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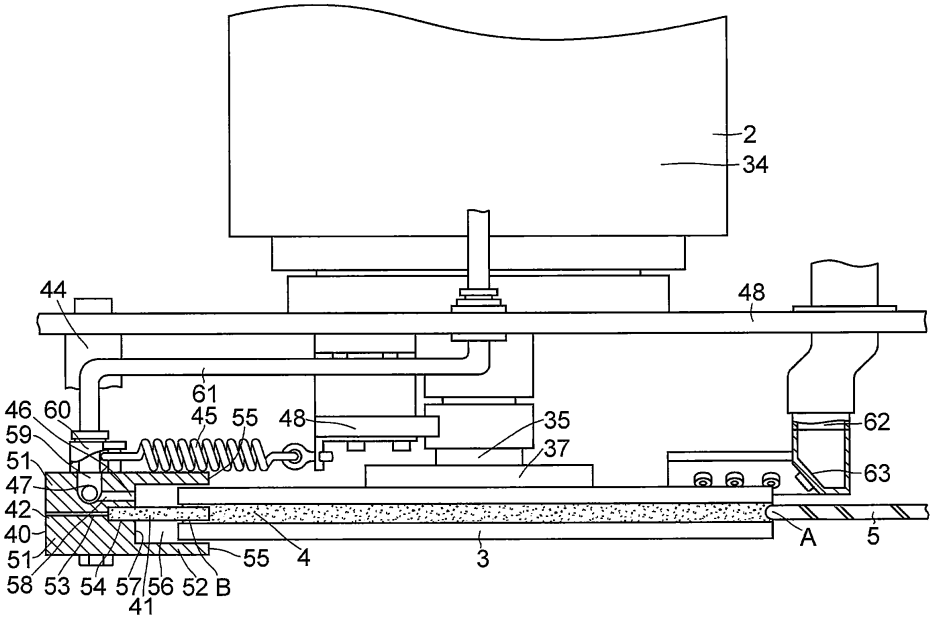
(54) GLASS PLATE GRINDING METHOD AND GRINDING DEVICE

(57) In a glass-plate grinding apparatus 1, a grinding head 2 itself is provided with a dressing device 40 holding a dresser, the dressing device 40 is disposed in correspondence with an opposite side B of a grinding wheel 3 to a grinding operation point A thereof for performing the grinding of a glass plate 5, and the dressing device 40 is adapted to effect the pressing and separation of a dresser 41 with respect to a grinding surface 4 of the grinding wheel 3 on the basis of an ON/OFF command signal.

FIG. 6



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Description

TECHNICAL FIELD

[0001] The present invention relates to a glass-plate grinding method and a grinding apparatus for grinding end faces of a glass plate by a grinding head having a grinding wheel.

[0002] Further, the present invention concerns a glass-plate grinding apparatus equipped with a dressing device for dressing a grinding wheel of a grinding head.

[0003] Furthermore, the present invention concerns a grinding method and a grinding apparatus suitable for grinding end faces of a glass plate while integrally moving a grinding head and a dressing device.

[0004] Still further, the present invention concerns a grinding method and a grinding apparatus suitable for grinding end faces of a glass plate by a grinding wheel of such as a pencil edge type.

[0005] Further, the present invention concerns a glass-plate grinding method and a grinding apparatus suitable for grinding and producing outer peripheral end faces of glass plates that are used for window glass of automobiles.

BACKGROUND ART

[0006] Conventionally, in the grinding operation of end faces of glass plates, the dressing operation of a grinding wheel is carried out in a separate process. Namely, the dressing operation is carried out by an air cylinder unit or by an operator's manual operation by applying a stick-like dresser onto the grinding surface of the grinding wheel after temporarily interrupting the grinding operation.

[0007] In addition, even if the dressing operation is carried out not by an operator's manual operation but by a dressing device constituted by an air cylinder unit or the like holding a dresser, in the case of a glass-plate grinding apparatus or the like in which the grinding head is moved to grind the peripheries of the glass plate, the dressing device is separated from the grinding head and is disposed as a separate unit at a return position or the like of the grinding head.

[0008] When the grinding head returns to and stops at a starting point or the like after having moved from the grinding operation, the dressing operation is carried out by taking extra time.

PRIOR ART DOCUMENT

PATENT DOCUMENT

[0009] Patent Document 1: JP-A-6-134669

SUMMARY OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0010] Since the conventional dressing operation is carried out in a process separate from the grinding operation, as described above, the dressing operation must be performed after temporarily interrupting the grinding operation, so that the time of interruption constitutes a loss, and the efficiency of the grinding operation as a whole is poor.

[0011] In addition, the dressing operation based on the operator's manual operation involves a problem in the light of safety.

[0012] Furthermore, with the grinding apparatus in which the grinding head moves to effect the grinding operation, the dressing operation with the grinding head returned to and stopped at the starting point or the like requires the operation of the dressing device and the dressing operation time, which constitutes a loss time, so that the efficiency in the grinding operation as a whole is poor.

[0013] Accordingly, an object of the present invention is to provide a glass-plate grinding method and a grinding apparatus which impart utterly no loss time to the grinding operation even if the dressing operation is carried out frequently.

[0014] Another object of the present invention is to provide a glass-plate grinding apparatus which is capable of performing the dressing operation of the grinding surface of the grinding wheel and of freely effecting an interruption of the dressing operation at any time and irrespective of any states of the grinding head such as whether the grinding head is engaged with the grinding operation of the glass plate, is interrupting the grinding operation, or is in the midst of movement (being returned to the starting point or is approaching the glass plate) or at a standstill during which time the grinding operation is not carried out.

MEANS FOR OVERCOMING THE PROBLEMS

[0015] A glass-plate grinding apparatus in accordance with the present invention comprises a grinding head which is provided with a dressing device holding a dresser, the dressing device is disposed in correspondence with a position on a grinding wheel different from a grinding operation position thereof for effecting the grinding of a glass plate, and the dressing device is provided so as to receive a resiliently pressing force toward a grinding surface of the grinding wheel and to advance or retreat with respect to the grinding surface of the grinding wheel, the dressing device having a water spouting port for effecting water spouting and stoppage of water spouting with respect to the grinding surface of the grinding wheel, such that when water spouting from the water spouting port is stopped, the dressing device is made to approach the grinding surface by the resiliently pressing force and

the dresser is pressed against the grinding surface, to thereby advance a dressing operation, and such that when water is spouted, the dresser is retreated from the grinding surface in opposition to the resiliently pressing force by the reaction force of water spouting and the dressing device is moved away from the grinding surface, to thereby stop the dressing operation.

[0016] In addition, a glass-plate grinding apparatus in accordance with the present invention in which a grinding head itself is provided with a dressing device holding a dresser, the dressing device is disposed in correspondence with a position on a grinding wheel different from a grinding operation position thereof for effecting the grinding of a glass plate, and the dressing device is adapted to effect the pressing and separation of the dresser with respect to a grinding surface of the grinding wheel, is characterized in that the dressing device includes: pressing means which constantly acts to press the dresser against the grinding surface; and a water spouting port provided in face-to-face relation to the grinding surface, so as to effect the separation and pressing of the dresser with respect to the grinding surface on the basis of the action of water spouting from the water spouting port and the stoppage of the water spouting in response to an ON/OFF signal.

[0017] Furthermore, in accordance with the present invention, there is provided a method of grinding a glass plate in a glass-plate grinding apparatus in which a grinding head itself is provided with a dressing device holding a dresser, the dressing device is disposed in correspondence with a position on a grinding wheel different from a grinding operation position thereof for effecting the grinding of a glass plate, and the dressing device is adapted to effect the pressing and separation of the dresser with respect to a grinding surface of the grinding wheel on the basis of an ON/OFF command signal, comprising effecting the pressing and separation of the dresser with respect to the grinding surface of the grinding wheel on the basis of an ON/OFF signal, to thereby allow the advancement of a dressing operation of the grinding surface and interruption of the dressing operation to be effected by the dressing device irrespective of any states of the grinding head such as whether the grinding head is engaged with the grinding operation of the glass plate, is interrupting the grinding operation, or is in the midst of movement or at a standstill during which time the grinding operation is not carried out.

[0018] Still further, in accordance with the present invention, there is provided a method of grinding a glass plate by a glass-plate grinding apparatus in which a grinding head itself is provided with a dressing device holding a dresser, the dressing device is disposed in correspondence with a position on a grinding wheel different from a grinding operation position thereof for effecting the grinding of a glass plate, and the dressing device is adapted to effect the pressing and separation of the dresser with respect to a grinding surface of the grinding wheel, characterized in that the dressing device includes: pressing means which constantly acts to press the dresser against the grinding surface; and a water spouting port provided in face-to-face relation to the grinding surface, so as to effect the separation and pressing of the dresser with respect to the grinding surface on the basis of the action of water spouting from the water spouting port and the stoppage of the water spouting in response to an ON/OFF signal.

[0019] It should be noted that the dresser refers to a grinding wheel for dressing.

ADVANTAGES OF THE INVENTION

[0020] According to the present invention, since the operation of pressing and separating the dresser with respect to the grinding surface of the grinding wheel is based on the water spouting and stoppage of water spouting from the dressing device holding the dresser, it is possible to adjust the pressing force of the dresser by adjustment of the amount of water spouting. In addition, the operating distance of pressing and separating the dresser with respect to the grinding surface is small, and the operation is made smooth so as to be reliable.

[0021] In addition, according to the present invention, the grinding head itself is provided with the dressing device, the dressing device is disposed in correspondence with a position on the grinding wheel different from a grinding operation position thereof for effecting the grinding of a glass plate, and the dressing device effects approach and separation with respect to the grinding surface of the grinding wheel on the basis of an ON/OFF command signal, so as to effect the dressing operation of the grinding surface by the approach and the interruption or stoppage of the dressing operation by the separation. Accordingly, it is possible to freely perform the advancing of the dressing operation of the grinding surface of the grinding wheel and stop the dressing operation at any time and irrespective of any states of the grinding head such as whether the grinding head is engaged with the grinding operation of the glass plate, is interrupting the grinding operation, or is in the midst of movement (being returned to the starting point or is approaching the glass plate) or at a standstill without performing the grinding operation.

[0022] Therefore, it is unnecessary to perform the dressing operation in a separate process, and the glass-plate grinding operation and the dressing operation can be set in a coexisting state, so that a time loss such as the temporary interruption of the grinding operation is nil, resulting in higher efficiency in the grinding operation.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023]

Fig. 1 is an explanatory overall front elevational view of a glass-plate grinding apparatus;

Fig. 2 is an explanatory cross-sectional view, taken

along line II - II, of the grinding apparatus shown in Fig. 1;

Fig. 3 is an enlarged explanatory vertical cross-sectional view of essential portions of a grinding head shown in Fig. 1;

Fig. 4 is an explanatory horizontal cross-sectional view of the essential portions of the grinding head shown in Fig. 3;

Fig. 5 is an enlarged explanatory vertical cross-sectional view of the essential portions of the grinding head shown in Fig. 3;

Fig. 6 is an explanatory cross-sectional view of a dressing device of the grinding head shown in Fig. 3;

Fig. 7 is an explanatory plan view of the dressing device shown in Fig. 6;

Fig. 8 is an explanatory rear view, partly in section, of the dressing device shown in Figs. 6 and 7;

Fig. 9 is a partly sectional explanatory plan view illustrating a glass-plate grinding apparatus in accordance with a second embodiment of the present invention; and

Fig. 10 is an explanatory plan view of the grinding head portion in the glass-plate grinding apparatus in accordance with a third embodiment of the present invention.

MODE FOR CARRYING OUT THE INVENTION

(First Embodiment)

[0024] In Figs. 1 to 8, a grinding apparatus 1 for grinding a glass plate 5 is equipped with a grinding head 2 and is adapted to effect in a sequential process the feeding of unshaped plate glass, the formation of a cut line, bend-breaking along a cut line, the grinding of an outer periphery of the bend-broken glass plate, and the discharging of the glass plate 5 with an outer periphery ground thereof.

[0025] The grinding head 2 moves together with the glass plate 5 in a planar coordinate system under numerical control, and a grinding wheel 3, while being angularly controlled so as to be oriented in a direction normal to a profile line of the glass plate 5, is moved along the outer periphery of the glass plate 5 to effect the grinding of an end face of the outer periphery of the glass plate 5.

[0026] In this grinding apparatus 1, a feeding position 7 of the glass plate 5, a cut-line forming position 8, a bend-breaking position 9, a grinding operation position 6, and a discharging position 10 are provided at fixed intervals sequentially in that order from a right-side end. A glass-plate transporting device 11 is provided in such a manner as to extend linearly above the respective positions 7, 8, 9, 6, and 10, and the glass plate 5 is sequentially sent from the feeding position 7 to the respective positions 8, 9, 6, and 10 by the glass-plate transporting device 11.

[0027] A cutter head 69 and a support table 68 for supporting the glass plate 5 are equipped in the cut-line forming position 8, a bend-breaking head 67 is equipped in the bend-breaking position 9, and the grinding head 2 and a suction table unit 15 for sucking the glass plate 5 are equipped in the grinding operation position 6. In the grinding apparatus 1, an X-axis mount 71 is installed on the front side in such a manner as to extend linearly above the respective positions 7, 8, 9, 6, and 10, and an X-axis moving means 12 is provided on the front side of this X-axis mount 71. The X-axis moving means 12 has on a front side thereof a moving base 13 which undergoes X-axis movement under numerical control. On the moving base 13, the cutter head 69 and the grinding head 2 are installed in a suspended manner in correspondence with the cut-line forming position 8 and the grinding operation position 6, respectively, by means of their respective angle controlling means 17.

[0028] Accordingly, the cutter head 69 and the grinding head 2 commonly use the moving base 13, which undergoes X-axis movement and, hence, the X-axis moving means 12, and effect X-axis movement in an integral manner.

[0029] The cutter head 69 and the grinding head 2 are respectively mounted on the moving base 13 via the angle controlling means 17, and the respective angle controlling means 17 undergoes angle controlled operation under synchronous control, so that the cutter head 69 and the grinding head 2 synchronously and concurrently undergo angle controlled rotation.

[0030] In the cut-line forming position 8, a Y-axis moving means 14 is disposed on a machine base 72 perpendicularly to the X-axis moving means 12, and the support table 68 for supporting the glass plate 5 is mounted on the Y-axis moving means 14 and undergoes Y-axis movement. In the grinding operation position 6, the Y-axis moving means 14 is similarly disposed on the machine base 72 perpendicularly to the X-axis moving means 12, and the suction table unit 15 for sucking the glass plate 5 is mounted on the Y-axis moving means 14 and undergoes Y-axis movement. The Y-axis moving means 14 in the cut-line forming position 8 and the grinding operation position 6 are driven under synchronous control, with the result that the support table 68 in the cut-line forming position and, hence, the supported glass plate 5, as well as the suction table unit 15 in the grinding operation position 6 and, hence, the sucked glass plate 5, synchronously and concurrently undergo Y-axis movement.

[0031] The cutter head 69 and the glass plate 5 in the cut-line forming position 8 and the grinding head 2 and the glass plate 5 in the grinding operation position 6 synchronously and concurrently undergo both planar coordinate system movement under numerical control and angle controlled rotation of the cutter head 69 and the grinding head 2. The formation of a contour cut line of the glass plate 5 is effected in the cut-line forming position 8, while the grinding of an end face of the outer periphery of the glass plate 5 is effected in the grinding operation position 6.

[0032] The X-axis moving means 12 consists of a guide rail 18 laid on the front surface of the X-axis mount 71, the moving base 13 which is held by the guide rail 18 and is movable in the X-axis direction, a feed screw 19 for causing this moving base 13 to effect X-axis movement, and an X-axis servo motor 20 for driving the feed screw 19.

[0033] As shown in Fig. 2, the Y-axis moving means 14 in the grinding operation position 6 is equipped with a guide rail 21 laid on an upper surface of the machine base 72 along the Y-axis direction, the suction table unit 15 which is held by the guide rail 21 and is movable in the Y-axis direction, a feed screw 22 for causing the suction table unit 15 to effect Y-axis movement, and a Y-axis servo motor 23 for driving the feed screw 22, and a plurality of suction pads 16 are disposed on the upper surface of the suction table unit 15. The glass plate 5 carried into the grinding operation position 6 is placed horizontally on the supper surfaces of the suction pads 16, is sucked, and undergoes Y-axis movement together with the suction table unit 15.

[0034] The angle controlling means 17, which is mounted on the moving base 13 of the X-axis moving means 12 to effect the angle controlled rotation of the grinding head 2, has a rotating shaft 24 and is equipped with a bearing device 25 for holding the rotating shaft 24 horizontally rotatably, an angle controlling servo motor 26 coupled to an upper end portion of the rotating shaft 24 through engagement by spur gears, and a bracket 28 for mounting the grinding head 2 to a lower end portion 27 of the rotating shaft 24 so that the grinding head 2 is horizontally rotated integrally with the rotating shaft 24.

[0035] The angle controlling means 17 is mounted, at the bearing device 25, on the moving base 13 which undergoes X-axis movement. The rotating shaft 24 is incorporated such that an axis 36 thereof is perpendicular to an X-Y planar coordinate system, i.e., to the upper surface of the glass plate 5.

[0036] The grinding head 2 is mounted on the bracket 28 which clamps the rotating shaft 24 from sideways and fixes it at the lower end portion 27 of the rotating shaft 24.

[0037] The grinding head 2 is equipped with an X-direction bracket 29 which is firmly mounted on the bracket 28 at the lower end portion 27 of the rotating shaft 24 in a suspended manner, an X-direction slide unit 30 mounted on the X-direction bracket 29, a Y-direction bracket 31 mounted on the X-direction slide unit 30, a Y-direction slide unit 32 provided on the Y-direction bracket 31, a vertical slide unit 33 mounted on the Y-direction slide unit 32, a spindle motor 34 mounted on the vertical slide unit 33 along the vertical direction, the grinding wheel 3 installed on a rotating shaft 35 of the spindle motor 34 via a mounting disk 37, and a cover bracket 48 protruding from both the spindle motor 34 and the vertical slide unit 33 in such a manner as to surround the grinding wheel 3 excluding a grinding operation portion thereof.

[0038] The grinding head 2 is mounted on the rotating shaft 24 of the angle controlling means 17 and is rotated horizontally integrally with the rotating shaft 24 such that an angle thereof is controlled with the axis 36 of the rotating shaft 24 as a center.

[0039] A portion where an extension line of the axis 36 and a grinding surface 4 of the grinding wheel 3 intersect is a grinding operation point A. The grinding wheel 3 is rotated (oscillated) with an angle thereof controlled with the grinding operation point A as a center, and grinds the periphery of the glass plate 5 while moving the circumferential portion of the glass plate 5 at the grinding operation point A such that the center of rotation of the grinding wheel 3 is located in a direction normal to a contour line (programmed contour line) of the glass plate 5.

[0040] The grinding head 2 is equipped with a dressing device 40 in correspondence with an opposite side B of the grinding wheel 3 to the grinding operation point A thereof for grinding the glass plate 5, so as to effect the dressing operation of the grinding surface 4 of the grinding wheel 3. Instead of being equipped with the dressing device 40 in correspondence with the opposite side B, the grinding head 2 may be equipped with the dressing device 40 in correspondence with another position, i.e., a position different from the grinding operation point A.

[0041] The dressing device 40 holding a dresser 41 approaches the grinding surface 4 of the grinding wheel 3 in response to an operation based on an ON command signal, continues to approach it, and moves away from the grinding surface 4 in response to an operation based on an OFF command signal.

[0042] In an approach thereof to the grinding wheel 3 and, hence, the grinding surface 4, the dressing device 40 advances the dressing operation by pressing against the grinding surface 4 the dresser 41 which it holds, whereas, in a movement thereof away from the grinding surface 4, the dressing device 40 interrupts or stops the dressing operation by moving the dresser 41 away from the grinding surface 4.

[0043] In this embodiment, to cause the dressing device 40 to approach or move away from the grinding surface 4 of the grinding wheel 3 means to cause a dresser holder 42 and a main body 43 of the dressing device 40 to approach or move away from the same. The dresser 41 clamped by the dresser holder 42 is thereby pressed against or moved away from the grinding surface 4.

[0044] The dressing device 40 is composed of the dresser holder 42 for clamping a root portion of the stick-like dresser 41 in a state in which the dresser 41 projects toward the grinding surface 4 of the wheel 3; the main body 43 to a distal end of which the dresser holder 42 is bolted; a pivotally supporting device 44 for holding the dresser holder 42 in the main body 43 so as to allow the dresser holder 42 to undergo swinging rotation in such a manner as to be freely movable back and forth with respect to the grinding surface 4 of the grinding wheel 3; a tension coil spring 45 stretched between the main body 43 and the cover bracket 48 fixed to the spindle motor 34, so as to resiliently press the dresser 41 of the dresser holder 42 against the grinding surface 4 of the grinding

wheel 3; a separating device 47 for the dresser 41 which effects water spouting with respect to the outer periphery of the grinding wheel 3 from a water spouting port 46 provided in the dresser holder 42, so as to separate, in opposition to the tension spring force of the tension coil spring 45, the dresser 41 pressed against the grinding surface 4 of the grinding wheel 3; a switching valve (not shown) for switching between water spouting and the stopping of water spouting in the separating device 47; and an output device (not shown) for outputting ON/OFF command signals for opening or closing this switching valve. The switching valve is so configured as to be set in the "closed" state by an ON command signal and to be set in the "open" state by an OFF command signal.

[0045] In a state in which the ON command signal is outputted, water spouting from inside a U-shaped chamber 56 of the dresser holder 42 is stopped, whereupon the dresser holder 42 is drawn toward and approaches the grinding wheel 3 by the tension coil spring force of the tension coil spring 45, and the dresser 41 is pressed against the grinding surface 4.

[0046] In a state in which the OFF command signal is outputted, water spouting from inside the U-shaped chamber 56 occurs, so that the dresser holder 42 is moved away from the grinding wheel 3 in opposition to the tensile force of the tension coil spring 45 by the reaction force hydraulic pressure of water spouting, causing the dresser 41 to move away from the grinding surface 4.

[0047] The pivotally supporting device 44, which swingingly rotatably holds the dresser holder 42 and the main body 43 which are integrated by bolting, has a shaft 49 which protrudes downwardly from the cover bracket 48 fixed to the spindle motor 34, and the main body 43 is mounted on a lower end portion of the shaft 49 by means of a sliding bush or a bearing. A stopper 50 is adapted to come into contact with the main body 43 and prevents any further rotation of the main body 43 so as to prevent excessive approaching of the dresser holder 42 and the main body 43 toward the grinding wheel 3.

[0048] The dresser holder 42 is constituted by a pair of upper and lower stepped pressers 51 which are combined together. The clamping of the dresser 41 is effected by inserting a base portion of the dresser 41 between the pair of upper and lower stepped pressers 51 and by bolting the upper and lower stepped pressers 51.

[0049] Each of the stepped pressers 51 has an L-shaped configuration, in which an outer surface is formed into a flat surface, while an inner side is formed into a low stepped surface portion 52 and a high stepped surface portion 53, and a recessed step 54 conforming to the width of the stick-like dresser 41 is formed in the high stepped surface portion 53.

[0050] The combining of the upper and lower stepped pressers 51 with the dresser 41 clamped therebetween is effected by inserting the base portion of the dresser 41 between the recessed steps 54 of the respective stepped pressers 51 and by causing the respective high stepped surface portions 53 to oppose each other and to be combined. In the formed dresser holder 42, the U-shaped chamber 56 is formed which has wall bodies 55 at the upper and lower positions on the front side and has an opening at the front. The upper and lower wall bodies 55 for forming the U-shaped chamber 56 are respectively formed by the low stepped portions 52 of the stepped pressers 51.

[0051] A bottom wall 57 of the U-shaped chamber 56 is formed by front faces of the respective high stepped surface portions 53 of the stepped pressers 51.

[0052] The dresser 41 is positioned in the U-shaped chamber 56 in such a manner as to protrude from the bottom wall 57 in parallel with the upper and lower wall bodies 55 and at an intermediate position from the upper and lower wall bodies 55.

[0053] The water spouting port 46, from which water is spouted, is open at the bottom wall 57 of the U-shaped chamber 56 formed by the fastening of the upper and lower stepped pressers 51 in an inwardly opposing manner.

[0054] The water spouting port 46 communicates with a through hole 58 provided in one stepped presser 51 and further with a through hole 59 provided in the main body 43.

[0055] The through hole 59 in the main body 43 is open in the upper surface of the main body 43, and is connected to a water supply pump (not shown) by means of a pipe joint 60 threadedly secured to the opening portion and a hose 61 connected to the pipe joint 60 and via a switching valve (not shown) installed outside the grinding head 2.

[0056] The separating device 47, which separates the dresser 41 pressed against the grinding surface 4 of the grinding wheel 3 and, hence, the dresser holder 42 in opposition to the tension spring force of the tension coil spring 45 when the dresser 41 of the dressing device 40 is moved away from the grinding surface 4 to stop the dressing operation, consists of the water spouting port 46 of the dresser holder 42, the through hole 58 provided in one stepped presser 51, the through hole 59 provided in the main body 43, the pipe joint 60, the hose 61, the switching valve, and the water supply pump.

[0057] The movement of the dresser 41 away from the grinding surface 4 and the maintenance of the state of being moved away are effected by applying spouted water from the dressing device 40 itself to the grinding wheel 3. In addition, by weakening the spouting force of water, it is possible to perform the dressing operation in a state of floating in water.

[0058] A grinding fluid supplying device 62 for supplying a grinding fluid to the grinding operation point A of the grinding wheel 3 is provided on the grinding operation side of the glass plate 5.

[0059] The grinding fluid supplying device 62 has grinding fluid spraying portions 63, and the grinding fluid spraying portions 63 are mounted on the cover bracket 48. It goes without saying that the grinding fluid spraying

portions 63 are connected to a pump (not shown) via a hose and the like.

[0060] According to the grinding apparatus 1, the grinding head 2 itself is provided with the dressing device 40 holding the dresser, the dressing device 40 is disposed in correspondence with the opposite side B of the grinding wheel 3 to the grinding operation point A thereof for performing the grinding of the glass plate 5, and the dressing device 40 is adapted to effect the pressing and separation of the dresser 41 with respect to the grinding surface 4 of the grinding wheel 3 on the basis of an ON/OFF command signal; therefore, at any time irrespective of any states of the grinding head 2 such as whether the grinding head 2 is engaged with the grinding operation of the glass plate 5, or is in the midst of movement or at a standstill during which time the grinding operation is not carried out, it is possible to proceed with the dressing operation of the grinding surface 4 of the grinding wheel 3 and to interrupt and stop the dressing operation.

[0061] Namely, since it is possible to concurrently proceed with the dressing operation of the grinding surface 4 of the grinding wheel 3 in the rear while the grinding operation of the glass plate 5 is proceeding at the front portion of the grinding wheel 3, the grinding operation of the glass plate 5 and the dressing operation can be simultaneously set in a coexisting state. Since the dressing operation can be performed freely even during pauses in the grinding operation by the grinding head 2, which necessarily exist in a series of grinding processes, and during the unloaded movement and stoppage of the grinding head 2, the dressing operation of another process is not required.

[0062] Accordingly, the loss time which is incurred due to such as the interruption of the grinding operation and the extension of other operation time can be eliminated, so that the grinding efficiency improves. In addition, since the timing for adjusting, starting, and interrupting the continuing time of the dressing operation can be freely and appropriately can be set irrespective of such as whether the grinding operation is being performed or the grinding head 2 is being moved, the grinding surface 4 can be refreshed at any time, and wasteful consumption of the dresser 41 can be avoided.

(Second Embodiment)

[0063] In Fig. 9, a grinding apparatus 100 having a grinding head 102 in accordance with the present invention includes a table unit 80 which sucks the glass plate 5 on an upper surface thereof and rotates horizontally and the grinding head 102 which undergoes linearly advancing and retreating movement with respect to the table unit 80 from sideways. The table unit 80 is adapted to rotate horizontally under numerical control, and the grinding head 102 is adapted to undergo linearly advancing and retreating movement under numerical control and effect the grinding of an end face of the glass plate 5 by causing a grinding surface 104 of a grinding wheel 103 of the grinding head 102 to follow a peripheral edge 101 of the glass plate 5.

[0064] The grinding head 102 is mounted via a vertical slide unit 88 on a moving base 84 of a linearly moving means 83 which is provided on a frame 89 installed in such a manner as to extend from above a side of the table unit 80 to above the table unit 80.

[0065] The linearly moving means 83 consists of a guide rail 85 laid on the frame 89, the moving base 84 which is held by the guide rail 85 and is linearly movable, a feed screw 86 for moving the moving base 84, and a servo motor 87 for driving the feed screw 86.

[0066] The table unit 80 is installed on a machine base 90 and is connected to an output shaft of a rotary device 81 coupled to the servo motor.

[0067] The grinding head 102 includes a spindle motor 106 and the grinding wheel 103 mounted on a lower end portion of a rotating shaft (not shown) of the spindle motor 106 by means of an adapter (not shown).

[0068] The grinding head 102 is mounted, at the spindle motor 106, on the moving base 84 by means of the vertical slide unit 88. The spindle motor 106 has the grinding wheel 103 at a lower portion thereof and is mounted along the vertical direction, and the grinding wheel 103 has a horizontal posture and is positioned in the same plane as that of the glass plate 5.

[0069] A cover bracket 105 is fixed to the spindle motor 106. The cover bracket 105 has a substantially identical structure to that of the cover bracket 48 fixed to the spindle motor 34 in the grinding apparatus 1 in accordance with the first embodiment.

[0070] The grinding head 102 is equipped with a dressing device 108 in correspondence with an opposite side D of the grinding wheel 103 to a grinding operation side C thereof for grinding the glass plate 5, so as to effect the dressing operation of the grinding surface 104 of the grinding wheel 103.

[0071] The dressing device 108 holding a dresser 109 approaches the grinding surface 104 of the grinding wheel 103 in response to an operation based on an ON command signal, and moves away from the grinding surface 104 in response to an operation based on an OFF command signal.

[0072] In an approach thereof to the grinding surface 104, the dressing device 108 effects the dressing operation by pressing against the grinding surface 104 the dresser 109 which it holds, whereas, in an movement thereof away from the grinding surface 104, the dressing device 108 interrupts or stops the dressing operation by moving the dresser 109 away from the grinding surface 104.

[0073] The mechanism and operation of the dressing device 108 are identical to those of the dressing device 40 in accordance with the first embodiment, and the mounting relationship between the dressing device 108 and the cover bracket 105 is also identical to that in the first embodiment.

(Third Embodiment)

[0074] In Fig. 10, in a grinding apparatus 110 having a grinding head 112 in accordance with the present invention, the glass plate 5 is linearly transported in a state in which the glass plate 5 is clamped by belt conveyors from above and below or in a state in which a lower surface thereof is sucked by suction pads which suck, and a side end face of the glass plate 5 is adapted to be linearly ground by the grinding head 112, which is disposed fixedly laterally of the glass plate 5 being linearly transported, and, hence, by a grinding wheel 113.

[0075] The side end face of the glass plate 5 linearly passes alongside a front portion G of the grinding head 112 and, hence, the grinding wheel 113, and the grinding wheel 113 at the front portion G linearly grinds the side end face of the glass plate 5.

[0076] The grinding head 112 includes a spindle motor 115 and the grinding wheel 113 mounted on a lower end portion (not shown) of a rotating shaft (not shown) of the spindle motor 115.

[0077] The grinding head 112 is mounted, at the spindle motor 115, on a rising block 119, which is disposed uprightly on a machine base 118, by means of a feeding slide unit 111 and a vertical slide unit 116.

[0078] The spindle motor 115 is mounted along the vertical direction with the grinding wheel 113 set on the lower side. The grinding wheel 113 is set in a horizontal posture.

[0079] A cover bracket 122 is fixed to the spindle motor 115. The cover bracket 122 has a substantially identical structure to that of the cover bracket 48 fixed to the spindle motor 34 in the grinding apparatus 1 in accordance with the first embodiment.

[0080] The grinding wheel 113 at the front portion G is brought into contact with the side end portion of the glass plate 5 which moves straightly forward, and the front portion G is a grinding operation point E which is a point at which the grinding operation is performed.

[0081] The grinding head 112 is equipped with a dressing device 120 in correspondence with an opposite side F of the grinding wheel 113 to a grinding operation point E thereof for grinding the glass plate 5, so as to effect the dressing operation with respect to a grinding surface 114 of the grinding wheel 113.

[0082] The dressing device 120 holding a dresser 121 is adapted to approach the grinding surface 114 of the grinding wheel 113 in response to an operation based on an ON command signal, and to move away from the grinding surface 114 in response to an operation based on an OFF command signal.

[0083] In an approach thereof to the grinding surface 114, the dressing device 120 effects the dressing operation by pressing against the grinding surface 114 the dresser 121 which it holds, whereas, in a movement thereof away from the grinding surface 114, the dressing device 120 interrupts or stops the dressing operation.

[0084] The mechanism and operation of the dressing device 120 are identical to those of the dressing device 40 in accordance with the first embodiment, and the mounting relationship between the dressing device 120 and the cover bracket 122 is also identical to that in the first embodiment.

DESCRIPTION OF REFERENCE NUMERALS

[0085]

1: grinding apparatus
5: glass plate

Claims

1. A glass-plate grinding apparatus comprising a grinding head which is provided with a dressing device holding a dresser, said dressing device is disposed in correspondence with a position on a grinding wheel different from a grinding operation position thereof for effecting the grinding of a glass plate, and said dressing device is provided so as to receive a resiliently pressing force toward a grinding surface of said grinding wheel and to advance or retreat with respect to the grinding surface of said grinding wheel, said dressing device having a water spouting port for effecting water spouting and stoppage of water spouting with respect to the grinding surface of said grinding wheel, such that when water spouting from said water spouting port is stopped, said dressing device is made to approach the grinding surface by the resiliently pressing force and said dresser is pressed against the grinding surface, to thereby advance a dressing operation, and such that when water is spouted, said dresser is retreated from the grinding surface in opposition to the resiliently pressing force by the reaction force of water spouting and said dressing device is moved away from the grinding surface, to thereby stop the dressing operation.

2. A glass-plate grinding apparatus in which a grinding head itself is provided with a dressing device holding a dresser, said dressing device is disposed in correspondence with a position on a grinding wheel different from a grinding operation position thereof for effecting the grinding of a glass plate, and said dressing device is adapted to effect the pressing and separation of said dresser with respect to a grinding surface of said grinding wheel, said dressing device including: pressing means which constantly acts to press said dresser against the grinding surface; and a water spouting port provided in face-to-face relation to the grinding surface, so as to effect the separation and pressing of said dresser with respect to the grinding surface on the basis of the action of water spouting from said water spouting port and the stoppage of the water spouting in response to an

ON/OFF signal.

3. A method of grinding a glass plate in a glass-plate grinding apparatus in which a grinding head itself is provided with a dressing device holding a dresser, said dressing device is disposed in correspondence with a position on a grinding wheel different from a grinding operation position thereof for effecting the grinding of a glass plate, and said dressing device is adapted to effect the pressing and separation of said dresser with respect to a grinding surface of said grinding wheel on the basis of an ON/OFF command signal, comprising effecting the pressing and separation of said dresser with respect to the grinding surface of said grinding wheel on the basis of an ON/OFF signal, to thereby allow the advancement of a dressing operation of the grinding surface and interruption of the dressing operation to be effected by said dressing device irrespective of any states of said grinding head such as whether said grinding head is engaged with the grinding operation of the glass plate, is interrupting the grinding operation, or is in the midst of movement or at a standstill during which time the grinding operation is not carried out.

4. A method of grinding a glass plate in a glass-plate grinding apparatus in which a grinding head itself is provided with a dressing device holding a dresser, said dressing device is disposed in correspondence with a position on a grinding wheel different from a grinding operation position thereof for effecting the grinding of a glass plate, and said dressing device is adapted to effect the pressing and separation of said dresser with respect to a grinding surface of said grinding wheel, said dressing device including:

    pressing means which constantly acts to press said dresser against the grinding surface;
    and a water spouting port provided in face-to-face relation to the grinding surface, so as to effect the separation and pressing of said dresser with respect to the grinding surface on the basis of the action of water spouting from said water spouting port and the stoppage of the water spouting in response to an ON/OFF signal.

FIG. 1

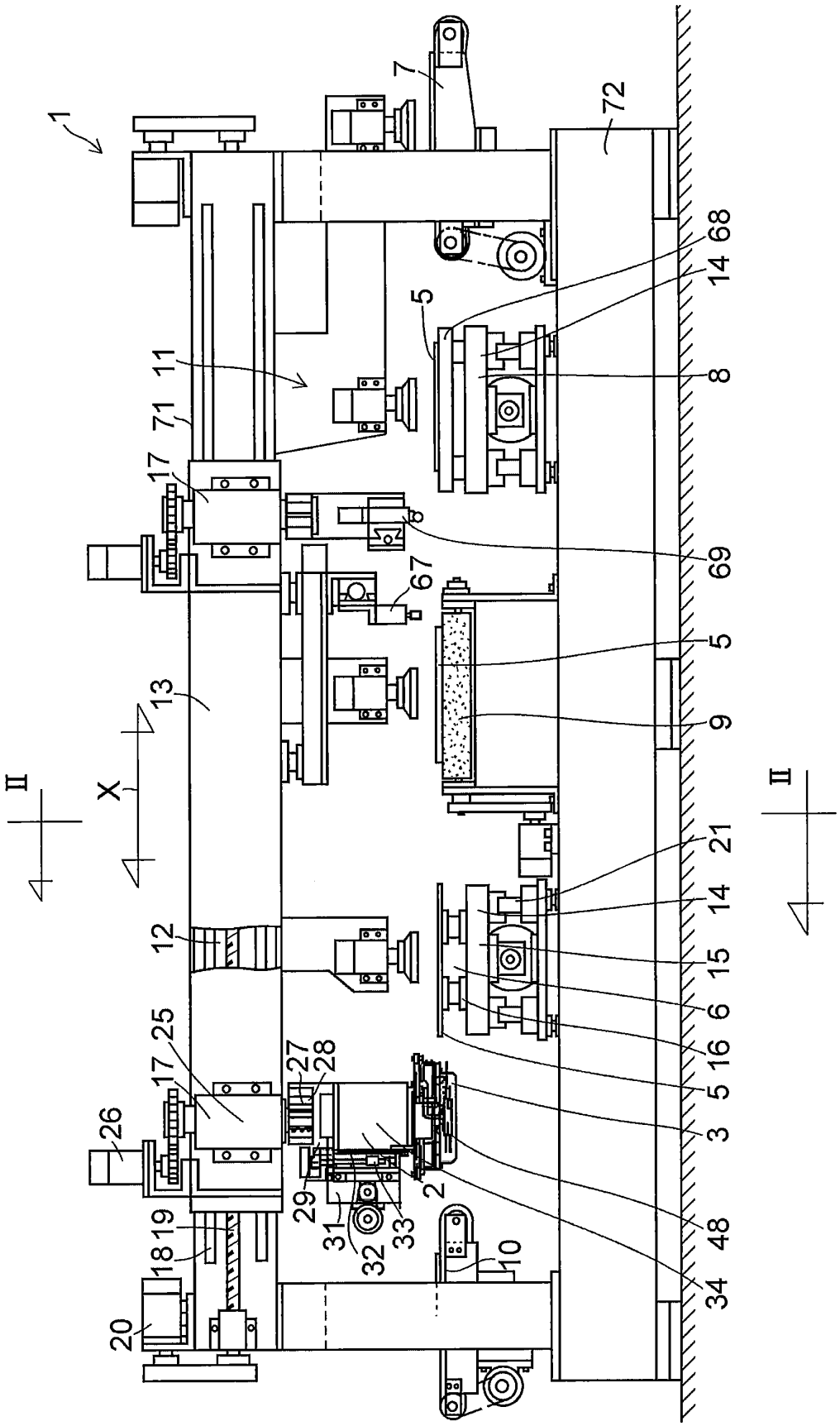
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FIG. 2

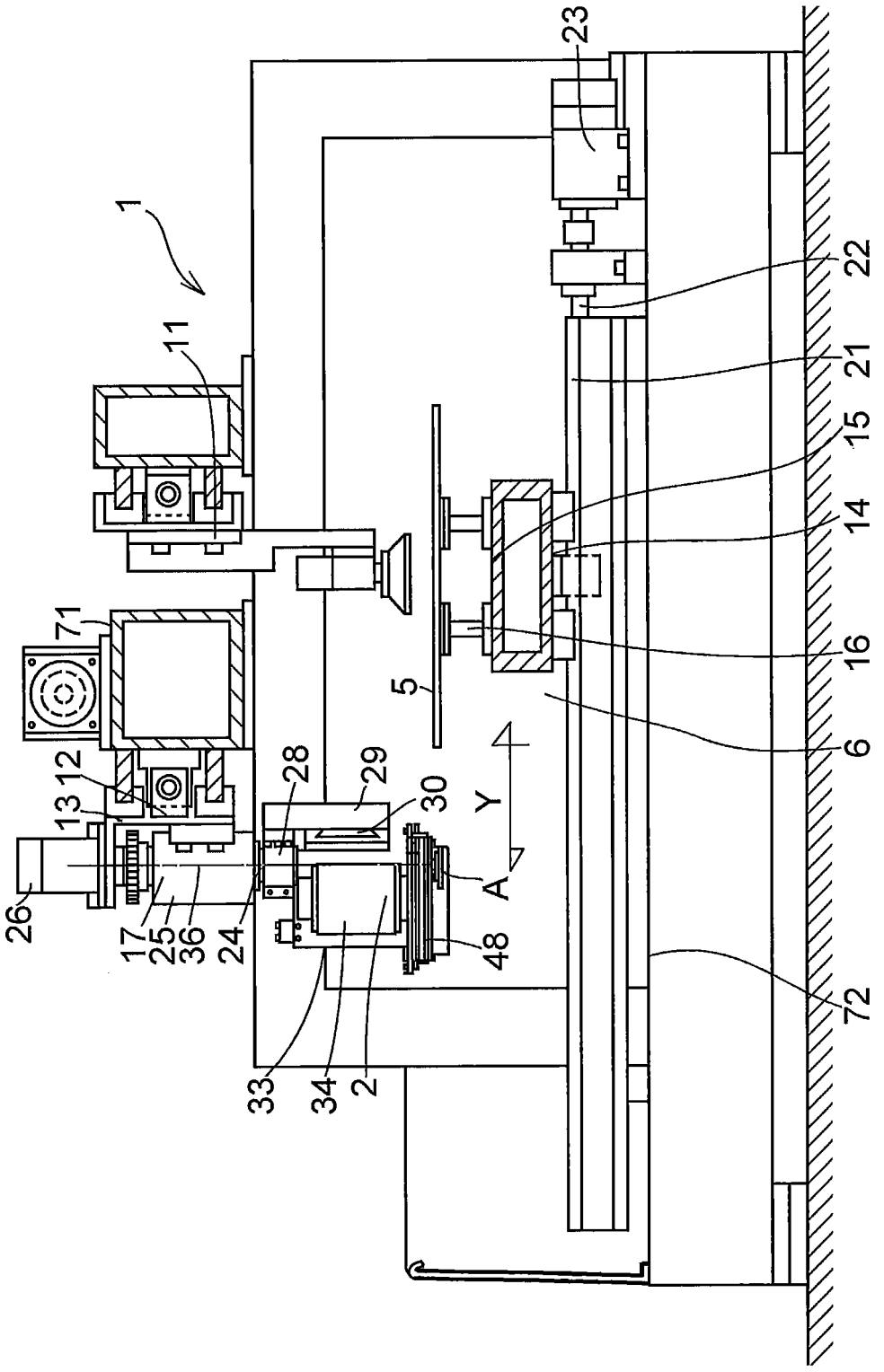
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FIG. 3

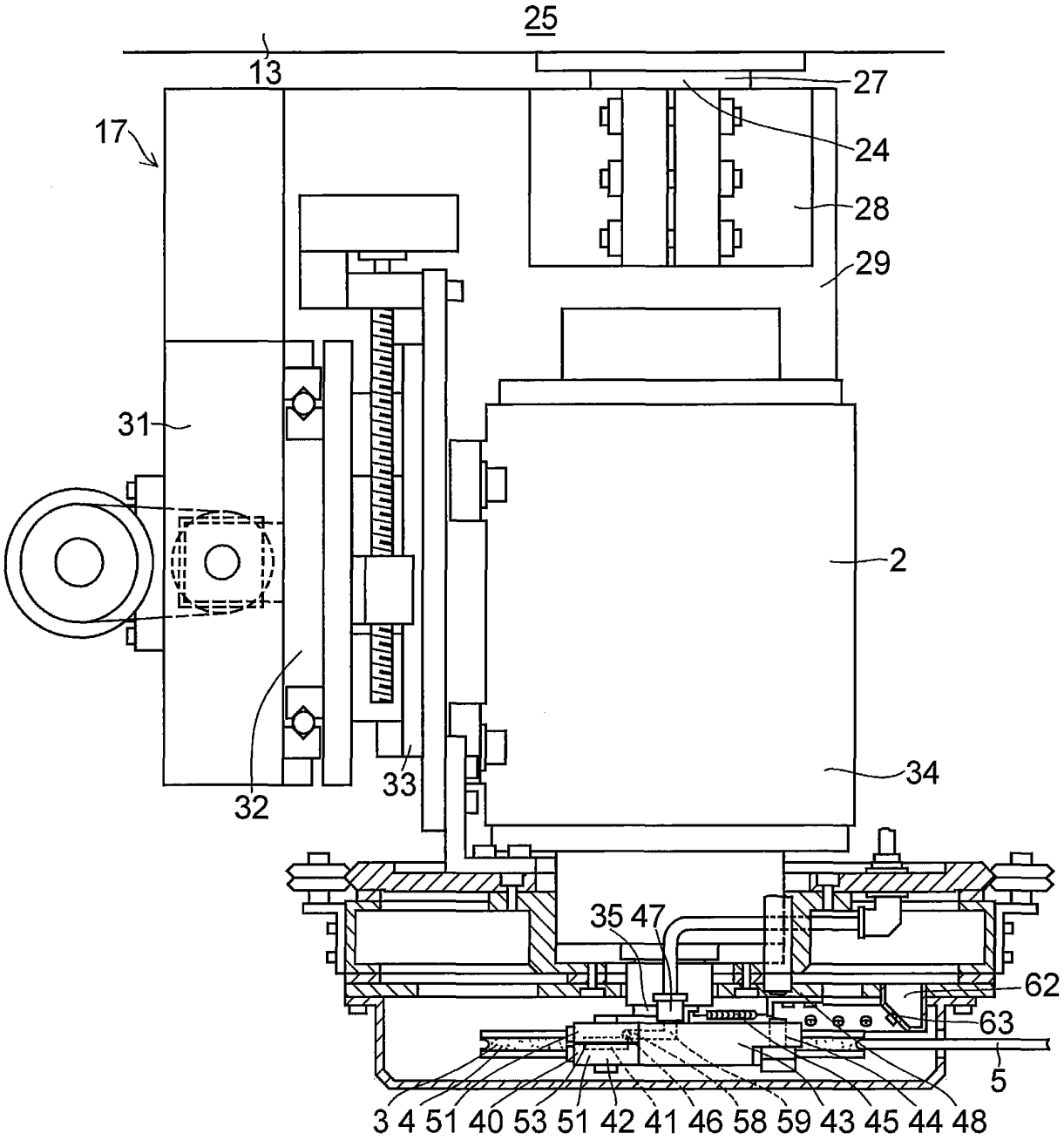
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FIG. 4

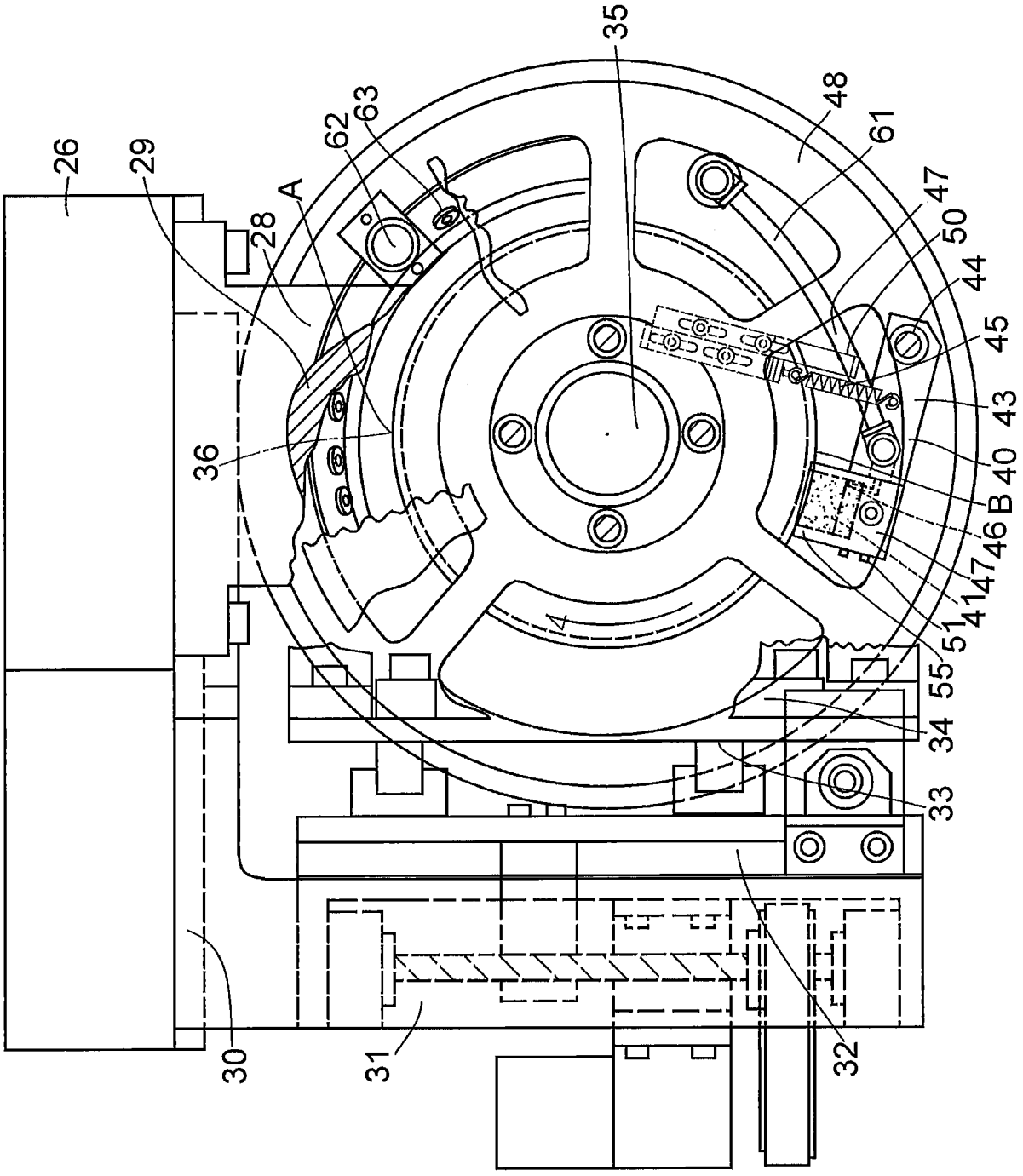
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FIG. 5

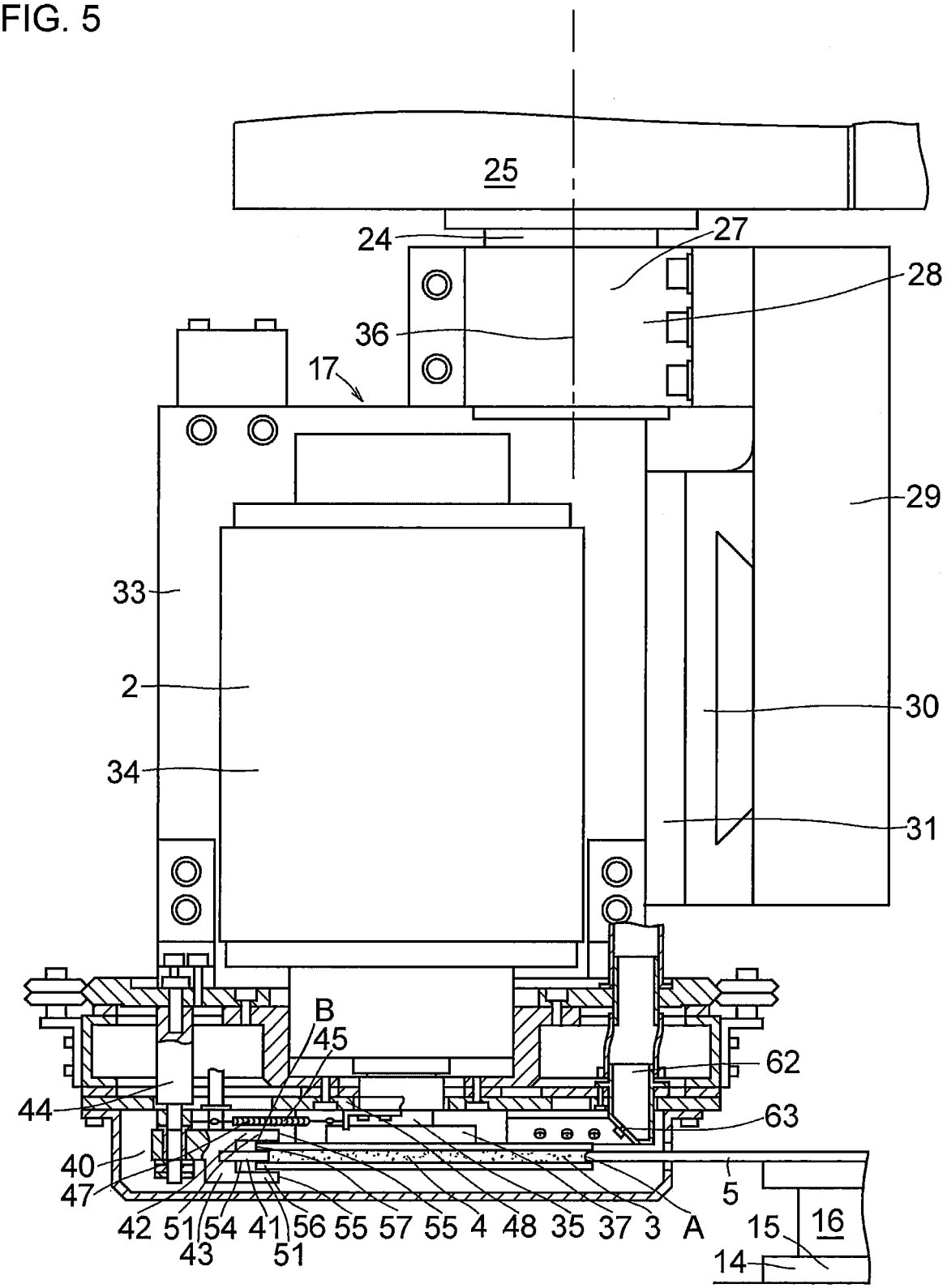
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FIG. 6

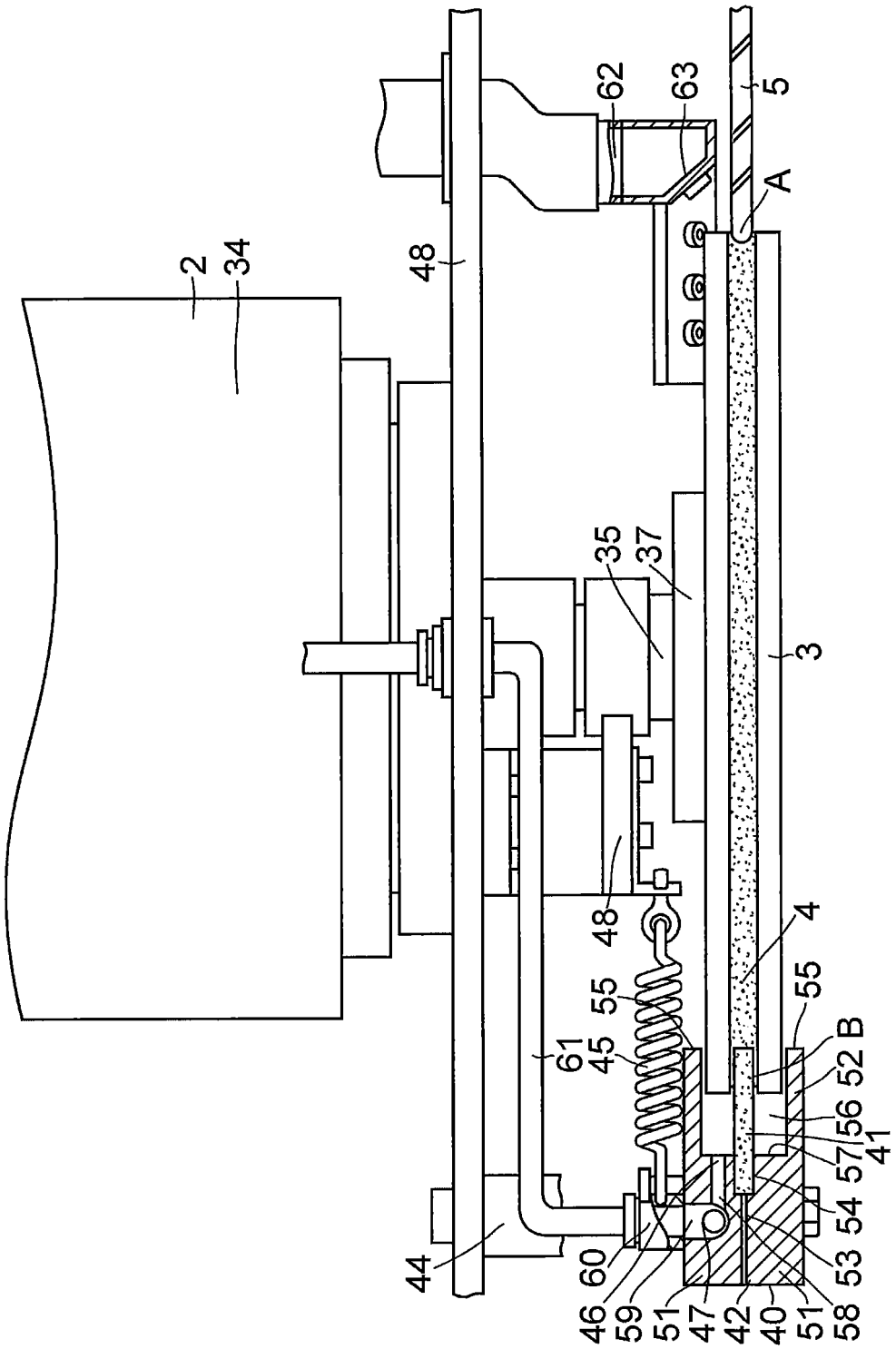
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FIG. 7

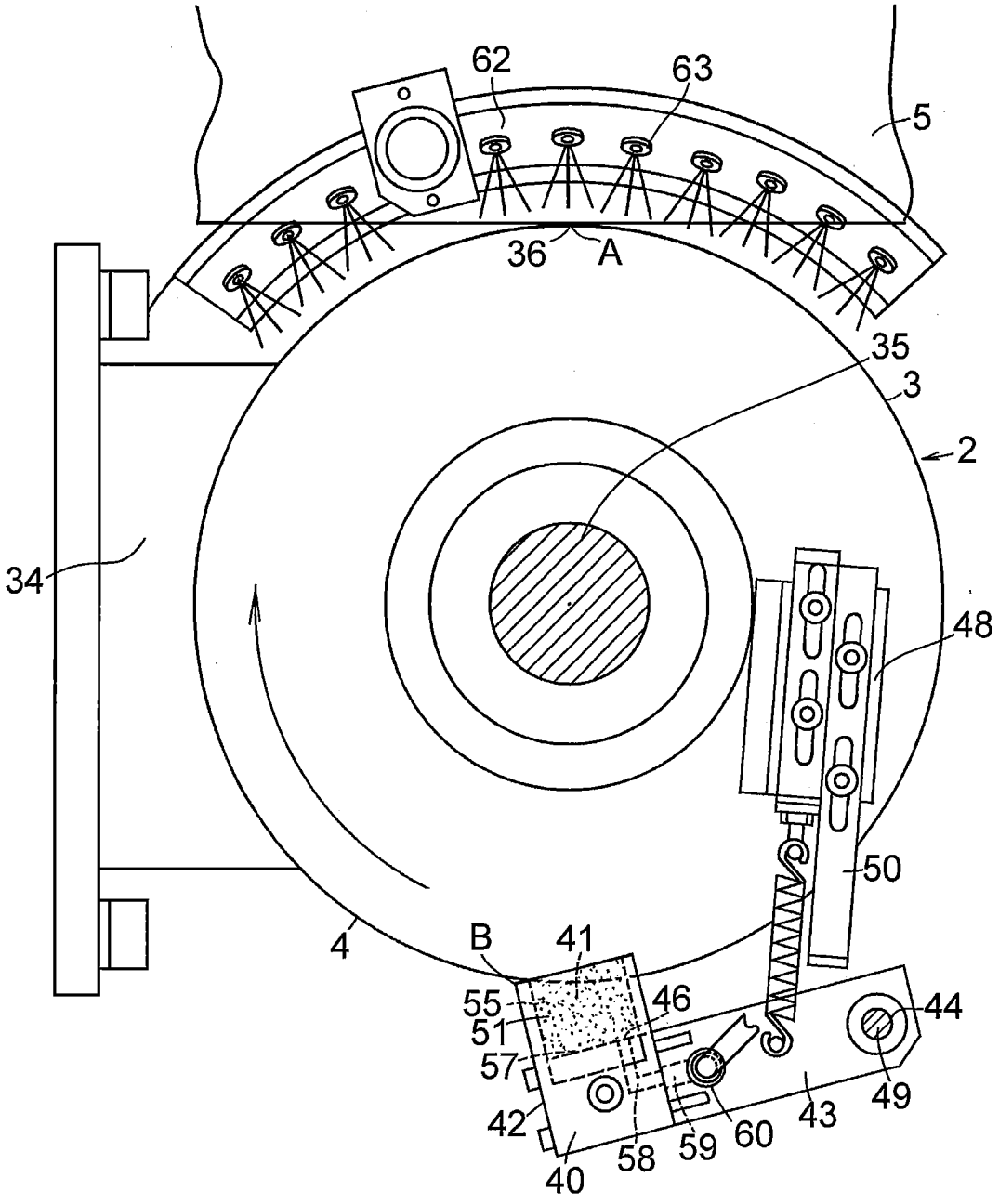


FIG. 8

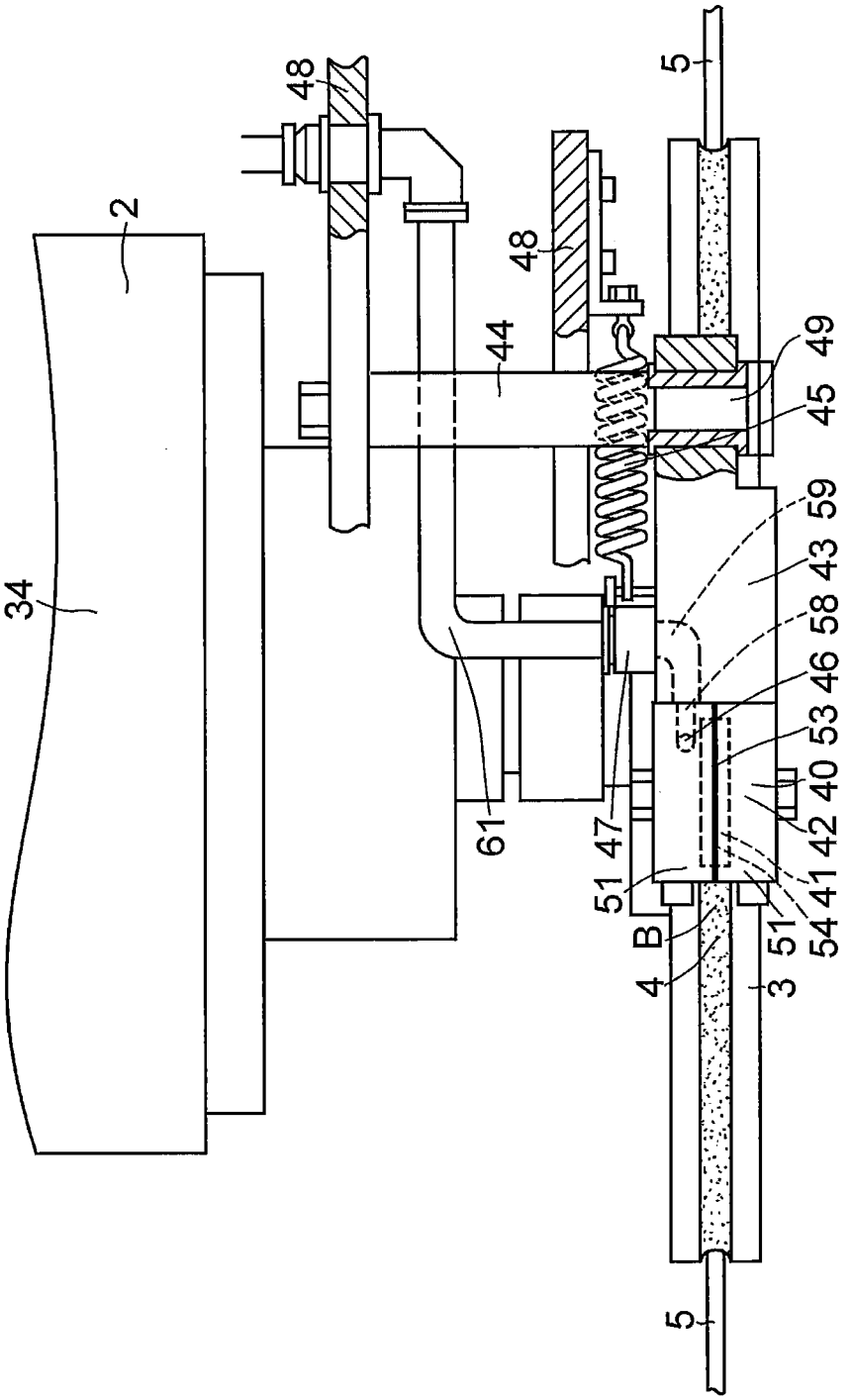
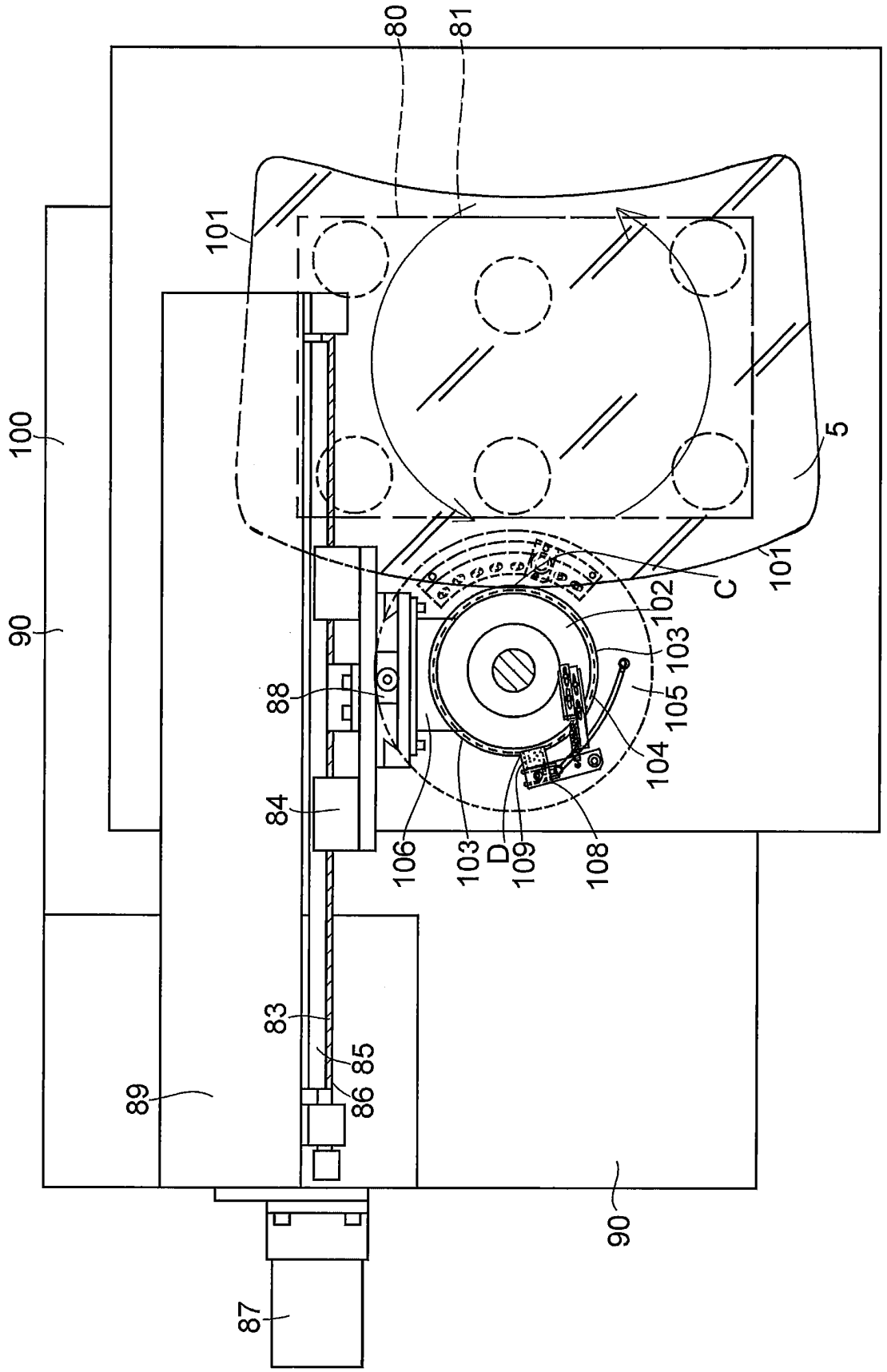


FIG. 9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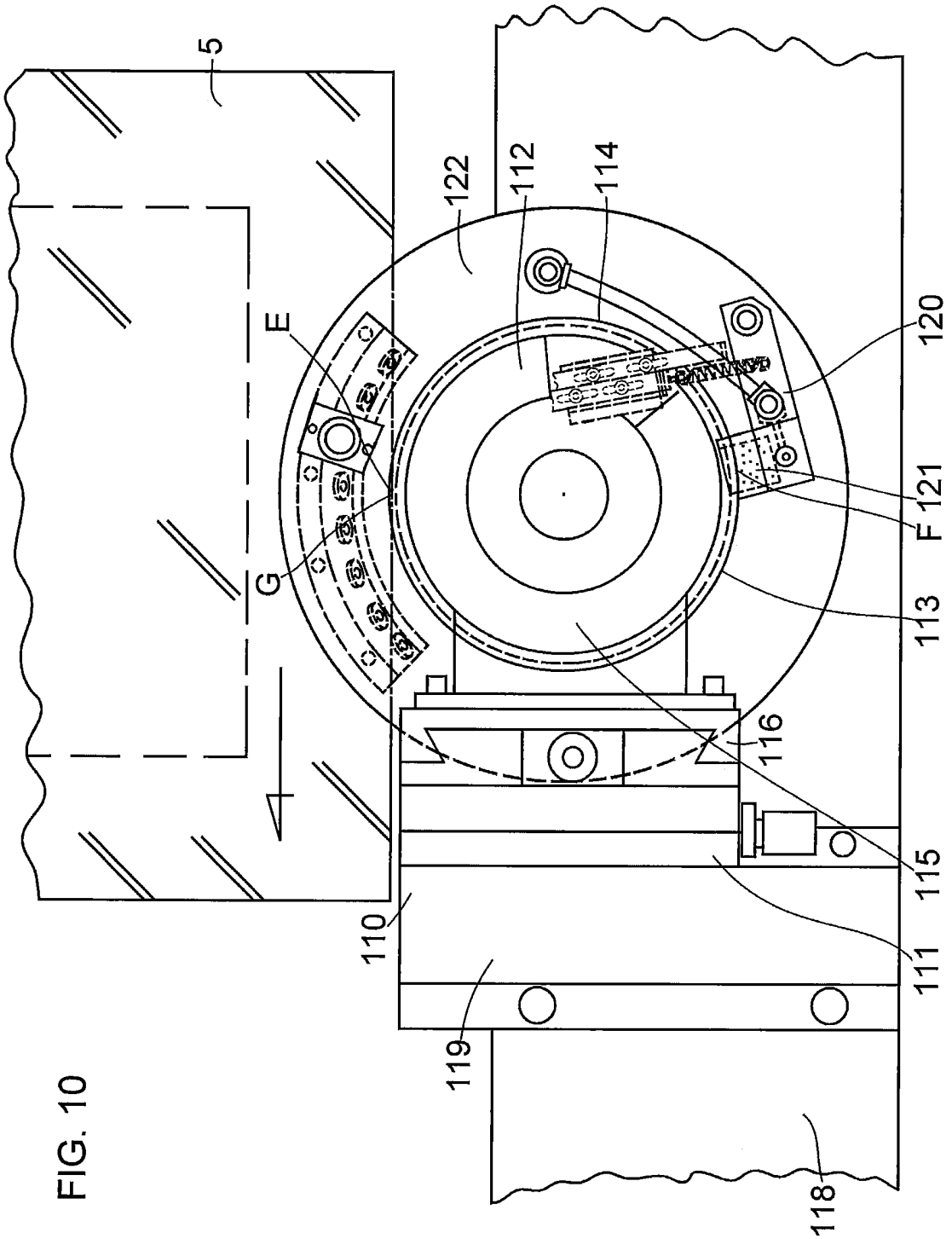

FIG. 10

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2013/000262

A. CLASSIFICATION OF SUBJECT MATTER
B24B53/00(2006.01)i, *B24B9/10*(2006.01)i, *B24B53/053*(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B24B53/00, B24B9/10, B24B53/053

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 1996-2013
Kokai Jitsuyo Shinan Koho 1971-2013 Toroku Jitsuyo Shinan Koho 1994-2013

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	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 36435/1988(Laid-open No. 143350/1989) (Central Glass Co., Ltd.), 02 October 1989 (02.10.1989), entire text; all drawings & US 4907370 A & GB 2215649 A & DE 3830809 A1 & FR 2629001 A1	3 1-2,4
Y A	JP 11-179657 A (Toshiba Machine Co., Ltd.), 06 July 1999 (06.07.1999), paragraph [0022]; fig. 1 to 3 (Family: none)	3 1-2,4

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

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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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
25 March, 2013 (25.03.13)	02 April, 2013 (02.04.13)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2013/000262

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	JP 2011-189456 A (Disco Inc.), 29 September 2011 (29.09.2011), paragraphs [0022] to [0023]; fig. 3 to 4 (Family: none)	3 1-2,4
Y A	JP 2009-95952 A (Denso Corp.), 07 May 2009 (07.05.2009), paragraphs [0025] to [0028]; fig. 1 (Family: none)	3 1-2,4
A	JP 6-134669 A (Toyoda Van Moppes Ltd.), 17 May 1994 (17.05.1994), entire text; all drawings (Family: none)	1-4
A	JP 3-154776 A (Sumitomo Electric Industries, Ltd.), 02 July 1991 (02.07.1991), entire text; all drawings (Family: none)	1-4

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 6134669 A **[0009]**