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(54) LP gas filling apparatus.

(57) The apparatus carries a plurality of gas cylinders (a) held in upright disposition on a turntable (d). Each cylinder (a) is fed onto the turntable (d) at feed-on location, and is fed off at a feed-off location, whilst a detecting head (5) moves downwards to locate the filling valve (a') at the top of the cylinder. If it is angularly misaligned with a radially disposed filling nozzle (7'), the nozzle is rotated around the cylinder (a) until alignment is achieved when the nozzle is engaged and filling takes place. At the end of filling, the nozzle 7' is retracted.

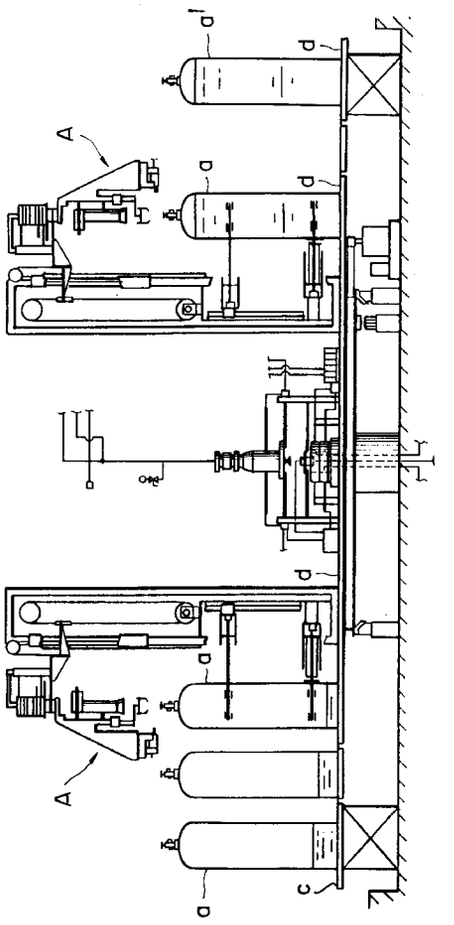

FIG. 12

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Background of the Invention

Field of the Invention

The present invention relates to an apparatus for automatically filling a gas cylinder with LP gas, and particularly to an LP gas filling apparatus for automating operations including opening an opening/closing valve of a gas cylinder and connecting a gas filling nozzle to a gas filling port of an opening/closing valve main body upon filling, and closing the opening/closing valve after completing the gas filling.

2. Description of the Related Art

Conventionally, the LP gas filling work has been performed by various filling apparatuses, in each of which the connection and removal of a gas filling nozzle to and from a gas filling port of a gas cylinder, and the opening/closing of an opening/closing valve have been required to be manually performed by an operator.

The present applicant has already proposed an LP gas filling apparatus for automatically carrying a gas cylinder in and out of a gas filling location for the purpose of rationally concentrating the filling operations, in the prior application (Unexamined Japanese Patent Publication No. SHO 59-93598).

In this apparatus, a carry-in port and a carry-out port are provided on a turn table at specified positions, and a carry-in passage and a carry-out passage for carrying a gas cylinder are connected to the carry-in port and carry-out port, respectively. A gas cylinder is automatically carried by way of the carry-in passage onto each of vessel mounting portions disposed around the same circumference on the upper surface of the turn table at equal intervals, and a gas filling nozzle of a gas filling machine is manually connected to a gas filling port of the gas cylinder mounted on the vessel mounting portion.

The gas cylinder is filled with LP gas in a specified amount while being carried from the carry-in port to the carry-out port by the rotation of the turn table. When the gas cylinder is carried to the carried-out port, the gas filling nozzle is manually removed from the gas filling port of the gas cylinder.

In the above apparatus, when the gas filling nozzle is connected to the gas filling port, the adjustment for the direction and position of the gas filling port of the gas cylinder to the filling nozzle must be manually performed while turning the vessel. This operation takes a lot of labor, and is required to be automated.

Summary of the Invention

An object of the present invention is to provide a mechanism of holding a gas filling nozzle, adjusting the direction and position of the gas filling nozzle to a gas filling port of a gas cylinder, connecting the gas filling nozzle to the gas filling port, and opening/closing an opening/closing valve, thereby rationally performing the gas filling operations.

Brief Description of the Drawings

Fig. 1 is a side view of an LP gas filling apparatus carrying out the present invention;

Fig. 2 is a front view of the apparatus of the present invention;

Fig. 3 is an enlarged view of the apparatus of the present invention, a valve opening/closing head portion being broken away;

Fig. 4 is a sectional view taken along line IV-IV of Fig. 2;

Fig. 5 is a sectional view taken along line V-V of Fig. 2;

Fig. 6 is a vertical sectional view of a shaft supporting portion of a turning frame;

Fig. 7 is an enlarged view of a valve direction detecting portion in the descended state;

Fig. 8 is an enlarged view of the valve direction detecting portion in the state of detecting the direction of an opening/closing valve;

Fig. 9 is a an enlarged view of a valve opening/closing head in the state the head portion is descended;

Fig. 10 is a sectional view taken along line X-X of Fig. 8;

Fig. 11 is a schematic plan view of the filling apparatus of the present invention which is mounted on a turn table;

Fig. 12 is a side view of the filling apparatus of the present invention;

Fig. 13 is a side view of the valve direction detecting portion; and

Fig. 14 is a sectional view taken along line XIV-XIV of Fig. 13.

Description of the Preferred Embodiments

Hereinafter, one embodiment of the present invention will be described with reference to the drawings.

An LP gas filling apparatus A shown in Figs. 1 and 2 automatically performs gas filling operations including holding a gas cylinder (a) carried by a carrying-in conveyor (c) at a specified position (reference axis (e)); opening an opening/closing valve (a1) of the gas cylinder (a); connecting a gas filling nozzle 7 to a gas filling port (a3) Fig. 3 of an opening/closing valve main body (a1'); filling the gas cylinder (a) with a specified amount of LP gas; and closing the opening/closing valve (a1). The LP gas filling apparatus A is provided on a turn table (d) connected to the carrying-in conveyor (c).

The turn table (d) connected to the carrying-in

conveyor (c) is so constructed as shown in Figs. 11 and 12.

In the course of the carrying-in conveyor (c) for carrying the gas cylinder (a) to the LP gas filling apparatus A, there are provided an electronic balance 202 for measuring the weight of each gas cylinder (a) moved along the carrying-in conveyor (c); and a bar code reading device 201 for reading a bar code including information on the kind of a vessel which is written on the peripheral surface of the gas cylinder (a). A carrying-out conveyor (g) is connected to the turn table (d) in parallel to the carrying-in conveyor (c). In the vicinity of the carrying-out conveyor (g), there is provided a control panel 203 containing a control unit (not shown) for calculating the amount of a gas remaining in the gas cylinder (a) and the amount of gas to fill each gas cylinder (a) on the basis of the weight of each gas cylinder (a) measured by the electronic balance 202, and controlling the amount of a gas to fill each gas cylinder (a).

A plurality of such LP gas filling apparatuses A are mounted, spaced at intervals, along the outer peripheral portion of the turn table (d) connected to the terminal portion of the carrying-in conveyor (c). Each of the LP gas filling apparatuses A on the turn table (d) sequentially passes through the terminal portion of the carrying-in conveyor (c) by the rotation of the turn table (d), and it receives the gas cylinder (a) when passing through the carrying-in conveyor (c) and fills the gas cylinder (a) with gas in a specified amount calculated by the control unit (not shown) of the above control panel 203 during the turn table (d) makes about one round. A gas cylinder (a') filled with gas in a specified amount is transferred on to the carrying-out conveyor (g) provided in parallel to the carrying-in conveyor (c), and is carried to a specified recovery location.

The LP gas filling apparatus A includes a clamp mechanism 1 for receiving the outer peripheral portion of the gas cylinder (a) carried-in by the carrying-in conveyor (c) in the erected state and holding it such that the axis of the vessel (a) corresponds to the reference axis (e); a valve opening/closing head 3 provided directly over the gas cylinder (a) in such a manner as to be vertically movable, engagebale and rotatable relative to a handle (a2) of the opening/closing valve (a1) of the gas cylinder (a); a valve direction detecting portion 5 supported to freely advance and retreat to and from the reference axis (e) connecting the valve opening/closing head 3 to the opening/closing valve (a1) of the gas cylinder (a) and to be vertical movable along the reference axis (e); and a gas filling nozzle 7 supported to be turnable around the reference axis (e) together with the valve direction detecting portion 5 and to be connectable to the gas filling port (a3) of the opening/closing valve (a1). Each member is mounted on and supported by a machine casing 9 erected around the outer peripheral portion of the turn table (d).

The gas cylinder (a), which is carried from the carrying-in conveyor (c) onto the turn table (d) in the erected state, is held at the outer peripheral portion thereof by the clamp mechanism 1.

The clamp mechanism 1 includes an upper and lower clamps 11 and 12 for holding the outer peripheral portion of the cylindrical gas cylinder (a) from both the sides. The clamps 11 and 12 are mounted on and supported by the lower portion of the machine casing 9 so as to be vertically spaced from each other.

The clamp 11 for holding the upper portion of the gas cylinder (a) has a pair of clamp bodies 11a and 11b for holding the outer periphery of the gas cylinder (a) as shown in Fig. 4 .

The holding portion of each of the clamp bodies 11a and 11b is formed to be cut-out in a substantially U-shape, and has rollers 13c at the projecting ends thereof which abut the outer peripheral surface of the gas cylinder (a).

The base ends of arms 13a and 13b for supporting the clamp bodies 11a and 11b are slidably mounted on and supported by a sliding plate 14 horizontally mounted on the machine casing 9, so that the clamp bodies 11a and 11b are simultaneously close to and separated from the axis of the gas cylinder (a).

Racks 15a and 15b are provided to be parallel to each other and to respectively project inward from the clamp bodies 11a and 11b, and which mesh with each other by way of a gear 16 put between the tooth surfaces of the racks 15a and 15b.

The gear 16 is rotated integrally with a drive gear 18 by way of a shaft 17. As shown in Fig. 4, the drive gear 18 meshes with a rack 20 linearly reciprocated by an air cylinder 19. Accordingly, the drive gear 18 and the gear 16 are rotated by the linearly reciprocating motion of the rack 20 by the air cylinder 19, and the racks 15a and 15b meshing with the gear 16 are simultaneously moved outward or inward in parallel to each other, thus releasing or clamping the clamps 11a and 11b.

The above upper clamp 11 can be moved up to a specified height by the motion of the supporting base plate or sliding plate 14 slidably mounted on and supported by guide levers 21 vertically mounted on the machine casing 9, and by the operation of a rodless air cylinder 22. In other words, the upper clamp 11 can be changed in its upper holding position according to the size of the gas cylinder (a).

The clamp 12 for holding the lower portion of the gas cylinder (a) has the same construction as that of the clamp 11, and is operated in association with the clamp 11. However, the clamp 12 is fixed on the machine casing 9, that is, it is fixed in its lower holding position for the gas cylinder (a).

A stopper 25 is provided on the lower clamp 12 for receiving the lower portion of the gas cylinder (a)

transferred from the carrying-in conveyor (c) at a specified position. The stopper 25 is supported by an air cylinder 25a in such a manner as to be movable to the reference axis according to the diameter of the gas cylinder (a).

When the outer peripheral portion of the gas cylinder (a) is clamped by the clamps 11 and 12 having the above constructions, the gas cylinder (a) is held such that the axis thereof corresponds to the reference axis (e), as shown in Fig. 1.

A vessel mounting portion (b) is provided under the ground surface of the gas cylinder (a) held by the clamp mechanism 1, and it is electrically connected to the above-described control unit (not shown) for measuring a change in the weight, that is, the filling amount of LP gas, of the gas cylinder (a) moved on the turn table (d) and outputting the measured signal to the control unit. A plurality of rollers are juxtaposed on the upper surface of the vessel mounting portion (b) for making smooth the sliding of the ground surface of the gas cylinder (a) transferred from the carrying-in conveyor (c).

A valve opening/closing head 3 for opening/closing the handle (a2) of the opening/closing valve (a1) of the gas cylinder (a) is provided directly over the gas cylinder (a) which is held such that the axis thereof corresponds to the reference axis (e). As shown in Fig. 3, the valve opening/closing head 3 includes a head portion 31 for fitting to the handle (a2) of the opening/closing valve (a1) from the upper side.

The head portion 31 is fixed on the lower end of a piston rod 33 of an air cylinder 32 vertically provided along the reference axis (e), and is descended/ascended toward the handle (a2) along the reference axis (e) by the vertical movement of the piston rod 33. The piston rod 33 is formed with a spline groove, and passes through the lower surface wall of a cylinder 34.

The cylinder 34 is communicated with a motor 36 by way of a gear mechanism 35 mounted on the upper portion of the air cylinder 32, and is normally/reversely rotated by the drive of the motor 36. By this rotation of the cylinder 34, the head 31 is turned by way of the above spline engagement. Namely, the head portion 31 is supported in such a manner as to be vertically movable along the reference axis (e) and normally/reversely rotatable by the drive of the air cylinder 32 and the motor 36.

The air cylinder 32 is vertically fixed along the upright portion of a turning frame 45 rotatably hung from a mounting base 40 on the side of machine casing 9 such that the axis thereof corresponds to the reference axis (e).

The turning frame, which is formed substantially in a right-angled triangular shape, is rotatably supported at the vertex portion thereof on the leading edge of a supporting plate 40a horizontally extending from the mounting base 40 by way of a shaft supporting portion 80, and is thus hung to be turnable by 360° around the axis (reference axis (e)) of the air cylinder 32 mounted along the upright side portion.

As shown in Fig. 6, a hollow rotational shaft 81 of the shaft supporting portion 80 turnably hanging the turning frame 45 is vertically inserted in the leading edge portion of the supporting plate 40a of the mounting base 40 by way of two thrust bearings 82. The vertex portion of the turning frame 45 is fitted to the lower end of the rotating shaft 81, and is fastened thereto by a set screw 81a. Thus, the vertex portion of the turning frame 45 is hung by the supporting plate 40a of the mounting base 40 and is supported to be rotatable around a rotating shaft 81.

A gear 41 is rigidly fitted on the upper end portion of the rotational shaft 81, and it meshes with a gear 42 mounted on an input shaft of a drive motor 43 such as an air motor. The air motor 43 is fixed on the supporting plate 40a of the mounting base 40. The rotational shaft 81 and the turning frame 45 are driven within the range of 360° or more by the drive of the air motor 43.

A joint portion 85 of a compression air supply pipe system is provided on the shaft supporting portion 80.

The joint portion 85 rotatably connects, without any torsion, each air suction pipe 86 communicated to a supply source (not shown) for compression air to each air supply pipe 88 communicated to the air cylinders of the valve direction detecting portion 5 and the gas filling nozzle 7. The joint portion 85 is formed by laminating each inner ring 85a which is connected to the upper portion of the gear 41 of the shaft supporting portion 80 and is integrally turned with the gear 41, and each outer ring 85b slidably and rotatably fitted on the outside of the inner ring 85a in such a manner as to be coaxial with the gear 41.

Specifically, each outer ring 85b is fixed on a mounting plate 87 fixed on the mounting base 40, and each inner ring 85a fitted in the outer ring 85b is rotated together with the gear 41, rotational shaft 81 and turning frame 45.

A ventilation groove 85c is formed along the inner peripheral surface of each outer ring 85b, and each air suction pipe 86 communicated to the ventilation groove 85c is connected to the outer peripheral portion of each outer ring 85b. Each air suction pipe 86 is communicated to the supply source (not shown) for compression air.

On the other hand, one end portion of each air supply pipe 88 communicated to the air cylinders of the valve direction detecting portion 5 and the gas filling nozzle 7 by way of the hollow portion of the shaft supporting portion 80 is connected to the inner peripheral surface of each inner ring 85a, and the air suction pipe 86 is communicated to the air supply pipe 88 by way of the ventilation groove 85c contacted with the sliding surface. O-rings are fitted around the fitting surface and connection surface between the in-

ner and outer rings 85a and 85b for keeping the airtightness of the jointing surfaces. In addition, the joint portion 85 is so constructed as to connect the air suction pipe 86 to the air supply pipe 88; however, it may be so constructed as to feed a liquid from a hydraulic system.

A gas supply pipe 91 fixed on the upper end of a supporting column 86a of each air suction pipe 86 is bent downward by way of a swivel joint 92 for absorbing the rotation like the above-described joint portion 85, and passes through the joint portion 85 and the hollow portion of the shaft supporting portion 80, to be thus communicated to the gas filling nozzle 7 by way of a flexible pipe 93 Fig.3.

The mounting base 40 for mounting and supporting the joint portion 85 and the turning frame 45 is supported so as to be vertically slidable along guide rails 46 vertically provided along both the sides of the upper portion of the machine casing 9. The leading edge of an arm body 47 projecting from the mounting base 40 to the rear surface side is connected to a chain 48c hung between pulleys 48a and 48b provided at the upper and the middle positions of the machine casing 9. The mounting base 40 and the turning frame 45 are descended/ascended within the range of the guide rails 46 by the rotation of a drive motor 49 such as an air motor with a brake which is provided on the lower pulley 48b.

One end of a wire 62 hung around each of sheaves 61 provided on both the sides of the upper portion of the machine casing 9 is connected to the mounting base 40, and a weight 63 is hung from the other end of the wire 62. The mounting base 40 is thus balanced against the weight 63, to thereby reduce the load applied when the mounting base 40 is ascended/descended by the air motor 49.

The valve direction detecting portion 5 Figs.7 to 10 detects the direction of the opening/closing valve (a1) of the gas cylinder (a) even if the gas cylinder (a) is directed in any direction. As shown in Fig. 7, engagement pieces 51a and 51b to be engaged with the opening/closing valve main body (a1') are mounted on and supported by both the leading edges of a piston rod, projecting to both the sides, of the air cylinder 52.

An abutment body 56 to abut the handle (a2) of the opening/closing valve (a1) is rotatably supported at the center portion of the air cylinder 52 in such a manner as to be elastically projected directly below or sunk. The air cylinder 52 is mounted on and supported by the leading edge of a turning arm 55 horizontally extending from the leading edge of a piston rod 53a of an air cylinder 53.

The air cylinder 53 is mounted on and supported by the upright side portion of the turning frame 45 connected in series to the elastic air cylinder 54, and is supported with the piston rod 53a directed directly below.

The piston rod 53a is vertically expanded/contracted and rotated by the air cylinder 53. By the turning of the piston rod 53a, the center portions of the engagement pieces 51a and 51b provided at the leading edge of the turning arm 55 are turned between the position on the reference axis (e) and the position separated from the opening/closing valve (a1). Moreover, by the expansion/contraction of the air cylinder 53, the engagement pieces 51a, 51b and the abutment body 56 positioned on the reference axis (e) are ascended/descended relative to the opening/closing valve (a1).

Since the engagement pieces 51a and 51b are mounted on the leading edges of the piston rod of the air cylinder 52, they can be opened/closed in the horizontal direction as shown in Fig. 7. In the open state, the interval between the engagement pieces 51a and 51b is made larger than the diameter of the handle (a2), which allows the handle (a2) to vertically pass through the interval between the engagement pieces 51 and 51b. In the closed state, cut-out portions 57a and 57b formed at the leading edges of the engagement pieces 51a and 51b engage and substantially correspond to the outer peripheral shapes (in the plan view) of the gas filling port (a3) of the opening/closing valve main body (a1') and the circumference portion of opposed side thereof. Thus, the opening/closing valve main body (a1') is fitted between the cut-out portions 57a and 57b with a suitable clearance (Fig. 10).

For example, the engagement pieces 51a and 51b are pushed onto the opening/closing valve (a1) from the upper side in the closed state, and the opening/closing valve main body (a1') is never fitted between the engagement pieces 51a and 51b when the direction of the opening/closing valve main body (a1') does not correspond to that of the cut-out portions 57a and 57b. However, when the engagement pieces 51a and 51b are horizontally turned such that the direction thereof corresponds to that of the opening/closing valve main body (a1'), the opening/closing valve main body (a1') is fitted between the cut-out portions 57a and 57b of the engagement pieces 51a and 51b. The direction of the opening/closing valve main body (a1') is thus detected on the basis of the above corresponding direction of the engagement pieces 51a and 51b.

As shown in Fig. 7, the elastic air cylinder 54 connected in series to the air cylinder 53 acts to elastically press the engagement pieces 51a and 51b, which descended to the position directly over the opening/closing valve main body (a1), at a small pressure not to generate excessive load, by a stroke as small as the diameter of the gas filling port (a3). By the engagement pieces 51a and 51b by a pressing force applied from the elastic air cylinder 54, at the time when the direction of the opening/closing valve main body (a1') corresponds to that of the engagement pieces

51a and 51b, the engagement pieces 51a and 51b are dropped by the stroke of the elastic air cylinder 54.

A sensor 58 provided to the air cylinder 52 for supporting the engagement pieces 51a and 51b acts to be contacted with the upper end of a supporting shaft 56a of the abutment body 56, when the abutment body 56 abuts the upper surface of the handle (a2) by the descending of the valve direction detecting portion 5. On the basis of the operation of the sensor 58, the descending of the valve direction detecting portion 5 is stopped, and the air cylinder 52 is contracted to close the engagement pieces 51a and 51b, after which the elastic cylinder 54 is expanded.

A sensor 59 provided in parallel to the sensor 58 acts to be contacted with the upper end of the supporting shaft 56a of the abutment body 56, when the engagement pieces 51a and 51b are dropped by the stroke of the elastic air cylinder 54 after the direction of the engagement pieces 51a and 51b corresponds to that of the opening/closing valve main body (a1'). The detection for the direction of the opening/closing valve main body (a1') can be confirmed by the operation of the sensor 59.

The gas filling nozzle 7 includes a nozzle portion 71 to be horizontally inserted in and connected to the gas filling port (a3) of the opening/closing valve (a1) of the gas cylinder (a), and a control valve 72. The gas filling nozzle 7 is provided on the bottom side portion of the turning frame 45 in the state that the nozzle 7 is directed at right angles to the reference axis (e), that is,to the opening/closing valve (a1) of the gas cylinder. The flexible pipe 93 communicated to the gas supply pipe 91 is connected to the rear portion of the control valve 72 for supplying LP gas to the control valve 72.

A sliding board 73 for mounting and supporting the control valve 72 and the nozzle portion 71 is slidably supported on guide rails 74 horizontally provided along the bottom side portion of the turning frame 45, and which linearly advances and retreats to and from the reference axis (e) by the drive of a rodless air cylinder 75.

The direction of the nozzle portion 71 corresponds to that of the engagement pieces 51a and 51b detected by the valve direction detecting portion 5, that is, directed to the reference axis (e). The vertical interval between the nozzle portion 71 and the engagement pieces 51a and 51b is kept at a specified value so that the position of the nozzle portion 71 corresponds to that of the gas filling port (a3) of the opening/closing valve (a1) when the engagement pieces 51a and 51b are fitted around the outer periphery of the opening/closing valve main body (a1).

The operation of the LP gas filling apparatus having the above-described construction will be described below.

The gas cylinder (a) carried by the carrying-in conveyor (c) up to the terminal of the conveyor (c) is mounted on the vessel mounting portion (b) manually or using an automatic charging machine. The air cylinder 19 of the clamp mechanism 1 is then operated to clamp the outer periphery of the gas cylinder (a) from both the sides by the clamps 11 and 12. The gas cylinder (a) is thus held such that the axis thereof corresponds to the reference axis (e).

In such a state, the opening/closing valve (a1) of the gas cylinder (a) may be directed in any direction. In other words, the gas cylinder (a) can be mounted on the vessel mounting portion (b) from the carrying-in conveyor (c), without any attention to the direction of the opening/closing valve (a1). Accordingly, there is no trouble even when the gas cylinder (a) is charged using the automatic charging machine.

The interval between the upper and lower clamps 11 and 12 is dependent on the kind of the gas cylinder (a) to be filled with gas, and is changed prior to the carrying-in of the gas cylinder (a). The kind of each gas cylinder (a) is read by a bar-code reading device (not shown) provided in the course of the carrying-in conveyor (c), and on the basis of the control signal from the control unit (not shown), the interval between the upper and lower clamps 11 and 12 is changed by the operation of the rodless cylinder 22.

After the gas cylinder (a) is held by the clamps 11 and 12, the air motor 49 of the pulley 48a is operated and the mounting base 40 is descended. Thus, the valve opening/closing head 3 located at the upper side and the valve direction detecting portion 5 positioned on the reference axis (e) are descended, and the abutment body 56 of the detecting portion 5 abuts the upper surface of the handle (a2), thus operating the sensor 58 (Fig. 7).

The air cylinder 52 of the valve direction detecting portion 5 is contracted on the basis of the operation of the sensor 58, and the engagement pieces 51a and 51b in the open state are closed and the elastic air cylinder 54 is expanded. The engagement pieces 51a and 51b in the closed state are elastically pressed on the opening/closing main body (a1') at a relatively weak force. In most cases, as shown in Fig. 10, since the direction of the opening/closing valve main body (a1') does not correspond to that of the cut-out portions 57a and 57b of the engagement pieces 51a and 51b, the engagement pieces 51a and 51b are pressed on the upper portion of the opening/closing valve main body (a1'), as shown in Fig. 7.

Next, the air motor 43 of the valve opening/closing head 3 portion is operated, and the valve direction detecting portion 5 and the gas filling nozzle 5 are turned together with the turning frame 45. As the turning operation proceeds, at a certain time, the cut-out portions 57a and 57b of the engagement pieces 51a and 51b correspond to the opening/closing valve main body (a1') in the shape, and they are fitted outside the opening/closing valve main body (a1'). The engagement pieces 51a and 51b are thus dropped as

shown in Fig. 8, and the leading edge of the supporting shaft 56a of the abutment body 56 abuts the sensor 59, thus operating the sensor 59. On the basis of the operation of the sensor 59, the operation of the air motor 43 is stopped, and the turning of the engagement pieces 51a, 51b and the gas filling nozzle 7 is stopped. At this time, the direction of the opening/closing valve (a1) is detected, and the gas filling nozzle 7 corresponds to the gas filling port (a3) of the opening/closing valve (a1) in the direction and the height.

As described above, the turning frame 45 can be turned within the range of 360° or more. Accordingly, upon the carrying-in of the gas cylinder (a), even when the opening/closing valve (a1) of the gas cylinder (a) is directed in any direction, the engagement pieces 51a and 51b are necessarily fitted outside the opening/closing valve main body (a1') during the valve direction detecting portion 5 is turned by 360° together with the turning frame 45, thus making it possible to detect the direction of the opening/closing valve (a1).

The air cylinder 52 of the valve direction detecting portion 5 is expanded along with the operation of the sensor 59, so that the engagement pieces 51a and 51b are opened. The air cylinders 53 and 54 are then contracted to ascend the valve direction detecting portion 5. By further turning the air cylinder 53 by 90°, the valve direction detecting portion 5 is retreated from the opening/closing valve (a1), and it waits at the position shown in Fig. 9.

The air cylinder 32 of the valve opening/closing head 3 is expanded, and the head portion 31 is descended to be fitted to the handle (a2) of the opening/closing valve (a1) from the upper side. Next, by the drive of the motor 36, the head portion 31 turns the handle (a2) in the open direction, thus opening the opening/closing valve (a1).

The rodless air cylinder 75 of the gas filling nozzle 7 is operated, and the nozzle 71 advances to be connected to the gas filling port (a3). The control valve 72 is then opened, and the gas filling is started. The filling amount of gas is measured on the basis of a change in the weight of the gas cylinder (a) on the vessel mounting portion (b), and the measured value is supplied to the control unit (not shown) as a signal.

On the basis of the control by the control unit (not shown), the gas cylinder (a) is filled with gas in a specified amount, after which the control valve 72 is closed and the head portion 31 turns the handle (a2) in the closing direction by the drive of the motor 43 of the valve opening/closing head, thus closing the opening/closing valve (a1) of the gas cylinder (a).

After that, the gas filling nozzle 7 is retreated by the operation of the air cylinder 75 and is removed from the gas filling port (a3) of the opening/closing valve (a1). The valve opening/closing head 3 is then ascended up to the original position, and the clamps 11 and 12 are opened. By the ascending of the mounting base 40, the valve opening/closing head 3, valve direction detecting portion 5, gas filling nozzle 7 are ascended up to the original specified positions. Moreover, by the drive of the air motor 43, the turning frame 45 is reversely turned to the original position, and the air cylinder 53 of the valve direction detecting portion 5 is expanded and reversed by 90°. The filling apparatus is thus returned to the initial state.

The above-described filling operations are performed as the turn table (d) makes a revolution and the gas cylinder (a) after completion of the gas filling is transferred manually or using an automatic ejecting machine to the carrying-out conveyor (g) provided in parallel to the carrying-in conveyor (c), and is transferred to a specified recovery location.

As described above, according to the gas filling apparatus A carrying out the present invention, it becomes possible to automatically perform all the operations including positioning, connection and the separation between the gas filling port (a3) of the gas cylinder (a) carried onto the vessel mounting portion (b) of the turn table (d) and the gas filling nozzle 7, and the opening/closing of the opening/closing valve (a2), and hence to rationally automate the gas filling operations avoiding heavy labor.

In the above filling apparatus, by supporting the gas filling nozzle 7 and the valve direction detecting portion 5 in such a manner as to be turnable within the range of 360° or more, even when the opening/closing valve (a1) of the gas cylinder (a) is directed in any direction, the direction of the valve can be detected. In other words, the gas cylinder (a) can be mounted on the vessel mounting portion (b) from the carrying-in conveyor (c) without attention to the direction of the opening/closing valve (a1). Accordingly, the manual operations for gas filling can be made easy, and further, an automatic charging machine can be used to charge the gas cylinder (a) without any trouble.

Moreover, since the engagement body to be engaged with the opening/closing valve main body (a1') is formed of the two engagement pieces 51a and 51b and the engagement pieces 51a and 51b are so constructed as to be opposed to each other and to be horizontally opened/closed, the moving path and the direction of the engagement body to the opening/closing valve main body (a1') is not required to be complicated, thus making it possible to simplify the structure and to smoothly detect the direction of the opening/closing valve main body (a1').

In the above-described LP gas filling apparatus A, the valve direction detecting portion 5 for detecting the direction of the opening/closing valve (a1) of the gas cylinder (a) and introducing the gas filling nozzle 7 to the gas filling port (a3) of the opening/closing valve (a1), is mechanically constructed using the engagement pieces 51a and 51b; however, it may be

constructed using photoelectric sensors, as in a valve direction detecting portion 105 shown in Figs. 13 and 14.

The valve direction detecting portion 150 is mounted on and supported by the leading edge of a turning arm 55 like the above valve direction detecting portion 5. By the turning of the turning arm 55, the valve direction detecting portion 150 is turned between the position on the reference axis (e) connecting the valve opening/closing head 3 to the opening/closing valve (a1) of the gas cylinder (a) and the position separated from the opening/closing valve (a1). In addition, in the LP gas filling apparatus A including the valve direction detecting portion 150 , the parts other than the valve direction detecting portion 150 are the same as those in the previous apparatus A.

As shown in Fig. 13, the valve direction detecting portion 150 includes supporting pieces 151 and 152, on specified positions of which photoelectric sensors 153, 154 and 155 are mounted.

In Fig. 13, the supporting piece 151 is formed in a U-shape in the side view, and is mounted at the lower edge of the turning arm 55 such that both the projecting portions thereof are directed downward. The two supporting pieces 152 are provided in parallel to each other such that the inner surfaces are opposed to each other, along both the side edges of one Projecting portion of the supporting piece 151.

A pair of photoelectric sensors 153a and 153b are oppositely mounted at both the projecting ends of the U-shaped supporting piece 151.

The photoelectric sensor 153a emits a light beam 153c to the other photoelectric sensor 153b in the horizontal direction. The other photoelectric sensor 153b receives the light beam 153c, and outputs a signal to a drive control UNIT (not shown).

In addition, the remaining photoelectric sensors 154 and 155 are the same in the construction as the photoelectric sensor 153, and are electrically connected to the drive control unit (not shown).

Photoelectric sensors 154a and 154b are mounted at the positions higher than those of both the projecting portions of the supporting piece 151 mounting the photoelectric sensors 153a and 153b.

The photoelectric sensors 155a and 155b are oppositely mounted on both the lower ends of the supporting pieces 152 perpendicular to the supporting piece 151 in the plan view.

The photoelectric sensors 153, 154 and 155 mounted on the supporting pieces 151 and 152 are in the positional relationship shown in Figs.13 and 14.

Fig. 14 shows the relationship between the light beams horizontally emitted from the photoelectric sensors 153, 154 and 155 and the opening/closing valve (a1).

The light beam 153c horizontally emitted from the photoelectric sensor 153 is in the relationship to be in parallel to the side surface of the opening/closing valve main body (a1') and to be close thereto with a slight gap, as shown in Fig. 14 (plan view). The light beam 153c corresponds to the X-axis in the plan view, and is in parallel to the direction of the nozzle 71. The level of the light beam 153c corresponds to a center (f1) of the gas filling port (a3) in Fig. 13 (side view).

The light beam 155c horizontally emitted from the photoelectric sensor 155 is in the relationship to be in parallel to the end surface of the gas filling port (a3) of the opening/closing valve (a1) and to be close thereto, and is perpendicular to the light beam 153c emitted from the photoelectric sensor 153 (Fig. 14). In addition, the light beam 155c corresponds to the Y-axis in the plan view.

The level of the light beam 155c is set to be in the range between a highest portion (f2) of a safety valve (a4) projecting to the side opposed to the gas filling port (a3) and the lower end (f3) of the filling port (a3).

The light beams 153c and 155c emitted form the photoelectric sensors 153 and 155 are perpendicular to each other in an L-shape in the plan view, and they are horizontally rotated around the reference axis (e) together with the gas filling nozzle 7.

The light beams 153c and 155c rotated in the plan view while keeping the plan form are contacted with the opening/closing valve main body (a1') except in the positional relationship shown by the solid line in Fig. 14. A drive control unit (not shown) electrically connected with the photoelectric sensors 153 and 155 simultaneously receives the light beams and thus judges that the direction of the nozzle 71 corresponds to that of the opening/closing valve (a1), as a result of which the turning of the valve direction detecting portion 105 and the gas filling nozzle 7 is stopped.

The light beam 153c emitted from the photoelectric sensor 153 is in the state to be closely in parallel to the opening/closing valve main body (a1') even when the direction of the opening/closing valve (a1) shown in Fig. 14 is reversed by 180°. However, since the distance between the center (e) of the opening/closing valve (a1) to the end surface of the safety valve (a4) is longer than that between the center (e) to the end surface of the gas filling port (a3), the light beam 155c emitted from the photoelectric sensor 155 is shielded by the safety valve (a4). The drive control unit (not shown) thus judges that the direction of the valve does not correspond to that of the nozzle.

As shown in Fig. 13, the light beam 154c horizontally emitted from the photoelectric sensor 154 is in the relationship to be in parallel to the highest portion of the center of the upper surface of the opening/closing valve (a1) and to be contacted therewith. In addition, the interval between the highest portion of the handle (a2) and the center (f1) of the gas filling port (a3) is kept at the specified value according to the standard, so that the interval between the highest portion of the handle (a2) and each of the reference

lines (f2) and (f3) is also kept at the specified value.

The operation of the valve direction detecting portion 150 having the above construction will be described below.

The valve direction detecting portion 150 is moved up to the position directly over the reference axis (e) of the gas cylinder (a) by the turning of the air cylinder 53, and is descended by the lowering of the air cylinder 53. When the light beam 154c emitted from the photoelectric sensor 154 is contacted with the upper surface of the handle (a2) of the gas cylinder (a), and the light receiving by the photoelectric sensor 154b is obstructed, the drive control unit (not shown) stops the descending of the valve detecting portion 150. In such a state, the photoelectric sensors 153 and 155 are kept at the level shown in Fig. 13.

However, in most cases, for example as shown by virtual lines in Fig. 14, since the direction of the opening/closing valve main body (a1') does not correspond to that of the L-shape formed by the light beams 153c and 155c emitted by the photoelectric sensors 153 and 155, both or either of the light beams 153c and 155c are contacted with the opening/closing valve main body (a1') and are not received by the photoelectric sensors 153b and 155b.

On the basis of the signal supplied from the photoelectric sensors 153b and 155b, the drive control unit (not shown) turns the valve direction detecting portion 150 around the reference axis (e) together with the turning frame 45 by the operation of the air motor 43 of the valve opening/closing head portion 3.

Next, the air motor 43 of the valve opening/closing head 3 portion is operated, and the valve direction detecting portion 5 and the gas filling nozzle 5 are turned together with the turning frame 45.

As the turning of the valve direction detecting portion 150 proceeds, at a single certain point, the L-shape formed by the light beams 153c and 155c emitted by the photoelectric sensors 153 and 155 corresponds to the shape of the outer peripheral portion of the opening/closing valve main body (1a'), so that the photoelectric sensors 153b and 155b are simultaneously in the state of receiving the light beams (solid line in Fig. 14).

On the basis of the input signal indicating that the photoelectric sensors 153b and 155b are in the state of receiving the light beam, the drive control unit (not shown) stops the operation of the air motor 43 thus stopping the turning of the gas filling nozzle 7.

The direction of the opening/closing valve (a1) is thus detected, and the gas filling nozzle 7 corresponds to the gas filling port (a3) of the opening/closing valve (a1) in the direction and the height.

After that, like the gas filling apparatus A, the valve opening/closing head 3 is descended and opens the handle (a2), thus opening the opening/closing valve (a1). The nozzle 71 then advances to be connected to the gas filling port (a3), thus starting the gas filling.

As described above, in the apparatus including the valve direction detecting portion using the photoelectric sensors, it becomes possible to smoothly detect, in a non-contact manner, the direction of the opening/closing valve (a1) and to allow the nozzle 71 to correspond to the gas filling port (a3) of the opening/closing valve (a1) in the direction and height, and hence to reduce the failure caused by the mechanical wear and the noise caused by the contact between metal members.

In addition, the valve direction detecting portion 150 uses the photoelectric sensor 154 as the position detecting means for allowing the nozzle 71 to correspond to the gas filling port (a3) in the height; however, it may be constituted of a mechanical switch as in the previous embodiment.

Having described specific preferred embodiments of the invention with reference to the accompanying drawings, it will be appreciated that the present invention is not limited to those precise embodiments, and that various changes and modification can be effected therein by one of ordinary skill in the art without departing from the scope or spirit of the invention as defined by the appended claims.

Claims

1. An LP gas cylinder filling apparatus for gas cylinders (a) which have a valve main body (a1), including a filling part (a3) said apparatus being characterised by a clamp mechanism (11, 12) for holding the cylinder (a) with its axis on a reference axis (e), a valve direction detecting means (5, 150), means (53, 54) for moving the valve direction detecting means (5, 150) back and forth along the reference axis (e), a gas filling nozzle (7') mounted for movement back and forth transverse to the reference axis (e) and thus engage the cylinder filling part (a3), said detecting means (5, 150) including sensing means (58, 59; 153, 154, 155) for sensing misalignment of the valve direction detecting means (5, 150) and the cylinder valve main body (a1) when the said detecting means (5, 150) is moved into operational relationship therewith along the reference axis (e), and a frame (45) connecting the nozzle (71) and detecting means (5, 150) said frame being rotatable about the reference axis (e) by at least 360° to rotate the nozzle (7') and detecting means (5, 150) to bring the nozzle (7') into alignment with the valve main body fitting part (a3) by the detecting means (5, 150) detecting said alignment.

2. An apparatus according to claim 1, characterised in that the detecting means (5, 150) is movable between a first position in which it lies on the ref-

erence axis (e) and a second position in which it is displaced from said axis (e).

3. An apparatus according to claim 1 or 2, characterised in that said reference axis (e) is vertical.

4. An apparatus according to claim 1, 2 or 3 for cylinders having a handle (a2) above the valve main body (a1) which can be turned to open and close the valve opening characterised by a valve closing head (3) movable along the reference axis (e) and engagable with handle (a2) to open and close the valve in sequence with the filling thereof.

5. An apparatus according to any of claims 1 to 4, characterised in that the valve direction detecting means (5, 150) has a shape corresponding to the shape of the outer plan periphery of the valve main body (a1) and is pressed thereto as the frame (45) is rotated until detecting means (5, 150) and the valve main body (a1) correctly align and the detecting means (5, 150) moves over the body (a1).

6. An apparatus according to claim 5, characterised in that said detection means (5, 150) is formed of two opposed engagement pieces (51a, 51b) having cut-out portions (57a, 57b) corresponding in shape to the outer peripheral portion (in plan view) of the valve main body (a1), said engagement pieces (51a, 51b) being supported so as to be spaced from each other to allow the valve main body (a1) to pass therebetween.

7. An apparatus according to claim 6 characterised in that the pieces (51a, 51b) are movable towards and away from each other.

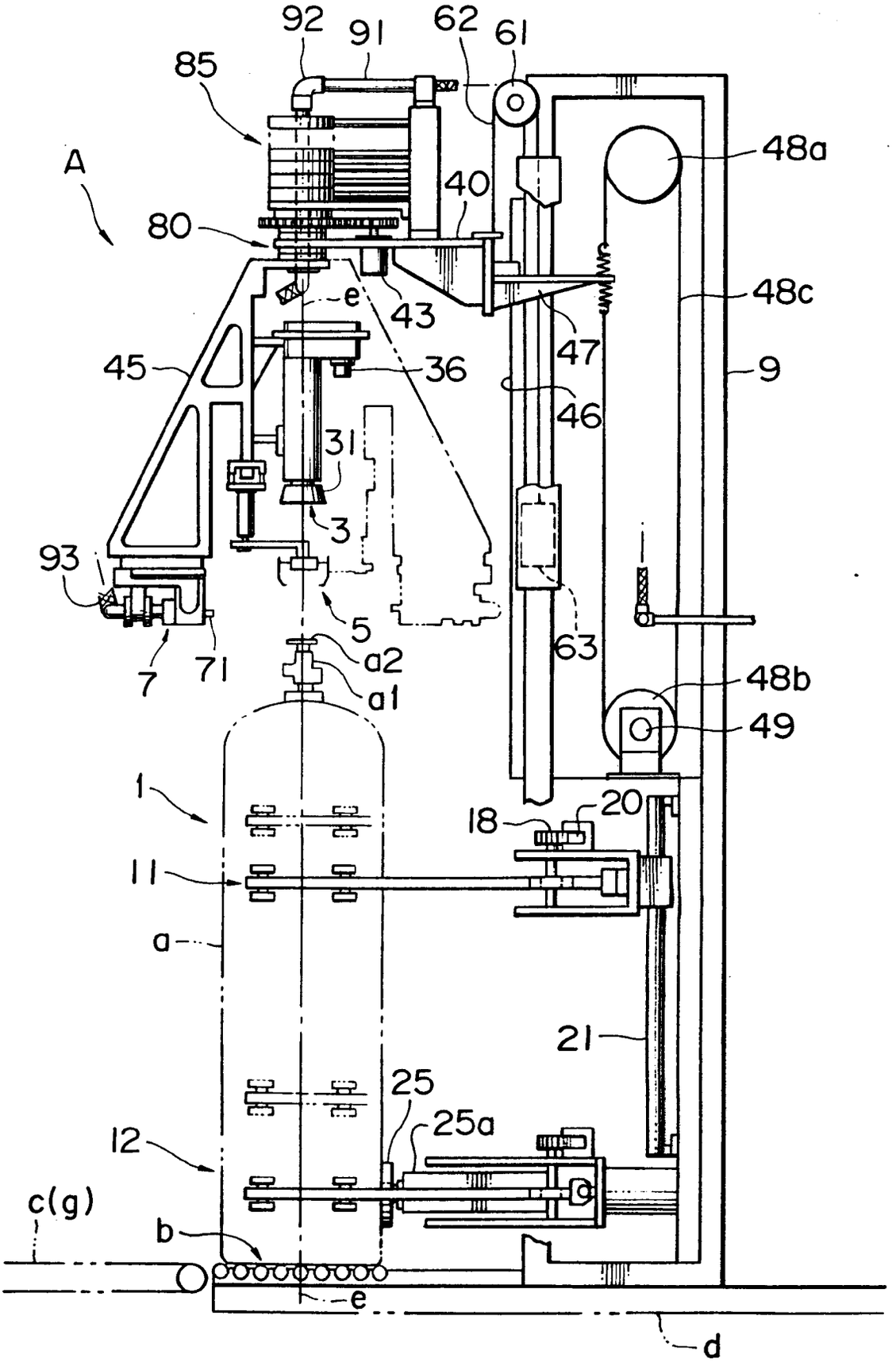
8. An apparatus according to any of claims 1 to 4, characterised in that said detecting means (5, 150) comprises a photoelectric sensor arrangement to detect the alignment of the valve main body (a1).

9. An apparatus according to claim 8, characterised by photoelectric cells and sensors (153, 155) defining X and Y light axes arranged so as to sense when the valve main body (a1) is in the correct alignment with detecting means (150) and the nozzle (7').

10. An apparatus according to claim 8 or 9 including additional photoelectric sensing device (155) for detecting the position of the valve main body (a1) relative to the detection means (150) along the length of the axis (e).

11. An apparatus according to any preceding claim, characterised in that a plurality of apparatus (A) are arranged on a rotatable turntable (d) and the sequence of cylinder coupling, filling and uncoupling of the cylinder as each apparatus takes place during a revolution of the turntable (d).

FIG. 1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A
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48c
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43
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36
9
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31
3
93
5
63
7
71
a2
a1
48b
49
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20
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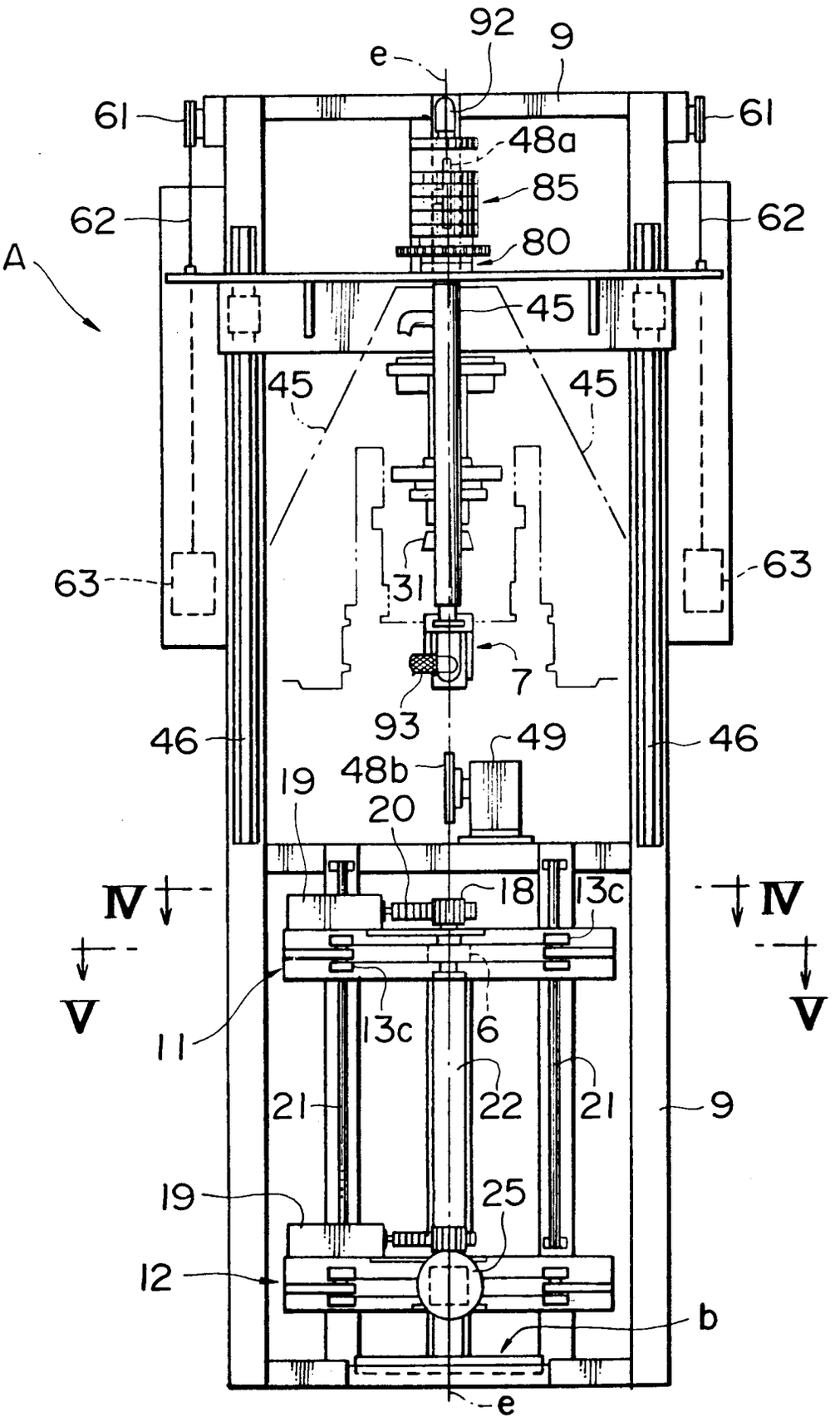
11
a
21
25
25a
12
c(g)
b
e
d

FIG. 2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A
45
45
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7
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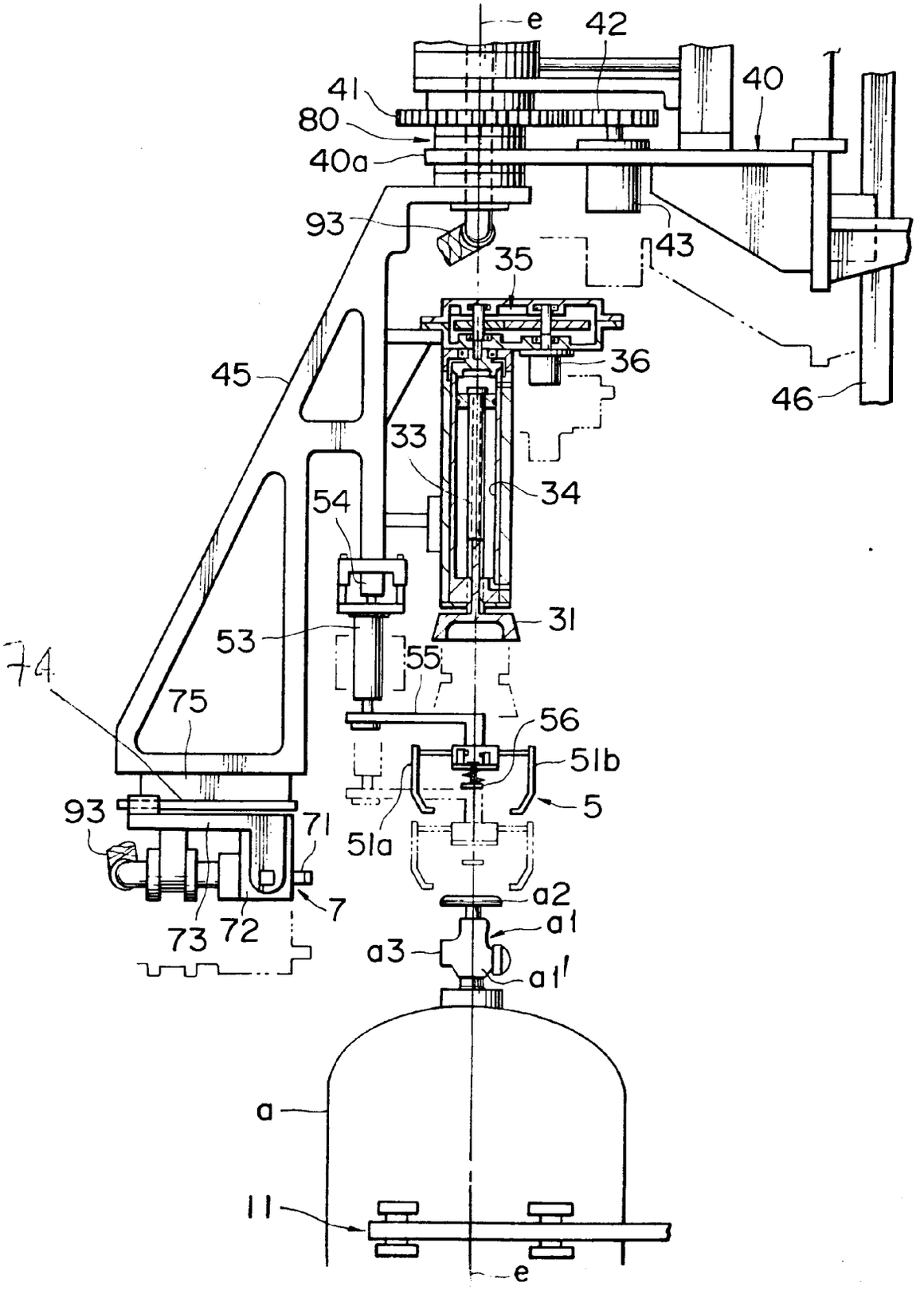
46
46
49
48b
19
20
IV
IV
18
13c
V
V
11
13c
6
21
22
21
9
19
25
12
b
e

FIG. 3


e
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40
80
40a
93
43
35
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36
46
33
34
54
31
53
55
74
75
56
51b
5
93
71
51a
a2
a1
7
73
72
a3
a1'
a
11
e

FIG. 4

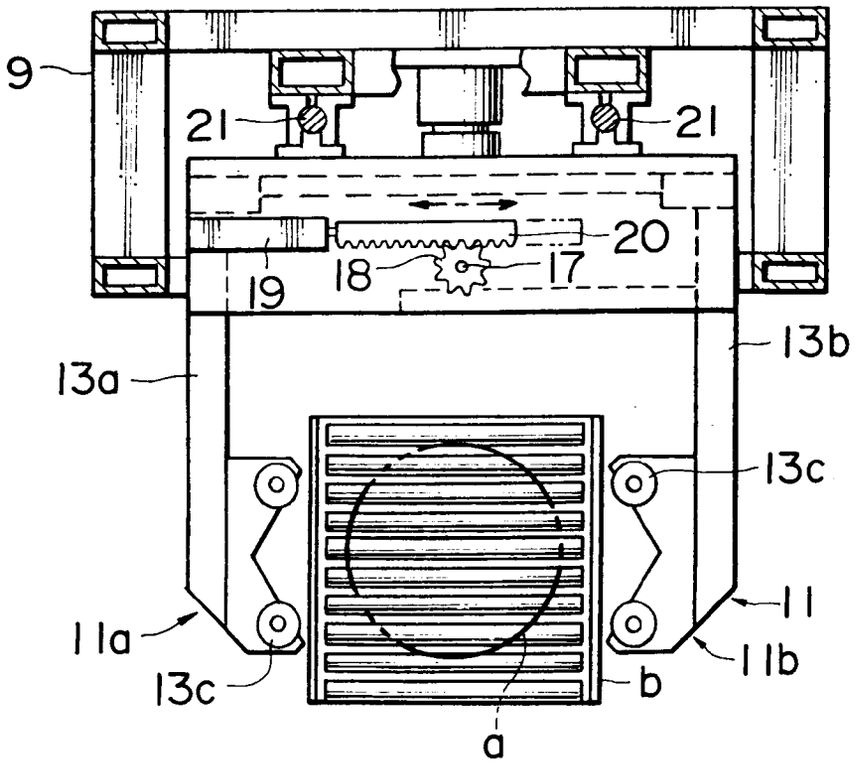
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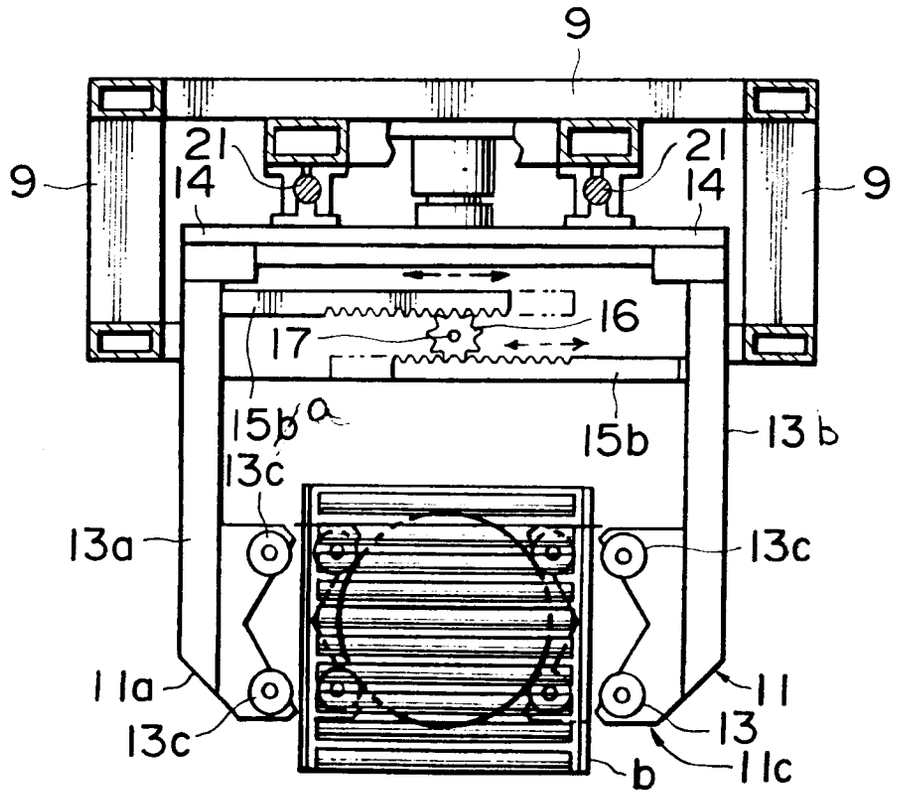
FIG. 5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14
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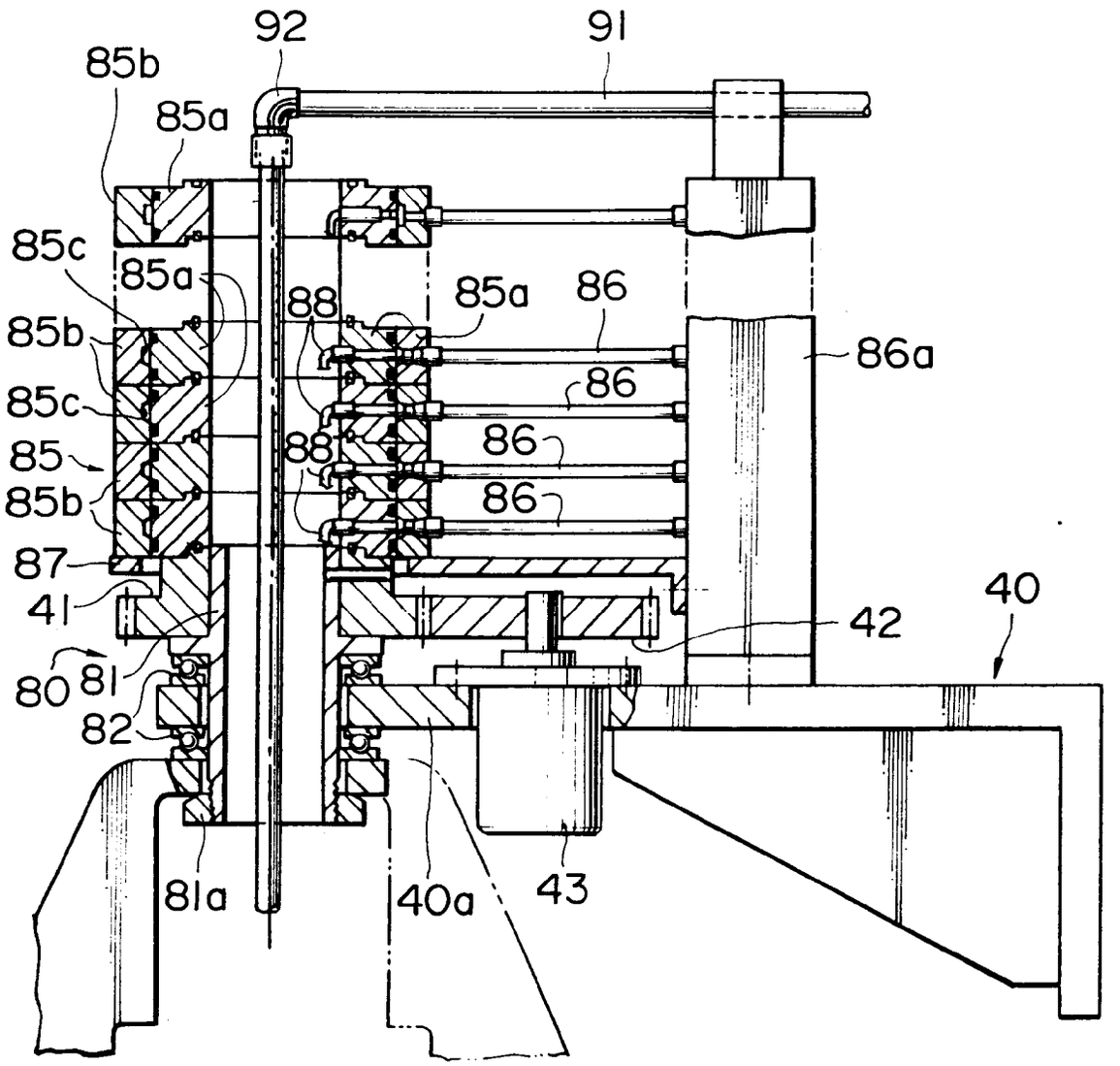
11c
b

FIG. 6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85a
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85a
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86a
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85b
86
87
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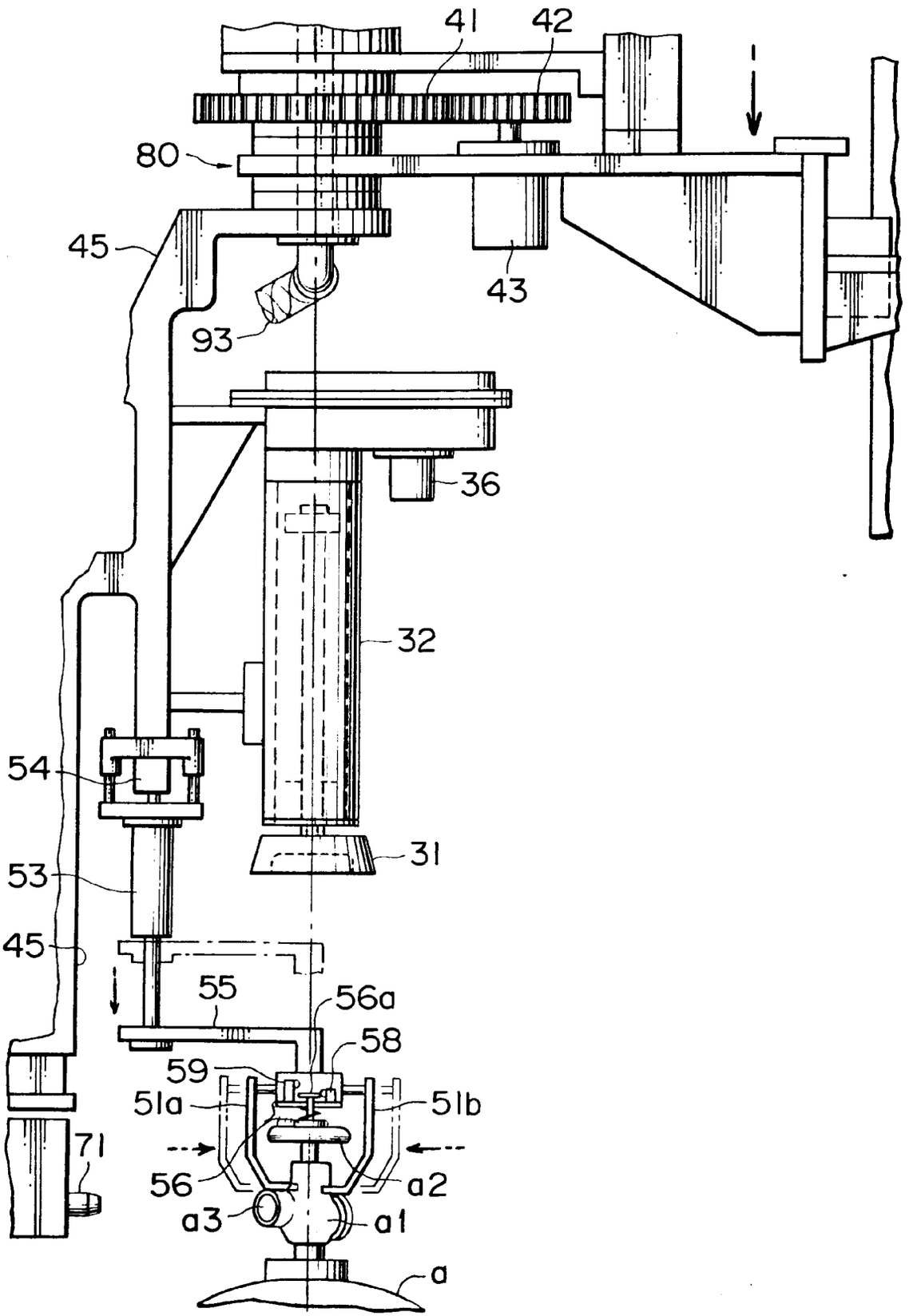
42
40
80
81
82
81a
40a
43

FIG. 7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93
36
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31
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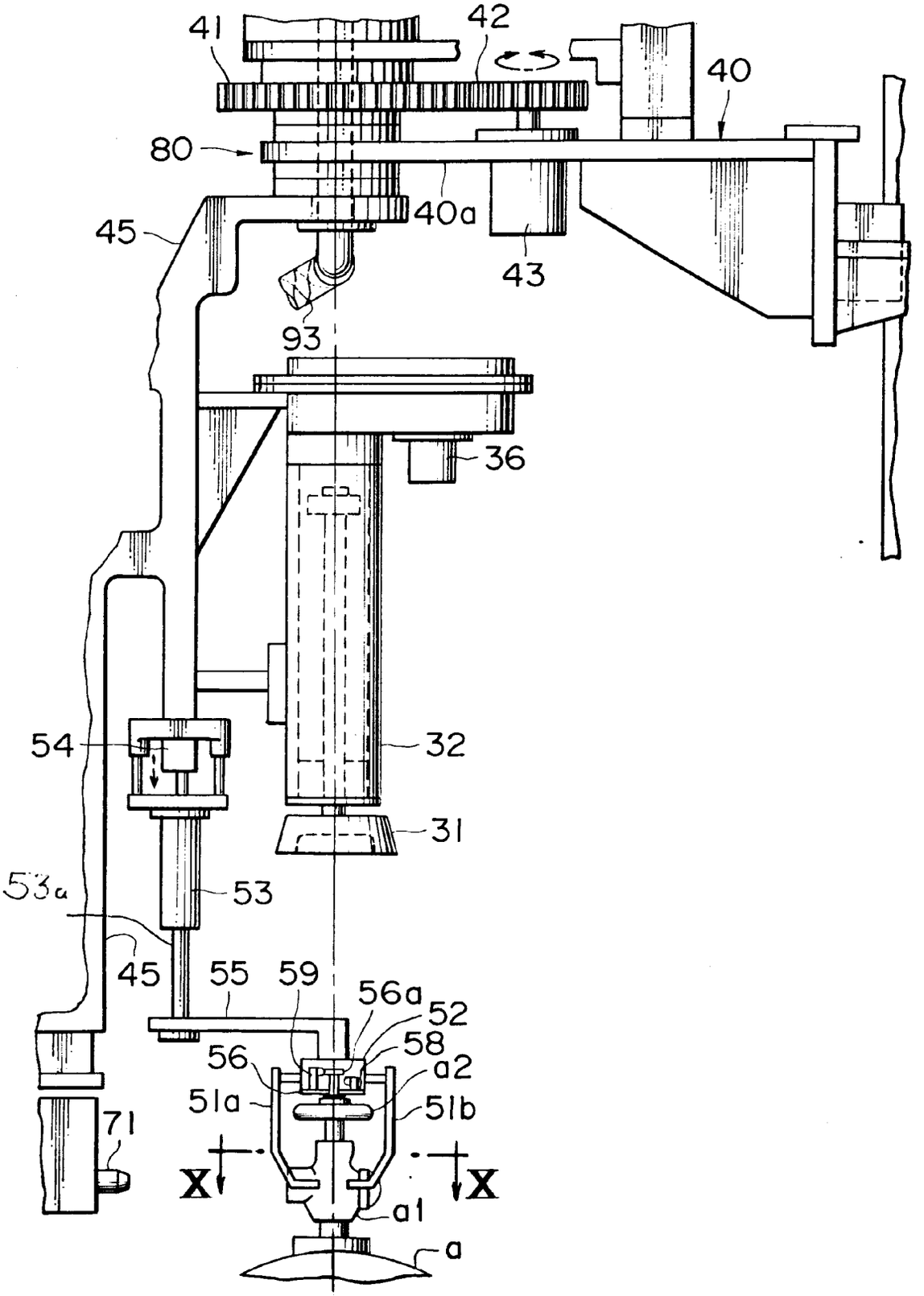
55
56a
58
59
51a
51b
71
56
a2
a3
a1
a

FIG. 8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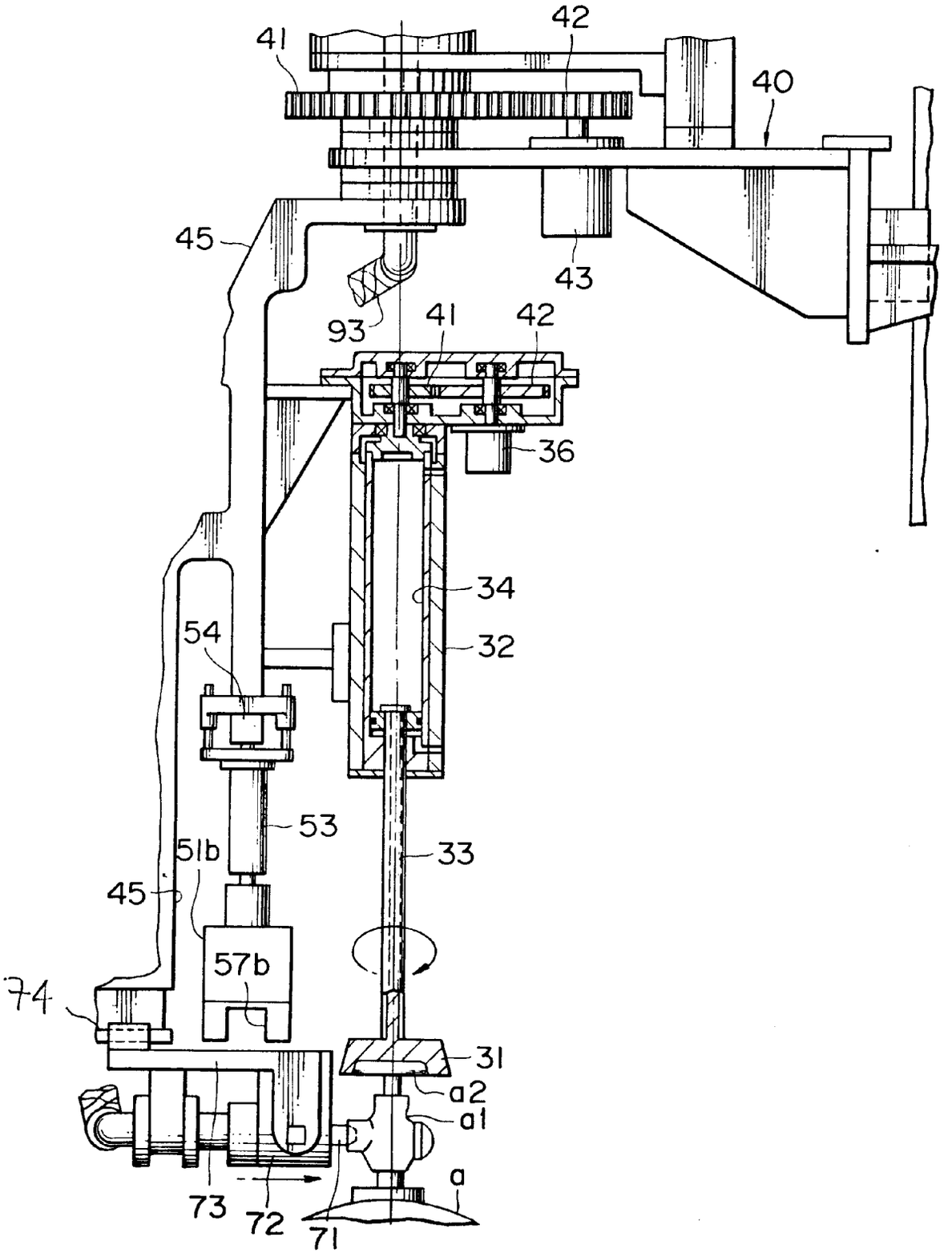
58
56
a2
51a
51b
71
X
X
a1
a

FIG. 9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73
72
71

FIG. 10

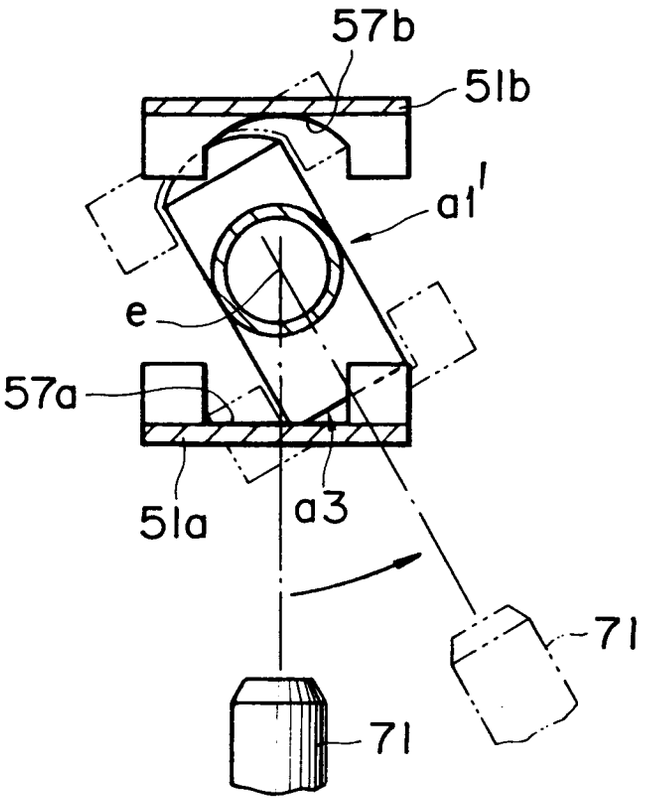


FIG. 11

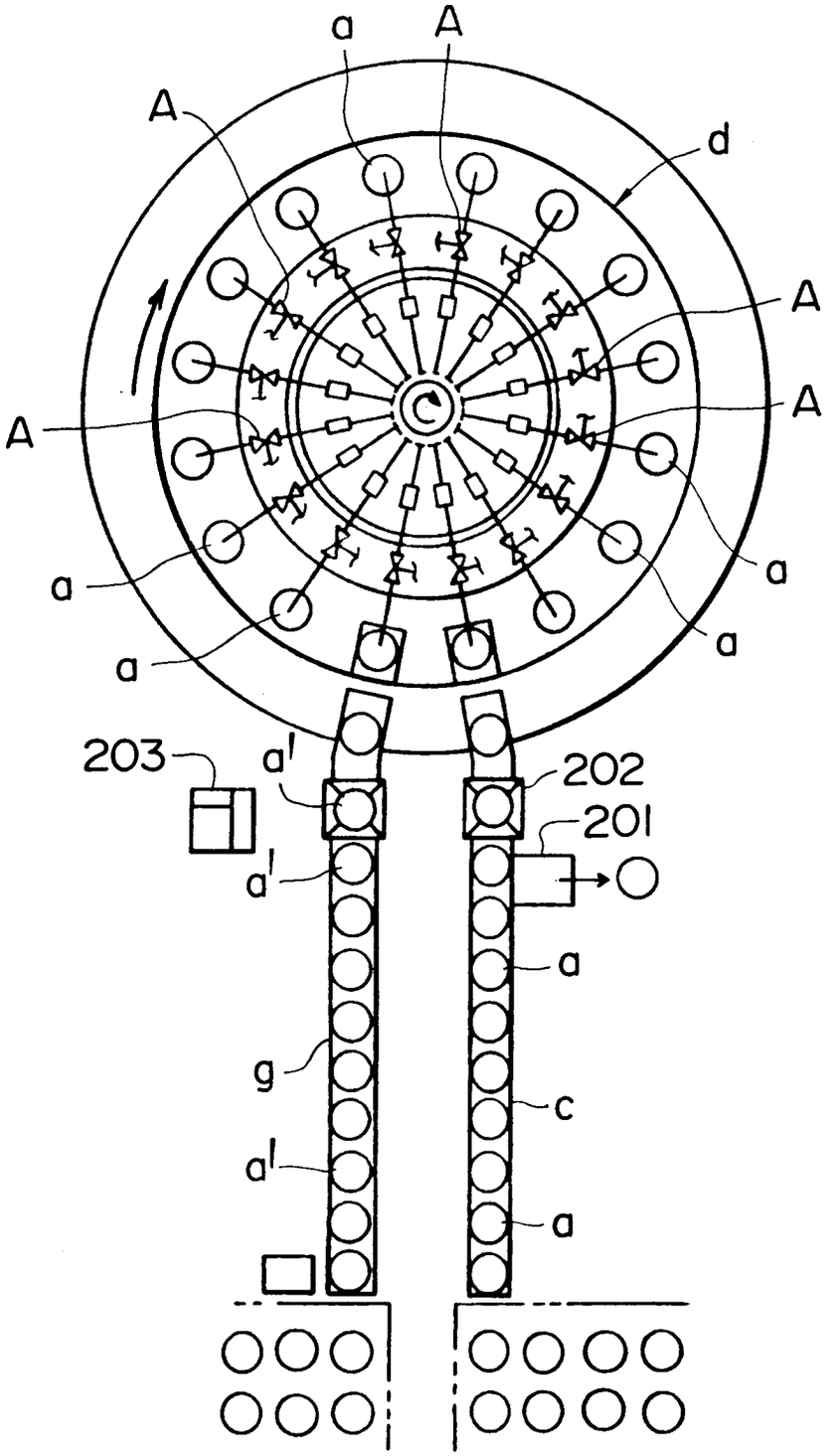


FIG. 12

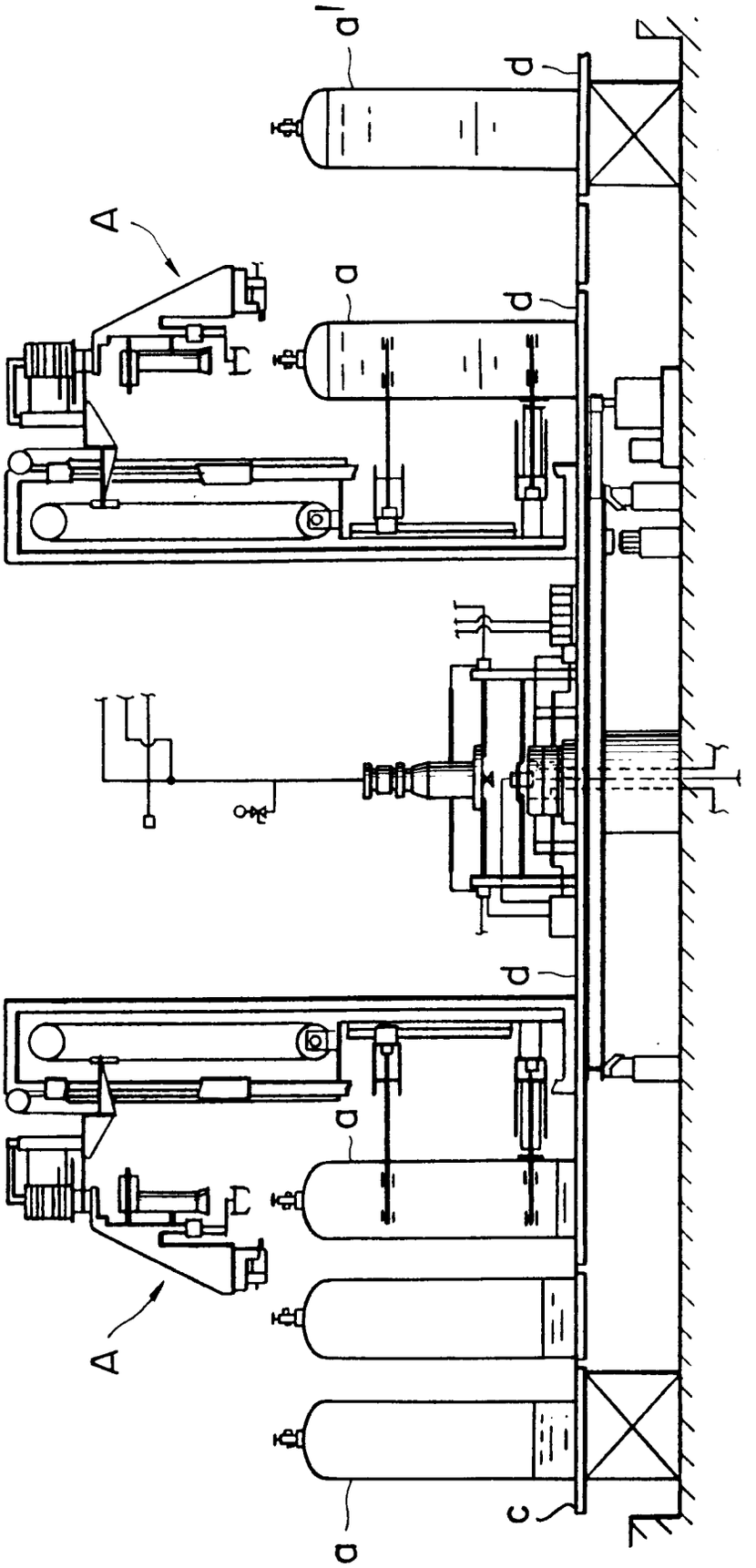
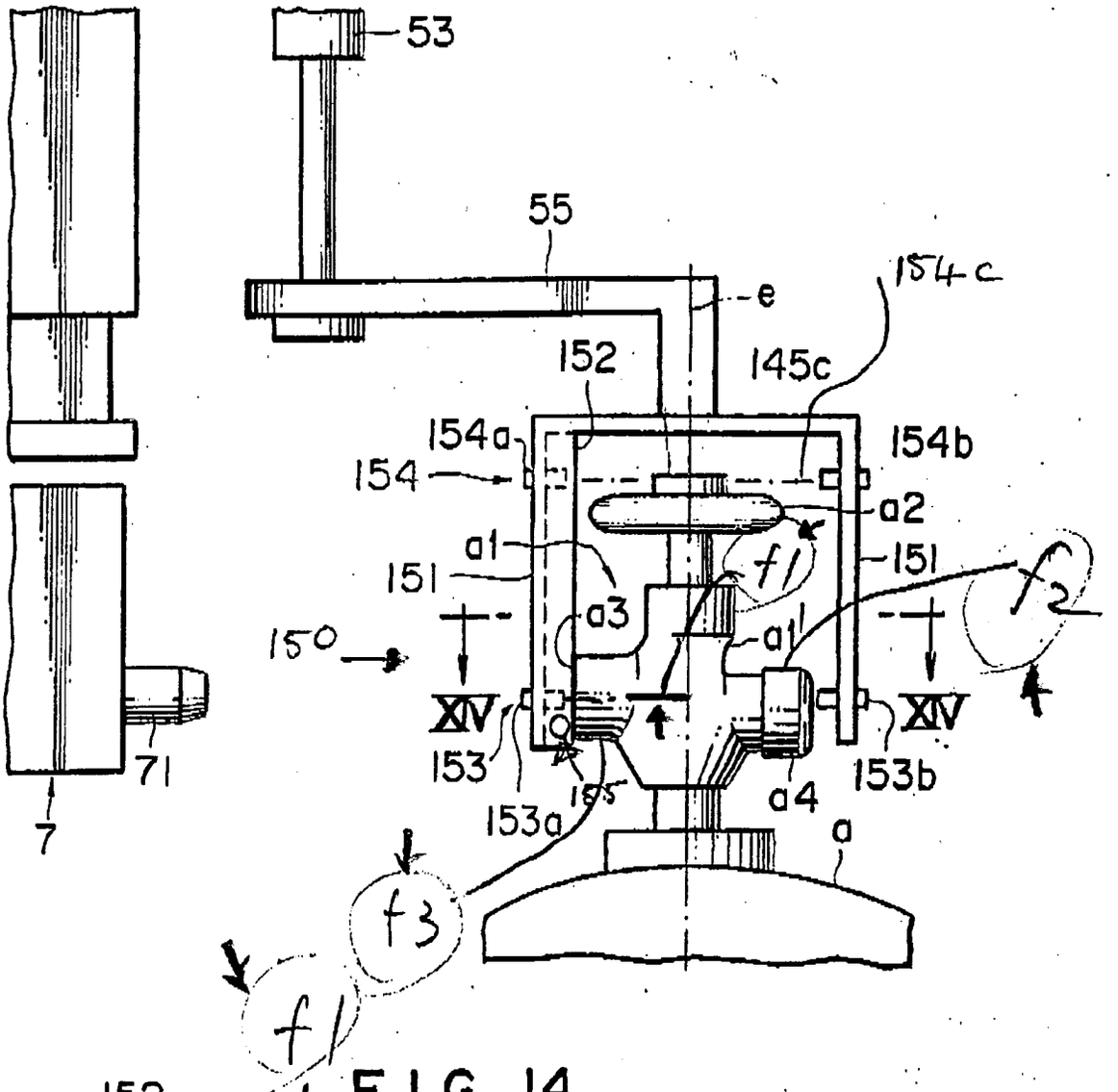


FIG. 13


53
55
e
154c
152
145c
154a
154b
154
a2
a1
151
f1
f2
a3
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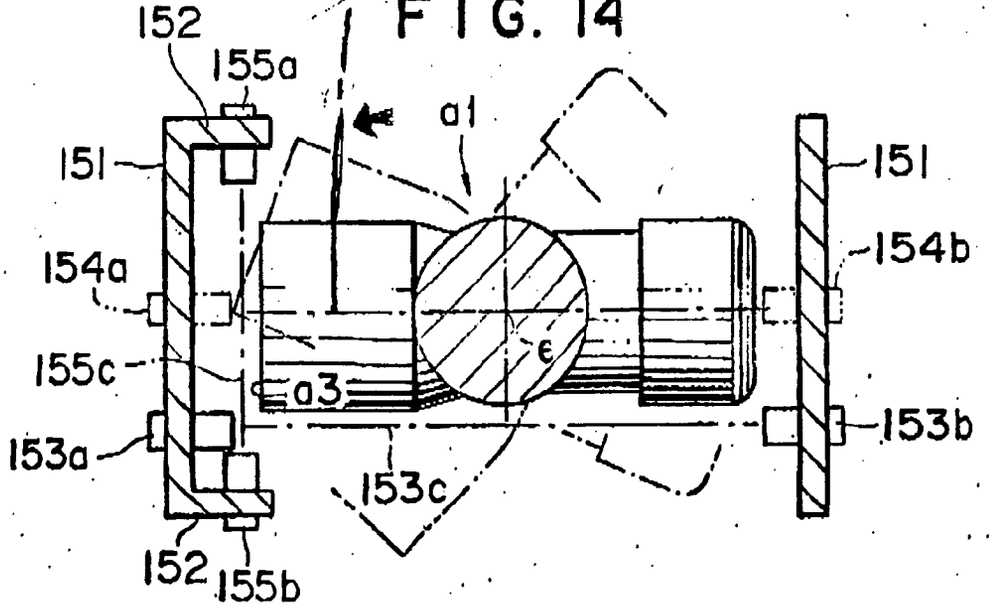
XIV
XIV
153
153b
153a
185
a4
a
f3
f1
7
71

FIG. 14


152
155a
a1
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151
154a
154b
155c
a3
e
153a
153b
153c
152
155b

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 94 30 9693

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	DE-A-20 28 634 (ETABLISSEMENTS R.M.S.A.) * page 1, paragraph 1 * * page 2, paragraph 1 * * page 2, paragraph 6 - page 8, paragraph 2 * * figures 1-3 *	1,3,4	F17C5/00
Y	---	11	
Y	EP-A-0 537 094 (PAM - PROVENCALE D'AUTOMATION ET DE MECANIQUE) * abstract * * column 5, line 1 - column 8, line 22 * * figures 1-4 *	11	
A	---	1	
P,A	EP-A-0 576 958 (MEIKO SANGYO K.K.) 5 January 1994 * abstract * * column 2, line 9 - column 5, line 9 * * column 6, line 7 - column 12, line 57 * * figures 1-12 *	1,3-7,11	
	-----		TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			F17C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	7 April 1995	Siem, T

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