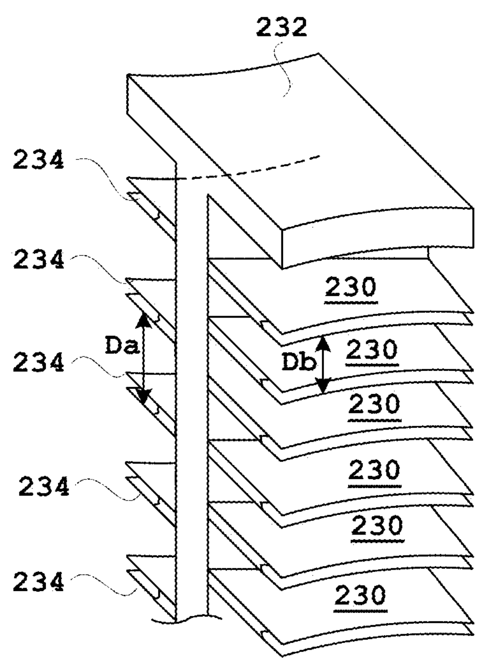


Fig.15

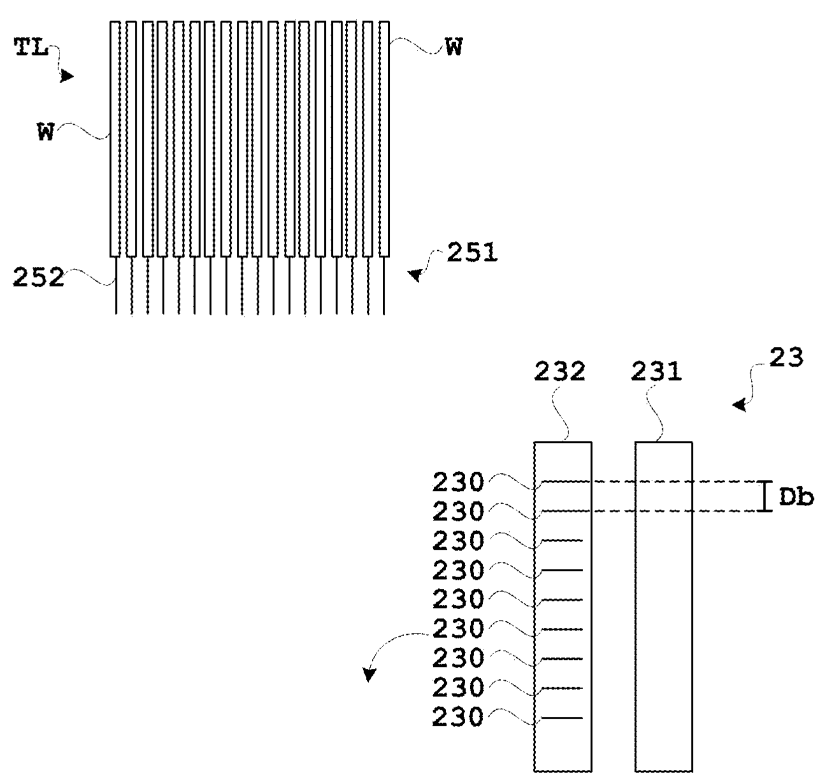


Fig.16A

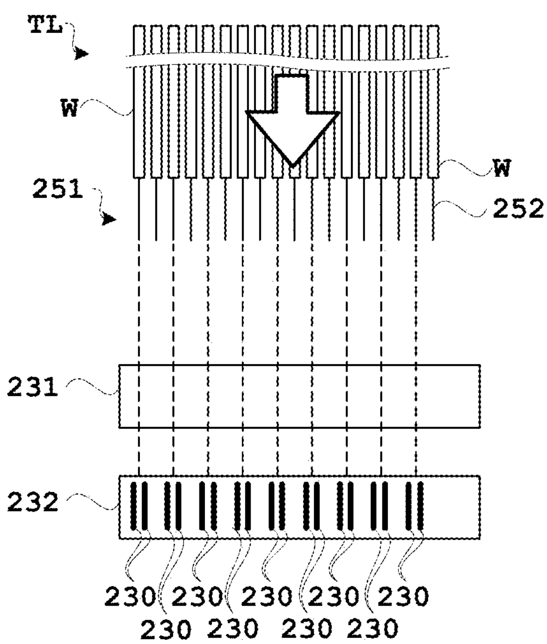


Fig.16B

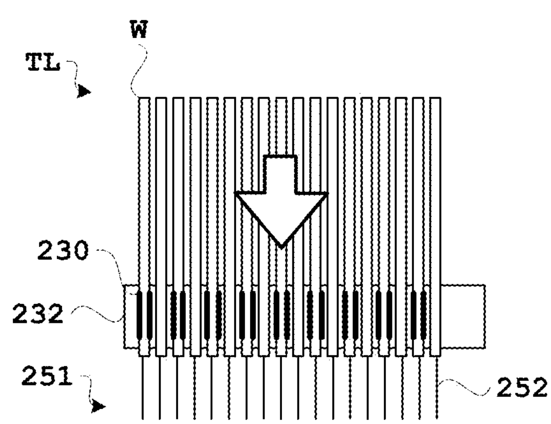


Fig.17A

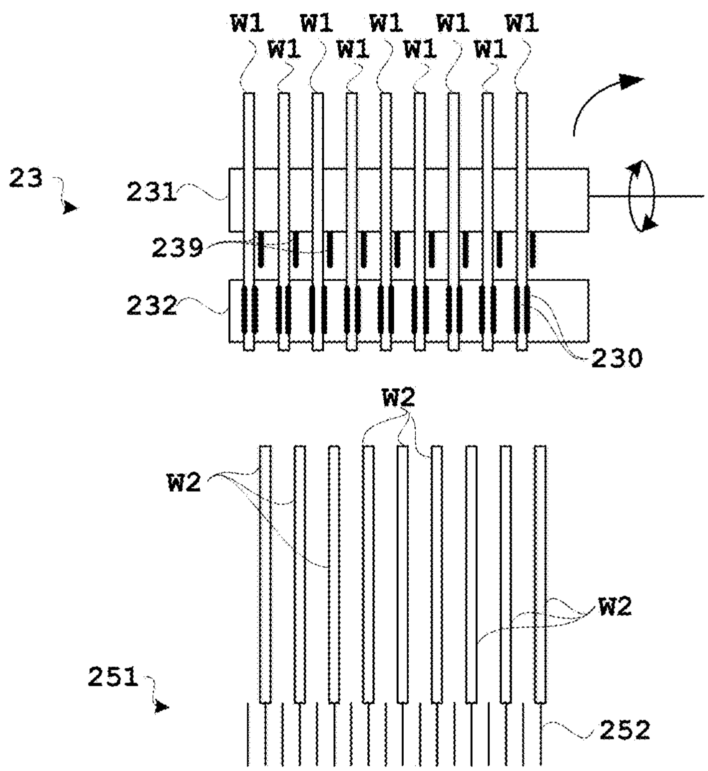


Fig.17B

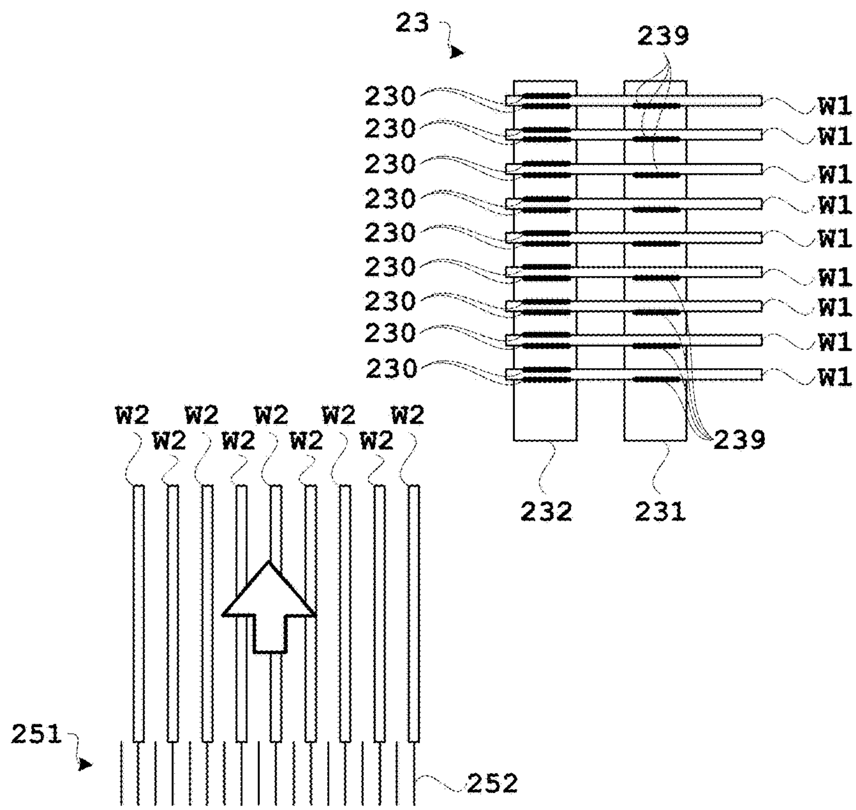


Fig.17C

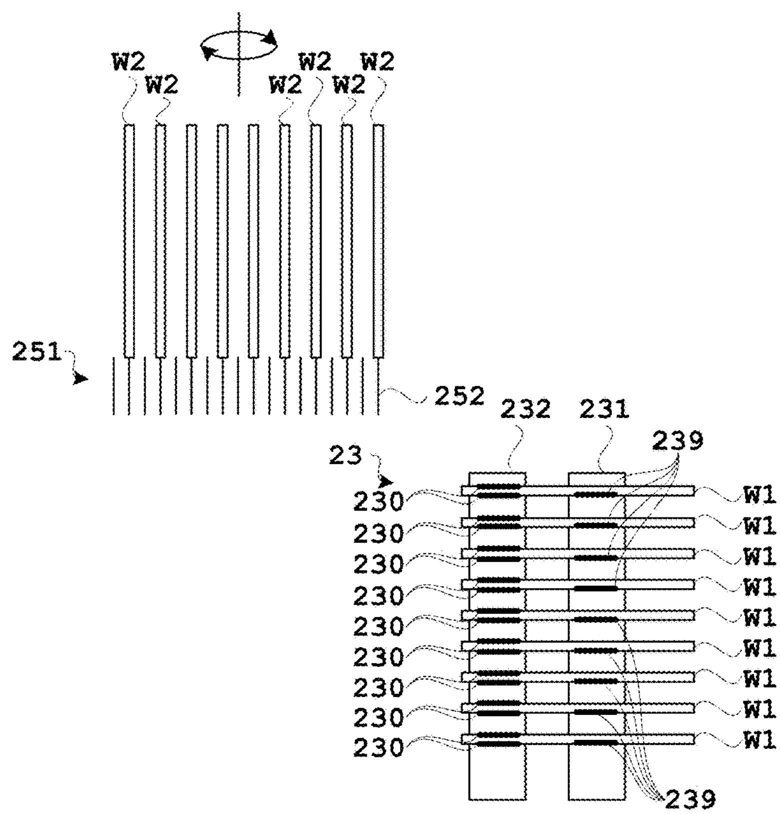


Fig.17D

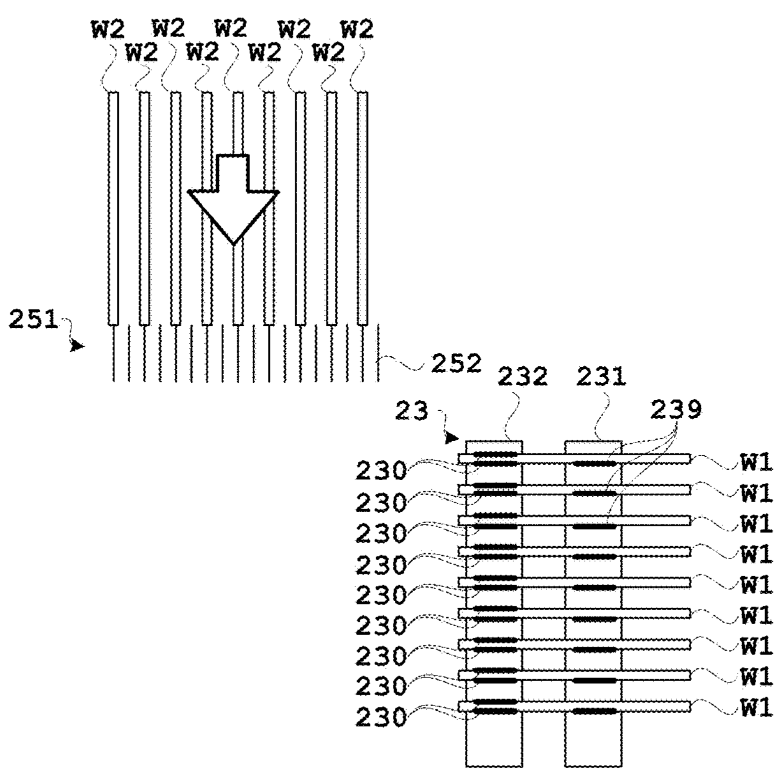


Fig.17E

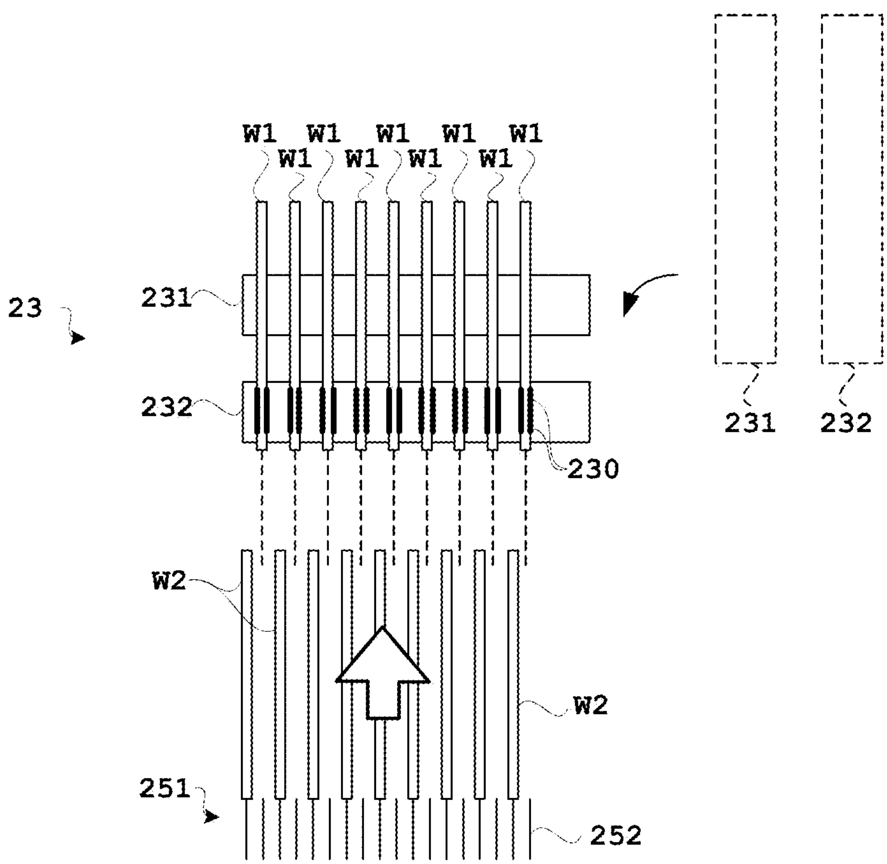


Fig.17F

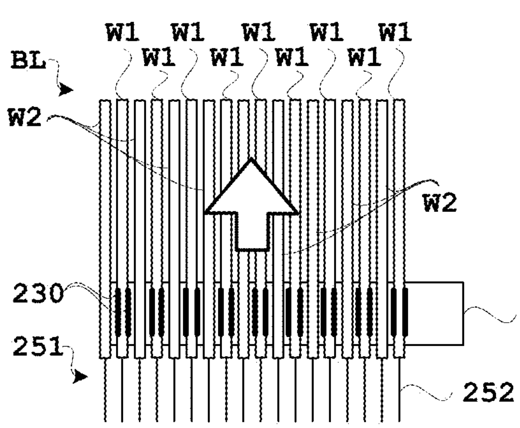


Fig.17G

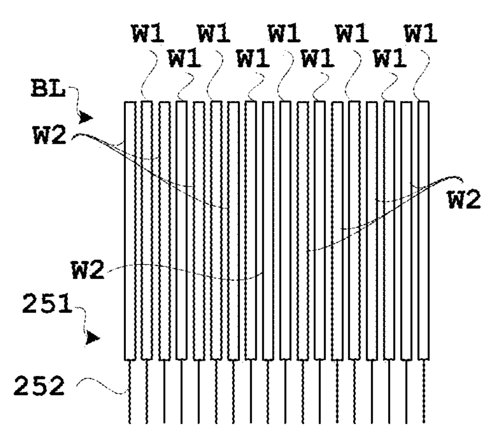


Fig.18

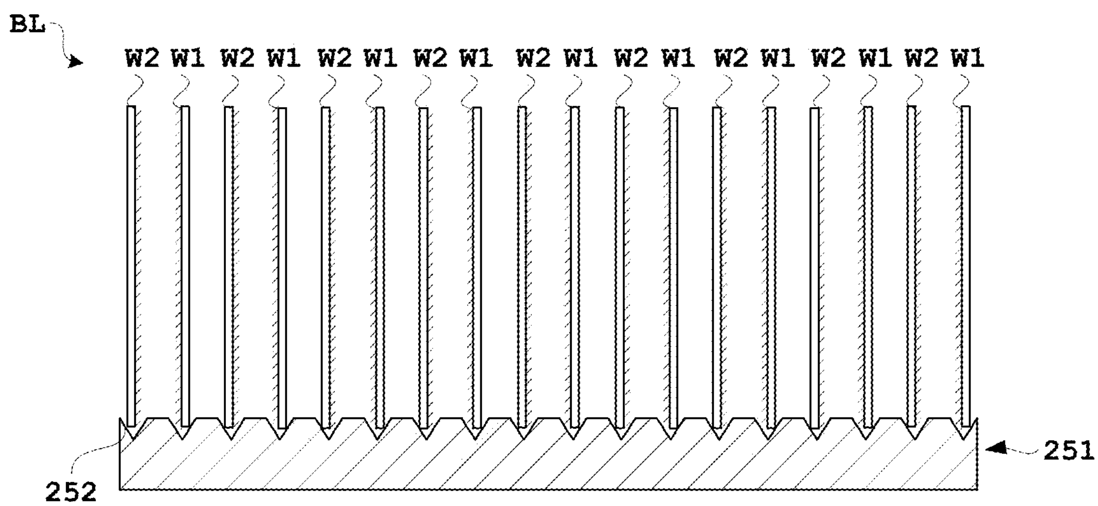
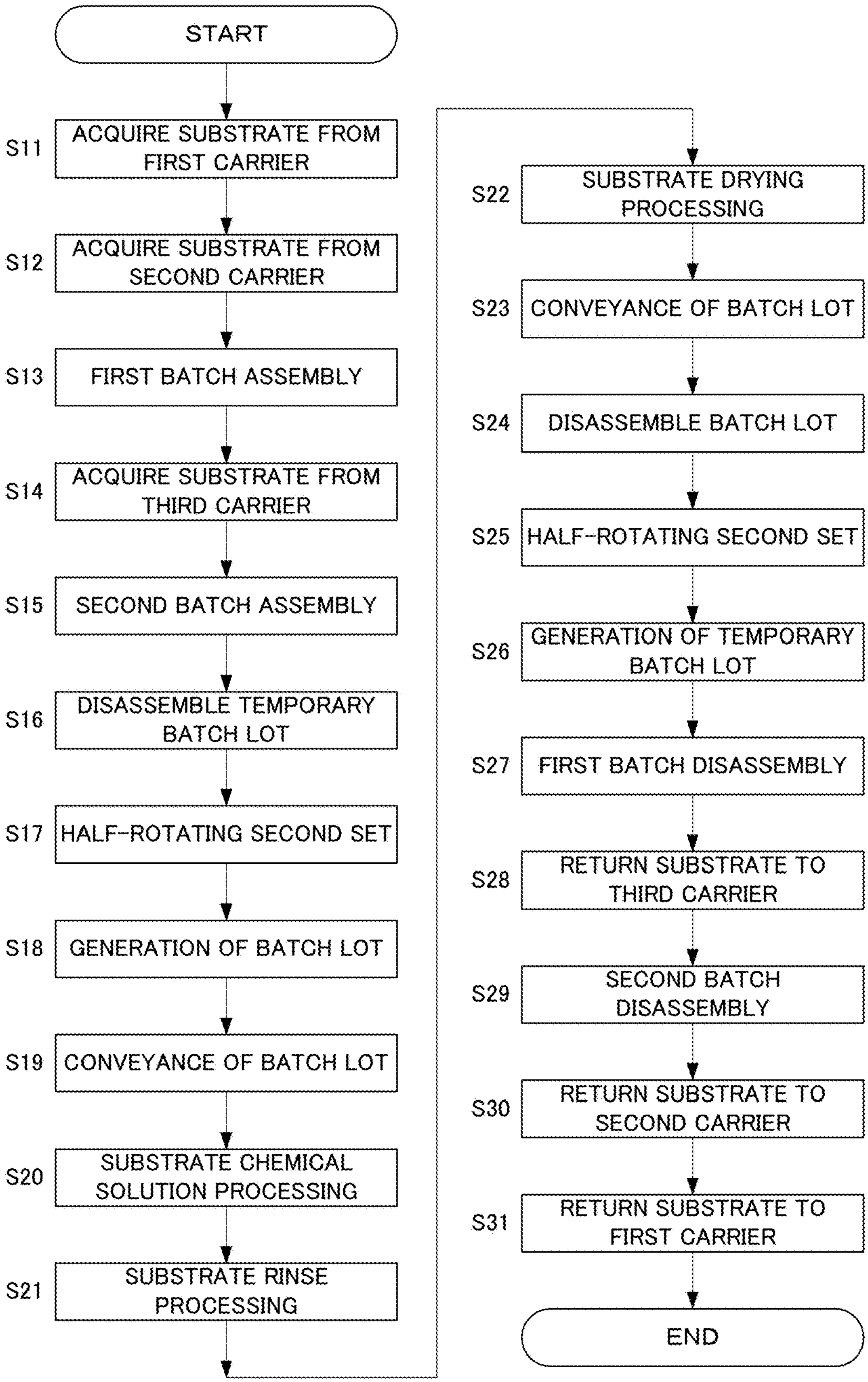


Fig.19


START
S11 ACQUIRE SUBSTRATE FROM FIRST CARRIER
S12 ACQUIRE SUBSTRATE FROM SECOND CARRIER
S13 FIRST BATCH ASSEMBLY
S14 ACQUIRE SUBSTRATE FROM THIRD CARRIER
S15 SECOND BATCH ASSEMBLY
S16 DISASSEMBLE TEMPORARY BATCH LOT
S17 HALF-ROTATING SECOND SET
S18 GENERATION OF BATCH LOT
S19 CONVEYANCE OF BATCH LOT
S20 SUBSTRATE CHEMICAL SOLUTION PROCESSING
S21 SUBSTRATE RINSE PROCESSING
S22 SUBSTRATE DRYING PROCESSING
S23 CONVEYANCE OF BATCH LOT
S24 DISASSEMBLE BATCH LOT
S25 HALF-ROTATING SECOND SET
S26 GENERATION OF TEMPORARY BATCH LOT
S27 FIRST BATCH DISASSEMBLY
S28 RETURN SUBSTRATE TO THIRD CARRIER
S29 SECOND BATCH DISASSEMBLY
S30 RETURN SUBSTRATE TO SECOND CARRIER
S31 RETURN SUBSTRATE TO FIRST CARRIER
END

SUBSTRATE PROCESSING METHOD

[0001] This application claims priority to Japanese Patent Application No. 2024-18108 filed Feb. 8, 2024, the subject matter of which is incorporated herein by reference in entirety.

BACKGROUND OF THE INVENTION

[0002] The present invention relates to a substrate processing method for a semiconductor substrate, a substrate for a flat panel display (FPD) such as a liquid crystal display or an organic electroluminescence (EL) display device, a glass substrate for a photomask, a substrate for an optical disk, and the like.

DESCRIPTION OF THE RELATED ART

[0003] JP H5-175179 A describes a substrate processing apparatus that takes out the same number of substrates from each of two carriers, forms a first substrate group and a second substrate group, inserts the second substrate group into a gap between the respective substrates of the first substrate group to convert the pitch to ½, forms a substrate group of twice the number of substrates, and collectively processes the substrates.

List of Documents

JP H5-175179 A

[0004] In recent years, there has been a demand for further improvement in efficiency of a substrate processing apparatus. In order to increase the number of substrates to be processed at one time by batch processing, it is necessary to further narrow the arrangement pitch of the substrates. A problem in this case is the orientation of the substrates. That is, for batch processing, it is more suitable from the viewpoint of preventing contamination of the device surface to form a batch lot by arranging substrates by a face-to-face method. In order to arrange the substrates by the face-to-face method with the device surfaces of the substrates facing each other, there is no choice but to combine the substrate arrangement acquired from a first carrier with the substrate arrangement acquired from a second carrier and rotated halfway. Therefore, according to the conventional configuration, although the arrangement pitch of the substrates can be halved, the arrangement pitch of the substrates cannot be further narrowed. When the substrates acquired from the second carrier are inserted into the gap of the substrate arrangement acquired from the first carrier to generate a batch lot, the arrangement pitch of the substrates in the batch lot is naturally determined to be half the original pitch.

[0005] The present invention has been made in view of such circumstances, and an object of the present invention is to provide a substrate processing method for efficiently performing substrate processing by narrowing an arrangement pitch of substrates.

SUMMARY OF THE INVENTION

[0006] In order to solve the above problems, the present invention has the following configurations.

[0007] In order to solve the above-described problem, the present invention has the following configuration.

[0008] That is, the present invention provides a substrate processing method for collectively processing a plurality of substrates having directions defined by a front surface and a back surface, the substrate processing method comprising:

- [0009] a substrate group acquisition process of acquiring a substrate group in which substrates oriented in one direction are arranged at a predetermined interval;
- [0010] a first assembly process of positioning a first substrate at a first position among the first position and a second position that divide the predetermined interval in the substrate group into three by combining a first arrangement in which the first substrate oriented in the one direction is arranged at the predetermined interval with the substrate group;
- [0011] a second assembly process of forming a temporary batch lot by positioning a second substrate at the second position by combining a second arrangement in which the second substrate oriented in the one direction is arranged at the predetermined interval with the substrate group;
- [0012] a disassembly process of disassembling the temporary batch lot by dividing the substrates into a first set and a second set such that two substrates facing each other among substrates constituting the temporary batch lot form different sets, and moving the first set and the second set relative to each other in a direction orthogonal to an arrangement direction of the substrates;
- [0013] a half-rotation process of orienting the substrates constituting the second set in a direction opposite to the one direction by half-rotating the second set;
- [0014] a rearrangement process of combining the first set and the second set to generate a batch lot such that the substrates oriented in the one direction and the substrates oriented in the opposite direction are alternately arranged; and
- [0015] a processing process of immersing the batch lot in a processing liquid.

Operation and Effect

[0016] According to the above-described configuration, the temporary batch lot in which the substrates are oriented in the same direction is formed. Then, the substrates are divided into a first set and a second set such that two substrates facing each other among the substrates constituting the temporary batch lot form different sets, and the second set is half-rotated. Then, by combining the first set and the second set, the substrates oriented in one direction and the substrates oriented in the opposite direction are alternately arranged to generate a batch lot. With this configuration, the substrates can be arranged face-to-face while the arrangement pitch of the substrates is narrower than that in the conventional method.

[0017] Further, it is preferable in the above-described configuration that in the disassembly process, the temporary batch lot is disassembled such that the substrates positioned at one end of the temporary batch lot and the substrates positioned at the other end of the temporary batch lot are divided into different sets.

Operation and Effect

[0018] According to the above-described configuration, in the disassembly process, the batch lot is disassembled such that the substrates positioned at one end of the temporary batch lot and the substrates positioned at the other end of the temporary batch lot are divided into different sets. With such a configuration, the orientation of the substrate constituting the batch lot can be made desired. That is, according to the above-described configuration, since the orientation of the substrates at one end and the orientation of the substrates at the other end in the batch lot can be made different, the arrangement of the substrates can be made face-to-face more reliably.

[0019] It is preferable in the above-described configuration that the number of substrates constituting the batch lot is three times the number of the substrate group in the substrate group acquisition process.

Operation and Effect

[0020] According to the above-described configuration, the number of substrates constituting the batch lot is three times the number of the substrate group in the substrate group acquisition process. With this configuration, no extra substrate is generated in the substrate group when the batch lot is formed. Since the substrate group is not divided into two batch lots, it is possible to reliably match the history of substrate processing in the substrates constituting the substrate group.

[0021] Furthermore, it is preferable in the above-described configuration that, a first process of collectively acquiring each substrate from a carrier that houses substrates that are in a horizontal posture and arranged at a predetermined interval in a vertical direction, and

- **[0022]** a second process of collectively converting the posture of each substrate from a horizontal posture to a vertical posture are provided, and
- **[0023]** the first process and the second process are performed before each assembly process.

Operation and Effect

[0024] According to the above-described configuration, a first process of collectively acquiring each substrate from a carrier that houses substrates that are in a horizontal posture and arranged at a predetermined interval in a vertical direction, and a second process of collectively converting the posture of each substrate from a horizontal posture to a vertical posture are provided, and the first process and the second process are performed before each assembly process. With this configuration, it is possible to provide a substrate processing method executed by receiving the first set of substrates or the second set of substrates arranged in one direction from the carrier.

[0025] Furthermore, it is preferable in the above-described configuration that, the predetermined interval is equal to the arrangement pitch of the substrates housed in the carrier.

Operation and Effect

[0026] According to the above-described configuration, the predetermined interval is equal to the arrangement pitch of the substrates housed in the carrier. With this configuration, it is easy to change the pitch of the substrate.

[0027] Furthermore, it is preferable in the above-described configuration that, the distance from the first position to the second position is ⅓ times the arrangement pitch of the substrates housed in the carrier.

Operation and Effect

[0028] According to the above-described configuration, the distance from the first position to the second position is ⅓ of the arrangement pitch of the substrates housed in the carrier. With this configuration, the pitch of the substrate arrangement to be generated can be ½ or less of the arrangement pitch of the substrates housed in the carrier.

[0029] Furthermore, it is preferable in the above-described configuration that, the first position and the second position are obtained by equally dividing the predetermined interval into three.

Operation and Effect

[0030] According to the above-described configuration, the first position and the second position equally divide the predetermined interval into three. With this configuration, the substrates can be arranged more orderly.

[0031] According to the present invention, it is possible to provide a substrate processing method of narrowing the arrangement pitch of substrates and efficiently performing substrate processing.

BRIEF OF DESCRIPTION OF THE DRAWINGS

[0032] FIG. **1** is a plan view for explaining an overall configuration of a substrate processing apparatus according to an embodiment;

[0033] FIG. **2** is a schematic diagram illustrating a configuration of a carrier according to the embodiment;

[0034] FIG. **3** is a perspective view for explaining each unit constituting a transfer block according to the embodiment;

[0035] FIG. **4** is a comparative view of a configuration of a carrier and a configuration of a handling robot according to the embodiment;

[0036] FIG. **5** is a perspective view illustrating a configuration of an HVC posture converter according to the embodiment;

[0037] FIG. **6** is a schematic view illustrating configurations of a placing rod and a clamping rod according to an embodiment;

[0038] FIG. **7**A is a plan view for explaining the configuration of each rod according to the embodiment;

[0039] FIG. **7**B is a plan view for explaining the configuration of each rod according to the embodiment;

[0040] FIG. **8** is a cross-sectional view for explaining a groove included in a clamping rod according to the embodiment;

[0041] FIG. **9** is a schematic diagram illustrating a pusher according to the embodiment;

[0042] FIG. **10** is a schematic diagram illustrating a pusher according to the embodiment;

[0043] FIG. **11**A is a schematic diagram illustrating a batch assembly according to the embodiment;

[0044] FIG. **11**B is a schematic diagram illustrating a batch assembly according to the embodiment;

[0045] FIG. **11**C is a schematic diagram illustrating a batch assembly according to the embodiment;

[0046] FIG. **11**D is a schematic diagram illustrating a batch assembly according to the embodiment;

[0047] FIG. **11**E is a schematic diagram illustrating a batch assembly according to the embodiment;

[0048] FIG. **11**F is a schematic diagram illustrating a batch assembly according to the embodiment;

[0049] FIG. **11**G is a schematic diagram illustrating a batch assembly according to the embodiment;

[0050] FIG. **11**H is a schematic diagram illustrating a batch assembly according to the embodiment;

[0051] FIG. **11**I is a schematic diagram illustrating a batch assembly according to the embodiment;

[0052] FIG. **11**J is a schematic diagram illustrating a batch assembly according to the embodiment;

[0053] FIG. **12** is a schematic diagram illustrating a batch assembly according to the embodiment;

[0054] FIG. **13** is a schematic diagram illustrating a batch assembly according to the embodiment;

[0055] FIG. **14**A is a schematic diagram illustrating a batch assembly according to the embodiment;

[0056] FIG. **14**B is a schematic diagram illustrating a batch assembly according to the embodiment;

[0057] FIG. **15** is a schematic diagram illustrating a batch assembly according to the embodiment;

[0058] FIGS. **16**A to **16**B are schematic diagrams each illustrating a batch assembly according to the embodiment;

[0059] FIG. **17**A is a schematic diagram illustrating a batch assembly according to the embodiment;

[0060] FIG. **17**B is a schematic diagram illustrating a batch assembly according to the embodiment;

[0061] FIG. **17**C is a schematic diagram illustrating a batch assembly according to the embodiment;

[0062] FIG. **17**D is a schematic diagram illustrating a batch assembly according to the embodiment;

[0063] FIG. **17**E is a schematic diagram illustrating a batch assembly according to the embodiment;

[0064] FIG. **17**F is a schematic diagrams each illustrating a batch assembly according to the embodiment;

[0065] FIG. **17**G is a schematic diagrams each illustrating a batch assembly according to the embodiment;

[0066] FIG. **18** is a schematic diagram illustrating a batch assembly according to the embodiment; and

[0067] FIG. **19** is a flowchart illustrating a flow of a substrate according to the embodiment.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0068] Hereinafter, embodiments of the present invention will be described with reference to the drawings. The substrate processing apparatus of the embodiment takes in substrates arranged at a pitch of 10 mm, and converts the arrangement pitch of the substrates to 10/3 mm to form a batch lot. The formed batch lot is subjected to various substrate processing such as chemical solution processing. When the substrate processing is performed by narrowing the arrangement pitch of the substrates in this manner, a required amount of chemical solution is reduced, so that it is possible to reduce the running cost and perform the substrate processing in consideration of the environment.

[0069] The present invention relates to a substrate processing method for collectively processing a plurality of substrates having directions defined by a front surface and a back surface. The front surface of the substrate is a device surface to be subjected to film formation processing and exposure processing. The back surface is a surface opposite to the device surface. When the substrate is held in a horizontal posture, the front surface of the substrate faces upward. Embodiment

1. Overall Configuration

[0070] The substrate processing apparatus **1** according to the present invention is configured to perform batch processing, and includes a housing **1**A that houses each block constituting the substrate processing apparatus **1**. The housing **1**A has a load port **9** protruding from a first wall surface orthogonal to the Y direction from a processing block **6** toward a transfer block **5**. In the load port **9**, a carrier C that houses a substrate arrangement in which substrates W in a horizontal posture are arranged in the vertical direction at a specific pitch can be placed.

[0071] In the present specification, for convenience, a direction in which the stocker block **3**, the transfer block **5**, and the processing block **6** in the substrate processing apparatus **1** are arranged is referred to as a “front-back direction X”. The front-back direction X extends horizontally. Of the front-back direction X, the direction from the transfer block **5** toward the stocker block **3** in the substrate processing apparatus **1** is referred to as “front side”. A direction opposite to the front is referred to as “back side”. A direction extending horizontally and orthogonal to the front-back direction X is referred to as a “width direction Y”. One direction of the “width direction Y” is referred to as a “right side” for convenience, and the other direction is referred to as a “left side” for convenience. A direction (height direction) orthogonal to the front-back direction X and the width direction Y is referred to as a “vertical direction Z” for convenience. In each drawing, front, back, upper, lower, right, and left are appropriately shown for reference.

2. Stocker Block

[0072] As illustrated in FIG. **1**, the stocker block **3** includes a load port **9** which is an entrance when a carrier C for housing a plurality of substrates W in a horizontal posture at predetermined intervals in a vertical direction is input into the block. The load port **9** protrudes from the outer wall of the stocker block **3** extending in the width direction (Y direction).

[0073] A plurality of substrates W (for example, 25 sheets) are stacked and housed in one carrier C at regular intervals in the horizontal posture. The carrier C storing the unprocessed substrates W carried into the substrate processing apparatus **1** is first placed on the load port **9**.

[0074] FIG. **2** illustrates a configuration of a carrier C of the present invention. The carrier C is formed with a plurality of slots S extending in the horizontal direction to hold the surfaces of the substrates W in a state of being separated from each other. The slots S are arranged in the vertical direction at a specific pitch (for example, 10 mm), and the substrates W are accommodated in each of the slots S. 25 slots S are provided in one carrier C. Therefore, in the carrier C, 25 substrates W are arranged in the vertical direction at a specific pitch. A placement plate **7** is positioned to partition each slot S and, together with its paired placement plate **7**, supports both ends of each of the substrates W. Therefore, the placement plates **7** are arranged one by one on the side surface of the carrier C and the surface parallel to the side surface. As the carrier C, for example, there is a sealed front opening unify pod (FOUP). In the present invention, an open type container may be employed as the carrier C.

[0075] The internal structure of the stocker block **3** will be described. The stocker block **3** includes a conveyance/storage unit ACB that stocks and manages the carrier C. The conveyance/storage unit ACB includes a carrier conveyance mechanism **11** that conveys the carrier C and a shelf **13** on which the carrier C is placed. The number of carriers C that can be stocked by the stocker block **3** is one or more.

[0076] The stocker block **3** has a plurality of shelves **13** on which the carrier C is placed. The shelf **13** is provided on a partition wall separating the stocker block **3** and the transfer block **5**. The shelf **13** includes a stock shelf **13***b* on which the carrier Cis simply temporarily placed and a carrier placement shelf **13***a* on which a first handling robot HTR of the transfer block **5** accesses and from which the substrate is taken out.

[0077] The carrier placement shelf **13***a* has a configuration on which the carrier C can be placed. The carrier placement shelf **13***a* is configured to place the carrier C, from which the substrates W are to be taken out. In the present embodiment, one carrier placement shelf **13***a* is provided, but a plurality of carrier placement shelves **13***a* may be provided. The carrier conveyance mechanism **11** takes in the carrier C housing the unprocessed substrates W from the load port **9** and places the carrier C on the carrier placement shelf **13***a* for substrate extraction. At this time, the carrier conveyance mechanism **11** can also temporarily place the carrier C on the stock shelf **13***b* before placing the carrier C on the carrier placement shelf **13***a*. The number of carrier placement shelves **13***a* included in the stocker block **3** is 1 or more.

[0078] Note that the carrier placement shelf **13***a* is also configured to place an empty carrier C for housing the processed substrates W. The processed substrates W are housed in the carrier C waiting on the carrier placement shelf **13***a*. The carrier conveyance mechanism **11** obtains the carrier C storing the processed substrates W from the carrier placement shelf **13***a* and conveys the carrier C to the load port **9**. When the carrier C is conveyed to the load port **9**, the carrier conveyance mechanism **11** may temporarily place the carrier C on the shelf **13***b* for stock.

3. Transfer Block

[0079] The transfer block **5** is adjacent to the carrier placement shelf **13***a*. The transfer block **5** is disposed adjacent to the back side of the stocker block **3**. The transfer block **5** includes a handling robot HTR that can access the carrier C placed on the carrier placement shelf **13***a* for substrate extraction, an HVC posture converter **23** that collectively converts the posture of the plurality of substrates W from the horizontal posture to the vertical posture, and a pusher mechanism **25**. The HVC posture converter **23** collectively converts the plurality of substrates W from the horizontal posture to the vertical posture. Further, in the transfer block **5**, a substrate transfer position PP for transferring a plurality of substrates W to an advance/retract conveyance mechanism WTR provided in a collective conveyance region R**2** is set.

[0080] As illustrated in FIG. **3**, the handling robot HTR, the HVC posture converter **23**, and the pusher mechanism **25** are arranged in this order in the Y direction. The handling robot HTR includes hands **211** capable of gripping substrates W in the horizontal posture. The hand **211** can grip one substrate W. In the handling robot HTR, the hands **211** are arranged in the vertical direction. The handling robot HTR can convey a plurality of substrates W at one time by gripping the substrates with each of the hands **211**. The movement support mechanism **213** is a mechanism constituting the handling robot HTR, and is configured to rotate the hands **211** around the vertical axis, raise and lower the hands **211**, advance and retract the hands **211** in the front-back direction X, or traverse in the left-right direction Y.

[0081] FIG. **4** illustrates a state where the handling robot HTR receives the substrates W in the carrier C using the hands **211**. As illustrated in FIG. **4**, the hands **211** are arranged in the vertical direction at an arrangement pitch of the slots S provided in the carrier C. That is, the hands **211** are arranged at a pitch of 10 mm. 10 mm corresponds to a predetermined interval of the present invention, and is represented by an arrangement pitch Da in each drawing. The handling robot HTR conveys all of the substrates W arranged at intervals of 10 mm on the carrier C at one time. Since the front surfaces of the substrates W housed in the carrier C all face upward, the substrates W extracted by the handling robot HTR all face upward. Note that each of the hands **211** is provided with a guide **214** that brings a peripheral portion of the substrate into contact with the guide **214**. The guide is provided at the distal end portion and the proximal end portion of the pair of blades constituting the hands **211**. Therefore, four guides **214** are provided in the hands **211**.

[0082] The handling robot HTR has **25** hands **211**. The handling robot HTR collectively conveys the **25** substrates housed in the carrier C.

[0083] The HVC posture converter **23** illustrated in FIG. **3** is configured to convert the substrate W taken out from the carrier C from a horizontal posture to a vertical posture by the handling robot HTR. The HVC posture converter **23** includes a pair of placing rods **231** and a pair of clamping rods **232** extending in the vertical direction (Z direction). The support base **237** has a support surface extending in an XY plane that supports the placing rods **231** and the clamping rods **232**. A rotary drive mechanism **238** is configured to rotate the placing rods **231** and the clamping rods **232** together with the support base **237** by 90°. This rotation causes the placing rods **231** and the clamping rods **232** to extend in the left-right direction (Y direction).

[0084] The placing rod **231** each includes a rod driving mechanism **235** that rotates about a rotation axis along the extending direction. The pair of placing rods **231** can be synchronously rotated by a pair of rod driving mechanisms **235**. The rod driving mechanism **235** can extend and contract the placing rod **231**. A specific example when the placing rod **231** is driven by the rod driving mechanism **235** will be described later.

[0085] The clamping rod **232** each includes a rod rotary mechanism **236** that rotates about a rotation axis along the extending direction. The pair of clamping rods **232** can be synchronously rotated by a pair of rod rotary mechanisms **236**.

[0086] FIG. **5** illustrates flat plates **233** and flat plates **239** of the placing rod **231**. The flat plates **233** are arranged on the placing rod **231** at a pitch of 10 mm in an extending direction of the placing rod **231**. Each of the flat plates **233** is a plate extending on a plane orthogonal to the arrangement direction of the flat plates **233**, and the substrate W is supported by the placing rod **231** when the end of the substrate W is placed on the upper surface of the flat plate **233**. Since it is not possible to hold the entire substrate W only by holding one end portion of the substrate W, two placing rods **231** are provided in the HVC posture converter **23**. One end of the substrate W is held by the flat plate **233** of one placing rod **231**, and the other end of the substrate W is held by the flat plate **233** of the other placing rod **231**. One end and the other end are separated by a distance of the diameter of the substrate W. Therefore, the pair of placing rods **231** is separated by a distance of the diameter of the substrate Was illustrated in FIG. **7**A. In this way, the substrate W held by the flat plate **233** does not float from the flat plate **233**. This is because the weight of the substrate W is symmetrically applied to the flat plate **233**, so that the weight of the substrate W in the flat plate **233** is balanced between the left and right. The pair of placing rods **231** is parallel to each other.

[0087] The flat plates **239** are arranged on the placing rod **231** at a pitch of 20/3 mm in an extending direction of the placing rod **231**. The 20/3 mm pitch is referred to as an arrangement pitch Db. The flat plate **239** is a plate extending on a plane orthogonal to the arrangement direction of the flat plates **233**. On the flat plate **239**, similarly to the flat plate **233**, the end portion of the substrate W is placed on the upper surface of the flat plate **233**, whereby the substrate W is supported by the placing rod **231**. Two placing rods **231** are provided in the HVC posture converter **23**. One end of the substrate W is held by the flat plate **239** of one placing rod **231**, and the other end of the substrate W is held by the flat plate **239** of the other placing rod **231**.

[0088] In this manner, the placing rod **231** has one surface on which the flat plates **233** are arranged and the other surface on which the flat plates **239** are arranged. The placing rod **231** can rotate about a rotation axis along the extending direction, and the surface facing the substrate W can be switched between one surface related to the flat plate **233** and the other surface related to the flat plate **239**. In the placing rod **231** in the initial state, as illustrated in FIG. **5**, one surface related to the flat plate **233** faces the substrate W. Therefore, the HVC posture converter **23** in the initial state holds the substrate W by the flat plate **233**.

[0089] FIG. **5** illustrates clamping plates **234** and clamping plates **230** of the clamping rod **232**. The clamping plate **234** has an arcuate side **234***a* along the curve of the substrate W, and the arcuate side **234***a* is provided with a V groove **234***b* for clamping the substrate W. Since the substrate W has a shape along the curve of the arcuate side **234***a*, the substrate W is clamped in the V groove **234***b* of the arcuate side **234***a*. The clamping plates **234** are arranged on the clamping rod **232** at a pitch of 10 mm in the extending direction of the clamping rod **232**. Each of the clamping plates **234** is a plate extending on a plane orthogonal to the arrangement direction of the clamping plates **234**, and a part of the substrate W is fitted into the V groove **234***b* of the arcuate side **234***a*, so that the substrate W is clamped by the clamping rod **232**.

[0090] Note that, since it is not possible to realize the clamping of the entire substrate W only by clamping a part of the substrate W, two clamping rods **232** are provided in the HVC posture converter **23**. A part of the substrate W is clamped by the clamping plate **234** of one clamping rod **232**, and a part of the substrate W is clamped by the clamping plate **234** of the other clamping rod **232**. The pair of clamping rods **232** is separated by a distance shorter than the diameter of the substrate W. Since the pair of clamping rods **232** is configured to clamp the substrate W in the vertical posture, it is sufficient that the pair of clamping rods **232** is configured to clamp the lower side of the substrate W, and it is not necessary to separate the pair of clamping rods **232** by the diameter of the substrate W unlike the placing rod **231**. Nevertheless, as illustrated in FIG. **10**, since the clamping rod **232** is disposed at a position shifted from the bottom portion of the substrate W in the vertical posture, two of a rod for clamping a portion on the right side as viewed from the bottom portion of the substrate W and a rod for clamping a portion on the left side as viewed from the bottom portion of the substrate W are required. As illustrated in FIG. **5**C, the two clamping rods **232** clamp the substrate W from both sides by the V groove **234***b* of the clamping plate **234**. The pair of clamping rods **232** is parallel to each other. As illustrated in FIG. **8**, the two clamping rods **232** clamp the substrate W from both sides by the V groove **234***b* of the clamping plate **234**. The pair of clamping rods **232** is parallel to each other.

[0091] The clamping plates **230** are arranged on the clamping rod **232** at a pitch of 20/3 mm in the extending direction of the clamping rod **232**. The clamping plate **230** is a plate extending on a plane orthogonal to the arrangement direction of the clamping plates **230**. Similarly to the clamping plate **234**, the clamping plate **230** has an arcuate side **230***a* along the curve of the substrate W, and the arcuate side **230***a* is provided with a V groove **230***b* for clamping the substrate W.

[0092] In this manner, the clamping rod **232** has one surface on which the clamping plates **234** are arranged and the other surface on which the clamping plates **230** are arranged. The clamping plate **234** can rotate about a rotation axis along the extending direction, and the surface facing the substrate W can be switched between one surface related to the clamping plate **234** and the other surface related to the clamping plate **230**. In the clamping rod **232** in the initial state, as illustrated in FIG. **5**, one surface related to the clamping plate **234** faces the substrate W. Therefore, the HVC posture converter **23** in the initial state holds the substrate W by the clamping plate **234**.

[0093] FIG. **6** illustrates the arrangement pitch of the flat plates **233** and **239** of the placing rod **231**. The arrangement pitch Da of the flat plates **233** is 10 mm, and the arrangement pitch Db of the flat plates **239** is 20/3 mm. Therefore, one flat plate **233** is positioned between a pair of flat plates **233** separated by a width of 20 mm in the extending direction of the placing rod **231**. On the other hand, two flat plates **239** are positioned between a pair of flat plates **239** separated by a width of 20 mm in the extending direction of the placing rod **231**.

[0094] FIG. **6** also illustrates an arrangement pitch of the clamping plates **234** and the clamping plates **230** of the clamping rod **232**. The arrangement pitch Da of the clamping plates **234** is 10 mm, and the arrangement pitch Db of the clamping plates **230** is 20/3 mm. Therefore, one clamping plate **234** is positioned between a pair of clamping plates **234** separated by a width of 20 mm in the extending direction of the clamping rod **232**. On the other hand, two clamping plates **230** are positioned between a pair of clamping plates **230** separated by a width of 20 mm in the extending direction of the clamping rod **232**.

[0095] The pusher mechanism **25** in FIG. **3** includes a pusher **251** capable of horizontally arranging substrates W in a vertical posture. The pusher **251** is a half-pipe type along the curve of the bottom portion of the substrate W. In the pusher **251** in the initial state, the U groove **251***a* constituting the half-pipe extends in the left-right direction Y. The pusher **251** in this state can receive the substrate W from the HVC posture converter **23**.

[0096] FIG. **9** is a cross-sectional view for explaining the configuration of the pusher **251**. The pusher **251** has a plurality of V-shaped clamping grooves **252**. The clamping grooves **252** are arranged in the extending direction of the U groove described with reference to FIG. **3**. An arrangement pitch of the clamping grooves **252** is 10/3 mm. As illustrated in FIG. **9**, one substrate W is clamped by each of the clamping grooves **252**.

[0097] FIG. **10** illustrates a relationship between the pair of clamping rods **232** and the pusher **251**. Unlike the state of FIG. **3**, the pair of clamping rods **232** in FIG. **10** is tilted by 90° together with the support base **237** by the rotary drive mechanism **238**. Therefore, the clamping rod **232** in FIG. **10** extends in the horizontal direction. As can be seen with reference to FIG. **10**, the pusher **251** is at a position sandwiched between the pair of clamping rods **232** in the front-back direction X. Therefore, the pair of clamping rods **232** and the pusher **251** do not interfere with each other, and can cooperatively clamp the substrate W in the vertical posture.

[0098] The pusher rotation mechanism **253** in FIG. **3** can rotate the pusher **251** by at least 180°. The pusher rotation mechanism **253** can rotate the pusher **251** in the initial state to orient the pusher **251** in the opposite direction, or can rotate the pusher **251** oriented in the opposite direction to return the pusher **251** to the initial state. The pusher shift mechanism **254** can reciprocate the pusher **251** in the initial state in the left-right direction Y. The pusher shift mechanism **254** can bring the pusher **251** close to the HVC posture converter **23** or can bring the pusher **251** close to the advance/retract conveyance mechanism WTR.

[0099] A pusher lifting mechanism **255** can raise the pusher **251** at the initial position to the upper position. The pusher lifting mechanism **255** can also return the pusher **251** in the upper position to the initial position.

4. Pitch Change in Transfer Block

[0100] In the substrate processing apparatus of the present embodiment, since the arrangement pitch of the substrates W can be changed in the transfer block **5**, this point will be described. The substrates W arranged at a pitch of 10 mm in the carrier C are first rearranged at a pitch of 10/3 mm in the transfer block **5**. The temporary lot formed in this manner becomes a batch lot in which the substrates are arranged in a face-to-face method by the operation of the pusher mechanism **25**. Hereinafter, this configuration will be specifically described.

[0101] FIG. **11**A compares the arrangement pitch of the substrates in each configuration. In the carrier C, the placement plates **7** constituting the slots S are arranged at a pitch of 10 mm. The placement plate **7** has the same configuration as the flat plate **233** of the placing rod **231**. Therefore, the placement plates **7** are arranged in the vertical direction on one surface of the carrier C, and are arranged in the vertical direction on the other surface of the carrier C. Both ends of the substrate W are placed on the pair of placement plates **7** facing each other, so that the substrate W is held by the carrier C.

[0102] The flat plates **233** are arranged at a pitch of 10 mm on the placing rod **231** in the HVC posture converter **23**. Therefore, the 25 substrates W held by the carrier C are collectively conveyed to the HVC posture converter **23**. This conveyance is achieved by the handling robot HTR.

[0103] FIG. **11**B schematically illustrates a state in which 25 substrates W are arranged on the carrier C. Since three carriers C of different individuals appear in the following description, the carrier C in FIG. **11**B is referred to as a first carrier C**1**. In the first carrier C**1**, 25 substrates W are arranged at a pitch of 10 mm.

[0104] FIG. **11**C illustrates a state in which the substrates W housed in the first carrier C**1** are transferred to the HVC posture converter **23** by the handling robot HTR. FIG. **7**A illustrates a state in which both ends of the substrate W are supported by the pair of placing rods **231** at this time.

[0105] At this time, the peripheral edge portion of the substrate W is in contact with each of the clamping plates **234** of the pair of clamping rods **232**. Specifically, the peripheral edge portion of the substrate W is fitted into the V groove of the clamping plate **234**. Therefore, even if the support base **237** is rotated by 90° in this state illustrated in FIG. **7**B, since the substrate W is clamped by the V groove **234***b* of the clamping plate **234**, the substrate W does not slide down from the HVC posture converter **23**.

[0106] FIG. **11**C also illustrates a state in which the placing rod **231** supports the substrate W by the flat plate **233**. Similarly, FIG. **11** C illustrates a state in which the clamping rod **232** clamps the substrate W with the clamping plate **234**.

[0107] FIG. **11**D illustrates a state when the rotary drive mechanism **238** in the HVC posture converter **23** operates. By this operation, the support base **237** is rotated by 90°, and the placing rod **231** and the clamping rod **232** are in a state of extending horizontally. Then, the load of the substrate W is transferred from the placing rod **231** to the clamping rod **232**, and the flat plate **233** of the placing rod **231** is brought into a state of only being in contact with the substrate W. FIG. **11**D illustrates a state where placing rod **231** is contracted by rod driving mechanism **235**. When the placing rod **231** contracts, the flat plate **233** separates from the substrate W. Even when such an operation is performed, since the substrate W is supported by the clamping rod **232**, the substrate W does not move along with the movement of the flat plate **233**.

[0108] By separating the flat plate **233** from the substrate W, even if the substrate W clamped by the clamping rod **232** is lifted by the pusher **251**, the flat plate **233** does not damage the back surface of the substrate W.

[0109] FIG. **11**E illustrates a state when the placing rod **231** is rotated by 90° by rod driving mechanism **235**. The flat plate **233** of the placing rod **231** faces upward by the rotation of the placing rod **231**. This movement of the flat plate **233** is performed above the pusher **251**. The placing rod **231** approaches the pusher **251** together with the substrate W clamped by the clamping rod **232**, but at that time, the flat plate **233** does not collide with the substrate W held by the pusher **251**. Since the pusher **251** in FIG. **11**E does not clamp the substrate W, the rotation operation of the flat plate **233** can be omitted.

[0110] FIG. **11**F illustrates a state when the pusher **251** subsequently rises. Then, the bottom portion of the substrate W clamped by the clamping rod **232** is fitted into the clamping groove **252** of the pusher **251**. When the pusher **251** further rises in this state, the substrate W is removed from the clamping plate **234** of the clamping rod **232**. In this manner, the substrate W is transferred from the HVC posture converter **23** to the pusher mechanism **25**.

[0111] Thereafter, the pusher **251** rises to an upper position UR set above the placing rod **231**. The pusher **251** located in the upper position UR does not collide with the placing rod **231** returned to the upright state. FIG. **11**F also illustrates a state in which the placing rod **231** and the clamping rod **232** are moved to a virtual position IR indicated by broken lines by the rotary drive mechanism **238**. At this time, the placing rod **231** that has contracted returns to the original stretched state. In addition, placing rod **231** reversely rotates to return to the original state described in FIG. **11**C.

[0112] In this way, the substrates W arranged at a pitch of 10 mm are transferred from the HVC posture converter **23** to the pusher mechanism **25**. The clamping groove **252** in the pusher **251** at this time includes a groove that clamps the substrate W and an empty groove that does not clamp the substrate W. The grooves that clamp the substrate W are separated from each other by 3 times the arrangement pitch of the clamping grooves **252**. This is because the arrangement pitch of the clamping grooves **252** is 10/3 mm. 10 mm, which is the arrangement pitch of the substrates W, corresponds to exactly 3 times the arrangement pitch of the clamping groove **252**. At this time, the substrates W arranged in the pusher **251** are referred to as an initial substrate group. The initial substrate group corresponds to the substrate group of the present invention. In the initial substrate group, substrates oriented in one direction are arranged at intervals of 10 mm. 10 mm corresponds to a predetermined interval of the present invention.

[0113] FIG. **11**G illustrates a state in which the substrates W (first substrate) are conveyed from the second carrier C**2** to the HVC posture converter **23** by broken lines. The second carrier C**2** is a new carrier that the carrier conveyance mechanism **11** has transported to the carrier placement shelf **13***a* instead of the empty first carrier C**1**. This substrate conveyance process corresponds to the first process of the present invention. In the first process, each substrate is collectively acquired from the second carrier C**2** housing the first substrates in which the substrates W in the horizontal posture are arranged at intervals of 10 mm in the vertical direction Z.

[0114] FIG. **11**H illustrates a state in which the substrate W held by the HVC posture converter **23** is then transferred to the pusher **251**. Among the clamping grooves **252** in the pusher **251**, the clamping grooves **252** in which the substrates W related to the first carrier C**1** are already fitted cannot clamp the substrates W any more. Therefore, the substrates W held by the HVC posture converter **23** are conveyed from the substrates W related to the first carrier C**1** to a position shifted by one pitch in the arrangement of the clamping grooves **252**, and are fitted into the clamping grooves **252** on the spot. Such positioning of the substrates W and the pusher **251** is realized by the pusher shift mechanism **254**.

[0115] At this time, the tilting of the placing rod **231** and the clamping rod **232** and the contraction of the placing rod **231** described with reference to FIG. **11**D are executed, which have already been specifically described. By the tilting motion of the clamping rod **232**, the posture of each substrate W is collectively converted from the horizontal posture to the vertical posture. This operation corresponds to the second process of the present invention. Similarly, in FIG. **11**H, the rotation of the placing rod **231** described with reference to FIG. **11**E, the fitting of the substrate W into the pusher **251** described with reference to FIG. **11**F, the rising and lowering of the pusher **251**, the rising operation of the placing rod **231** and the clamping rod **232**, the extending operation of the placing rod **231**, and the reverse rotation operation of the placing rod **231** are also omitted.

[0116] In this way, the substrates W related to the second carrier C**2** are transferred from the HVC posture converter **23** to the pusher mechanism **25**. In the pusher **251** at this time, a region in which two clamping grooves **252** that clamp the substrates W are continuous and a region in which empty grooves that do not clamp the substrates W are positioned are alternately arranged. That is, the first substrate is positioned at a predetermined position (first position P**1**) in the pusher **251** by combining the first arrangement in which the first substrate oriented in one direction is arranged at an interval of 10 mm with the initial substrate group. FIG. **12** can be referred to for the first position P**1**.

[0117] FIG. **11**I illustrates a state in which the substrates W (second substrate) are conveyed from the third carrier C**3** to the HVC posture converter **23** by broken lines. The third carrier C**3** is a new carrier that the carrier conveyance mechanism **11** has transported to the carrier placement shelf **13***a* instead of the empty second carrier C**2**. This substrate conveyance process corresponds to the first process of the present invention. In the first process, each substrate is collectively acquired from the third carrier C**3** housing the second substrates in which the substrates W in the horizontal posture are arranged at intervals of 10 mm in the vertical direction Z.

[0118] FIG. **11**J illustrates a state in which the substrate W held by the HVC posture converter **23** is then transferred to the pusher **251**. Among the clamping grooves **252** in the pusher **251**, the clamping grooves **252** in which the substrates W related to the first carrier C**1** and the second carrier C**2** are already fitted cannot clamp the substrates W any more. Therefore, the substrates W held by the HVC posture converter **23** are conveyed from the substrates W related to the second carrier C**2** to a position shifted by one pitch in the arrangement of the clamping grooves **252**, and are fitted into the clamping grooves **252** on the spot. Such positioning of the substrates W and the pusher **251** is realized by the pusher shift mechanism **254**.

[0119] At this time, the tilting of the placing rod **231** and the clamping rod **232** and the contraction of the placing rod **231** described with reference to FIG. **11**D are executed, which have already been specifically described. By the tilting motion of the clamping rod **232**, the posture of each substrate W is collectively converted from the horizontal posture to the vertical posture. This operation corresponds to the second process of the present invention. Similarly, in FIG. **11**H, the rotation of the placing rod **231** described with reference to FIG. **11**E, the fitting of the substrate W into the pusher **251** described with reference to FIG. **11**F, the rising and lowering of the pusher **251**, the rising operation of the placing rod **231** and the clamping rod **232**, the extending operation of the placing rod **231**, and the reverse rotation operation of the placing rod **231** are also omitted.

[0120] In this way, the substrates W related to the third carrier C**3** are transferred from the HVC posture converter **23** to the pusher mechanism **25**. The clamping grooves **252** in the pusher **251** at this time all clamp the substrates W. In this way, **75** substrates W are arranged on the pusher **251** at a pitch of 10/3 mm.

[0121] A substrate array thus produced is referred to as a temporary batch lot TL. Since the substrates W held by the carrier C are arranged at a pitch of 10 mm, the arrangement pitch of the substrates W of the carrier C is converted from 10 mm to 10/3 mm in the transfer block **5**. That is, the second substrate is positioned at a predetermined position (second position P**2**) in the pusher **251** by combining the second arrangement in which the second substrate oriented in one direction is arranged at an interval of 10 mm with the initial substrate group. FIG. **12** can be referred to for the second position P**2**.

[0122] FIG. **12** illustrates the temporary batch lot TL. In the temporary batch lot TL, the substrates W derived from the third carrier C**3**, the substrates W derived from the second carrier C**2**, and the substrates derived from the first carrier C**1** are repeatedly arranged in this order at a 10/3 mm pitch. These substrates W are all oriented in one direction. Therefore, the temporary batch lot TL is formed by arranging the substrates W by a face-to-back method.

[0123] Next, a relationship between the clamping groove **252** of the pusher **251** and the substrate W will be described. There are three types of positions where the clamping groove **252** is provided: a reference position P where the substrates W related to the first carrier C**1** are positioned; a first position P**1** where the substrates W related to the second carrier C**2** are positioned; and a second position P**2** where the substrates W related to the third carrier C**3** are positioned. The reference positions P are arranged at a pitch of 10 mm in the pusher **251**, and the first position P**1** and the second position P**2** divide 10 mm between the reference positions P into three. Specifically, 10 mm between the reference positions P is equally divided into three by the first position P**1** and the second position P**2**. Therefore, the distance from the first position P**1** to the second position P**2** is ⅓ times of the arrangement pitch of the substrates W housed in the carrier C.

5. Rearrangement of Temporary Batch Lot

[0124] In the temporary batch lot TL configured in this manner, the orientation of the arranged substrates W is constant. Such an arrangement mode cannot be said to be optimal when batch chemical solution processing is performed. The transfer block **5** of the present embodiment can convert the arrangement mode of the substrates W from face-to-back to face-to-face by performing the disassembly operation and the rearrangement operation on the temporary batch lot TL.

[0125] FIG. **13** illustrates a state when the pusher **251** in the state of FIG. **11**J rises to the upper position UR set above the placing rod **231**. As described above, when the arrangement mode is changed for the substrates W held by the pusher **251**, the pusher **251** is raised. This is because it is necessary to transfer a part of the substrate W held by the pusher **251** to the HVC posture converter **23** in order to change the arrangement mode.

[0126] FIG. **13** also illustrates a state in which the clamping rod **232** in the upright state is half-rotated about a rotation axis parallel to the extending direction thereof. The clamping rod **232** before the half-rotation is configured to clamp the substrate W by the clamping plate **234**, but the clamping rod **232** after the half-rotation clamps the substrate W by the clamping plate **230**. FIG. **14**A and FIG. **14**B illustrate a state in which the arrangement pitch of the clamping plates is changed by rotating the clamping rod **232**. The clamping rod **232** before the half-rotation can collectively clamp the substrates W arranged at a pitch of 10 mm. The clamping rod **232** after the half-rotation can collectively clamp the substrates W arranged at a pitch of 20/3 mm.

[0127] However, since the clamping rod **232** clamps the substrate W in cooperation with the pair of clamping rods **232**, the half-rotation operation is executed by the pair of clamping rods **232**. The pair of clamping rods **232** before the half-rotation orient the clamping plates **234** to face each other, but the pair of clamping rods **232** after the half-rotation orient the clamping plates **230** to face each other.

[0128] FIG. **15** illustrates a state in which the HVC posture converter **23** is then operated and the placing rod **231** and the clamping rod **232** in the upright state are rotated by 90°. With this operation, the HVC posture converter **23** is ready to receive the substrates W from the pusher **251**.

[0129] FIG. **16**A illustrates a state in which the pusher **251** at the upper position starts to descend to transfer the substrates W to the HVC posture converter **23**. As can be seen with reference to the drawing, the arrangement pitch of the clamping plates **230** is longer than the arrangement pitch of the substrates W in the temporary batch lot TL. Therefore, the number of the clamping plates **230** is smaller than the number of the substrates W in the temporary batch lot TL.

[0130] FIG. **16**B illustrates a state where the temporary batch lot TL held by the pusher **251** is transferred to the clamping rod **232**. The clamping rod **232** cannot clamp all the substrates W of the temporary batch lot TL. This is because the number of the clamping plates **230** is smaller than the number of the substrates W in the temporary batch lot TL. As a result, the half of the substrates W constituting the temporary batch lot TL is clamped by the corresponding clamping plate **230**, and the remaining half is not clamped by the clamping plate **230** and remains held by the pusher **251**. FIG. **16**B illustrates a state in which the substrates W clamped by the clamping plates **230** and the substrates W held by the pusher **251** are alternately arranged.

[0131] The pusher **251** continues to descend even after the substrates W are transferred to the clamping rod **232**.

[0132] FIG. **17**A illustrates a state after the pusher **251** passes through the clamping rod **232**. In this manner, the temporary batch lot TL is dissembled into the first set substrate W**1** arranged at a 20/3 mm pitch and the second set substrate W**2** arranged at the same 20/3 mm pitch. Assuming that the first set substrate W**1** is the first set and the second set substrate W**2** is the second set, the temporary batch lot TL is divided into the first set and the second set. The substrate of the first set is clamped by the clamping rod **232**, and the substrate in the second set is held by the pusher **251**.

[0133] FIG. **17**A illustrates the rotation of the placing rod **231** about the left-right axis. When the flat plate is inserted into the gap of the first set substrate W**1**, the arrangement pitch of the first set substrate W**1** and the arrangement pitch of the flat plates need to coincide with each other. The arrangement pitch of the first set substrate W**1** is 20/3 mm, and the arrangement pitch of the flat plates **233** described in FIG. **5** is 10 mm. Therefore, when the flat plate **233** is positioned in the gap of the first set substrate W**1**, the arrangement pitches do not match each other, and the first set substrate W**1** and the flat plate **233** collide with each other.

[0134] Assuming such a situation, the placing rod **231** of the present example has an arrangement in which the flat plates **239** are arranged at a pitch of 20/3 mm. When the placing rod **231** is rotated to position the flat plate **239** in the gap of the first set substrate **W1**, the first set substrate **W1** and the flat plate **239** do not collide with each other because the arrangement pitches are matched with each other.

[0135] This rotating operation is executed with the placing rod **231** in the contracted state. When the same operation is performed on the placing rod **231** in the extended state, the flat plate **239** collides with the first set substrate **W1**. This is because the position in the left-right direction Y of the flat plate **239** arranged on the placing rod **231** in the extended state coincides with the position in the left-right direction Y of the first set substrate **W1** clamped by the clamping rod **232**. Therefore, when the flat plate **239** is inserted into the gap of the first set substrate **W1**, it is necessary to shift the flat plate **239** in the left-right direction Y with respect to the first set substrate **W1**.

[0136] When the placing rod **231** rotates and the flat plate **239** is inserted into the gap of the first set substrate **W1**, the placing rod **231** is extended this time. In this way, the flat plate **239** abuts on the back surface of the first set substrate **W1**, and the substrate W is reliably held by the placing rod **231** even if the placing rod **231** is brought into the upright state.

[0137] FIG. **17**B illustrates a state when the HVC posture converter **23** is operated and the placing rod **231** is in the upright state. At this time, since the clamping rod **232** merely clamps the end portion of the first set substrate **W1**, the first set substrate **W1** in the horizontal posture cannot be held only by this. In this respect, since the flat plate **239** of the placing rod **231** can hold the center of the first set substrate **W1**, the first set substrate **W1** in the horizontal posture is reliably held by the pair of placing rods **231** even when the clamping rod **232** is in the upright state.

[0138] FIG. **17**B illustrates a state in which the pusher **251** rises. The placing rod **231** and the clamping rod **232** in the HVC posture converter **23** are already rotated by 90° and retracted from the pusher **251**. Therefore, even if the pusher **251** rises, the pusher does not collide with the clamping rod **232** and the placing rod **231**.

[0139] FIG. **17** C illustrates a state in which the pusher **251** is half-rotated at the upper position of the HVC posture converter **23**. The pusher **251** rotates about the vertical axis by the operation of the pusher rotation mechanism **253**. By performing such an operation, the second set substrate **W2** oriented in one direction is all oriented in the opposite direction.

[0140] FIG. **17**D illustrates a state in which the pusher **251** is lowered after the half-rotation operation. The pusher **251** passes through the arrangement of the first set substrate **W1** and stops at a position below the first set substrate **W1**.

[0141] FIG. **17**E illustrates a state in which the HVC posture converter **23** is then operated and the placing rod **231** and the clamping rod **232** in the upright state are rotated by 90°. With this operation, the HVC posture converter **23** is ready to transfer the first set substrate **W1** to the pusher **251**. Before the state of FIG. **17**E is obtained, the placing rod **231** performs the contraction operation and the rotation operation described with reference to FIGS. **11**D and **11**E, and the clamping plate **230** is retracted from the gap of the first set substrate **W1**. If such an operation is performed in advance, the clamping plate **230** does not collide with the pusher **251** appearing from below and the second set substrate **W2** supported by the pusher **251**.

[0142] FIG. **17**E also illustrates a state where the pusher **251** starts to rise after the placing rod **231** and the clamping rod **232** are tilted.

[0143] FIG. **17**F illustrates a state in which the pusher **251** receives the first set substrate **W1** from the clamping rod **232**. At this time, the batch lot BL in which the first set substrate **W1** oriented in one direction and the second set substrate **W2** oriented in the opposite direction are alternately arranged is generated in the pusher **251**.

[0144] The pusher **251** continues to rise even after the first set substrate **W1** is acquired from the clamping rod **232**.

[0145] FIG. **17**G illustrates a state after the pusher **251** extracts the first set substrate **W1** from the clamping rod **232**. In this way, the batch lot BL of the present example is generated.

[0146] The generation of the batch lot BL is performed in the following procedure. First, the substrates W constituting the temporary batch lot TL are divided into a first set and a second set such that two substrates W facing each other form different sets. Then, the temporary batch lot TL is disassembled by moving the first set and the second set relative to each other in a direction (vertical direction Z) orthogonal to the arrangement direction (left-right direction Y) of the substrates. Then, the second set substrate **W2** is half-rotated. As a result, the initial direction of the second set substrate **W2** is oriented in the opposite direction. Finally, the first set substrate **W1** and the second set substrate **W2** are combined such that the first set substrate **W1** oriented in one direction and the second set substrate **W2** oriented in the opposite direction are alternately arranged. The batch lot BL is obtained by arranging the substrates W by such a face-to-face method.

[0147] The number of substrates W constituting the batch lot BL is 75, which is the same as the number of substrates W related to the temporary batch lot TL. Therefore, the number of substrates constituting the batch lot BL is 3 times that of the initial substrate group.

[0148] FIG. **18** illustrates the batch lot BL. In the batch lot BL, the first set substrate **W1** oriented in one direction and the second set substrate **W2** oriented in the opposite direction are repeatedly arranged at a pitch of 10/3 mm. Therefore, the batch lot BL is formed by arranging the substrates W by a face-to-face method.

6. Holding Batch Lot in Transfer Block

[0149] The transfer block **5** has two sites capable of holding the batch lot BL. One of them is the pusher **251**. The pusher **251** can reciprocate between an initial position where the substrate W can be transferred to and from the HVC posture converter **23** and a transfer position PP where the batch lot BL can be transferred to the advance/retract conveyance mechanism WTR. This reciprocating movement is realized by the pusher shift mechanism **254**.

[0150] The transfer block **5** includes a lot support **33** as a portion capable of holding the batch lot BL separately from the pusher **251**. The lot support **33** serves as a batch lot holding part for temporarily retracting the batch lot BL when congestion of the batch lot BL occurs between the transfer block **5** and the processing block **6**.

7. Processing Block

[0151] Hereinafter, the configuration of the processing block **6** described with reference to FIG. **1** will be described.

The processing block **6** is adjacent to the transfer block **5**. The processing block **6** performs batch processing on the above-described batch lot BL. The processing block **6** is divided into a batch processing region R**1** and the collective conveyance region R**2** arranged in the width direction (Y direction). Each region extends in the front-back direction (X direction). Specifically, the batch processing region R**1** is disposed inside the processing block **6**. The collective conveyance region R**2** is adjacent to the batch processing region R**1** and is disposed on the leftmost side of the processing block **6**.

[0152] The batch processing region R**1** in the processing block **6** is a rectangular region extending in the front-back direction (X direction). One end side (front side) of the batch processing region R**1** is adjacent to the transfer block **5**. The other end side of the batch processing region R**1** extends in a direction away from the transfer block **5** (backward side). When the batch lot BL is conveyed from the transfer block **5** to the processing block **6**, the advance/retract conveyance mechanism WTR included in the processing block **6** is used.

[0153] The advance/retract conveyance mechanism WTR collectively conveys a plurality of substrates W in a vertical posture among the transfer block **5**, the batch processing units BPU**1** to BPU**6**, and a batch drying chamber DC. The advance/retract conveyance mechanism WTR can hold the batch lot BL including the substrates W arranged at a pitch of 10/3 mm.

[0154] The batch processing region R**1** includes a batch-type processing unit that performs batch-type processing. Specifically, in the batch processing region R**1**, the batch drying chamber DC for collectively drying a plurality of substrates W, and a plurality of batch processing units BPU**1** to BPU**6** for collectively immersing the plurality of substrates W in a direction in which the batch processing region R**1** extends are arranged. The batch processing units BPU**1** to BPU**6** collectively immerse a plurality of substrates in a vertical posture. The arrangement of the batch drying chamber DC and the batch processing units BPU**1** to BPU**6** will be specifically described. The batch drying chamber DC is adjacent to the transfer block **5** from the rear. The first batch processing unit BPU**1** is adjacent to the batch drying chamber DC from the rear. The second batch processing unit BPU**2** is adjacent to the first batch processing unit BPU**1** from the rear. The third batch processing unit BPU**3** is adjacent to the second batch processing unit BPU**2** from the rear. The fourth batch processing unit BPU**4** is adjacent to the third batch processing unit BPU**3** from the rear. The fifth batch processing unit BPU**5** is adjacent to the fourth batch processing unit BPU**4** from the rear. The sixth batch processing unit BPU**6** is adjacent to the fifth batch processing unit BPU**5** from the rear. Therefore, the batch drying chamber DC, the first batch processing unit BPU**1**, the second batch processing unit BPU**2**, the third batch processing unit BPU**3**, the fourth batch processing unit BPU**4**, the fifth batch processing unit BPU**5**, and the sixth batch processing unit BPU**6** are arranged so as to be separated from the transfer block **5** in this order.

[0155] Each of the batch processing units BPU**1** to BPU**6** includes a batch processing tank capable of holding liquid. The batch processing tank is a liquid tank that holds a chemical solution or pure water. The chemical solution may be an acidic aqueous solution, for example, a phosphoric acid aqueous solution. In the present specification, the chemical solution and pure water are collectively referred to as a processing liquid. A batch processing tank for holding a chemical solution is referred to as batch chemical solution processing tanks CHB**2** to CHB**6**, and a batch processing tank for holding pure water is referred to as batch rinse processing tank ONB.

[0156] Specifically, the second batch processing unit BPU**2** includes a batch chemical solution processing tank CHB**2** that collectively performs chemical solution processing on the batch lot BL, and a lifter LF**2** that raises and lowers the batch lot BL between the substrate transfer position and the chemical solution processing position (see FIG. **2**). The substrate transfer position is a position set above the batch chemical solution processing tank CHB**2** accessible by the advance/retract conveyance mechanism WTR, and the chemical solution processing position is a position set in the tank of the batch chemical solution processing tank CHB**2** capable of immersing the batch lot BL in the chemical solution. The batch chemical solution processing tank CHB**2** performs acid processing on the batch lot BL. The acid processing may be a phosphoric acid processing, but may be a processing using another acid. In the phosphoric acid processing, etching processing is performed on a plurality of substrates W constituting the batch lot BL. In the etching processing, for example, the nitride film on the front surface of the substrate W is chemically etched.

[0157] The lifter LF**2** can hold the batch lot BL including the substrates W arranged at a 10/3 mm pitch. Like the lifter LF**2**, lifters provided in other processing tanks can also hold the batch lot BL. The batch drying chamber DC can house the batch lot BL.

[0158] The batch chemical solution processing tank CHB**2** houses an acid solution such as a phosphoric acid solution. The batch chemical solution processing tank CHB**2** is provided with a lifter LF**2** for moving the batch lot BL up and down. The lifter LF**2** moves up and down in the vertical direction (Z direction). Specifically, the lifter LF**2** moves up and down between a processing position corresponding to the inside of the batch chemical solution processing tank CHB**2** and a delivery position corresponding to the upper side of the batch chemical solution processing tank CHB**2**. The lifter LF**2** holds the batch lot BL including the substrate W in a vertical posture. The lifter LF**2** delivers the batch lot BL to and from the advance/retract conveyance mechanism WTR at the delivery position. When the lifter LF**2** descends from the delivery position to the processing position in a state of holding the batch lot BL, the entire region of the substrate W is located below the liquid level of the chemical solution. When the lifter LF**2** rises from the processing position to the delivery position in a state of holding the batch lot BL, the entire region of the substrate W is located on the liquid level of the chemical solution. The lifter LF2 can collectively immerse the batch lot BL in the batch processing tank. At this time, the lifter LF**2** descends from the delivery position to the processing position.

[0159] Specifically, the third batch processing unit BPU**3** includes a batch chemical solution processing tank CHB**3** and a lifter LF**3** that raises and lowers the batch lot BL between the substrate transfer position and the chemical solution processing position. The batch chemical solution processing tank CHB**3** has the same configuration as the batch chemical solution processing tank CHB**2** described above. That is, the batch chemical solution processing tank CHB**3** houses the chemical solution described above, and is provided with the lifter LF**3**. The batch chemical solution processing tank CHB**3** performs the same processing as the batch chemical solution processing tank CHB**2** on the batch lot BL. The substrate processing apparatus **1** of the present example includes a plurality of processing tanks capable of performing the same chemical solution processing. This is because the phosphoric acid processing takes more time than other processing. The phosphoric acid processing requires a long time (for example, 60 minutes). Therefore, in the apparatus of the present example, the acid processing can be concurrently performed by a plurality of batch chemical solution processing tanks.

[0160] The fourth batch processing unit BPU**4** to the sixth batch processing unit BPU**6** have the same configuration as the second batch processing unit BPU**2** and the third batch processing unit BPU**3**. That is, the fourth batch processing unit BPU**4** includes the batch chemical solution processing tank CHB**4** and the lifter LF**4** that raises and lowers the batch lot BL between the substrate transfer position and the chemical solution processing position. Similarly, the fifth batch processing unit BPU**5** includes a batch chemical solution processing tank CHB**5** and a lifter LF**5** that raises and lowers the batch lot BL between the substrate transfer position and the chemical solution processing position. The sixth batch processing unit BPU**6** includes a batch chemical solution processing tank CHB**6** and a lifter LF**6** that raises and lowers the batch lot BL between the substrate transfer position and the chemical solution processing position. Therefore, the batch lot BL is acid-processed in any one of the batch chemical solution processing tank CHB**2** to the batch chemical solution processing tank CHB**6**. When the chemical solution processing is concurrently performed by the five processing units in this manner, the throughput of the apparatus is increased.

[0161] Specifically, the first batch processing unit BPU**1** includes a batch rinse processing tank ONB that houses a rinse solution, and a lifter LF**1** that raises and lowers the batch lot BL between the substrate transfer position and the rinse position. The substrate transfer position is a position set above the batch rinse processing tank ONB accessible by the advance/retract conveyance mechanism WTR, and the rinse position is a position set in a tank of the batch rinse processing tank ONB capable of immersing the batch lot BL in the rinse solution. The batch rinse processing tank ONB has the same configuration as the batch chemical solution processing tank CHB**2** described above. That is, the batch rinse processing tank ONB houses the rinse solution and is provided with the lifter LF**1**. Unlike other processing tanks, the batch rinse processing tank ONB houses pure water, and is provided for the purpose of cleaning the chemical solution attached to the plurality of substrates W. In the batch rinse processing tank ONB, when the specific resistance of the pure water in the tank increases to a predetermined value, the cleaning processing ends.

[0162] As described above, the batch rinse processing tank ONB in the present embodiment is located closer to the transfer block **5** than the batch chemical solution processing tanks CHB**2** to CHB**6**. With this configuration, the mechanisms constituting the transfer block **5** and the batch chemical solution processing tanks CHB**2** to CHB**6** are separated as much as possible, and the pusher mechanism **25** and the like are not adversely affected by an acid such as phosphoric acid. In addition, by arranging the transfer block **5** and the batch drying chamber DC close to each other, the batch lot BL for which the rinse processing has been finished is conveyed by a short distance and immediately returned to the transfer block **5**.

8. Collective Conveyance Region in Processing Block

[0163] The collective conveyance region R**2** in the processing block **6** is a rectangular region extending in the front-back direction (X direction). The collective conveyance region R**2** is provided along the outer edge of the batch processing region R**1**, and has one end side extending to the transfer block **5** and the other end side extending in a direction away from the transfer block **5**.

[0164] The collective conveyance region R**2** is provided with an advance/retract conveyance mechanism WTR that collectively conveys a plurality of substrates W. The advance/retract conveyance mechanism WTR collectively conveys a plurality of substrates W (specifically, batch lots BL) between the substrate transfer position PP defined in the transfer block **5**, the lot support **33**, the batch drying chamber DC, and each of the batch processing units BPU**1** to BPU**6**. The advance/retract conveyance mechanism WTR is configured to be able to reciprocate in the front-back direction (X direction) across the transfer block **5** and the processing block **6**. The advance/retract conveyance mechanism WTR can also enter the substrate transfer position PP and the lot support **33** in the transfer block **5** in addition to the collective conveyance region R**2** in the processing block **6**.

[0165] The advance/retract conveyance mechanism WTR includes a pair of chucks **29** for conveying the batch lot BL. The pair of chucks **29** can be changed to a closed state in which they are close to each other and an open state in which they are separated from each other. The chuck **29** is a member extending in the Y direction in which grooves for gripping the substrate W are arranged at a pitch of 10/3 mm. The pair of chucks **29** is closed to receive the plurality of substrates W constituting the batch lot BL. Then, the pair of chucks **29** is opened to transfer the plurality of substrates W constituting the batch lot BL to another member (the lifter LF**1** or the like). The advance/retract conveyance mechanism WTR transfers the batch lot BL between the substrate transfer position PP in the transfer block **5** and the lot support **33**. In addition, the advance/retract conveyance mechanism WTR transfers the batch lot BL to and from each of the lifters LF**1** to LF**6** belonging to the batch processing units BPU**1** to BPU**6** in the processing block **6** and the batch drying chamber DC.

[0166] In the collective conveyance region R**2**, a guide rail **31** extending in the X direction for guiding the advance/retract conveyance mechanism WTR is provided. The advance/retract conveyance mechanism WTR can advance and retract in the X direction along the guide rail **31**. Therefore, the guide rail **31** extends from the processing block **6** to the transfer block **5**. More specifically, the guide rail **31** faces the substrate transfer position PP in the transfer block **5** from the Y direction, and faces the sixth batch processing unit BPU**6** in the processing block **6** from the Y direction. Besides, the guide rail **31** faces the lot support **33** in the transfer block **5**, the batch drying chamber DC in the processing block **6**, and the first batch processing unit BPU**1** to the sixth batch processing unit BPU**6** from the Y direction.

9. Other Configurations in Processing Block

[0167] The batch drying chamber DC is disposed at a position sandwiched between the first batch processing unit

BPU**1** and the transfer block **5**. The batch drying chamber DC has a drying chamber that accommodates the batch lot BL in which the substrates W in the vertical posture are arranged. The drying chamber includes an inert gas supply nozzle that supplies an inert gas into the chamber, and a vapor supply nozzle that supplies vapor of an organic solvent into the tank. The batch drying chamber DC first supplies an inert gas to the batch lot BL supported in the chamber to replace the atmosphere in the chamber with the inert gas. Then, pressure reduction in the chamber is started. In a state where the inside of the chamber is depressurized, vapor of the organic solvent is supplied into the chamber. The organic solvent is discharged to the outside of the chamber together with moisture adhering to the substrate W. In this way, the batch drying chamber DC performs the drying of the batch lot BL. The inert gas at this time may be, for example, nitrogen, and the organic solvent may be, for example, isopropyl alcohol (IPA).

[0168] The carrier placement shelf **13***a*, the batch drying chamber DC, and the batch processing units BPU**1** to BPU**6** in the substrate processing apparatus **1** are arranged in the front-back direction. That is, the carrier placement shelf **13***a* is arranged in front, and the batch drying chamber DC is arranged behind the carrier placement shelf **13***a*. The batch processing units BPU**1** to BPU**6** are disposed further behind the batch processing units BPU**1** to BPU**6**. In the substrate processing apparatus **1** of the present embodiment, the layout in the apparatus is optimized so that the moving distance of the advance/retract conveyance mechanism WTR decreases.

10. Controller

[0169] FIG. **1** can be referred to for the controller **131** included in the substrate processing apparatus **1**. Although not illustrated in FIG. **1**, the controller **131** is provided with a corresponding storage unit. The controller **131** includes, for example, a central processing unit (CPU). A specific configuration of the controller is not limited, and for example, each controller may be configured by a single processor, or each controller may be configured by an individual processor.

[0170] Examples of the control related to the controller **131** include control related to the carrier conveyance mechanism **11**, the handling robot HTR, the HVC posture converter **23**, the pusher mechanism **25**, the advance/retract conveyance mechanism WTR, the batch processing units BPU**1** to BPU**6**, and the batch drying chamber DC.

11. Flow of Substrate Processing

[0171] Hereinafter, the flow of the substrate processing of the present example will be described with reference to the flowcharts of FIG. **19**.

[0172] Step S**11**: The substrates W arranged at a pitch of 10 mm conveyed from the first carrier C**1** by the handling robot HTR are acquired by the pusher **251** after posture conversion. Step S**11** corresponds to the substrate group acquisition process of the present invention.

[0173] Step S**12**: The handling robot HTR acquires the substrates W from the second carrier C**2** and transfers the substrates W to the HVC posture converter **23**. Step S**12** corresponds to the first process of the present invention.

[0174] Step S**13**: The substrates W arranged at a pitch of 10 mm acquired from the second carrier C**2** are transferred to the pusher **251** after posture conversion. Since the substrates W related to the first carrier C**1** have already been arranged in the pusher **251**, the substrates W related to the first carrier C**1** and the substrates W related to the second carrier C**2** are batch assembled in the pusher **251**. Step S**13** corresponds to the first assembly process of the present invention. Between step S**12** and step S**13**, the above-described second process is executed.

[0175] Step S**14**: The handling robot HTR acquires the substrates W from the third carrier C**3** and transfers the substrates W to the HVC posture converter **23**. Step S**14** corresponds to the first process of the present invention.

[0176] Step S**15**: The substrates W arranged at a pitch of 10 mm acquired from the third carrier C**3** are transferred to the pusher **251** after posture conversion. Since the substrates W related to the first carrier C**1** and the substrates W related to the second carrier C**2** are already arranged in the pusher **251**, the substrate array related to the first carrier C**1** and the second carrier C**2** and the substrates W related to the third carrier C**3** are batch assembled in the pusher **251**. In this way, the temporary batch lot TL is generated. Step S**15** corresponds to the second assembly process of the present invention. Between step S**14** and step S**15**, the above-described second process is executed.

[0177] Step S**16**: The substrates W constituting the temporary batch lot TL are divided into a first set and a second set. The pusher **251** holding the temporary batch lot TL transfers the first set substrate W**1** related to the first set to the clamping rod **232** and separates the first set substrate W**1** from the second set substrate W**2** related to the second set. Step S**16** corresponds to a disassembly process of the present invention.

[0178] Step S17: A half-rotation of the second set substrate W**2** is executed. By this operation, the second set substrate W**2** that has been oriented in one direction is oriented in the opposite direction. Step S**17** corresponds to a half-rotation process of the present invention.

[0179] Step S**18**: The pusher **251** moves up and down to acquire the first set substrate W**1** from the clamping rod **232**. In the pusher **251**, clamping grooves **252** for clamping the second set substrate W**2** and empty clamping grooves **252** are alternately arranged. When the first set substrate W**1** each is inserted into the corresponding empty clamping groove **252**, the generation of the batch lot BL is completed. Step S**18** corresponds to a rearrangement process of the present invention.

[0180] Step S**19**: The generated batch lot BL is conveyed from the transfer block **5** to the processing block **6** by the advance/retract conveyance mechanism WTR.

[0181] Step S**20**: The batch lot BL is subjected to a chemical solution processing. Step S**20** corresponds to a processing process of the present invention.

[0182] Step S**21**: The batch lot BL is subjected to a rinse processing.

[0183] Step S**22**: The batch lot BL is subjected to a drying processing.

[0184] In this way, the substrate processing is realized in batch lot units.

[0185] Step S**23**: The batch lot BL subjected to the substrate processing is conveyed from the processing block **6** to the transfer block **5** by the advance/retract conveyance mechanism WTR.

[0186] Step S**24**: The pusher **251** holds the second set substrate W**2** and transfers the first set substrate W**1** to the clamping rod **232**.

[0187] Step S**25**: A half-rotation of the second set substrate W**2** is executed. By this operation, the second set substrate W**2** that has been oriented in the opposite direction is oriented in one direction.

[0188] Step S**26**: The pusher **251** acquires the first set substrate W**1** from the clamping rod **232**. In the pusher **251**, clamping grooves **252** for clamping the second set substrate W**2** and empty clamping grooves **252** are alternately arranged. When the first set substrate W**1** each is inserted into the corresponding empty clamping groove **252**, the generation of the temporary batch lot TL is completed.

[0189] Step S**27**: In the pusher **251**, the substrates W related to the third carrier C**3** are arranged at a pitch of 10 mm. The pusher **251** moves up and down to transfer the substrates W related to the third carrier C**3** to the clamping rod **232**. In this manner, the temporary batch lot TL is disassembled.

[0190] Step S**28**: The substrates W transferred across the clamping rod **232** is returned to the third carrier C**3** by the handling robot HTR after posture conversion.

[0191] Step S**29**: In the pusher **251**, the substrates W related to the second carrier C**2** are arranged at a pitch of 10 mm. The pusher **251** moves up and down to transfer the substrates W related to the second carrier C**2** to the clamping rod **232**. In this manner, the disassembly of the temporary batch lot TL proceeds.

[0192] Step S**30**: The substrates W transferred across the clamping rod **232** is returned to the second carrier C**2** by the handling robot HTR after posture conversion.

[0193] Step S**31**: In the pusher **251**, the substrates W related to the first carrier C**1** are arranged at a pitch of 10 mm. The pusher **251** moves up and down to transfer the substrates W related to the first carrier C**1** to the clamping rod **232**. The transferred substrates W are returned to first carrier C**1** by the handling robot HTR after posture conversion.

12. Effects of Present Example

[0194] According to the present example, the temporary batch lot TL in which the substrates W are oriented in the same direction is formed. Then, the substrates W are divided into a first set and a second set such that two substrates W facing each other among the substrates W constituting the temporary batch lot TL form different sets, and the second set is half-rotated. Then, by combining the first set and the second set, the substrates W oriented in one direction and the substrates W oriented in the opposite direction are alternately arranged to generate a batch lot BL. With this configuration, the substrates W can be arranged face-to-face while the arrangement pitch of the substrates W is narrower than that in the conventional method.

[0195] According to the present example, the number of the substrates W constituting the batch lot BL is **3** times the number of the substrate groups in step S**11**. With this configuration, no extra substrate W is generated in the substrate group when the batch BL lot is formed. Since the substrate group is not divided into two batch lots BL, it is possible to reliably match the history of substrate processing in the substrates constituting the substrate group.

[0196] According to the present example, a first process of collectively acquiring each substrate W from a carrier C that houses substrates W that are in a horizontal posture and arranged at a predetermined interval in a vertical direction, and a second process of collectively converting the posture of each substrate W from a horizontal posture to a vertical posture are provided, and the first process and the second process are performed before step S**13** and step S**15**. With this configuration, it is possible to provide a substrate processing method executed by receiving the first set of the first set substrate W**1** or the second set of the second set substrate W**2** arranged in one direction from the carrier C.

[0197] According to the present example, the predetermined interval is equal to the arrangement pitch of the substrates W housed in the carrier C. With this configuration, it is easy to change the pitch of the substrates W.

[0198] According to the present example, the distance from the first position P**1** to the second position P**2** is ⅓ of the arrangement pitch of the substrates W housed in the carrier C. With this configuration, the pitch of the substrate arrangement to be generated can be ½ or less of the arrangement pitch of the substrates W housed in the carrier.

[0199] According to the present example, the first position P**1** and the second position P**2** equally divide the predetermined interval into three. With this configuration, the substrates W can be arranged more orderly.

13. Modified Example

[0200] The present invention is not limited to the configuration of the embodiment, and modifications can be made as follows.

<Modification 1>

[0201] In the substrate processing method of the embodiment, the substrates W are acquired from the carrier C that houses the odd number of substrates W, but the present invention is not limited to this configuration. The substrate may be acquired from the carrier C that houses the even number of substrates W. With such a configuration, the number of substrates W constituting the temporary batch lot TL is an even number. Then, the number of the first set substrate W**1** and the number of the second set substrate W**2** are the same. With this configuration, the temporary batch lot TL is disassembled such that the substrates W positioned at one end of the temporary batch lot TL and the substrates W positioned at the other end of the temporary batch lot TL are divided into different sets. With such a configuration, the orientation of the substrates W constituting the batch lot BL can be made desired. That is, according to the present modification, since the orientation of the substrates W at one end and the orientation of the substrates W at the other end in the batch lot BL can be made different, the arrangement of the substrates W can be made face-to-face more reliably.

<Modification 2>

[0202] Although the temporary batch lot TL in the substrate processing method of the embodiment includes the odd number of substrates W, the number of the first set substrate W**1** and the number of the second set substrate W**2** can be the same by adding the dummy wafer to the temporary batch lot TL. With this configuration, since the orientation of the substrates W at one end and the orientation of the substrates W at the other end in the batch lot BL can be made different, the arrangement of the substrates W can be made face-to-face more reliably.

What is claimed is:

1. A substrate processing method for collectively processing a plurality of substrates having directions defined by a front surface and a back surface, the substrate processing method comprising:

a substrate group acquisition process of acquiring a substrate group in which substrates oriented in one direction are arranged at a predetermined interval;

a first assembly process of positioning a first substrate at a first position among the first position and a second position that divide the predetermined interval in the substrate group into three by combining a first arrangement in which the first substrate oriented in the one direction is arranged at the predetermined interval with the substrate group;

a second assembly process of forming a temporary batch lot by positioning a second substrate at the second position by combining a second arrangement in which the second substrate oriented in the one direction is arranged at the predetermined interval with the substrate group;

a disassembly process of disassembling the temporary batch lot by dividing the substrates into a first set and a second set such that two substrates facing each other among substrates constituting the temporary batch lot form different sets, and moving the first set and the second set relative to each other in a direction orthogonal to an arrangement direction of the substrates;

a half-rotation process of orienting the substrates constituting the second set in a direction opposite to the one direction by half-rotating the second set;

a rearrangement process of combining the first set and the second set to generate a batch lot such that the substrates oriented in the one direction and the substrates oriented in the opposite direction are alternately arranged; and

a processing process of immersing the batch lot in a processing liquid.

2. The substrate processing method according to claim **1**, wherein in the disassembly process, the temporary batch lot is disassembled such that the substrates positioned at one end of the temporary batch lot and the substrates positioned at the other end of the temporary batch lot are divided into different sets.

3. The substrate processing method according to claim **1**, wherein the number of substrates constituting the batch lot is 3 times the number of the substrate group in the substrate group acquisition process.

4. The substrate processing method according to claim **1**, comprising

a first process of collectively acquiring each substrate from a carrier that houses substrates that are in a horizontal posture and arranged at a predetermined interval in a vertical direction, and

a second process of collectively converting the posture of each substrate from a horizontal posture to a vertical posture,

wherein the first process and the second process are performed before each assembly process.

5. The substrate processing method according to claim **4**, wherein the predetermined interval is equal to an arrangement pitch of the substrates housed in the carrier.

6. The substrate processing method according to claim **4**, wherein a distance from the first position to the second position is ⅓ times an arrangement pitch of substrates housed in the carrier.

7. The substrate processing method according to claim **1**, wherein the predetermined interval is equally divided into three by the first position and the second position.

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