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

(11) EP 3 308 870 A1

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

(43) Date of publication:
18.04.2018 Bulletin 2018/16

(21) Application number: **16847621.6**

(22) Date of filing: **11.03.2016**

(51) Int Cl.:
B21D 43/22 *(2006.01)* ***B21D 53/08*** *(2006.01)*

(86) International application number:
PCT/JP2016/057813

(87) International publication number:
WO 2017/154211 (14.09.2017 Gazette 2017/37)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
MA MD

(71) Applicant: **Mitsubishi Electric Corporation**
Chiyoda-ku
Tokyo 100-8310 (JP)

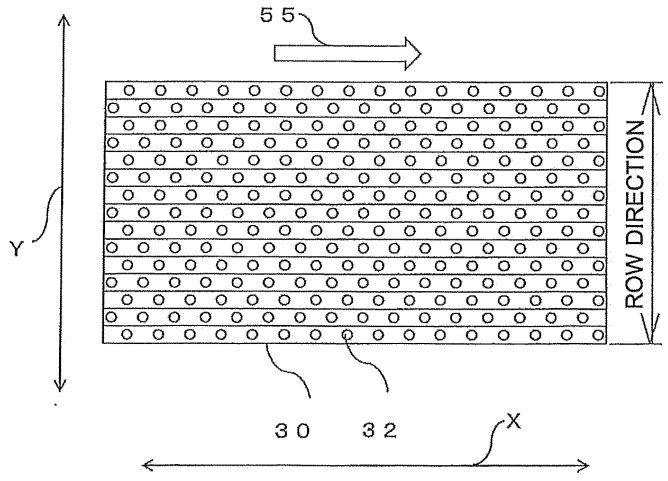
(72) Inventors:
- **ONO, Junichi**
  Tokyo 100-8310 (JP)
- **SAKAGUCHI, Noritaka**
  Tokyo 100-8310 (JP)

(74) Representative: **Pfenning, Meinig & Partner mbB**
Patent- und Rechtsanwälte
Joachimsthaler Straße 10-12
10719 Berlin (DE)

(54) **FIN STACK DEVICE**

(57) Provided is a fin stacking apparatus, which is configured to stack a fin having a flat-plate shape and a plurality of holes formed therein, including: a suction plate having a plurality of holes and being configured to retain the fin or to cause the fin to fall in accordance with presence or absence of suction through the plurality of holes; a plurality of stacking pins being arranged below the suction plate and configured to be inserted to the plurality of holes of the fin separated from the suction plate; and a stacking pin drive unit configured to rotate at least one of the plurality of stacking pins in a circumferential direction about an axis of the plurality of stacking pins.

FIG. 2



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Description

Technical Field

[0001] The present invention relates to a fin stacking apparatus configured to stack a fin.

Background Art

[0002] The term "fin stacking" refers to an action of receiving a fin, which is conveyed from a press machine, through penetration of stacking pins into the fin to stack the fins. The fin stacking is summarized herebelow. A fin having been delivered from a press machine moves on a suction plate, which has a plurality of holes formed therein, while being sucked by the suction plate. After the movement of the fin, the fin is cut. After that, the suction plate cancels a suction force so that the fin falls. The fallen fin is received with so-called stacking pins which are bars each having a needle-shaped tip, and fins are sequentially stacked (for example, see Patent Literature 1).

Citation List

Patent Literature

[0003] Patent Literature 1: Japanese Unexamined Patent Application Publication No. 2015-164741

Summary of Invention

Technical Problem

[0004] In the apparatus disclosed in Patent Literature 1, there is a case where, after the fin falls from the suction plate so that the stacking pins are inserted to the fin, the fin is caught by the stacking pins. For example, a fin having a low rigidity, a long fin being liable to deform, a fin having stacking holes each deviated from a center of the fin, and a fin defining a small clearance between an inner peripheral portion of a stacking hole and an outer peripheral portion of a stacking pin are more liable to cause a contact between the inner peripheral portion of the stacking hole of the fin and the outer peripheral portion of the pin, with the result that the fin is caught by the stacking pins in some cases.

[0005] The present invention has been made to solve the problem described above, and has an object to provide a fin stacking apparatus which is configured to prevent a fin, which is fallen from a suction plate, from being caught by stacking pins when the fin is stacked onto the stacking pins.

Solution to Problem

[0006] According to one embodiment of the present invention, there is provided a fin stacking apparatus, which is configured to stack a fin having a flat-plate shape and a plurality of holes formed therein, including: a suction plate having a plurality of holes and being configured to retain the fin or to cause the fin to fall in accordance with presence or absence of suction through the plurality of holes; a plurality of stacking pins being arranged below the suction plate and configured to be inserted to the plurality of holes of the fin separated from the suction plate; and a stacking pin drive unit configured to rotate at least one of the plurality of stacking pins in a circumferential direction about an axis of the plurality of stacking pins.

Advantageous Effects of Invention

[0007] With the fin stacking apparatus according to one embodiment of the present invention, the stacking pin is rotated to move a contact point between the inner peripheral portion of the hole of the fin and the outer peripheral portion of the stacking pin, thereby defining a clearance thereat. As a result, after the fin is inserted onto the staking pins, the fin is prevented from being caught during the falling movement onto the stacking pins.

Brief Description of Drawings

[0008]

[Fig. 1] Fig. 1 is a front view of a fin stacking apparatus according to Embodiment 1 of the present invention.
[Fig. 2] Fig. 2 is a top view for illustrating a fin for use in the fin stacking apparatus according to Embodiment 1 of the present invention, in which stacking holes are arranged in a staggered manner.
[Fig. 3] Fig. 3 is a top view for illustrating a fin for use in the fin stacking apparatus according to Embodiment 1 of the present invention, in which the stacking holes are aligned in a row direction.
[Fig. 4] Fig. 4 is a top view for illustrating a fin for use in the fin stacking apparatus according to Embodiment 1 of the present invention, in which the fin is divided into adjacent fins along a direction which is substantially perpendicular to a advancing direction of the fin.
[Fig. 5] Fig. 5 is a partial enlarged view of the fin stacking apparatus according to Embodiment 1 of the present invention.
[Fig. 6] Fig. 6 is an enlarged view of the stacking pin and the fin in the fin stacking apparatus according to Embodiment 1 of the present invention.
[Fig. 7] Fig. 7 is a view for illustrating a case where the fin for use in the fin stacking apparatus according to Embodiment 1 of the present invention is long in the advancing direction.
[Fig. 8] Fig. 8 is a flowchart for illustrating an operation of the fin stacking apparatus according to Embodiment 1 of the present invention.

[Fig. 9] Fig. 9 is a top view of a fin for use in the fin stacking apparatus according to Embodiment 1 of the present invention, in which positions of stacking holes are deviated from a center.

[Fig. 10] Fig. 10 is a view for illustrating a state in which the fin is inserted onto the stacking pins for use in the fin stacking apparatus according to Embodiment 1 of the present invention and thereafter the fin falls with an inclination.

[Fig. 11] Fig. 11 is a view for illustrating a rotating movement of the stacking pins in the fin stacking apparatus according to Embodiment 1 of the present invention.

[Fig. 12] Fig. 12 is a view for illustrating a case where the fin for use in the fin stacking apparatus according to Embodiment 1 of the present invention is a deformed long fin.

[Fig. 13] Fig. 13 is a front view of a fin stacking apparatus according to Embodiment 4 of the present invention.

[Fig. 14] Fig. 14 is a view for illustrating a rotating movement and an axial movement of stacking pins in the fin stacking apparatus according to Embodiment 4 of the present invention.

[Fig. 15] Fig. 15 is a front view of a fin stacking apparatus according to Embodiment 5 of the present invention.

[Fig. 16] Fig. 16 is a view for illustrating a rotating movement and a horizontal movement of stacking pins in the fin stacking apparatus according to Embodiment 5 of the present invention.

[Fig. 17] Fig. 17 is a front view of a fin stacking apparatus according to Embodiment 6 of the present invention.

[Fig. 18] Fig. 18 is a view for illustrating a rotating movement and a vibrating movement of stacking pins in the fin stacking apparatus according to Embodiment 6 of the present invention.

Description of Embodiments

Embodiment 1

[0009] Fig. 1 is a front view of a fin stacking apparatus according to Embodiment 1 of the present invention. A fin stacking apparatus 1 of Fig. 1 includes a suction unit 10 and a fin stacking unit 20 which is arranged below the suction unit 10 (Z-axis). The suction unit 10 includes a blower 13, a suction box 12, and a suction plate 11. The suction box 12 is arranged below the blower 13. The suction plate 11 is arranged below the suction box 12.

[0010] The blower 13 is located at an uppermost part of the suction unit 10, and is configured to perform a suction operation so as to set a negative pressure state in the suction box 12 which is arranged therebelow (Z-axis). The suction box 12 causes a suction force of the blower 13 to act entirely on the suction plate 11. Dampers 25 are arranged on outer wall surfaces of the suction box 12 so as to open and close with respect to an outer side of the suction box 12. In the closed state of the dampers 25, the suction box 12 maintains the negative pressure state in the suction box 12. In the opened state of the dampers 25, the suction box 12 releases an inside of the suction box 12 to the atmosphere to cancel the negative pressure state. The suction plate 11 is arranged below the suction box 12 and has a plurality of holes formed in a lower surface thereof to suck a fin 30. Further, the lower surface of the suction plate 11 has grooves (not shown) formed therein. Protruding portions formed at peripheral edges of stacking holes of the fin 30 are positioned so as to fit into the grooves, and the fin 30 moves on the surface of the suction plate 11 in that state.

[0011] Now, description is made of the fin 30 which moves while being sucked by the suction plate 11. Fig. 2 is a top view of the fin for use in the fin stacking apparatus according to Embodiment 1 of the present invention, in which the stacking holes are arranged in a staggered manner. Fig. 3 is a top view of a fin for use in the fin stacking apparatus according to Embodiment 1 of the present invention, in which the stacking holes are aligned in a row direction. As in the fin 30 of Fig. 2 and a fin 34 of Fig. 3, the fin 30 and the fin 34 conveyed from a press machine 2 of Fig. 1 are divided along a direction which is parallel to a advancing direction 55 (X-axis). Further, the fin 30 and the fin 34 have stacking holes 32 along the advancing direction 55 (X-axis) at predetermined intervals.

[0012] Fig. 4 is a top view of a fin for use in the fin stacking apparatus according to Embodiment 1 of the present invention, in which the fin is divided into adjacent fins along a direction which is substantially perpendicular to the advancing direction of the fin. As in a fin 35 of Fig. 4, the fin 35 conveyed from the press machine 2 of Fig. 1 is divided along a direction which is parallel to the substantially perpendicular direction (Y-axis) with respect to the advancing direction 55 (X-axis). Further, the fin 35 has stacking holes 32 along the substantially perpendicular direction (Y-axis) with respect to the advancing direction at predetermined intervals.

[0013] Fig. 5 is a partial enlarged view of the fin stacking apparatus according to Embodiment 1 of the present invention. With reference to Fig. 5, description is made of the fin stacking unit 20 of Fig. 1 in which the fin 30 separated from the suction plate 11 is stacked. The fin stacking unit 20 of Fig. 1 includes a base 21, an elevator 24, and a plurality of stacking pins 23. The elevator 24 is arranged above the base 21. The stacking pins 23 are arranged so as to penetrate through the elevator 24 and have respective needle-shaped tips oriented upward in the Z-axis. Further, stacking pin drive units 22 are arranged at base bottom portions of the stacking pins 23 on the base 21. The fin 30 fallen in a vertical direction 54 from the suction plate 11 is stacked onto the stacking pins 23 arranged below (Z-axis) the suction plate 11. The stacking pins 23 are located immediately below stacking holes 32 of the fin 30. Each stacking pin 23 has a diameter

slightly smaller than that of the stacking hole 32 and has a length corresponding to a stack height of the fin 30. Fig. 6 is an enlarged view of the stacking pin and the fin in the fin stacking apparatus according to Embodiment 1 of the present invention. The fin 30 has stacking holes 32 and protruding portions 33 formed at respective peripheral edges of the stacking holes 32. A tip of each stacking pin 23 has a tapered shape so that the fin 30 can easily be guided downward at the time of insertion of the fin 30 onto the stacking pin 23. Thus, a clearance 44 is defined between an outer peripheral portion of the stacking pin 23 and an inner peripheral portion of the stacking hole 32 of the fin 30.

[0014] The stacking pin drive unit 22 is configured to rotate the stacking pin 23 about an axis of the stacking pin, for example, at a constant speed. The rotating direction and speed of the stacking pin drive unit 22 are controlled by a controller 4. A rotating direction 53 of Fig. 5 is a clockwise direction, but may be a counterclockwise direction. The stacking pin drive unit 22 is constructed by, for example, a motor. As a method of mounting the motor, for example, the motor is mounted to each stacking pin 23. Alternatively, the stacking pins 23 in the advancing direction (X-axis direction) of the fin 30 or in the direction which is substantially perpendicular to the advancing direction of the fin 30 may be coupled to each other through intermediation of a pulley, a gear, a chain, and other member to simultaneously rotate the plurality of stacking pins 23 by one motor.

[0015] The elevator 24 is positioned around an upper portion of the stacking pins 23, and is lowered so that an uppermost surface of stacked fins 31 is maintained at a certain height position. A sensor is provided, and at this time, the elevator 24 is controlled in accordance with an output from the sensor. The elevator 24 repeats movement of being lowered by a predetermined distance after a preset number of fins 30 fall.

[0016] Fig. 7 is a view for illustrating a case where the fin for use in the fin stacking apparatus according to Embodiment 1 of the present invention is long in the advancing direction. The fin 30 when the length of the fin 30 is increased in the advancing direction (X-axis) as in Fig. 7, or the fin 30 when having a low rigidity such as in the case where the thickness of the fin 30 is reduced is more liable to deform when the fin 30 falls along the stacking pins 23, with the result that the fin 30 is more liable to be caught by the stacking pins 23. In this case, the number of stacking pins 23 is increased in accordance with the increased length of the fin 30 as in Fig. 7.

[0017] Fig. 8 is a flowchart for illustrating an operation of the fin stacking apparatus according to Embodiment 1 of the present invention. The operation is described based on Fig. 8 with reference to Fig. 1.

[0018] First, the blower 13 starts suction (Step S1). Next, the stacking pins 23 start rotation about an axis direction (Step S2). The rotation of the stacking pins 23 is started at the same timing as the start of suction by the blower 13. The rotation of the stacking pins 23 is not stopped until stacking is completed, and the rotation continues always in a certain direction and at constant speed. Next, the press machine 2 is activated (Step S3), and the fin 30 is delivered (Step S4). The delivered fin 30 moves under a state of being sucked by the blower 13 onto the lower surface of the suction plate 11 (Step S5). The fin 30 delivered to a predetermined length is cut by a cutoff unit 3 (Step S6). At substantially the same timing as the cutting, the suction plate 11 is lowered in the vertical direction (Step S7). Immediately after the lowering, the dampers 25 are opened to release the inside of the suction box 12 to the atmosphere to restore the pressure inside the suction box 12, thereby cancelling the suction force generated on the suction plate 11 (Step S8). After that, the fin 30 falls in the vertical direction (Step S9), and the suction plate 11 is raised (Step S10). The fin 30 is guided so that the stacking pins 23 penetrate through the stacking holes (Step S11), and is placed on the elevator 24 (Step S12). The elevator 24 is positioned around the upper portion of the stacking pins 23, and the fallen fins 30 are sequentially stacked thereon. At this time, the stacking pins 23 are rotated, thereby preventing the fin 30, which is guided so that the stacking pins 23 penetrate therethrough, from being brought into contact with and caught by the stacking pins 23 during falling along the stacking pins 23. Further, at this time, the uppermost surface of the stacked fins 31 is detected by a sensor (not shown) (Step S13), and the elevator 24 is lowered (Step S14) so that the uppermost surface of the stacked fins 31 is maintained at a certain position. The above-mentioned operation is repeated to proceed the stacking.

[0019] As described above, when the fin 30 is guided by the stacking pins 23 and falls along the stacking pins 23, the stacking pins 23 are rotated, thereby preventing the fin 30 from being brought into contact with and caught by the stacking pins 23 during falling. As a result, sequentially received fins 30 can be moved to a predetermined position and stacked thereat without delay, thereby stacking the fin 30 with good alignment. That is, according to the related-art invention, a fin deviated from a center as illustrated in Fig. 9 and a fin which falls with an inclination as illustrated in Fig. 10 are sometimes caught by the stacking pins. With the fin stacking apparatus according to the present invention, the rotating movement of the stacking pins in the fin stacking apparatus is performed, thereby preventing the fin from being brought into contact with and caught by the stacking pins during falling of the fin.

[0020] Fig. 9 is a top view of a fin for use in the fin stacking apparatus according to Embodiment 1 of the present invention, in which positions of the stacking holes are deviated from a center. A fin 36 has stacking holes 32 along the advancing direction 55 (X-axis) at predetermined intervals. The line A-A connecting center points of the stacking holes 32 is deviated from the center line B-B in a width (Y-axis) in the advancing direction of the fin 36, and the positions of the stacking holes 32 are deviated from the center. Fig. 10 is a view for illustrating

a state in which the stacking pins are inserted to the fin for use in the fin stacking apparatus according to Embodiment 1 of the present invention and thereafter the fin falls with an inclination. According to the related-art invention, there is a case where the fin 36 which is deviated from the center as illustrated in Fig. 9 or the fin which falls with an inclination as illustrated in Fig. 10 is inclined or deformed during falling in the vertical direction 54 along the stacking pins 23, with the result that the inner peripheral portion of the stacking hole 32 and the outer peripheral portion of the stacking pin 23 are brought into contact with each other to catch the fin.

[0021] Fig. 11 is a view for illustrating the rotating movement of the stacking pins in the fin stacking apparatus according to Embodiment 1 of the present invention. When the fin 30 is guided by the stacking pins 23 and falls in the vertical direction 54 along the stacking pins 23, the stacking pins 23 are rotated in the rotating direction 53 about an axis direction. As a result, the fin 30 can be prevented from being brought into contact with and caught by the stacking pins 23 during falling.

[0022] Fig. 12 is a view for illustrating a case where the fin for use in the fin stacking apparatus according to Embodiment 1 of the present invention is a deformed long fin. For the fin such as the deformed fin 30 of Fig. 13 which is liable to be caught, a rotational speed being a reference for the stacking pins 23 rotating at constant speed in the rotating direction 53 may be changed to deal with the catching.

Embodiment 2

[0023] In Embodiment 1, the rotational speed of the stacking pins 23 is constant. Next, in Embodiment 2, description is made of a case where the rotational speed of the stacking pins 23 is changed. Parts having the same configuration as those of the fin stacking apparatus of Fig. 1 to Fig. 3 are denoted by the same reference symbols, and description thereof is omitted. The configuration and operation of the fin stacking apparatus itself is unchanged, and only the control method for the stacking pins 23 is changed for use. The rotation speed of the stacking pin drive units 22 is controlled by the controller 4.

[0024] The fin stacking apparatus according to Embodiment 2 is configured so that the rotation of the stacking pins 23 is stopped until the stacking pins 23 are inserted to the fin 30. Basically, it is necessary that a preceding fin 30 be stacked with respect to the stacking pins 23 without being caught before the stacking pins 23 are inserted to a next fin 30. Thus, as long as the fin 30 can be stacked without being caught, there is no need to rotate the stacking pins 23 during the movement of the fin 30 before the insertion of the stacking pins 23. In view of this, the rotation of the stacking pins 23 is stopped until the stacking pins 23 are inserted to the fin 30, and the rotation of the stacking pins 23 is set to a first set rotational speed when the stacking pins 23 are inserted to the fin 30. The first set rotational speed is stored in advance or is determined by the controller 4 based on data detected by a sensor (not shown) which is configured to detect a moving speed or a position of the fin 30.

[0025] As described above, when the fin 30 is guided by the stacking pins 23 and falls along the stacking pins 23, the stacking pins 23 are rotated, thereby preventing the fin 30 from being brought into contact with and caught by the stacking pins 23 during falling. Thus, the sequentially received fins 30 can be moved to the predetermined position and stacked thereat without delay, thereby stacking the fins 30 with good alignment. Further, the rotation of the stacking pins 23 is stopped before the fin 30 is inserted to the stacking pins 23, thereby reducing power consumption of the apparatus itself.

Embodiment 3

[0026] In Embodiment 1, the rotational speed of the stacking pins 23 is constant. Next, in Embodiment 3, description is made of a case where the rotational speed of the stacking pins 23 is changed. Parts having the same configuration as those of the fin stacking apparatus of Fig. 1 to Fig. 3 are denoted by the same reference symbols, and description thereof is omitted. The configuration and operation of the fin stacking apparatus itself is unchanged, and only the control method for the stacking pins 23 is changed for use. The rotation speed of the stacking pin drive units 22 is controlled by the controller 4.

[0027] In the fin stacking apparatus according to Embodiment 3, until the stacking pins 23 are inserted to the fin 30, the rotational speed of the stacking pins 23 is set lower as compared to the rotational speed at the time of insertion to the fin 30. For example, in a case where a conveyance speed for conveyance of the fin 30 by the press machine 2 is increased, time for feeding of the fin 30 is shortened. Along with this, time for elimination of catching of the fin 30 is also shortened. In this case, it is necessary to shorten time required for the stacking pins 23 to reach a target rotational speed, to thereby secure sufficient time for elimination of the catching. As a countermeasure, the stacking pins 23 are rotated in advance at a second set rotational speed before the stacking pins 23 are inserted to the fin 30, and the stacking pins 23 are rotated at the first set rotational speed when the stacking pins 23 are inserted to the fin 30. The second set rotational speed is lower than the first set rotational speed. The first set rotational speed and the second set rotational speed are stored in advance or are determined by the controller 4 based on data detected by a sensor (not shown) which is configured to detect a moving speed or a position of the fin 30.

[0028] As described above, when the fin 30 is guided by the stacking pins 23 and falls along the stacking pins 23, the stacking pins 23 are rotated, thereby preventing the fin 30 from being brought into contact with and caught by the stacking pins 23 during falling. Thus, the sequentially received fins 30 can be moved to the predetermined position and stacked thereat without delay, thereby

stacking the fins 30 with good alignment. Further, the rotational speed of the stacking pins 23 is set lower before the stacking pins 23 are inserted to the fin 30, thereby reducing the power consumption of the apparatus itself and shortening time required to reach the target rotational speed. Such a configuration can deal with the rise in conveyance speed for conveyance of the fin 30 by the press machine 2.

Embodiment 4

[0029] Fig. 13 is a front view of a fin stacking apparatus according to Embodiment 4 of the present invention. Fig. 14 is a view for illustrating a rotating movement and an axial movement of the stacking pins in the fin stacking apparatus according to Embodiment 4 of the present invention. In the fin stacking apparatus according to Embodiment 1, stacking is performed under the state in which the stacking pins 23 are rotated at a constant speed and always in the same direction. In the fin stacking apparatus according to Embodiment 4, stacking is performed under a state in which stacking pins 123 are repeatedly moved up and down in an axial direction 57 while the stacking pins 123 are rotated. In Fig. 13 and Fig. 14, parts having the same configuration as those of the fin stacking apparatus of Fig. 1 to Fig. 3 are denoted by the same reference symbols, and description thereof is omitted. The configuration and operation of the fin stacking apparatus 1 itself is unchanged, and only the control method for the stacking pins 123 is changed for use.

[0030] The stacking pins 123 are moved up and down in the axial direction 57 by a vertical direction drive mechanism 26. As a mechanism of moving the stacking pins 123 in the axial direction 57, there may be employed, for example, a motor driving through use of a crank, or a power cylinder. The driving speed and driving width are stored in advance or determined by a controller 5 based on data detected by a sensor (not shown) which is configured to detect a moving speed and a position of the fin 30.

[0031] The movement in the axial direction 57 is not performed before insertion of the stacking pins 123 to a fin 130 but performed after insertion of the stacking pins 123 to the fin 130. Then, the movement in the axial direction 57 is stopped immediately before the next fin 130 falls. For example, the movement is started at a timing after the suction plate 11 is lowered and returns to an upper limit of rise. Further, the movement is stopped at a timing after the fin 130 is fed by a preset length on the suction plate 11. This is because positions of the stacking pins 123 and the stacking holes 132 need to be registered when the stacking pins 123 are to be inserted to the fin 130. The axial movement of the stacking pins 123 is performed for all of the installed stacking pins 123. This is because the catching can be eliminated faster when the rotation and axial movements are performed by all of the stacking pins 123.

[0032] As described above, when the fin 130 is guided by the stacking pins 123 and falls along the stacking pins 123, the stacking pins 123 are rotated and axially moved, thereby preventing the fin 130 from being brought into contact with and caught by the stacking pins 123 during falling. As a result, the sequentially received fins 130 can be moved to the predetermined position and stacked thereat without delay, thereby stacking the fins 130 with good alignment.

Embodiment 5

[0033] Fig. 15 is a front view of a fin stacking apparatus according to Embodiment 5 of the present invention. Fig. 16 is a view for illustrating a rotating movement and a horizontal movement of stacking pins in the fin stacking apparatus according to Embodiment 5 of the present invention. In the fin stacking apparatus according to Embodiment 1, stacking is performed under the state in which the stacking pins 23 are rotated always in the same direction. In the fin stacking apparatus according to Embodiment 5, stacking is performed under a state in which stacking pins 223 are repeatedly moved in a horizontal direction 58 while the stacking pins 223 are rotated. In Fig. 15 and Fig. 16, parts having the same configuration as those of the fin stacking apparatus of Fig. 1 to Fig. 3 are denoted by the same reference symbols, and description thereof is omitted. The configuration and operation of the fin stacking apparatus itself is unchanged, and only the control method for the stacking pins 223 is changed for use.

[0034] The stacking pins 223 are moved in the horizontal direction 58 by a horizontal direction drive mechanism 27. As a mechanism of moving the stacking pins 223 in the horizontal direction 58, there may be employed, for example, a motor driving through use of a crank, or a power cylinder. The driving speed and driving width are stored in advance or determined by a controller 6 based on data detected by a sensor (not shown) which is configured to detect a moving speed and a position of the fin 30.

[0035] The movement in the horizontal direction 58 is not performed before insertion of the stacking pins 223 to a fin 230 but performed after insertion of the stacking pins 223 to the fin 230. Then, the movement in the horizontal direction 58 is stopped immediately before the next fin 230 falls. For example, the movement is started at the timing after the suction plate 11 is lowered and returns to the upper limit of rise. Further, the movement is stopped at a timing after the fin 230 is fed by a preset length on the suction plate 11. This is because positions of the stacking pins 223 and the stacking holes 232 need to be registered when the stacking pins 223 are to be inserted to the fin 230. The horizontal movement of the stacking pins 223 is performed for all of the installed stacking pins 223. This is because the catching can be eliminated faster when the rotation and horizontal movements are performed by all of the stacking pins 223.

[0036] As described above, when the fin 230 is guided by the stacking pins 223 and falls along the stacking pins 223, the stacking pins 223 are rotated and horizontally moved, thereby preventing the fin 230 from being brought into contact with and caught by the stacking pins 223 during falling. As a result, the sequentially received fins 230 can be moved to the predetermined position and stacked thereat without delay, thereby stacking the fins 230 with good alignment.

Embodiment 6

[0037] Fig. 17 is a front view of a fin stacking apparatus according to Embodiment 6 of the present invention. Fig. 18 is a view for illustrating a rotating movement and a vibrating movement of stacking pins in the fin stacking apparatus according to Embodiment 6 of the present invention. In the fin stacking apparatus according to Embodiment 1, stacking is performed under the state in which the stacking pins 23 are rotated always in the same direction. In the fin stacking apparatus according to Embodiment 6, stacking is performed under a state in which stacking pins 323 are vibrated while the stacking pins 323 are rotated. In Fig. 17 and Fig. 18, parts having the same configuration as those of the fin stacking apparatus of Fig. 1 to Fig. 3 are denoted by the same reference symbols, and description thereof is omitted. The configuration and operation of the fin stacking apparatus itself is unchanged, and only the control method for the stacking pins 323 is changed for use.

[0038] The stacking pins 323 are vibrated by a vibration generating mechanism 28. As a mechanism configured to vibrate the stacking pins 323, there may be employed a vibration generating device of, for example, an electric type, a hydraulic type, or a pneumatic type. The driving speed and driving width are stored in advance or determined by a controller 7 based on data detected by a sensor (not shown) which is configured to detect a moving speed and a position of the fin 30.

[0039] The vibrating movement is not performed before insertion of the stacking pins 323 to the fin 330 but performed after insertion of the stacking pins 323 to the fin 330. Then, the vibrating movement is stopped immediately before the next fin 330 falls. For example, the movement is started at the timing after the suction plate 11 is lowered and returns to the upper limit of rise. Further, the movement is stopped at a timing after the fin 330 is fed by a preset length on the suction plate 11. This is because positions of the stacking pins 323 and the stacking holes 332 need to be registered when the stacking pins 323 are to be inserted to the fin 330. The vibrating movement of the stacking pins 323 is performed for all of the installed stacking pins 323. This is because the catching can be eliminated faster when the rotation and vibrating movements are performed by all of the stacking pins 323.

[0040] As described above, when the fin 330 is guided by the stacking pins 323 and falls along the stacking pins 323, the stacking pins 323 are rotated and vibrated, thereby preventing the fin 330 from being brought into contact with and caught by the stacking pins 323 during falling. As a result, the sequentially received fins 330 can be moved to the predetermined position and stacked thereat without delay, thereby stacking the fins 330 with good alignment.

[0041] The embodiments of the present invention are not limited to Embodiments 1 to 6 described above, and various modifications can be made thereto. For example, positions of the controllers 4 to 7 may be set as appropriate, and may be arranged in, for example, the suction unit 10. Further, the vertical direction drive mechanism, the horizontal direction drive mechanism, and the vibration generating mechanism are arranged for each stacking pin, but may be collectively arranged for a plurality of stacking pins. Further, the vertical direction drive mechanism, the horizontal direction drive mechanism, and the vibration generating mechanism may be used in combination. Reference Signs List

[0042] 1 fin stacking apparatus 2 press machine 3 cut-off unit 4 controller 5 controller 6 controller 7 controller 10 suction unit 11 suction plate 12 suction box 13 blower 20 fin stacking unit 21 base 22 stacking pin drive unit 23 stacking pin 24 elevator 25 damper 26 vertical direction drive mechanism 27 horizontal direction drive mechanism 28 vibration generating mechanism 30 fin 31 stacked fins 32 stacking hole 33 protruding portion 34 fin 35 fin 36 fin 44 clearance 53 rotating direction 54 vertical direction 55 advancing direction 57 axial direction 58 horizontal direction 123 stacking pin 130 fin 132 stacking hole 223 stacking pin 230 fin 232 stacking hole 323 stacking pin 330 fin 332 stacking hole

Claims

1. A fin stacking apparatus configured to stack a fin having a flat-plate shape and a plurality of holes formed therein, comprising:

   a suction plate having a plurality of holes and configured to retain the fin when suction through the plurality of holes is executed, and to cause the fin to fall when suction through the plurality of holes is not executed;
   a plurality of stacking pins arranged below the suction plate and configured to be inserted to the plurality of holes of the fin separated from the suction plate; and
   a stacking pin drive unit configured to rotate at least one of the plurality of stacking pins in a circumferential direction about an axis of the at least one of the plurality of stacking pins .

2. The fin stacking apparatus of claim 1, further comprising
   a controller configured to control the stacking pin

drive unit,
wherein the fin moves on the suction plate, and
wherein the controller controls the stacking pin drive unit to rotate the plurality of stacking pins at a second set rotational speed until the fin is arranged at a position of separation, and to rotate the plurality of stacking pins at a first set rotational speed when the plurality of stacking pins are inserted to the fin .

3. The fin stacking apparatus of claim 1, further comprising a controller configured to control the stacking pin drive unit,
wherein the fin moves on the suction plate, and
wherein the controller controls the stacking pin drive unit to stop rotation of the stacking pin until the fin is arranged at a position of separation, and to rotate the plurality of stacking pins at a first rotational speed when the plurality of stacking pins are inserted to the fin.

4. The fin stacking apparatus of any one of claims 1 to 3, further comprising a vertical direction drive mechanism configured to reciprocally drive the plurality of stacking pins in an axial direction of the plurality of stacking pins.

5. The fin stacking apparatus of any one of claims 1 to 3, further comprising a horizontal direction drive mechanism configured to reciprocally drive the plurality of stacking pins in a horizontal direction of the plurality of stacking pins.

6. The fin stacking apparatus of any one of claims 1 to 3, further comprising a vibration generating mechanism configured to vibrate the plurality of stacking pins.

7. The fin stacking apparatus of any one of claims 1 to 6, wherein the stacking pin drive unit is further configured to rotate all of the plurality of stacking pins.

FIG. 1

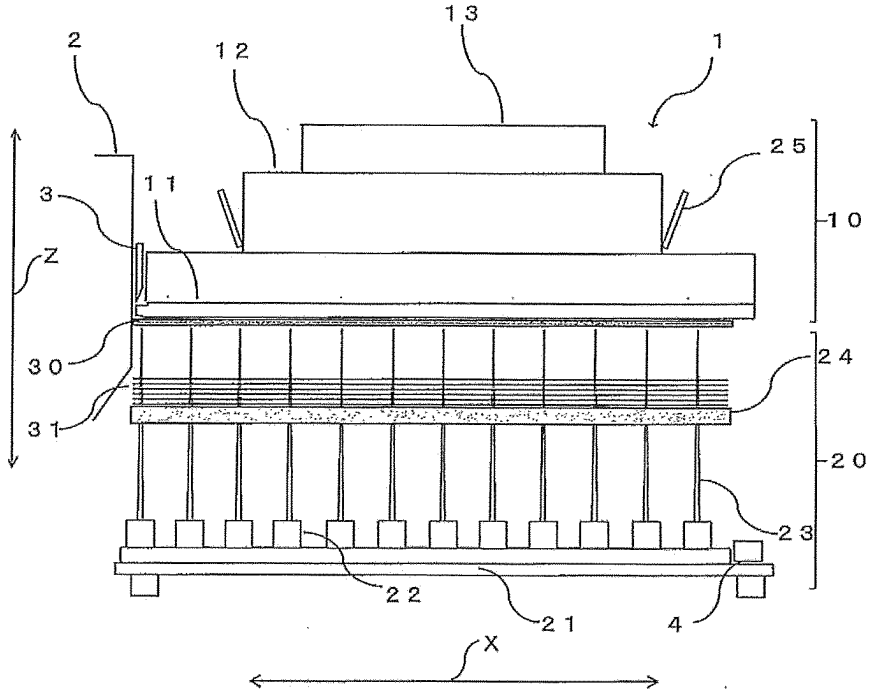

13
2
12
1
25
11
3
10
Z
30
24
31
20
23
22
21
4
X

FIG. 2

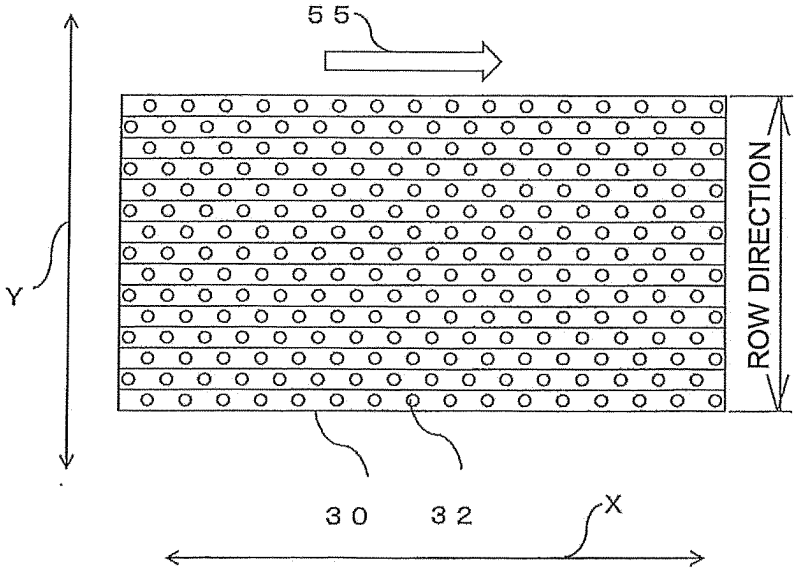

55
ROW DIRECTION
Y
30
32
X

FIG. 3

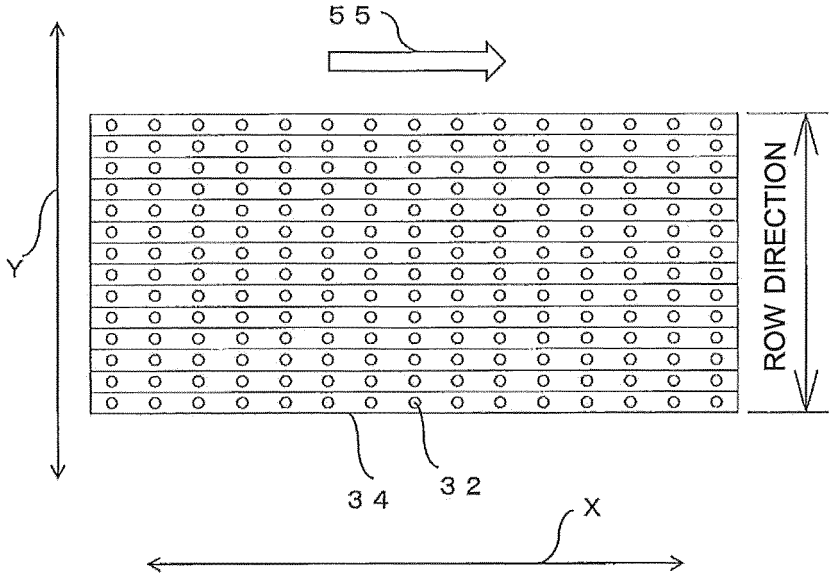


FIG. 4

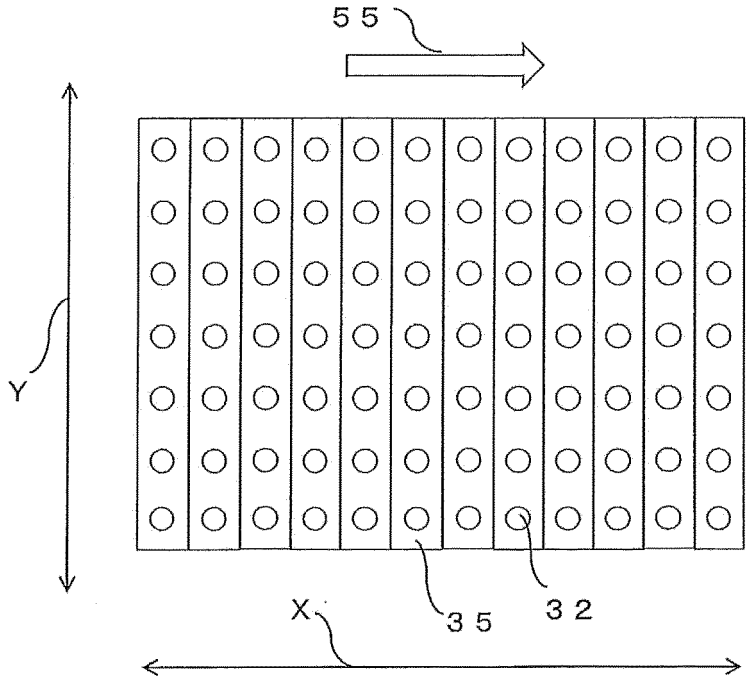


FIG. 5

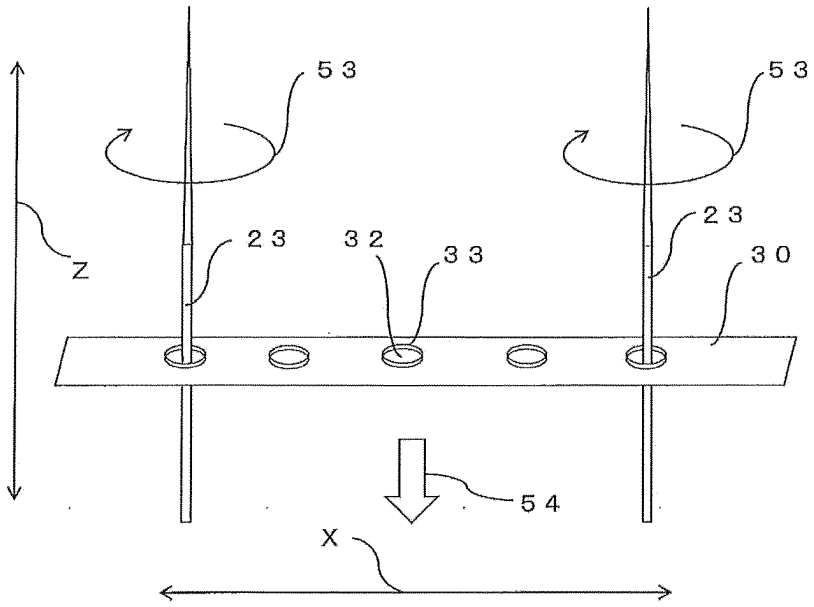


FIG. 6

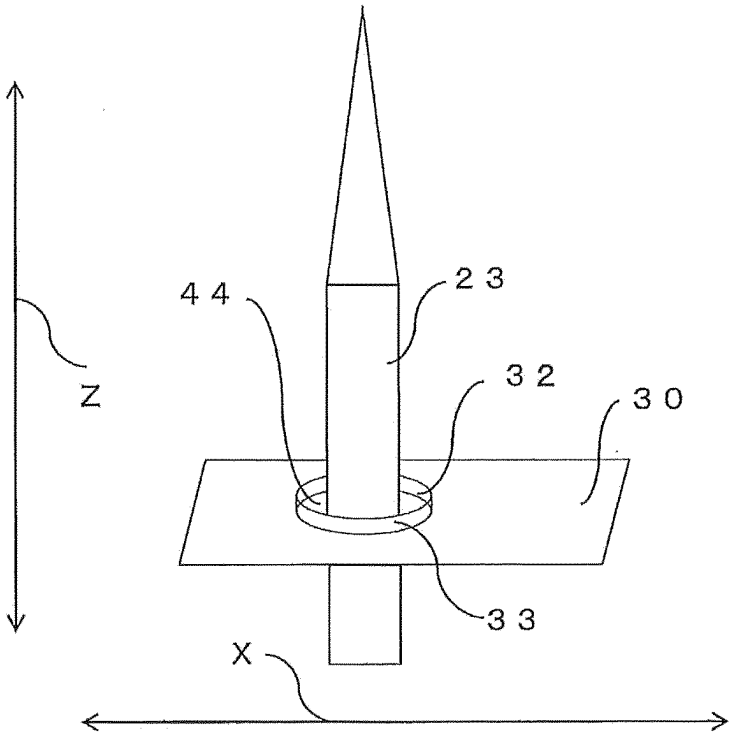


FIG. 7

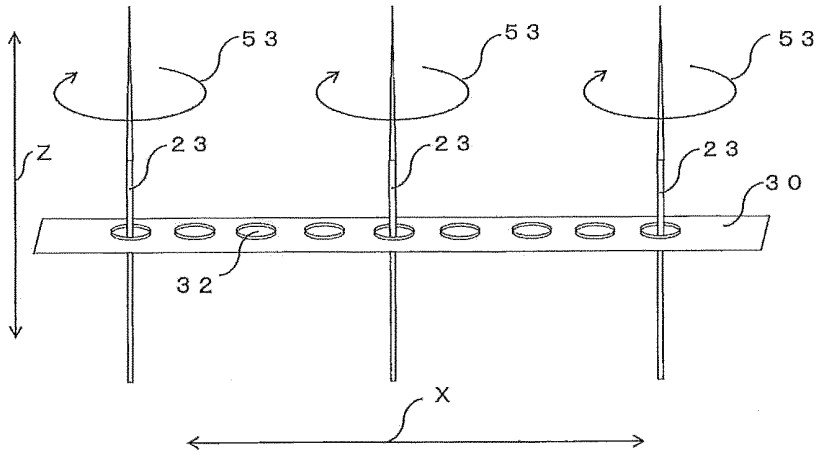

53
53
53
Z
23
23
23
30
32
X

FIG. 8

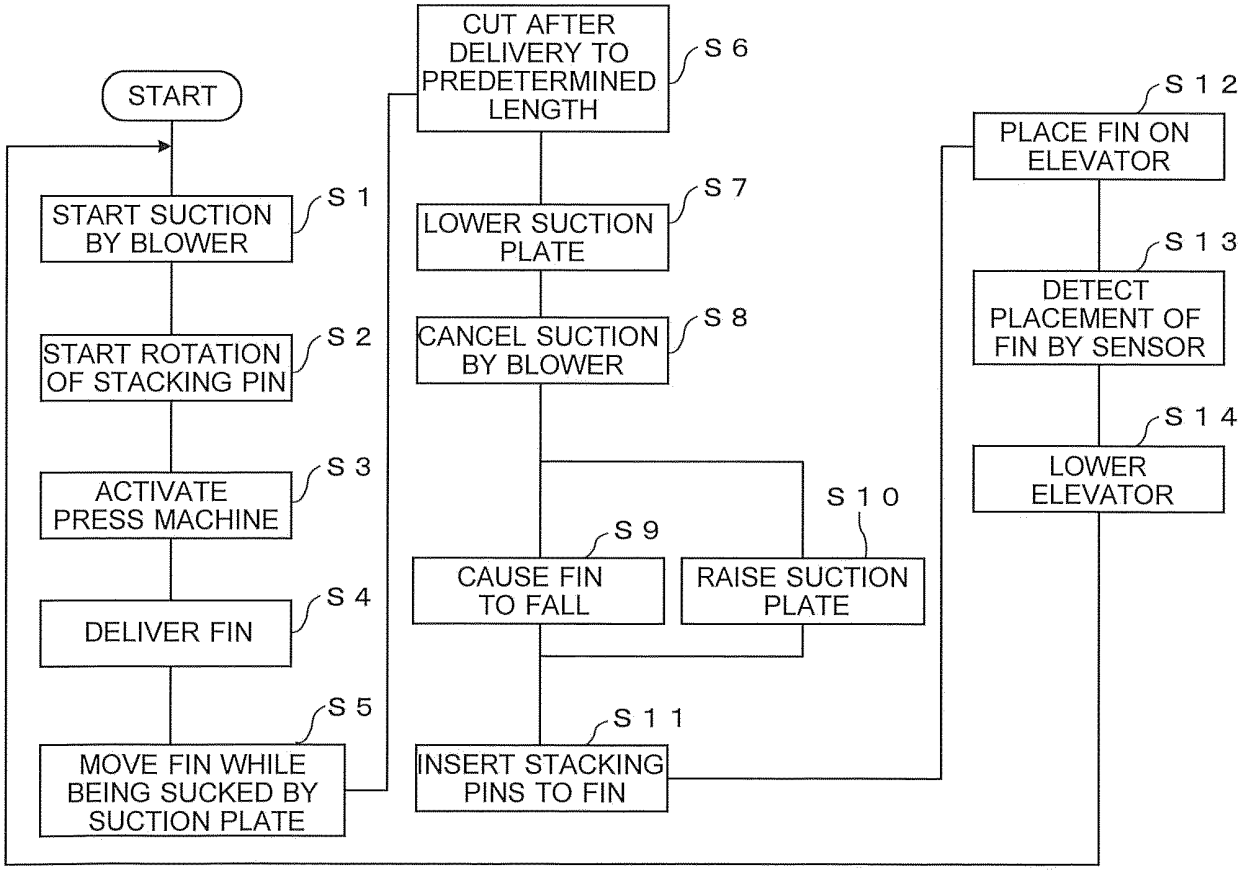

START
START SUCTION BY BLOWER
S 1
START ROTATION OF STACKING PIN
S 2
ACTIVATE PRESS MACHINE
S 3
DELIVER FIN
S 4
MOVE FIN WHILE BEING SUCKED BY SUCTION PLATE
S 5
CUT AFTER DELIVERY TO PREDETERMINED LENGTH
S 6
LOWER SUCTION PLATE
S 7
CANCEL SUCTION BY BLOWER
S 8
CAUSE FIN TO FALL
S 9
RAISE SUCTION PLATE
S 10
INSERT STACKING PINS TO FIN
S 11
PLACE FIN ON ELEVATOR
S 12
DETECT PLACEMENT OF FIN BY SENSOR
S 13
LOWER ELEVATOR
S 14

FIG. 9

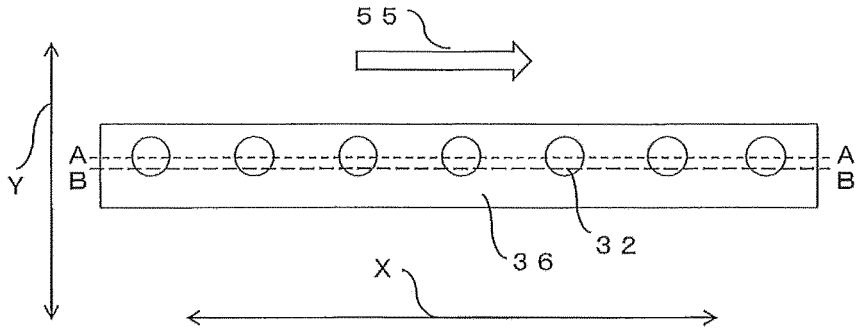


FIG. 10

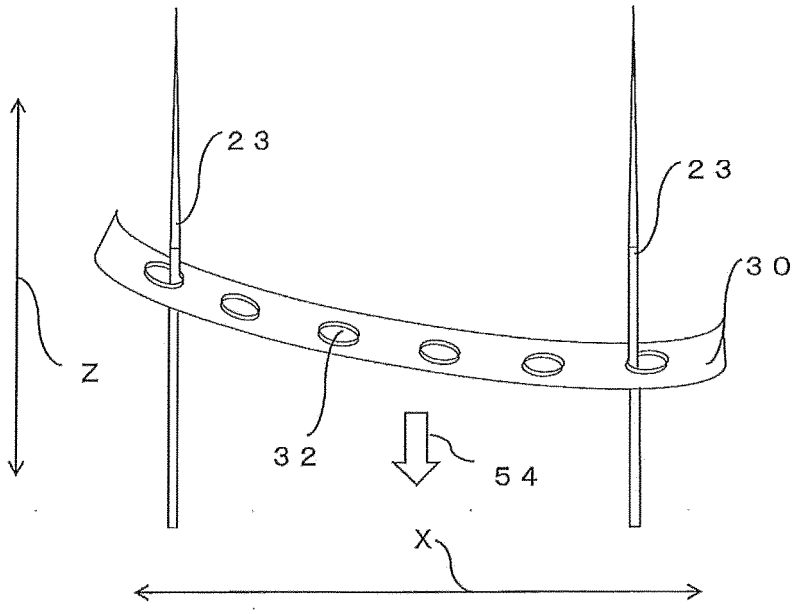


FIG. 11

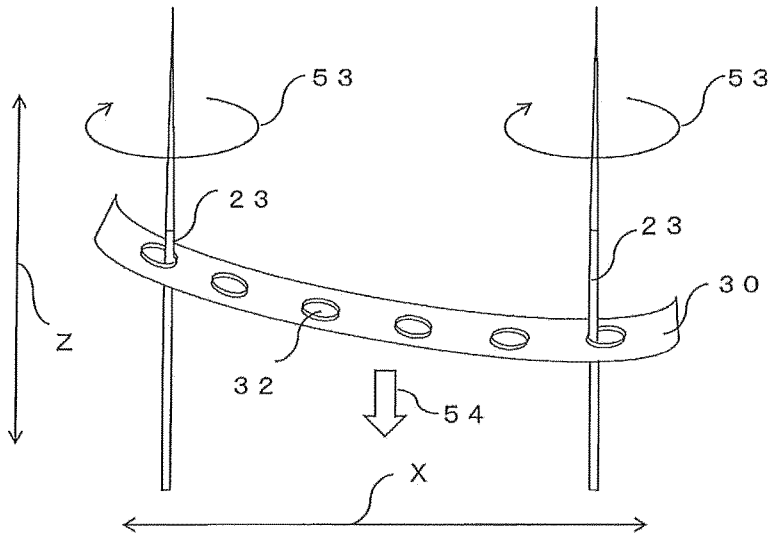


FIG. 12

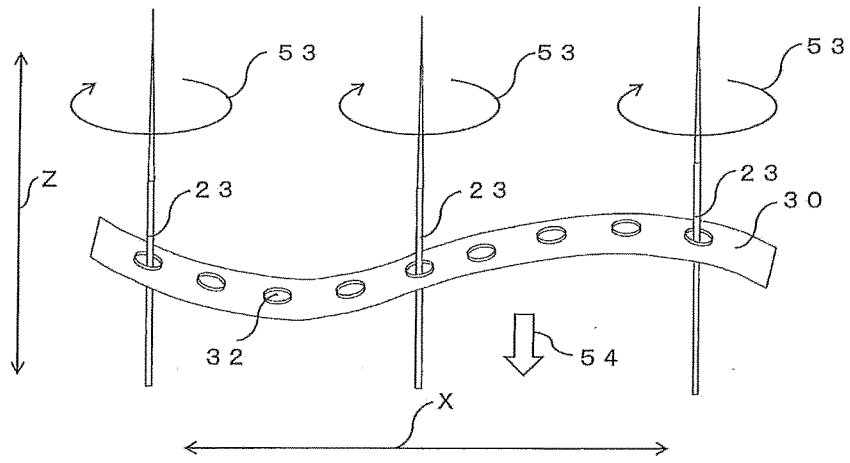


FIG. 13

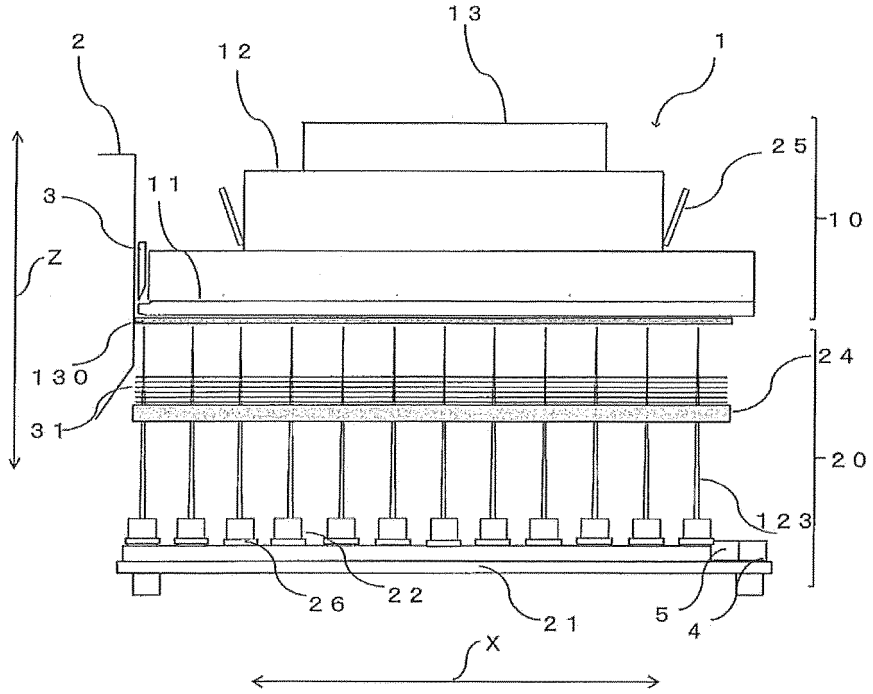

13
2
12
1
25
11
3
10
Z
130
24
31
20
123
26
22
21
5
4
X

FIG. 14

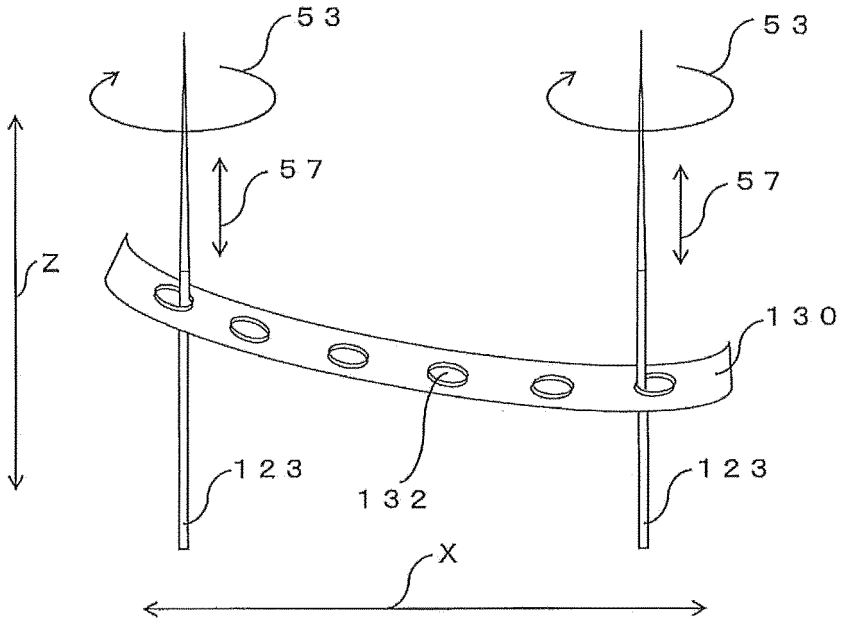

53
53
57
57
Z
130
123
132
123
X

FIG. 15

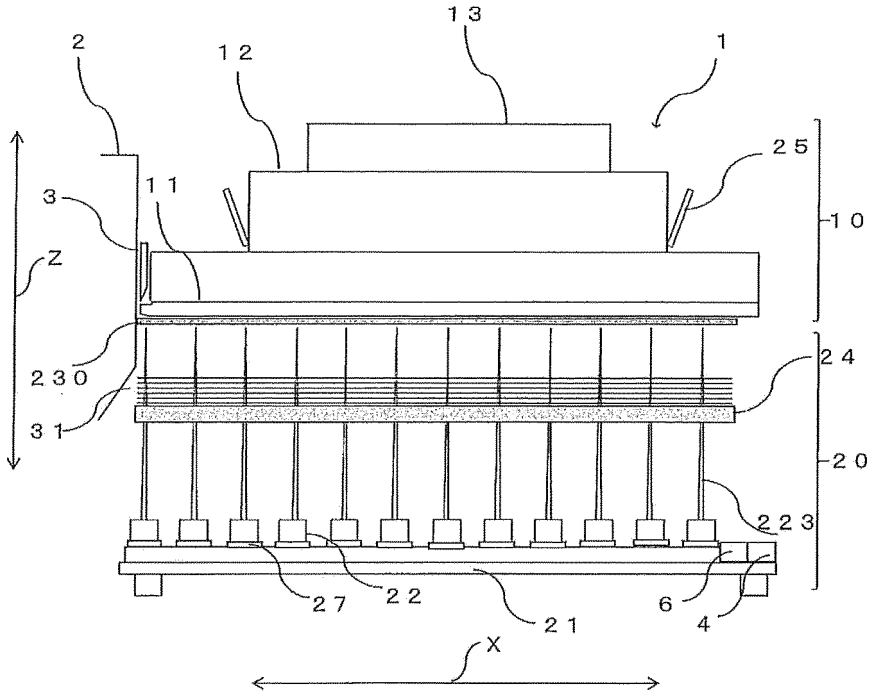

13
2
12
1
25
11
3
10
Z
230
24
31
20
223
27
22
21
6
4
X

FIG. 16

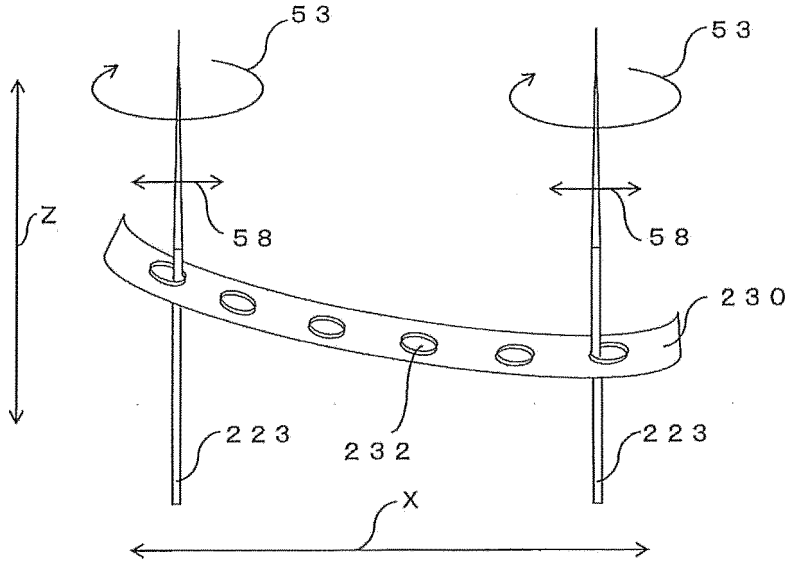

53
53
Z
58
58
230
223
232
223
X

FIG. 17

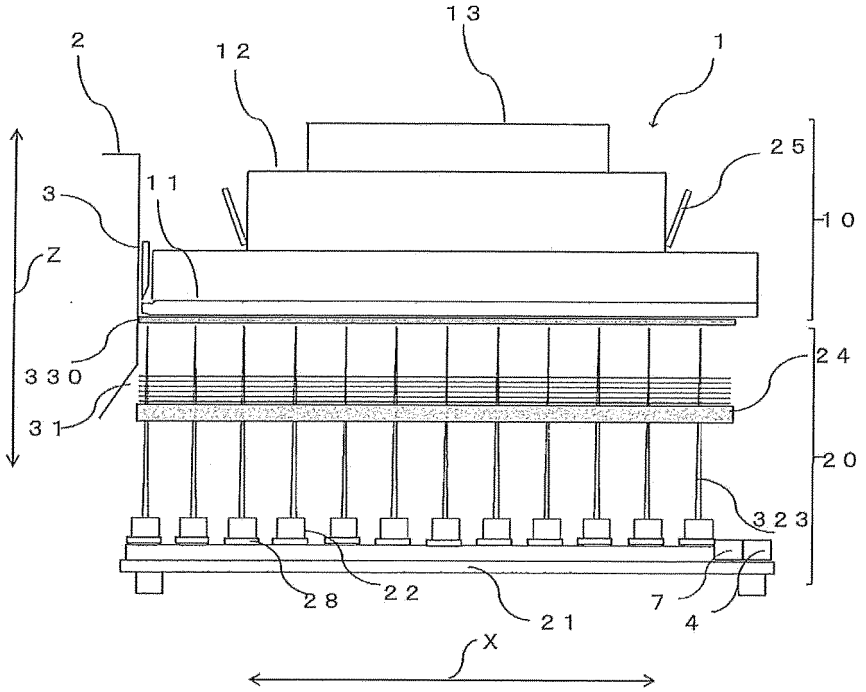
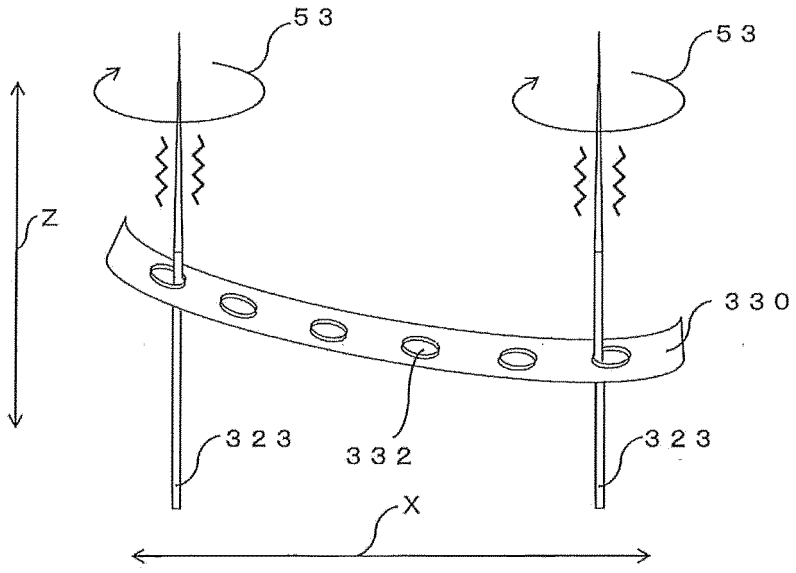

2
12
13
1
25
3
11
10
Z
330
24
31
20
323
28
22
21
7
4
X

FIG. 18


53
53
Z
330
323
332
323
X

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2016/057813

A. CLASSIFICATION OF SUBJECT MATTER
B21D43/22(2006.01)i, *B21D53/08*(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B21D43/22, B21D53/08

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2016
Kokai Jitsuyo Shinan Koho 1971-2016 Toroku Jitsuyo Shinan Koho 1994-2016

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	JP 2010-188506 A (Mitsubishi Electric Corp.), 02 September 2010 (02.09.2010), paragraph [0016]; fig. 1, 3, 5 (Family: none)	1,4-7 2-3
Y A	JP 8-132163 A (Toshiba Corp.), 28 May 1996 (28.05.1996), paragraphs [0066] to [0073]; fig. 1, 5 (Family: none)	1,4-7 2-3
Y A	JP 2-142630 A (Matsushita Refrigeration Co.), 31 May 1990 (31.05.1990), page 2, lower right, line 7 to page 3, upper left, line 13; fig. 1 (Family: none)	6-7 2-3

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

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
15 April 2016 (15.04.16)	26 April 2016 (26.04.16)
Name and mailing address of the ISA/ Japan Patent Office 3-4-3,Kasumigaseki,Chiyoda-ku, Tokyo 100-8915,Japan	Authorized officer Telephone No.

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

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Patent documents cited in the description

- JP 2015164741 A **[0003]**