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(54) Method and machine for filling containers with liquid products.

(57) The method for the filling of containers with liquid products envisages that containers (1) to be filled are picked up by grippers (8) with jaws designed to grip the necks of said containers (1) and rotated by a carousel (3) which rotates about a vertical axis and which receives the containers (1) from feed units (2) ; the containers (1) are then raised vertically together with the grippers (8) in such a way that nozzles (17) of liquid dispensing units (9), carried by the carousel (3) over the grippers (8), are inserted into the mouths of the containers ; the containers (1) are then gradually lowered while the liquid is being discharged into them by the nozzle (17) ; lastly the containers (1) are released when full and transferred to an outfeed system (10).

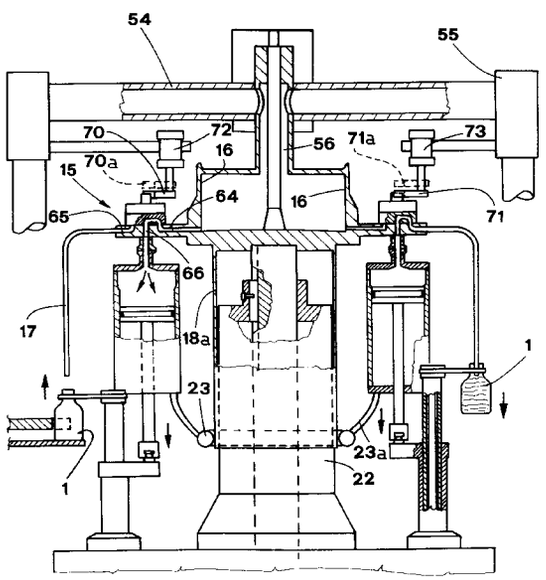

FIG. 2a

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The present invention relates to the technical sector of automatic machinery for filling containers with liquid products.

A variety of automatic machines are known which fill containers such as bottles or vials with liquids. These machines usually have carousels or star-wheels which rotate about a vertical axis and which are designed to receive the bottles to be filled in orderly fashion from a feed line. The carousel mounts means for dispensing the liquid product which work in synchrony with the bottle handling means in such a way that the bottles are lined up with the corresponding nozzles of the dispensing units. The filled bottles are then transferred to an outfeed line.

The bottles are placed on supports arranged around the carousel and are lifted by the aforesaid handling means so that the corresponding filling nozzles are inserted into the bottle mouths. After being filled, the bottles are lowered again.

In other known machines, the bottles are rotated by the carousel without being lifted and the liquid dispensing units alternate with the carousel so as to insert the filling nozzles into the bottle mouths.

The liquid dispensing units consist of a plurality of cylinder and plunger assemblies, each related to a liquid feed tube. The liquid feed tubes are connected to the liquid tank through a set of valves mounted on the outermost edge of the carousel.

In the aforesaid machines the liquid dispensing units and the means which move the bottles relative to the filling nozzles must operate in perfect synchrony.

In traditional machines drive is achieved through complicated mechanisms which hinder machine efficiency, usually because the diverse operations making up the filling cycle are difficult to synchronize exactly.

In addition, the known machines require a large number of separate liquid filling means which encumber the carousel and make it difficult to carry out the necessary maintenance operations.

The object of the invention is to provide a method to synchronize the various different stages of a liquid filling cycle in a completely novel manner.

Another object of the invention is to provide a machine for filling bottles with liquid products according to a simple, reliable technique with mechanisms that occupy the minimum of space and that can be applied to a wide range of bottle sizes.

These objects are achieved in accordance with the claims below.

The characteristics of the invention are highlighted in the following detailed description, with reference to the accompanying drawings, where:

– Figure 1 is a schematic plan view of the container filling machine;

– Figures 2a and 2b are cross sections along line II-II of Fig.1, showing the upper and lower sections of the aforesaid carousel, respectively;

– Figure 3 is a plan view, with enlarged details, of the aforesaid grippers;

– Figure 4 is a vertical, cross sectional view of one of the filling valves of the machine;

– Figure 5 is a schematic plan view of the machine showing the different stages in the operation of the aforesaid filling valve;

– Figures 6a, 6b, 6c and 6d are partial cross sectional views of the machine during successive stages of operation;

– Figure 7 is a cross section of the lower portion of the aforesaid carousel when the latter is set for filling bottles of the largest size.

– Figures 8a and 8b are cross sections of the lower and upper portions of the aforesaid carousel, respectively, during cleaning of the aforesaid dispensing units.

With reference to the drawings just listed, the machine for filling bottles 1 with a liquid product has means 2 for feeding the said bottles to a carousel 3 which rotates about a vertical axis in the direction indicated by arrow A.

Feed means 2 consist of a bottle 1 conveying line 4 along which there is an auger 5 which rotates axially in such a manner as to space the conveyed bottles 1 apart. Auger 5 is designed to operate in conjunction with a distributor 6, shaped like a star, for example, which rotates in the direction of arrow B.

The bottles to be fed are held and guided by recesses 6a in distributor 6 and by ring guide 7 which partially surrounds the distributor itself.

Carousel 3 receives bottles 1 fed by distributor 6 one by one at the point where the equally spaced grippers 8, mounted on the circumference of the carousel itself, are activated. Carousel 3 also mounts dispensing units, labelled 9 in the drawings, which fill the liquid product into bottles 1.

Downstream of carousel 3 there is a full bottle outfeed system 10 consisting of a conveyor line 11 and another distributor 12, shaped like a star, for example, which rotates in the direction of arrow C.

The outgoing bottles are received by distributor 12 at the point where they are released by grippers 8 and are held and guided by recesses 12a in the distributor and by a ring guide 13 which partially surrounds the distributor.

Dispensing units 9 consist of a plurality of cylinder and plunger assemblies mounted by carousel 3 which lines them up with grippers 8. Each of the said cylinder and plunger assemblies 14 is connected through a valve 15 to a liquid feed chamber 16 and to a filling nozzle 17 alternately. Chamber 16 is mounted on a platform 18 attached to the rotating part of carousel 3.

Platform 18 is secured to the top of a vertical shaft 19, rotated continuously by the drive motor of the machine through transmission means 20 located at the bottom of the said shaft where the lower face 21

of the carousel frame is situated. Shaft 19 is set inside a tubular casing 22 which rotates with it.

At the top, casing 22 is covered by a cylindrical sleeve 18a formed under platform 18. The base of sleeve 18a is surrounded by a trap 23 which collects the washing liquid of cylinder and plunger assemblies 14 to which it is connected via tubes 23a.

Between shaft 19 and casing 22 and coaxial to them there is a tubular element 24, with appropriate rotational means, about which shaft 19 and casing 22 rotate. The bottom end of tubular element 24 is attached to a plate 25 supported by columns 26 which pass through plate 21 and are fixed to plate 27. Plate 21 is adjustably mounted for height in relation to plate 27 according to the size of the bottles to be filled.

Grippers 8 and cylinder and plunger assemblies 14 are driven synchronously by drive means 28 which form a set of vertical columns arranged around the circumference of carousel 3. Each of the said drive means consists of a first sleeve 29 the top of which mounts casing 30 of grippers 8 and which is axially crossed by a stem 31. The first sleeve 29 is in turn located inside a second sleeve 32 at the top of which there is a crosswise fitting 32a attached to stem 33a of plunger 33 of cylinder and plunger assembly 14.

Second sleeve 32 is guided by a bushing 34 mounted on the circumference of a plate 35 attached to tubular casing 22.

First sleeve 29, on the other hand, mounts on its bottom end a roller 36 which rotates about a radial axis in relation to the carousel, the said roller engaging a cam 37 made on a cylindrical wall 38 mounted on lower plate 21 and concentric with the axis of the carousel.

The bottom end of stem 31 mounts a lever 39 with a roller 40 that rotates about a vertical axis. Roller 40 engages a ring cam 41 formed on lower plate 21, as shown in Fig.3.

As shown by enlarged details P and R in the said Fig. 3, grippers 8 consist of a pair of jaws 8a and 8b which rotate on casing 30 by means of pins 42a and 42b respectively. Jaws 8a and 8b are attached to toothed gears 43a and 43b which mesh with each other. Pin 42a has inserted in it a fork 44 which engages a pin 45 vertically attached to stem 31. The rotation of stem 31 through a defined angle, by action of cam 41, thus determines the rotation of the gear pair formed by toothed gears 43a and 43b in such a way as to cause jaws 8a and 8b to move symmetrically from the gripping position P to the release position R and vice versa.

The bottom end of the aforesaid second sleeve 32 mounts a roller 46 which rotates diametrically in relation to the carousel. Roller 46 runs in a groove 47 defined by a ring 48 around tubular casing 22. One side of ring 48 is hinged at the bottom to a pivot 49 whose axis is horizontally tangent to a circle concentric with the axis of the carousel. Pivot 49 is mounted on a support 50 fixed to a ring shaped disc supported horizontally by columns 52 standing on lower plate 21. On the side diametrically opposite pivot 49, ring 48 is pivotally attached to stem 53a of an actuator 53. The said actuator is supported in vertical position by disc 51.

Chamber 16, concentric with the axis of carousel 3, is fed through a tube 54 connected to a tank outside the machine. Tube 54 is located above chamber 16, diametrically with respect to carousel 3, and is supported by a frame 55 attached to the fixed structure of carousel 3. Tube 54 is connected to a mouthpiece 56 leading out of chamber 16 in accordance with the axis of rotation of the carousel.

As shown in detail in Fig.4, valve 15 consists of a lower casing 57 fixed to carousel platform 18 and an upper casing 58 which rotates on a pin 59 about the vertical axis of valve 15 itself and in relation to lower casing 57. Upper casing 58 has a cap 60 held by pin 59 and pushed axially by a spring 61 which presses down on casing 58.

Lower casing 57 is crossed by a pair of parallel, vertical holes 62 and 63, which, at their bottom ends, are connected with a pair of ducts, respectively 64 and 65, made in platform 18. Duct 64 leads out of chamber 16, whilst duct 65 is connected to dispensing nozzle 17.

Platform 18 is also crossed by a vertical hole 66, whose bottom end is connected to cylinder and plunger assembly 14 and whose top end extends into lower casing 57 of the valve. The axes of holes 62, 63 and 66 are distributed around a circle concentric with the axis of rotation of upper valve casing 58.

Upper, rotating casing 58, on the other hand, is crossed by an approximately semicircular channel 67 in a horizontal plane. At each end and in the middle of channel 67 there are downward opening holes 67a, 67b and 67c which serve to connect hole 66 to ducts 64 and 65 alternately, in accordance with the angular position assumed by rotating valve casing 58.

Cap 60 of rotating casing 58 has on its top an eccentric pin 68 which rotates axially and held by a sprung bolt 69.

Pin 68 is designed to intercept a pair of cams 70 and 71, respectively first and second cam, during the rotation of carousel 3, the said cams being carried by fixed frame 55 of the carousel in diametrically opposite positions in relation to the axis of the carousel itself. Cams 70 and 71 have a chamfered face designed to act as a sliding guide for pin 68. Cams 70 and 71 are supported by actuators 72 and 73 respectively driven in a vertical direction in such a manner that they can be lifted to positions 70a and 71a in which they are disengaged from pins 68. The raising of cams 70 and 71 make it possible for washing cycles to be performed on the machine.

The method by which the bottles are filled will now be described starting from the moment when grippers

8 and related cylinder and plunger assemblies 14, rotated by carousel 3, move to the area where the aforesaid bottles, fed by distributor 6, are picked up. Grippers 8 reach the said area with their jaws 8a and 8b open in release position R, in such a way that they can grip the neck of bottle 1 to be filled.

The closing of jaws 8a and 8b to gripping position P is effected by cam 41, which at the said pickup area, causes stem 31 to rotate axially (refer to Fig. 3). Stem 31 is carried in direction A by carousel 3, so that roller 40 slides in cam 41. The rotation of stem 31 through a defined angle is transmitted to gear pair 43a and 43b and hence to jaws 8a and 8b.

After being gripped by jaws 8a and 8b, bottle 1 is lifted vertically, as shown by arrow D in Fig.6a, in such a way that nozzle 17 of dispensing unit 9 is inserted into the mouth of bottle 1. The raising of the bottle is achieved by the axial sliding of the first sleeve 29, attached to casing 30 of grippers 8. The said sliding motion is controlled by cam 37 in which roller 36 carried by sleeve 29 slides.

During this stage, channel 67 of upper casing 58 of valve 15, is connected through holes 67a and 67c to duct 64 and to hole 66 leading into cylinder and plunger assembly 14. The said cylinder and plunger assembly 14 is thus connected to feed chamber 16 and liquid is sucked into the cylinder when plunger 33 is driven downwards in the direction of arrow E shown in Fig. 6a.

When nozzle 17 has been inserted into bottle 1, cylinder and plunger assembly 14 is ready to discharge its fill of liquid. For this purpose, valve 15 switches the connection of cylinder and plunger assembly 14 from liquid suction duct 64 to duct 65 which conveys the liquid to nozzle 17. To obtain this action, eccentric pin 68 of the valve is intercepted by cam 70, thus causing upper casing 58 of the valve to rotate in relation to lower, fixed casing 57. In this way, channel 67 of casing 58 is connected through holes 67a and 67b to hole 66 and to duct 65, thus enabling the liquid to flow out through the nozzle.

The reciprocating motion of plunger 33 of cylinder and plunger assembly 14 is achieved by the axial sliding of second sleeve 32, attached to stem 33a of the plunger. This sliding motion is effected by roller 46, mounted by sleeve 32, which runs in the circumferential groove of ring 48.

The stroke of plunger 33 may be adjusted by varying the angle of ring 48, usually set in an oblique plane in relation to carousel 3. To adjust the stroke, the ring may be shifted using actuator 53, to the side opposite its pivot 49, as shown schematically by dashed line 74 in Fig.2b. Adjusting the stroke of the plunger makes it possible to vary the amount of liquid to be filled into the bottles.

As it is being filled, bottle 1 is gradually lowered, as shown by arrow G in Fig.6b, through the sliding of first sleeve 29 controlled by cam 37.

When the bottle is full, the flow of liquid stops, whilst bottle 1 continues moving down until nozzle 17 is disengaged (refer to Fig. 6c). The flow of liquid is stopped by cam 71 which intercepts eccentric pin 68, causing casing 58 of valve 15 to rotate to the initial position, that is to say, with channel 67 connected to duct 64 and cylinder and plunger assembly 14. At the same time, the next suction stage begins and liquid flows into cylinder and plunger assembly 14 (Fig. 6d).

The full bottle is transferred to distributor 12 of outfeed system 10. To do this, cam 41 causes jaws 8a and 8b to open at release position R in such a way that distributor 12 of outfeed system 10 can engage the bottle and move it away. Obviously, the work cycle described above is carried out by all the dispensing units mounted on the circumference of carousel 3.

The machine described thus makes it possible to synchronize the driving of cylinder and plunger assembly 14, the opening and closing of bottle grippers 8 and the vertical movement of the said grippers 8, in such a way as to work in conjunction with nozzle 17 of liquid dispensing units 9.

It should be stressed in particular that the above movements are obtained with a device that forms a sort of upright column arranged around carousel 3.

The device therefore occupies very little space and allows easy access to the internal parts of the carousel.

It should also be noted that the supply of liquid to dispensing units 9 is effected by a single valve for each dispensing nozzle 17. The said valves are rotated by carousel 3 and are fed by a chamber mounted on the same axis as carousel 3 itself. The space occupied by the valves is thus very limited, making for a very practical set-up.

In addition, the machine may be adjusted in accordance with the size of the bottles to be filled, as shown in Fig. 7, which shows carousel 3 set for filling bottles of the largest size. Such adjustment is effected by moving plate 21 upwards away from plate 27 in such a manner as to also raise drive means 28, which are attached to plate 21, and thus vary the distance between grippers 8 and the feed level of bottles 1, the said level being defined by rotary distributor 6 (position X in Figures 2b and 7).

Finally, Figures 8a and 8b show carousel when cylinder and plunger assemblies 14 are being washed. To effect washing, ring 48 is moved to a horizontal position (position Y, Fig. 8b), by rotating it about its pivot 49 by means of actuator 53. In this way, roller 46, which runs in groove 47 of ring 48, is not moved in vertical direction and the reciprocating motion of plunger 33 of cylinder and plunger assemblies 14 is stopped. Column 19 is lowered by means of elements 80 (Fig.8b). In this way, plunger 33 stops in the raised position Z (Fig. 8a) where the inside diameter of the cylindrical lining of cylinder and plunger assembly 14 is larger and does not form a

hydraulic seal. At the same time, cams 70 and 71 are moved to raised positions 70a and 71a through their respective actuators 72 and 73, so as to interrupt drive to valves 15. Valves 15 are stopped in the position where chamber 16 is connected to cylinder and plunger assemblies 14.

Under these conditions, cylinder and plunger assemblies 14 may be filled with an appropriate washing liquid . The washing liquid flows to the bottom of cylinder and plunger assemblies 14 and collects in trap 23.

Claims

1) Method for filling containers with liquid products **characterized in that** it includes:

picking up containers (1) to be filled by means of grippers (8) with jaws designed to grip the necks of said containers (1) and rotated by a carousel (3) which rotates about a vertical axis and which receives the containers (1) from feed units (2);

vertically raising said containers (1) together with the said grippers (8) in such a way that nozzles (17) of liquid dispensing units (9), carried by said carousel (3) over said grippers (8), are inserted into the mouths of the containers;

gradually lowering said containers (1) while the liquid is being discharged into them by said nozzle (17);

releasing said containers (1) when full and transferring them to an outfeed system (10).

2) A machine for filling containers with liquid products, comprising means (2) for feeding containers (1) to be filled, a carousel 3 rotating about a vertical axis and designed to receive containers (1) one by one from feed means (2), liquid dispensing units (9) mounted on the circumference of said carousel (3), and an outfeed unit (10) for moving the full containers away from said carousel (3), the said machine being **characterized in that** it further comprises:

grippers (8) with jaws for holding said containers (1), the said jaws closing to gripping position (P) in an area where said containers (1) are fed in, and opening to release position (R) in an area where the said containers (1) are moved away;

a device (28) for synchronously driving said grippers (8) and said dispensing units (9), said device (28) being designed to vertically move said grippers (8) alternately between a lowered position where said containers (1) are picked up and released, and a raised position where nozzles (17) of said dispensing units (9) are inserted into the mouths of the containers;

a chamber (16) for supplying the liquid product mounted on, and concentric with, a platform (18) of carousel (3);

a plurality of ducts (64,65) made in said platform (18) and designed to connect chamber (16) to said dispensing units (9);

a plurality of valves (15) mounted on the circumference of said platform (18), each related to one of the said dispensing units (9), and designed to be activated in such a way that the liquid product can be supplied to said dispensing units (9) through said ducts (64,65).

3) A machine according to claim 2, **characterized in that** said device (28) for synchronously driving grippers (8) and dispensing units (9) consists of:
a first sleeve (29) the top of which mounts casing (30) of grippers (8) and the bottom of which mounts a roller (36) which engages a cam (37) made on a cylindrical wall (38) concentric with the axis of said carousel (3);

a second sleeve (32), crossed axially by said first sleeve (29), which is linked to plunger (33) of a cylinder and plunger assembly (14) of one of said dispensing units (9) and which mounts a roller (46) able to rotate according to a diametrical axis in relation to the carousel (3), the said roller being designed to run in a groove (47) defined by the circumference of a ring (48) which surrounds the axis of carousel (3) and which is set in an oblique plane in relation to carousel (3);

a stem (31) through said first sleeve (29), the bottom of said stem (31) mounting a roller (40) able to rotate about a vertical axis and designed to engage a cam (41) in the shape of a ring on a horizontal plate (21), whilst the top of said stem (31) is designed to rotate a gear pair (43a,43b) through a defined angle, which transmits motion to aforesaid grippers (8) in such a way as to cause the pair of jaws (8a,8b) to rotate from position (P) where said containers (1) are gripped to release position (R) where the containers are released.

4) A machine according to claim 3 **characterized in that** said jaws (8a,8b) are rotatably mounted on said casing (30) of the grippers (8) and have attached to them toothed gears (43a,43b), which mesh with each other to form a gear pair, and one of which has inserted in its centre a fork (44) designed to engage a pin (45) vertically attached to stem (31).

5) A machine according to claim 3 **characterized in that** one side of said ring (48) is hinged at the bottom to a pivot (49) whose axis is horizontally tangent to a circle concentric with the axis of carousel (3), whilst the diametrically opposite side of said ring (48) is pivotally attached to an actuator (53) with a vertical axis.

6) A machine according to claim 2 **characterized in that** each of said valves (15) consists of a lower casing (57), fixed to said platform (18) of carousel (3) and an upper casing (58) which rotates about the vertical axis of the valve (15) itself in relation to said lower casing (57), said upper casing (58) being crossed by a channel (67) designed to be connected to said ducts (64,65) alternately.

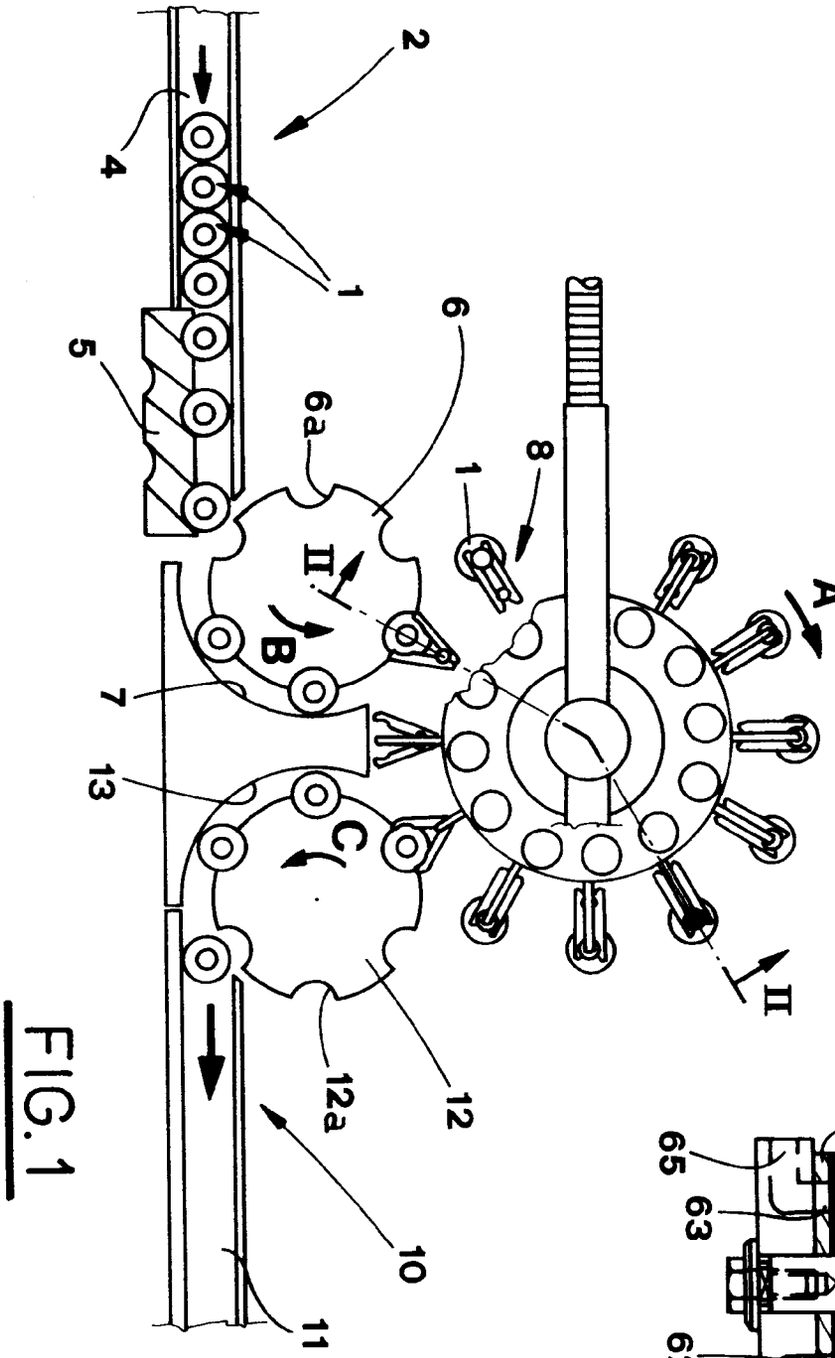
7) A machine according to claim 6 **characterized in that** said channel (67) has the shape of an arc, forming almost a semicircle, in a horizontal plane, at each end and in the middle of said channel (67) there being downward opening holes (67a,67b,67c) which serve to connect a cylinder and plunger assembly (14), rotated by carousel (3), to ducts (64,65) alternately, in such a way as to enable the liquid product to be sucked in from said chamber (16) and then to flow into dispensing nozzle (17).

8) A machine according to claim 6 **characterized in that** the top of said upper casing (58) has on it an eccentric pin (68) which rotates axially and which is designed to intercept a pair of cams (70,71), respectively first and second cam, during the rotation of carousel (3), the said cams being carried by fixed frame (55) of the carousel in diametrically opposite positions in relation to said carousel (3).

9) A machine according to claim 8 **characterized in that** said cams (70,71) are supported by actuators (72,73), respectively, driven in a vertical direction in such a manner that they can be lifted to positions (70a,71a) in which they are disengaged from pins (68) of valves (15), in order to stop said valves (15) in the position where chamber (16) is connected to cylinder and plunger assemblies (14).

10) A machine according to claim 3, wherein the cylindrical lining of the said cylinder and plunger assemblies are attached to said carousel (3) in such a way that they are perpendicular to the axis of the carousel itself, said machine being **characterized in that** the said linings, at their top ends, are larger in diameter than at their bottom ends, so that at the said top ends they do not form a hydraulic seal with the related plungers (33), in that there is a trap (23) to which the bottom of each lining is connected via a tube (23a), in that it comprises means (19,80) for moving the said carousel downwards in such a way that, with aforesaid ring (48) rotated about its pivot (49) until it is transverse to the axis of the said carousel, each plunger (33) may be moved to the topmost position so as to enable washing liquid to flow into all said linings, the said washing liquid flowing down the sides of the linings and into said trap (23).

11) A machine according to claim 2 **characterized in that** said chamber (16) is supplied through a tube (54) connected to a tank outside the machine and located above chamber (16), diametrically with respect to carousel (3), said tube (54) being supported by a fixed frame (55) and connected to a mouthpiece (56) leading out of chamber (16) in accordance with the axis of rotation of said carousel (3).


2
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11

FIG.1

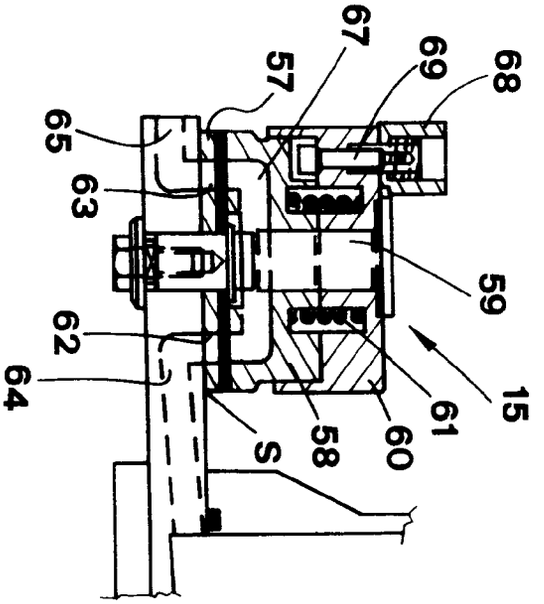
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FIG.4

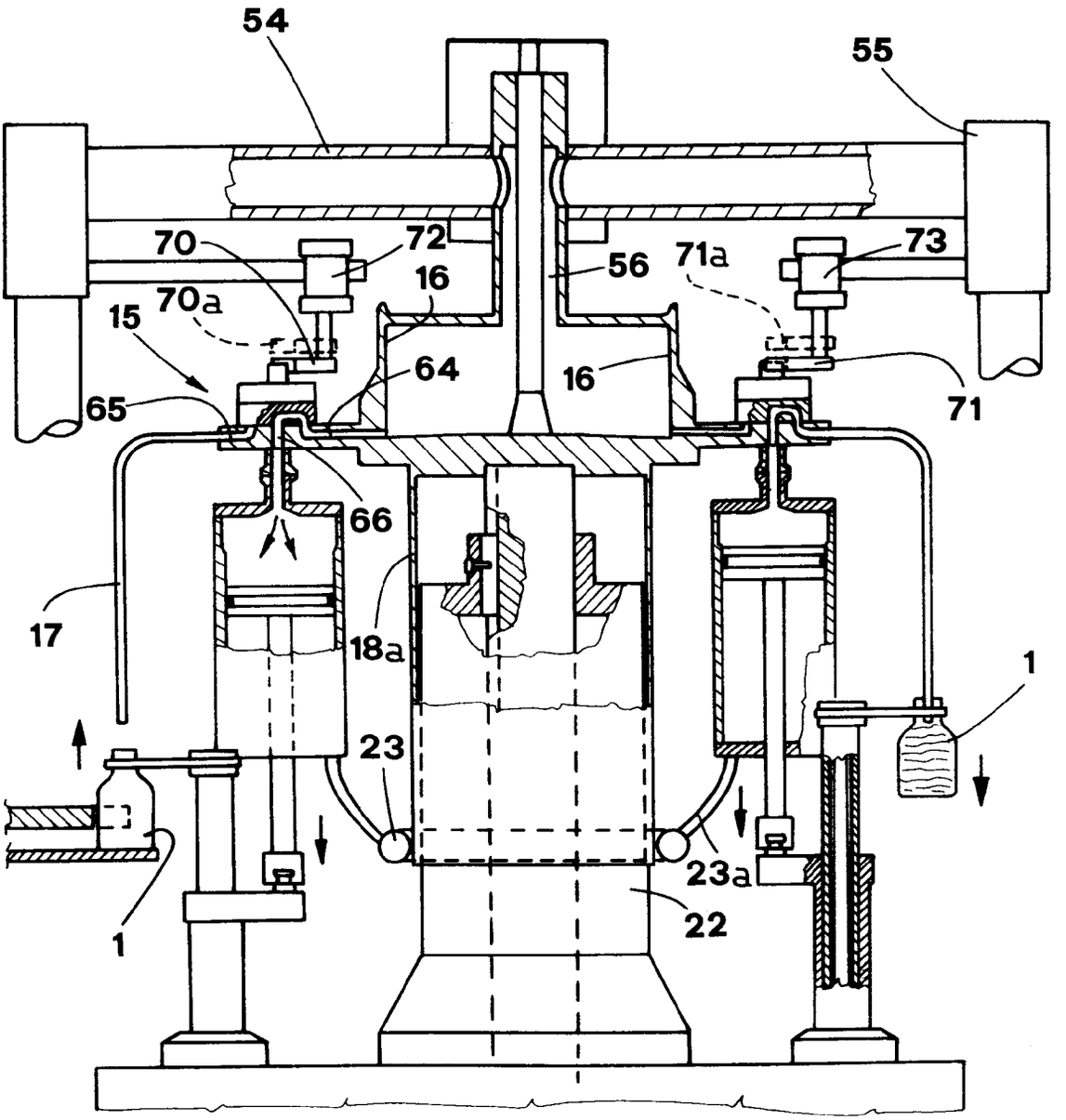

FIG. 2a

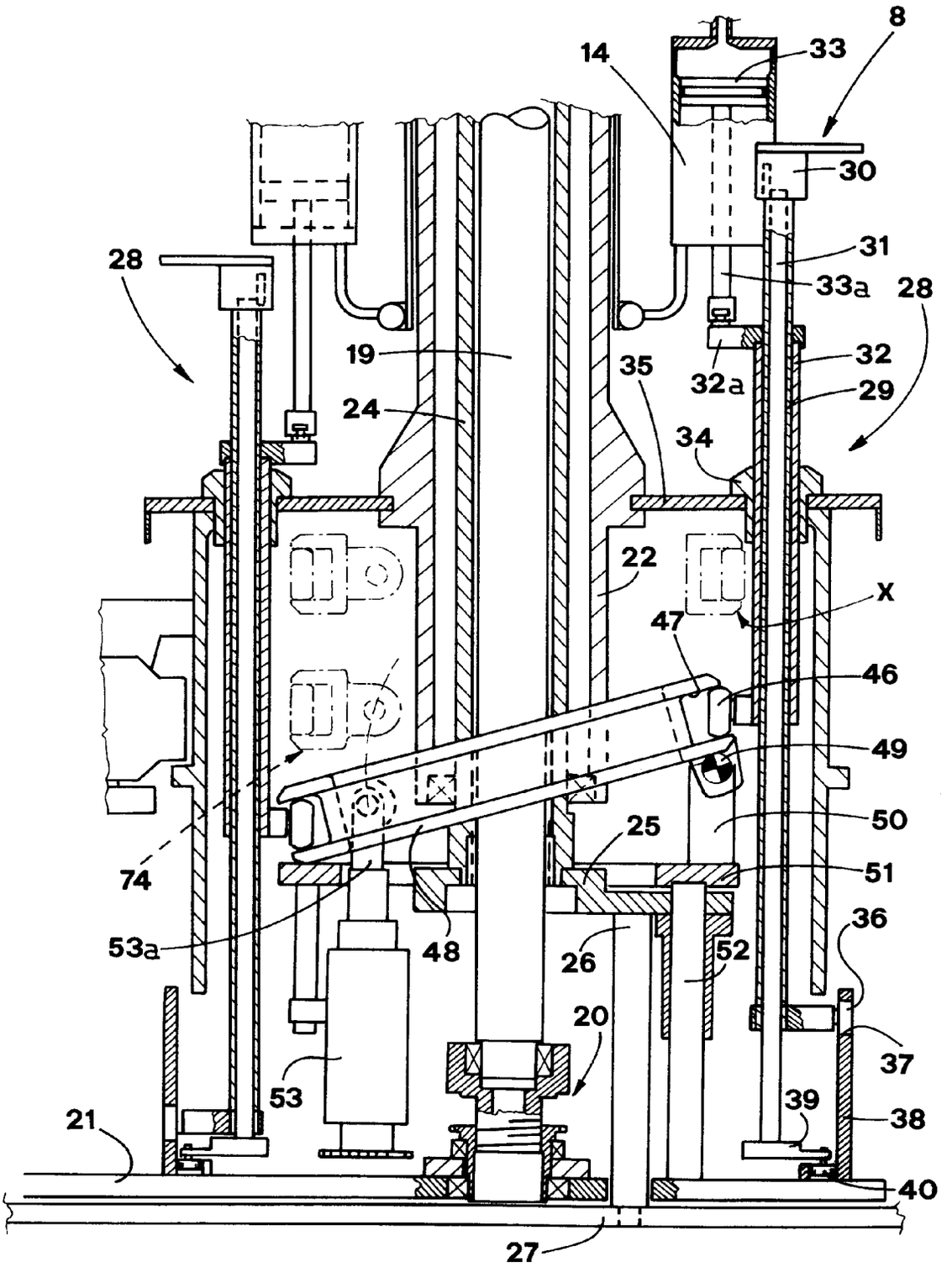
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FIG. 2b

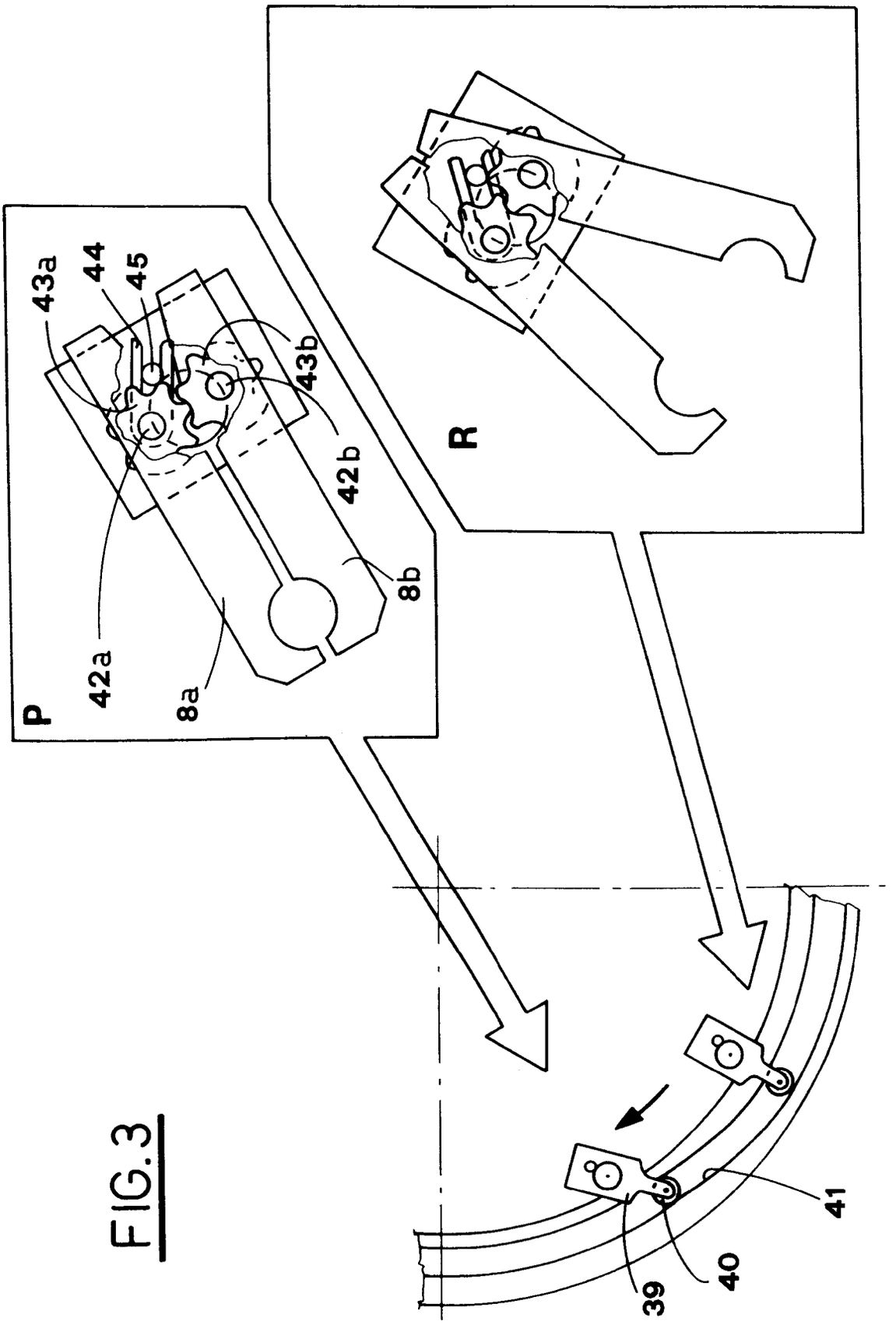


FIG.3

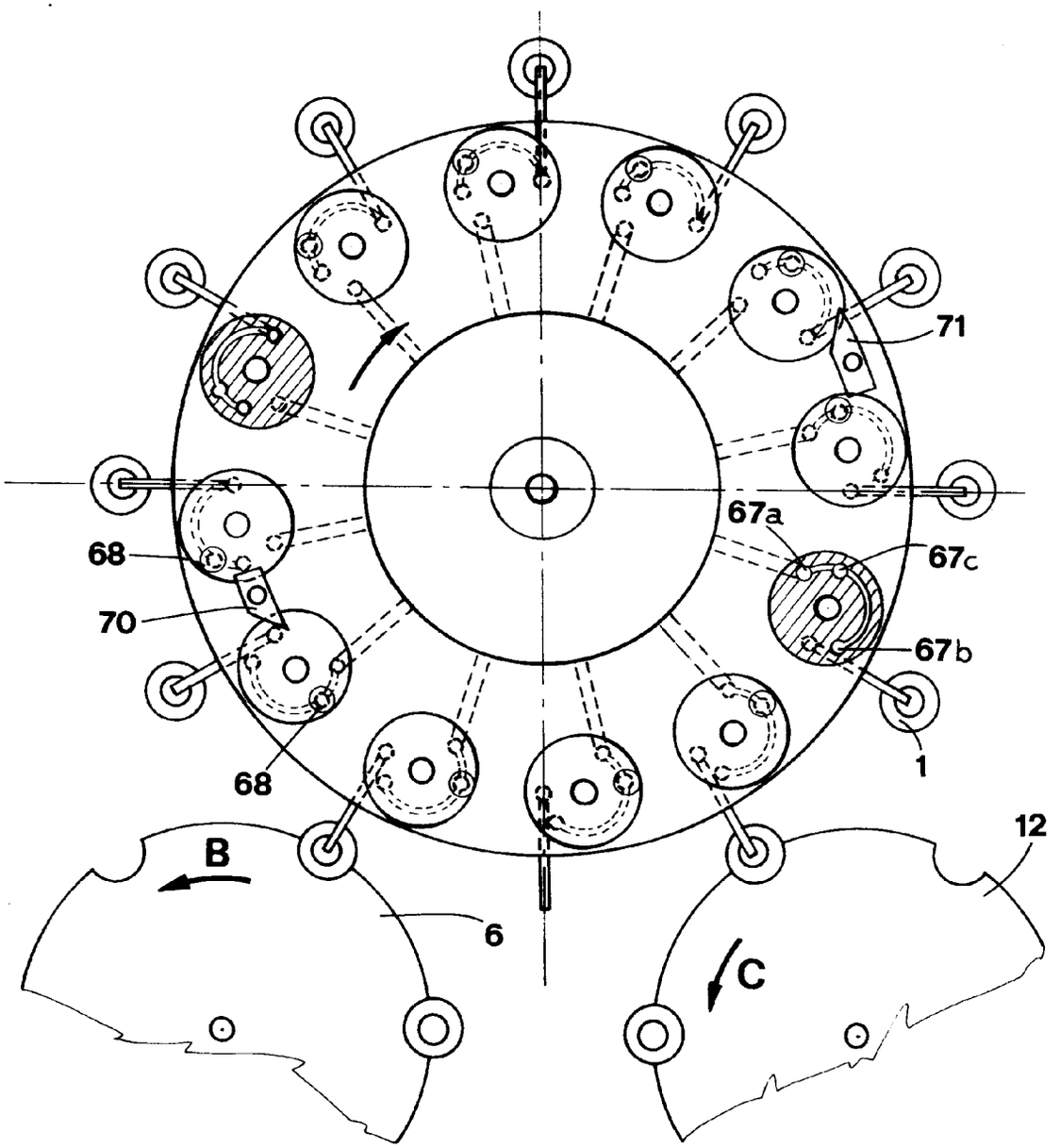


FIG.5

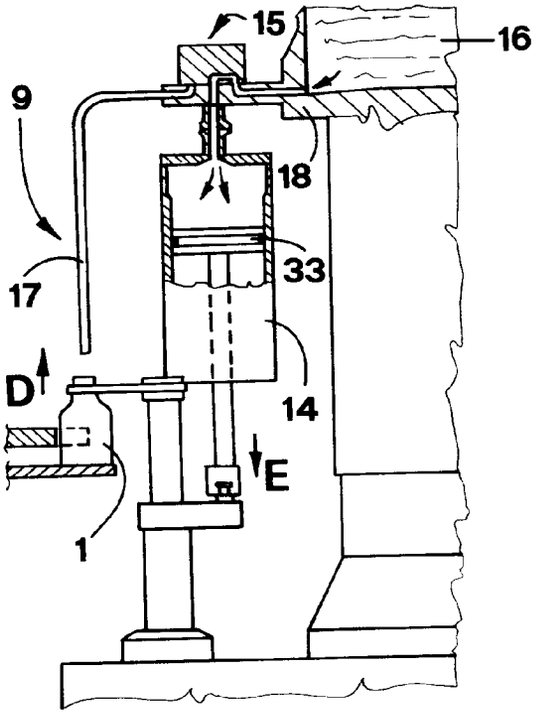


FIG.6a

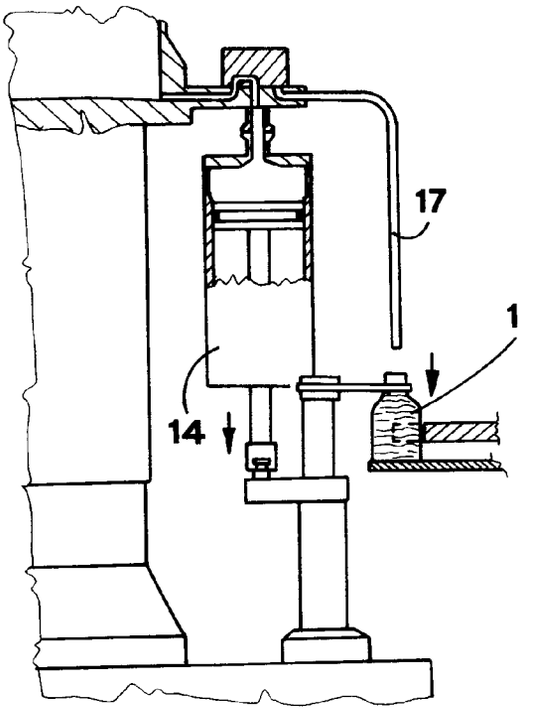


FIG.6d

FIG.6b

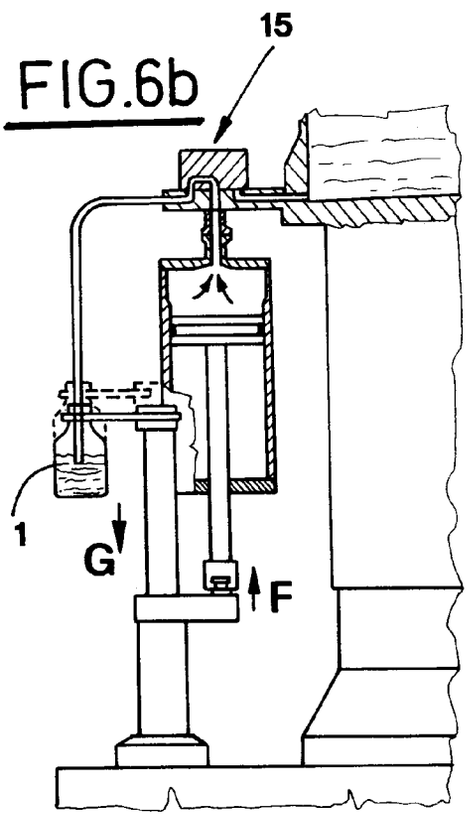
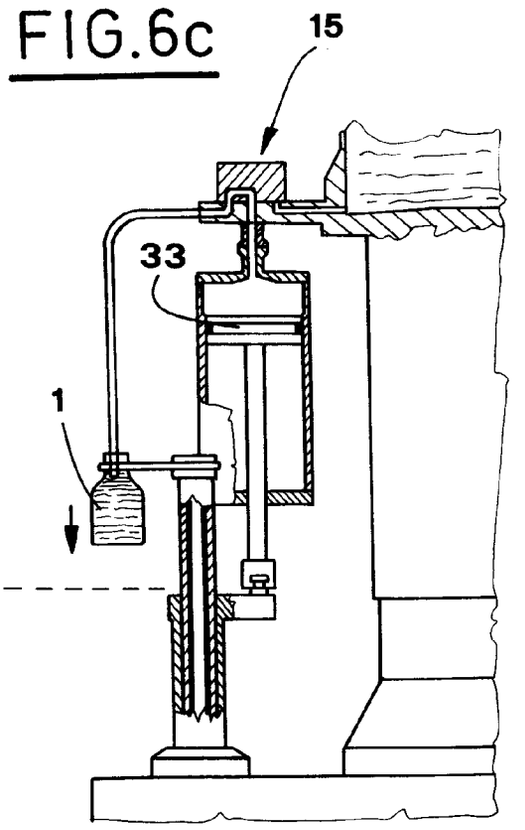


FIG.6c



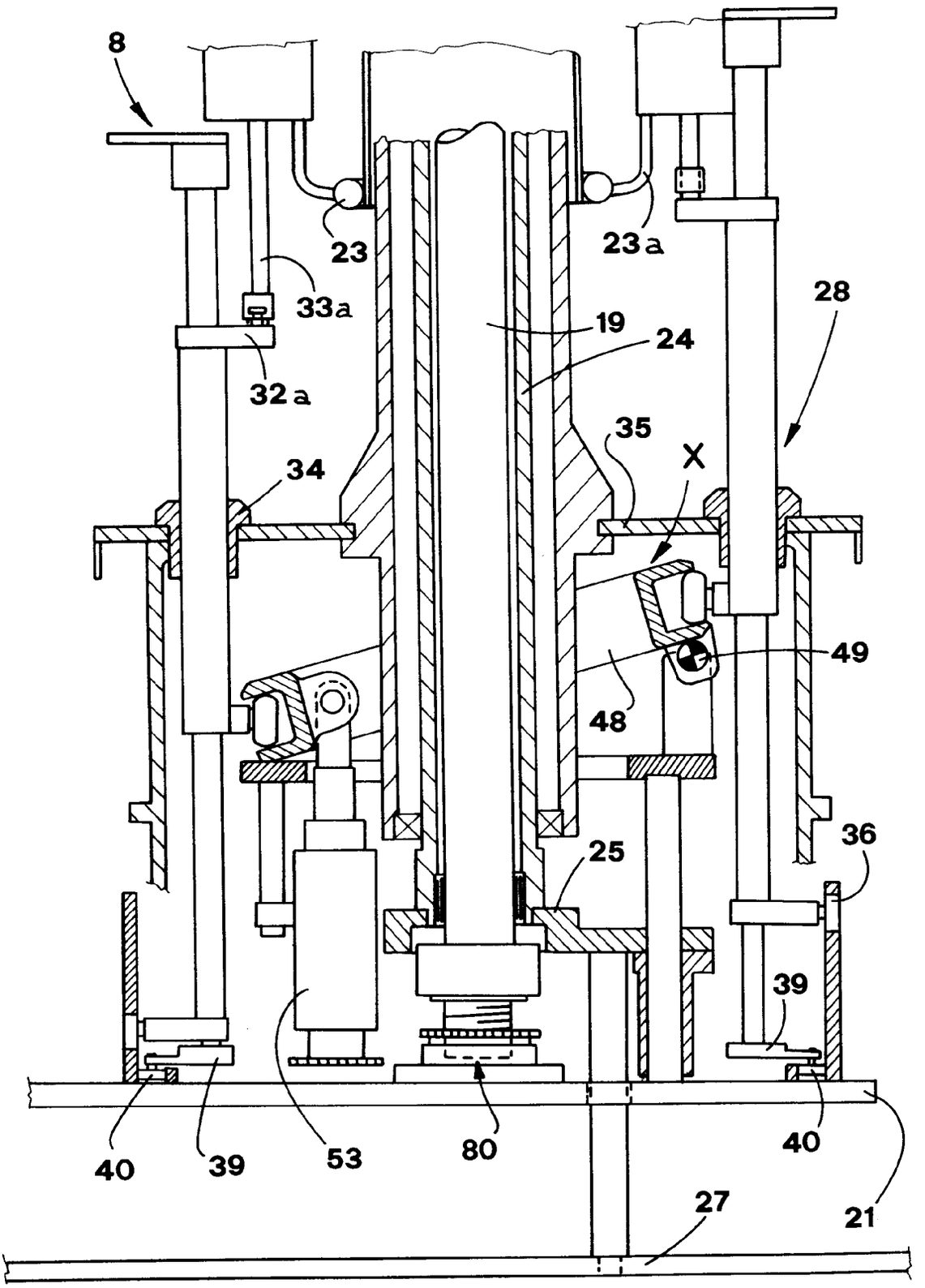


FIG.7

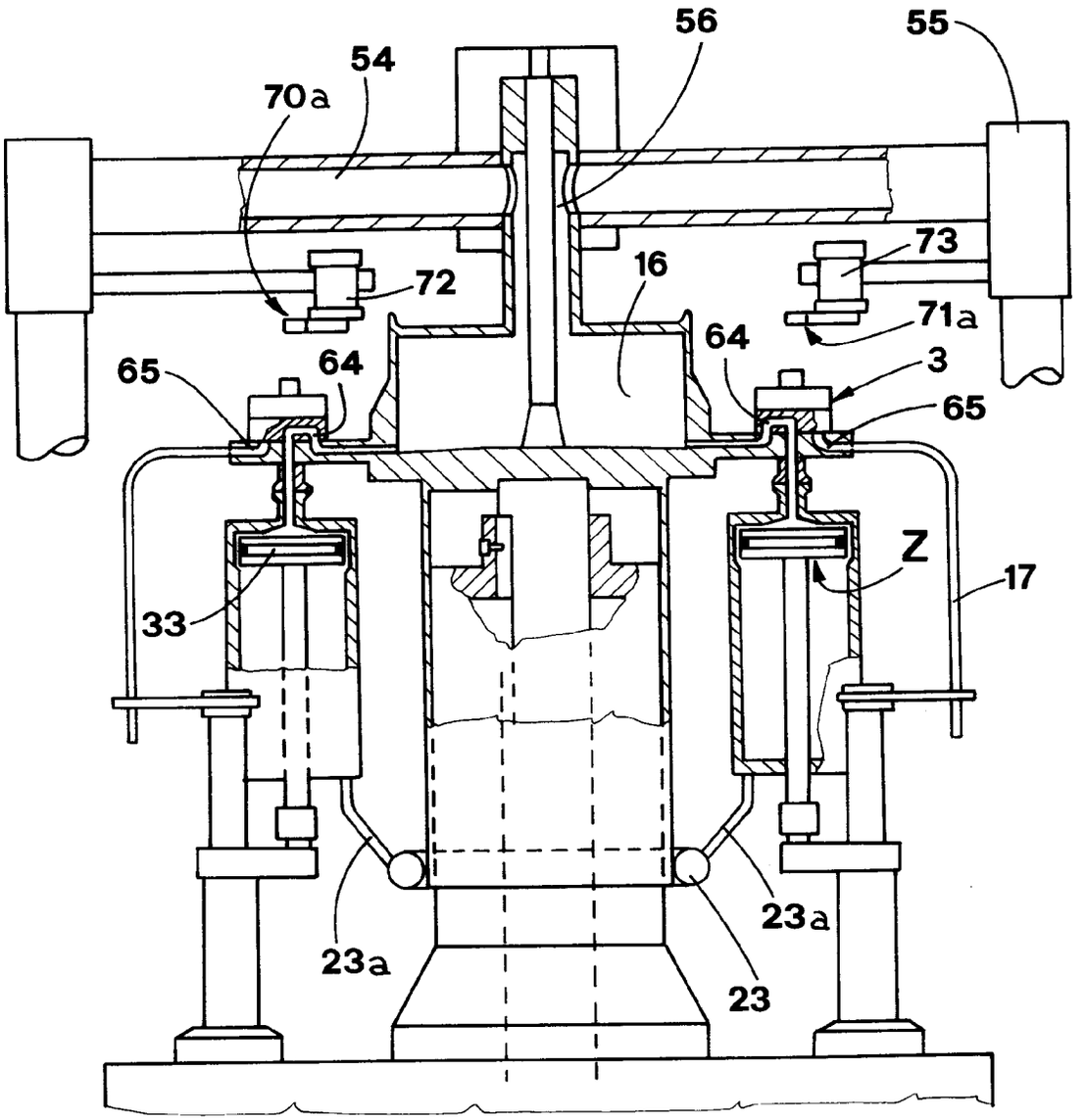


FIG.8a

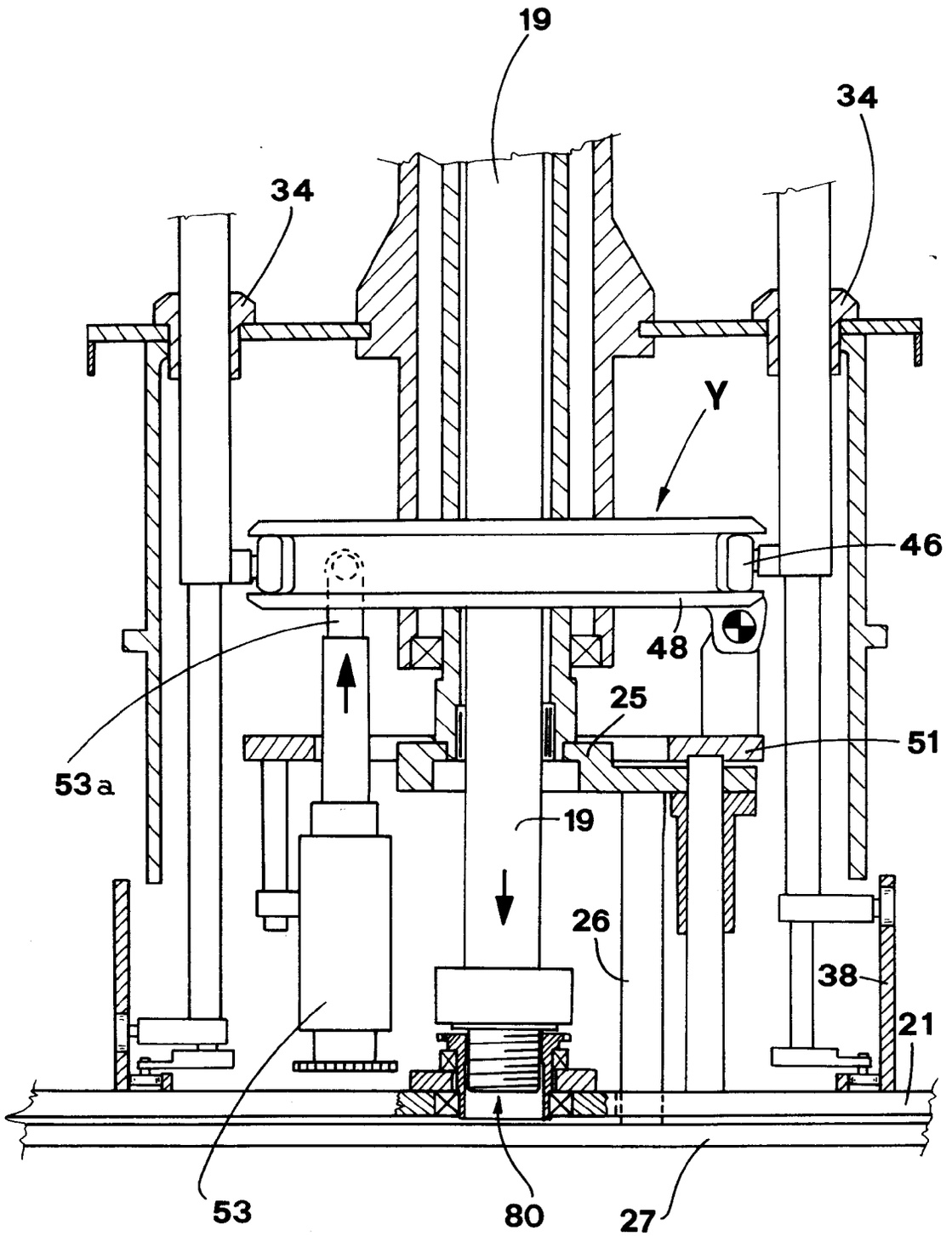


FIG.8b