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(54) Aseptic filling machine.

(57) Disclosed is an aseptic filling machine comprising a filling zone (15) defined by walls, a vessel-supporting mechanism arranged in the filling zone (15), a content-filling nozzle (8, 8a) arranged in the filling zone, a pipe passage (5, 5a) for supplying the content to the filling nozzle, an air blow-out opening (9, 9a) for producing a positive pressure locally in the filling zone, a fluid passage-forming connecting member (20, 20a) for detachably connecting the filling nozzle (8, 8a) and the air blow-out opening (9, 9a), and a changeover mechanism (22, 22a) for connecting the air blow-out opening (9, 9a) alternatively to an aseptic air supply source and a tank for recovering a cleaning liquid or a sterilizing fluid, wherein the air blow-out opening (9, 9a) forms a part of a pipe passage for recovering the cleaning liquid or sterilizing fluid.

In this filling machine, the filling zone (15) is defined and localized by walls (11, 12, 13, 14), and a positive pressure can be produced and maintained very easily in the filling zone (15). Furthermore, since the aseptic air supply pipe passage is utilized as a part of the cleaning liquid or sterilizing fluid recovery pipe passage, the aseptic air supply pipe passage and the content filling pipe passage or content feed passage can be simultaneously cleaned or sterilized by one mechanism and an excellent contamination-preventing effect can be attained by a simple structure and mechanism.

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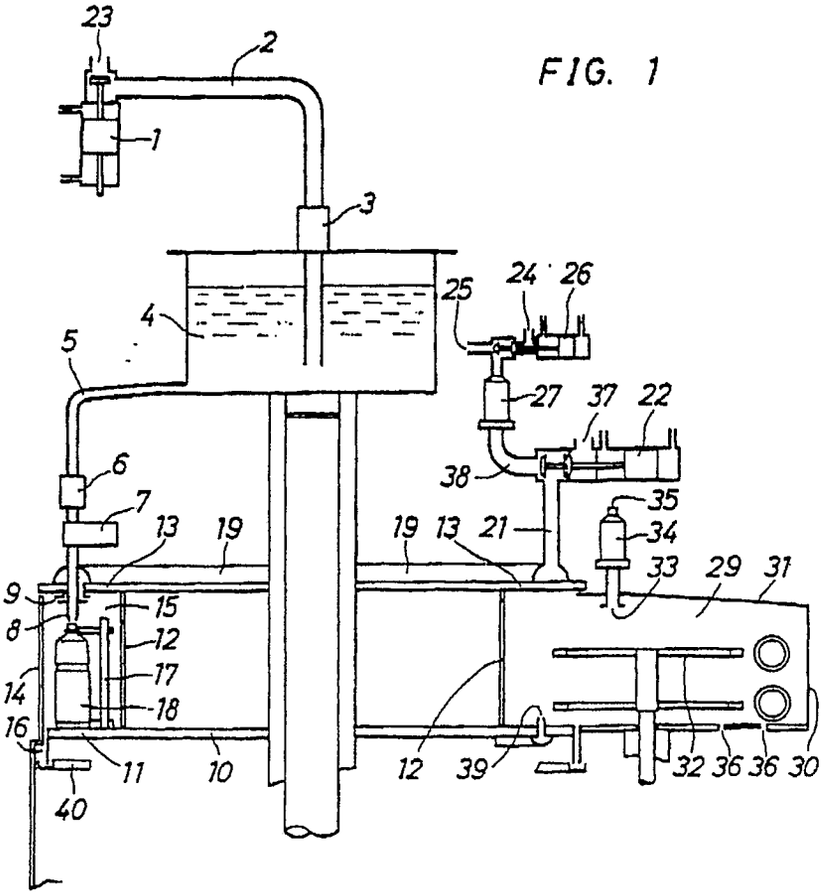
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FIG. 1

ASEPTIC FILLING MACHINE

Background of the Invention

(1) Filed of the Invention

The present invention relates to an aseptic filling machine for filling a liquid content such as a drink or food or a medicine under aseptic conditions. More particularly, the present invention relates to an aseptic filling machine showing excellent effects of keeping asepsis and preventing contamination in a filling zone.

(2) Description of the Related Art

In carrying out a filling operation in an aseptic or dust-free state, a filling machine or filling zone is disposed in an aseptic chamber. In general, aseptic air obtained by passing air through a filtration apparatus having an HEPA (high efficiency particulate air) filter arranged at the final stage is blown into a clean chamber through a pipe passage having a large diameter to maintain a positive pressure with aseptic air and keep asepsis in the aseptic chamber. In order to prevent contamination of a content with microorganisms and the like, asepsis is kept in the aseptic chamber, and simultaneously, the pipe passage for blowing out aseptic air, a filling pipe passage including a filling nozzle and a passage for the content are sterilized.

According to the conventional technique, sterilization of the aseptic air blow-out pipe passage is performed independently from sterilization of the filling passage of the filling machine and the passage for the content. Since the diameter of the aseptic air blow-out pipe passage is large, sterilization of this pipe passage is generally carried out in the open system. Accordingly, sterilization cannot be performed with hot water or super-heated steam (higher than 100°C), and therefore, sterilization with low-pressure steam (100°C at highest), a mixture of heated gas or heated air and steam or a mixture of heated air and a chemical sterilizing agent is adopted. When hot air or super-heated steam is used, even a deep layer portion can be sterilized, but the latter sterilization method is defective in that only a top layer portion is sterilized, or sufficient heat is not applied, and therefore, sterilization is insufficient. Also the method in which sterilization is effected only with a sterilizing agent is sometimes adopted. However, also in this method, only a top layer portion is sterilized and microorganisms present below a foreign matter cannot be killed. Moreover, the mechanism for cleaning and sterilizing the content-filling passage of the filling machine, the content delivery passage and the like is complicated and a great deal of labor is required for this operation. A liquid-filling apparatus for carrying out cleaning and sterilization in a simple manner is disclosed in Japanese Unexamined Patent Application No. 63-67201. In this apparatus, a nozzle cap having a liquid discharge pipe connected to the top end of an opening of a filling nozzle is dismountably combined with a vertical mechanism and a rotary mechanism. At the sterilization, the filling nozzle cap is attached and used for sterilizing the interior of the content passage with a sterilizing agent or steam, and at the filling, the nozzle cap is dismounted and brought down with the liquid discharge pipe so that the filling operation is not obstructed. However, this filling machine is still insufficient in that since the liquid discharge pipe comes into the filling zone of the aseptic chamber and goes out therefrom and many pipes, mechanical parts, parts having a sliding portion and movable parts are left in the aseptic chamber, the risk of contamination increases, and furthermore, if the filling head is of the moving type, the mechanism is complicated. Moreover, since the aseptic air blow-out pipe passage is independently sterilized, a great deal of labor is necessary.

Further, a method in which a filling machine or filling zone is arranged in an aseptic chamber is defective in that since the aseptic chamber is large, construction of the aseptic zone coats a great deal, a large quantity of aseptic air is necessary for maintaining a high degree of cheanliness and a great deal of labor is necessary for the filter-exchanging operation and the cleaning operation. Moreover, since many devices and machine parts are arranged in the chamber, the risk of contamination of the interior of the aseptic chamber increases when the machine is adjusted, and many limitations are imposed on used parts for keeping asepsis.

Japanese Unexamined Utility Model Publication No. 62-95595 discloses a filling machine in which aseptic filling is intended. According to the disclosed method, clean air is injected to the periphery of openings of bottles from the periphery of filling nozzles to envelop a space between the filling nozzles and the openings of the bottles with a clean air curtain, whereby asepsis is maintained at the filling step. The consumption of aseptic air is considerably large, and since asepsis is maintained only by the air curtain in the open state, it is apprehended that the asepsis will be destroyed at

the operation of adjusting the machine, or contamination will be caused at the feed and discharge of the bottles.

A filling machine of the linear and intermittent motion type is generally used for filling a content into containers formed from a paper or plastic film roll, and in this case, a local aseptic zone is sometimes formed with the filling zone being as the center in the interior of the machine, as disclosed in Japanese Examined Patent Publication No. 61-3502. According to this proposal, a large aseptic chamber is not necessary and sterilization of the entire machine is not necessary. However, since a delivery mechanism for the linear and intermittent feeding and a moving mechanism for the formation of containers are present in the interior of the aseptic zone surrounded by stationary walls, cleanliness cannot be maintained unless these moving portions are sufficiently sterilized, and many problems should be solved for maintaining complete asepsis. Furthermore, these rises a risk of contamination of the aseptic zone when the machine is adjusted, and many limitations are imposed on parts used, as in the case where the entire machine is arranged in the aseptic chamber. Moreover, since acceleration, deceleration and stoppage of the containers are repeated in the delivery of the linear and intermittent motion system, leakage of the liquid is often caused, and the operation should be performed at a low speed for avoiding this disadvantage. Thus, the filling machine of this type is defective in various points as compared with the rotary type filling machine.

Clean air to be used in the aseptic chamber or aseptic zone is generally obtained by using a filtering apparatus comprising HEPA filters arranged at the final stage. These filters are characterized in that since the pressure loss is small, a large flow quantity can be obtained, but the dust collection efficiency is not 100% and is only 99.97% in case of particles having a particle size of 0.3 μm. In contrast, in case of a membrane filter, a large flow quantity cannot be obtained but the dust collection efficiency is complete, and particles having an optical particle size within a range of about 15 to about 0.025 μm can be collected at a dust collection efficiency of 100%. Since sizes of bacteria and endospores are about 5 to about 0.5 μm, completely aseptic air can be obtained. However, according to the conventional technique, since the consumption of air is large, a membrane filter cannot be adopted, and the asepticity of clean air is limited.

According to the conventional aseptic filling method, since the air supply pipe passage of the aseptic chamber is sterilized independently from cleaning and sterilization of the content filling pipe passage and content delivery passage of the filling machine by a separate mechanism, the mechanism is complicated and a great deal of labor is required. Moreover, since sterilization is effected with low-pressure steam, heated gas, a mixture of heated air and steam, a mixture of heated air and a chemical sterilizing agent, or a sterilizing agent, or a sterilizing agent alone, troubles are caused and it is difficult to keep asepsis. For example, only a surface layer portion is sterilized, sterilization is insufficient in a water-stagnant portion, and bacteria below a foreign matter cannot be killed by sterilization. Furthemore, in connection with the maintenance of cleanliness in the aseptic chamber, the risk of contamination is high and the contamination-preventing mechanism is not completely satisfactory, and improvements are desired.

Furthemore, according to the conventional aseptic filling method, since the aseptic zone is large, it is apprehended that the asepsis will be destrolyed unless sterilization is carefully performed over a broad area, and in order to maintain asepsis, many limitations are imposed on an operator, and also on parts of the machine and parts disposed in the chamber. Still further, since a positive pressure has to be maintained, the consumption of the chamber, it is necessary to scatter the chemical sterilizing agent to the entire machine by the manual operation. For this purpose, large expenses and a great deal of labor are necessary. Therefore, improvements are desired.

Summary of the Invention

It is a primary object of the present invention to solve the foregoing problems of the conventional techniques and provide a linear or rotary aseptic filling machine, in which a filling zone is restricted to a local part, maintenance of a positive pressure with aseptic air is facilitated to improve the contamination-preventing effect, a aseptic air supply pipe passage is utilized as a part of a pipe passage for recovering a cleaning liquid or sterilizing fluid to make it possible to simultaneously clean or sterilize the aseptic air supply pipe passage and a content filling pipe passage or a content delivery passage, the structure is simple and operational restrictions for keeping asepsis are reduced, and a high labor-saving effect is attained.

Another object of the present invention is to solve the problems of the conventional techniques and provide a rotary aseptic filling machine in which a contamination-preventing mechanism is excellent, there are no operational restrictions and aseptic filling is easily accomplished.

Still another object of the present invention is to provide a rotary aseptic filling machine in which

a filling zone can be maintained in asepsis by using a relatively small amount of aseptic air and the asepsis is not destroyed by charging of an empty vessel or discharging of a filled vessel or by approach of an operator to the machine for the adjustment of the machine.

In accordance with one fundamental aspect of the present invention, there is provided an aspect filling machine comprising a filling zone defined by walls, a vessel-supporting mechanism arranged in the filling zone, a content-filling nozzle arranged in the filling zone, a pipe passage for supplying the content to the filling nozzle, an air blow-out opening for producing a positive pressure locally in the filling zone with aseptic air, a fluid passage-forming connecting member for detachably connecting the filling nozzle and the air blow-out opening, and a changeover mechanism for connecting the air blow-out opening alternatively to an aseptic air supply source and a tank for recovering a cleaning liquid or a sterilizing fluid, wherein the air blow-out opening forms a part of a pipe passage toe recovering the cleaning liquid or sterilizing fluid.

In accordance with another aspect of the present invention, there is provided a rotary aseptic filling machine comprising a rotary table having many vessel-supporting seats, a filling nozzle located above each vessel-supporting seat, a content feed pipe passage connected to the filling nozzle, a delivery mechanism for feeding sterilized vessels to the vessel-supporting seats and a discharge mechanism for taking out content-filled vessels from the vessel-supporting seats, wherein a filling zone is defined by a rotary wall having an inner circumferential wall and a top wall, which are formed integrally with the rotary table, and a fixed outer circumferential wall, a filling nozzle communicating with the filling zone is arranged on the top wall, an air blow-out opening for producing a positive pressure locally in the filling zone with aseptic air is arranged on at least one of the rotary wall and the fixed wall, a fluid passage-forming connecting member for detachably connecting the filling nozzle and the air blow-out opening and a changeover mechanism for connecting the air blow-out opening alternatively to a aseptic air supply source and a tank for recovering a cleaning liquid or a sterilizing liquid are disposed, and the air blow-out opening forms a part of a pipe passage for recovering the cleaning liquid or sterilizing fluid.

In accordance with still another aspect of the present invention, there is provided a linear aseptic filling machine comprising a filling zone, a vessel-supporting mechanism arranged in the filling zone, a content-filling nozzle arranged in the filling zone, a pipe passage for feeding a content to the filling nozzle, a heat forming mechanism for sterilizing and heat-forming a vessel material sheet and feeding a sterilized formed vessel to the filling zone, a lid member-heating mechanism for sterilizing and heating a lid member and feeding the lid member to a scaling step, a sealing mechanism for sealing the lid member to the content-filled vessel, and a mechanism for punching the lid-sealed content-filled vessel into a product, wherein the filling zone is defined by an outer circumferential wall, a filling nozzle communicating with the filling zone is arranged on a top wall of the outer circumferential wall, an air blow-out opening for producing a positive pressure locally in the filling zone with aseptic air is arranged on the outer circumferential wall, a fluid passage-forming connecting member for detachably connecting the filling nozzle and the air blow-out and a changeover mechanism for connecting the air blow-out opening alternatively to a aseptic air supply source and a tank for recovering a cleaning liquid or a sterilizing fluid are arranged, and the air blow-out opening forms a part of a pipe passage for recovering the cleaning liquid or sterilizing fluid.

In accordance with still another aspect of the present invention, there is provided a rotary aseptic filling machine comprising a rotary table having many vessel-supporting seats, a filling nozzle arranged above each vessel-supporting seat, a content feed pipe passage connected to the filling nozzle, a delivery mechanism for feeding sterilized vessels to the vessel-supporting seats and a discharge mechanism for taking out content-filled vessels from the vessel-supporting seats, wherein a filling zone is defined by a rotary wall having an inner circumferential wall and a top wall, which are formed integrally with the rotary table, and a fixed outer circumferential wall, a filling nozzle communicating with the filling zone is arranged on he top wall, and an air blow-out opening for producing a positive pressure locally in the filling zone with aseptic air is arranged on at least one of the rotary wall and the fixed wall.

Brief Description of the Drawings

Fig. 1 is a diagram illustrating in section a main part of one embodiment of the rotary aseptic filling machine of the present invention.

Fig. 2 is a plane view showing the rotation of the filling zone in Fig. 1 to a delivery mechanism and a discharge mechanism, disposed before and after the filling zone.

Fig. 3 is a sectional view illustrating a portion of a filling nozzle at the cleaning or sterilizing step.

Fig. 4 is a diagram illustrating the pipe line at the cleaning or sterilizing step.

Fig. 5 is a diagram illustrating the outline of one

embodiment of the linear aseptic filling machine of the present invention.

Fig. 6 is a sectional view illustrating a portion of a filling nozzle at the cleaning or sterilizing step in the embodiment shown in Fig. 5.

Detailed Description of the Preferred Embodiments

The aseptic filling machine of the present invention comprises a filling zone defined by a wall, a vessel-supporting mechanism arranged in the filling zone, a content-filling nozzle arranged in the filling zone, a pipe passage for feeding a content to the filling nozzle and an air blow-out opening for producing a positive pressure locally in the filling zone with aseptic air, and the aseptic filling machine of the present invention is prominently characterized in that a fluid passage-forming connecting member for detachably connecting the filling nozzle to the air blow-out opening and a changeover mechanism for connecting the air blow-out opening alternatively to an aseptic air supply source and a tank for recovering a cleaning liquid or a sterilizing fluid are disposed, and the air blow-out opening forms a part of a pipe passage for recovering the cleaning liquid or sterilizing fluid.

More specifically, since the filling zone is defined by the wall, the aseptic zone is localized, and the diameter of the aseptic air supply pipe passage can be much reduced, as compared with the case where the entire filling machine is arranged in an aseptic chamber. Accordingly, the difficulties involved in sterilization in an open system using a large-diameter pipe passage can be fundamentally eliminated by adopting a pipe passage of the closed system. At the filling operation, the air blow-out opening exerts an inherent function of blowing out aseptic air, and at the sterilizing or cleaning step, the air blow-out opening acts as a part of the pipe passage for recovering the cleaning liquid or sterilizing fluid. Accordingly, the structure of the interior of the filling zone can be much simplified, as compared with the case where both of the air blow-out opening and the opening for recovering the cleaning liquid or sterilizing fluid are independently arranged. Furthermore, the number of openings formed in the filling zone can be reduced and the risk of contamination can be drastically reduced.

Furthermore, at the sterilizing or cleaning step, the filling nozzle is connected to the air blow-out opening through a fluid passage-forming connecting member, whereby the cleaning liquid or sterilizing fluid is allowed to flow through the content feed pipe passage, the content-filling nozzle, the fluid passage-forming connecting member, the air blow-out opening and the air feed pipe passage in succession, and the content-filling system and the aseptic air blow-out system can be simultaneously cleaned or sterilized.

Especially, since even the aseptic air blow-out system can be sterilized while maintaining a closed state in this system, a sterilizing fluid having a higher reliability, such as hot water or super-heated steam, can be used, and therefore, the adaptability to sterilization can be improved, as compared with the conventional coating of a sterilizing liquid on a pipe passage of the open system.

If the air blow-out opening is arranged coaxially with the filling nozzle and annularly around the periphery thereof and a cap that can be fitted to the air blow-out opening is used as the fluid passage-forming connecting member, supply of aseptic air at the filling step is performed in a desirable state where a highest positive pressure is applied to the content as the enter, and furthermore, changeover between the filling operation and the sterilizing or cleaning operation can be easily accomplished by a simple operation of attaching or detaching the cap.

In the foregoing illustration, the flow direction of the washing liquid or sterilizing fluid is not limited to one direction, and even if the flow direction is reversed, no particular disadvantage is brought about. In this case, the above-mentioned pipe passage acts as the supply pipe passage and the above-mentioned recovery tank acts as the supply tank. Accordingly, it should be understood that in the instant specification, the recovery pipe passage means not only the recovery pipe passage but also the supply pipe passage, and the recovery tank means not only the recovery tank but also the supply tank.

In the rotary aseptic filling machine of the present invention, the filling zone is surrounded by a rotary wall having an inner circumferential wall and a top wall, which are integrated with a rotary table, and a fixed outer circumferential wall, whereby the filling zone is locally defined from the outside, and in this filling zone, there are arranged the filling nozzle and the air blow-out opening and this rotary aseptic filling machine is characterized in that a positive pressure is maintained within the filling zone with aseptic air. More specifically, a minimum space necessary for filling the content into vessels is substantially shielded and localized by the above-mentioned rotary wall and fixed wall, and therefore, the necessary amount of aseptic air to be filled into this localized filling zone can be greatly reduced. This is the first advantage. Since the inner circumferential wall and top walls are integrated with the rotary table to form a rotary wall, a special driving mechanism for delivering vessels is not present in this localized aseptic zone including this rotary wall as a part of the defining

wall, and the difficulty of keeping asepsis, which is due to the presence of such a moving member, is not caused at all. This is the second advantage. Moreover, by blowing out aseptic air from the air blow-out opening, a positive pressure can always be maintained in the filling zone, and since aseptic air flows to the outside from the filling zone through a minute clearance between the rotary wall and the fixed inner circumferential wall, outer air is not allowed to flow into the filling zone. Therefore, the filling zone is always kept clean with aseptic air. Moreover, the filling zone is barriered by the wall. Accordingly, filling can be accomplished in a completely asepsis, this is the third advantage.

Since an air blow-out opening having an annular blow-out hole is arranged around the periphery of each filling nozzle coaxially therewith, aseptic air is supplied uniformly into the filling zone and aseptic air is allowed to flow smoothly. moreover, if the structures of the filling nozzle and air blow-out opening are appropriately arranged, by attaching a cap as described hereinafter, an aseptic air supply pipe can be used as a part of the pipe passage for recovering the cleaning liquid or sterilizing fluid. In this case, the filling nozzle and the air blow-out opening can be simultaneously cleaned or sterilized.

If the aseptic zone is localized by defining the filling zone by the wall, maintenance of a positive pressure in the filling zone with aseptic air is facilitated and the consumption of aseptic air can be much reduced, and use of a membrane filter for rendering air aseptic becomes possible and the asepticity of air can be increased. Since a positive pressure is produced in the filling zone, which is barriered by the wall member, with aseptic air, an operator can adjust the filling machine while he approaches the machine without destroying the asepsis. Moreover, no substantial asepticity is required for machine parts used outside the localized aseptic zone. This is another advantage. Still further, since the aseptic zone is surrounded by the wall member, sterilization of this zone can be accomplished by spraying of a sterilizing agent by a spray nozzle instead of the conventional manual spraying of a sterilizing agent. Accordingly, automatization of steps can be facilitated. This is another great advantage.

Embodiments of the aseptic filling machine of the present invention will now be described in detail with reference to the accompanying drawings.

Fig. 1 is a diagram illustrating in section one embodiment of the rotary aseptic filling machine of the present invention, Fig. 2 is a plane view showing the relation of the filling zone in Fig. 1 to the delivery zone and discharge zone before and after the filling zone, Fig. 3 is a sectional view showing a portion of the filling zone at the cleaning or sterilizing step, and Fig. 4 is a diagram showing the pipe line at the cleaning or sterilizing step.

Referring to the drawings, a filling zone 15 is locally defined by a rotary wall having a ⊐-shaped section, which comprises an inner circumferential wall 12 and a top wall 13, which are integrated with a rotary table 10, and a fixed outer circumferential wall 14. The outer circumferential wall 14 is detachably arranged, and a minute clearance 16 is formed between the rotary wall and the outer circumferential wall 14 so that rotation of the rotary wall is facilitated and air is blown out through this clearance 16. Many vessel seats 11 are annularly arranged on the rotary table 10 in the filling zone 15, and a vessel-supporting member 17 is arranged on each vessel seat 11. A vessel 18 is placed on each vessel 11 and a filling nozzle 8 and an air blow-out opening 9 are arranged above each vessel 18 through the top wall 13 in correspondence to each vessel seat 11. The air blow-out opening 9 is coaxial with the filling nozzle 8 and has an annular blow-out hole on the periphery thereof. The filling nozzle 8 and air blow-out opening 9 are arranged to communicate with a filling pipe 5 and an aseptic air-distributing pipe 19, respectively, through the top wall 13.

A content (liquid to be filled) is supplied to a filler bowl 4 from a main supply pipe 23 through a supply flow quantity control valve 1, a content supply pipe 2 and a rotary joint 3, and the content is filled into the vessel from the filler bowl 4 through the filling pipe 5, a flow meter, a filling valve 7 and the filling nozzle 8.

A detachable cap 20 is used as a flow passage-forming connecting member for connecting flow passages of the filling nozzle 8 and air blow-out opening 9. This cap 20 is attached at the step of cleaning or sterilizing the filling pipe passage, and is detached at the filling step. Reference numeral 37 represents a cleaning liquid recovery opening connected to a changeover valve 22, reference numeral 25 represents an air supply opening of the changeover valve 26, and reference numeral 24 represents a sterilizing steam recovery opening of the changeover valve 26. The aseptic air-distributing pipe 19 and aseptic air supply pipe 21 form a part of the pipe passage for recovering the washing liquid or sterilizing fluid at the cleaning or sterilizing step.

Air supplied to the rotary filling machine proper through a rotary joint 41 is passed through a mist separator 44 to remove oil mists and dusts and is then supplied to the air supply opening 25 of the changeover valve 26 and is rendered aseptic through a film filter 27. Then, aseptic air is supplied to an aseptic air supply opening 38 and is blown out into the filling zone 15 from the air blow-out

opening 9 through the changeover valve 22, the aseptic air feed pipe 21 and the aseptic air-distributing pipe 19. Blow-out of air from the filling zone 15 is facilitated by the minute clearance 16, and replacement of air in the filling zone 15 with aseptic air and maintenance of a positive pressure with aseptic air can be easily accomplished.

A delivery zone 28 and a discharge zone 29 are defined by a fixed outer wall 30, an outer top wall 31, a table located below a star wheel 32 and the rotary wall. An aseptic blow-out opening 33 is arranged through the outer top wall 31 of the delivery zone 28 and discharge zone 29. Reference numeral 34 represents a membrane filter and reference numeral 35 represents an air supply opening connected to an air supply pipe passage where a mist separator, a pressure control valve and a pressure gauge are arranged. Reference 36 represents a minute clearance which exerts a function of facilitating blow-out of air as well as the minute clearance 16. Reference numeral 39 represents a spray nozzle and reference numeral 40 represents a cleaning liquid recovery conduit.

The procedure of cleaning and sterilizing pipe passages will now be described. The outer peripheral wall 14 of the filling machine is taken out, and the detachable cap 20 as the flow passage-forming connecting member is attached to the filling nozzle 8 and air blow-out opening 9 to form a flow passage. An external recovery pipe 50 connected to a recovery tank 57 is connected to the recovery opening 37 of the changeover valve 22. Then, an electromagnetic valve 52 is actuated by an electric signal, and an air cylinder of the changeover valve 22 is actuated by air supplied through the rotary joint 41 to the filling machine proper at a standstill, whereby the changeover valve 22 is closed on the side of the aseptic air supply opening 38 to connect the recovery tank 57 to the air blow-out opening 9. Then, an electromagnetic valve 53 is actuated by an electric signal and the air cylinder of the filling valve 7 is actuated by air of the same air source to open the filling valve 7 and connect the filling pipe passage to the pipe passage for recovering the cleaning liquid or sterilizing fluid.

When the above operation is completed, the cleaning liquid is caused to flow along the same passage as the content-filling passage. Namely, the cleaning liquid is fed to the filling machine at a standstill through the main supply pipe 23, the supply flow quantity control valve 1, the content supply pipe 2 and the rotary joint 3, is passed through the filler bowl 4, filling pipe 6, flow meter, filling valve 7, filling nozzle and flow passage-forming cap 20 of the filling machine, and is recovered in the recovering tank 57 through the aseptic air blow-out opening 9, the aseptic air-distributing pipe 19, the aseptic air supply pipe 21, the changeover valve 22, the recovery opening 37 and the recovery pipe 50. The cleaning liquid flows along the above course to clean the filling pipe passage and remove foreign matters.

Then, cooled aseptic water is caused to flow along the same course to wash away the cleaning liquid. The electromagnetic valve 51 is actuated by an electric signal and the air cylinder of the changeover valve 26 is actuated by air, and the changeover valve 26 is closed on the side of the air supply opening 25 to connect the sterilizing steam recovery opening 24 to the membrane filter 27. At this point, an external recovery pipe 50′ is connected to the sterilizing steam recovery opening 24, and simultaneously, the electromagnetic valve 52 is actuated by an electric signal to effect changeover in the changeover valve 22 and close the changeover valve 22 on the side of the recovery opening 37, whereby the membrane filter 27 is connected to the aseptic air supply pipe 21. Sterilizing steam, for example, supper-heated steam at 120 to 150 °C, is supplied from the main supply pipe 23 for 20 to 100 minutes, is passed through the supply flow quantity control valve 1, the content supply pipe 2, the rotary joint 3, the filler bowl 4, the filling pipe 5, the flow meter 6, the filling valve 7, the filling nozzle 8, the flow passage-forming connecting cap 20, the aseptic air blow-out opening 9, the aseptic air-distributing pope 19, the aseptic air-distributing pipe 19, the aseptic air feed pipe 21, the changeover valve 22, the membrane filter 27 and the changeover valve 26, and is recovered in the external recovery pipe 50′ from the recovery opening 24. After completion of sterilization of the pipe passage, changeover is effected in the changeover valve 22 again, and cooled aseptic water is caused to flow along the same course as that of the cleaning liquid to cool the heated pipe passage and filling machine. Simultaneously, changeover is effected in the changeover valve 26, and the changeover vale 26 is closed on the side of the sterilizing steam recovering opening 24 and the membrane filter 27 is connected to the air supply opening 25. The external steam recovery pipe 50′ is dismounted from the filling machine proper. When the temperature of the pipe passage and filling machine is lower to room temperature, supply of aseptic water is stopped and the electromagnetic valve 52 is actuated to close the changeovervalve 22 on the side of the recovery tank 57 and connect the membrane filter 27 to the air blow-out opening 9. By this changeover, the aseptic air supply passage is filled with aseptic air which has passed through the membrane filter 27. Simultaneously with this changeover in the changeover valve 22, the electromagnetic valve 53 is actuated to close the filling valve 7. Then, the recovery pipe 50 is taken out from the recovery opening 37 of the

changeover valve 22, and the detachable cap 20 connecting the filling nozzle 8 to the air blow-out opening 9 is dismounted, and the outer circumferential wall 14 of the filling machine is attached.

Thus, cleaning and sterilization of the filling pipe passage and the recovery pipe passage for the cleaning liquid and sterilizing fluid are completed.

Then, the sterilizing agent is sprayed from the spray nozzle 39 arranged in the filling zone 15, and aseptic water is further sprayed to render the interior of the filling zone 15 aseptic. Immediately, aseptic air is introduced through the blow-out opening 9 to produce and maintain a positive pressure in the filling zone 15 and form an aseptic zone.

Aseptic air is supplied in the following manner.

Air supplied to the filling machine from the rotary joint 41 is introduced into the changeover valve 26 from the air supply opening 25 through the mist separator 54 and the pressure control valve 55, and air is passed through the membrane filter 27 and is rendered aseptic. The pipe passage after the membrane filter 27 has been sterilized according to the above-mentioned procedures, and therefore, this aseptic air is introduced, without being contaminated, into the filling zone 15 from the aseptic air supply opening 38 through the changeover valve 22, the aseptic air supply pipe 21, the aseptic air-distributing pipe 19 and the blow-out opening 9. Since the filling zone 15 is defined by the walls, production of a positive pressure with aseptic air is easily accomplished, and filling is carried out in the state where a positive pressure is produced in the filling zone 15 with aseptic air.

As pointed out hereinbefore, the filling pipe passage or content feed passage is connected to the aseptic air supply pipe passage by attaching the cap 20 to the filling nozzle 8 and air blow-out opening 9, and therefore, cleaning or sterilization of the passages can be accomplished simultaneously and assuredly. Accordingly, as compared with the conventional technique where the pipe passages are independently sterilized by different mechanisms, the mechanism and structure can be drastically simplified and the sterilizing effect is improved, and also the contamination-preventing effect is enhanced. Moreover, the labor and running cost can be greatly reduced.

The filling is carried out in the state where a positive pressure is maintained within the filling zone 15, and a positive pressure is also maintained in the delivery zone 28 and delivery zone 29 with aseptic air supplied from the aseptic air blow-out opening 33. In the filling zone 15, a positive pressure is maintained by aseptic air blown out uniformly into the filling zone 15 from the air blow-out opening arranged coaxially with the filling nozzle 8 and annularly on the periphery thereof, and aseptic air flows little by little to the outside through the minute clearance 16. Accordingly, aseptic air is blown out uniformly without uneven distribution, and an aseptic zone not contaminated from the outside is formed in the filling zone 15. The degree of the positive pressure produced in the filling zone 15 with aseptic air is such that the pressure in the filling zone 15 is higher by 0.1 to 30 mmAg, preferably by 1 to 10 mmAg, than the pressure in the outside.

In the filling zone 15 where a positive pressure is thus maintained with aseptic air, the filling is carried out in the following manner.

The content fed through the main pipe passage is fed through the flow quantity control valve 1, the content supply pipe 2 and the rotary joint 3 and stored in the filler bowl 4. The filling valve 7 is opened by a filling-initiating electric signal. The content is fed from the filler bowl 4 and passed through the content-supplying filling tube 5, flow meter 6 and the filling valve 7, and is filled into a vessel from the filling nozzle 8. By a filling-stopping electric signal emitted from the flow meter 6, the filling valve 7 is closed and the filling is terminated.

Figs. 5 and 6 illustrate one embodiment of the linear filling machine of the present invention. Fig. 5 is a diagram illustrating the outline and Fig. 6 is a sectional view of a portion of the filling nozzle at the cleaning or sterilizing step. In Figs. 5 and 6, reference numeral 5a represents a filling pipe, reference numeral 6a represents a flow meter, reference numeral 7a represents a filling valve, reference numeral 8a represents a filling nozzle, reference numeral 9a represents an air blow-out opening, reference numeral 20a represents a detachable flow passage-forming connecting member, that is, a cap, and reference numeral 21a represents an aseptic air supply pipe which forms a part of a pipe for recovery of the cleaning liquid or sterilizing fluid. Reference numeral 38a represents an aseptic air supply opening communicating with the aseptic air supply pipe passage, and reference numeral 37a represents an opening for recovery of the cleaning liquid or sterilizing fluid, which communicates with the recovery tank. The operations conducted in the filling machine are now described. A vessel material 58 is sterilized by an aseptic agent 59, passed through a supporting roll 60, dried by a heater 61 and formed in a vessel-forming device 62. A content is filled in the formed vessel 63 through the filling nozzle 8a arranged in the filling zone. A lid material 64 is passed through a sterilizing agent 65 and dried by a heater 66. The content-filled vessel is lidded, sealed by a scaling device 67 and punched out by a punching device 68 to obtain a product 71. A scrap 70 is wound through a supporting roll 69.

The cleaning and sterilization of the pipe passages are carried out according to the following procedures.

The flow passage-forming cap 20a is attached to the filling nozzle 8a and the air blow-out opening 9a to form a flow passage. Changeover is effected in the changeover valve 22a so that the aseptic air supply pipe passage 21a is connected to the cleaning liquid or sterilizing fluid recovery opening 37a. The recovery pipe communicating with the cleaning liquid or sterilizing fluid recovery tank is connected to the recovery opening 37a. The filling valve 7a is opened and the cleaning liquid is caused to flow from the content supply pipe passage through the filling pipe 5a. The cleaning liquid is introduced into the changeover valve 22a through the filling pipe 5a, the flow meter 6a, the filling valve 7a, the filling nozzle 8a, the cap 20a, the aseptic air blow-out opening 9a and the aseptic air supply pipe 21a, and the cleaning liquid is recovered into the recovery tank from the recovery opening. When the cleaning is terminated, aseptic water is caused to flow along the same course to wash away the cleaning liquid. Then, the sterilizing fluid, for example, hot water at 120 to 150 °C, is caused to flow for 20 to 50 minutes along the same course to sterilize the pipe passage. Since the distance between the aseptic air supply opening 38a and the membrane filter 27a is very short, sufficient heating and sterilization are effected by heat conducted through the pipe passage wall from hot water passing through the changeover valve 22a. After termination of the sterilization, aseptic water is caused to flow to cool the pipe passages. after completion of the cooling, the changeover valve 22a is closed on the side of the recovery opening 37a to connect the aseptic air supply opening 38a to the aseptic air supply tube 21a, and the interior of the pipe passages is filled with aseptic air. Simultaneously, the filling valve 7a is closed and the cap 20a is taken out to separate the filling pipe passage from the aseptic air blow-out passage.

In the filling machine of the present invention, the filling zone is defined and localized by walls, and a filling nozzle is arranged in this filling zone and an aseptic air blow-out opening having an annular blow-out hole arranged coaxially with the filling nozzle and on the periphery thereof is arranged just above the filling nozzle. Accordingly, the effect of preventing contamination of the aseptic zone can be enhanced.

Since the content filling pipe passage or content feed pipe passage is connected to the aseptic air supply pipe passage by attaching the detachable flow passage-forming connecting member to the filling nozzle and air blow-out opening, the aseptic air supply pipe passage forms a part of the cleaning liquid or sterilizing fluid recovery pipe passage at the cleaning or sterilizing step, and the content filling pipe passage or content feed pipe passage and the aseptic air supply passage can be simultaneously cleaned or sterilized by the same mechanism. Therefore, it is not necessary to perform sterilization of the aseptic air blow-out pipe passage independently by a different mechanism as in the conventional technique. Furthermore, since the aseptic air blow-out opening (air nozzle) and the aseptic air supply pipe passage form a part of the cleaning liquid or sterilizing fluid recovery pipe passage, these members need not be independently disposed and the number of pipes and machine parts arranged in the filling zone can be reduced, and therefore, the risk of contamination is eliminated and limitations imposed on the operations are moderated.

Moreover, since the aseptic air blow-out opening forms a part of the cleaning liquid or sterilizing fluid recovery pipe passage, the pipe passage can be washed or sterilized in the closed system. Accordingly, foreign matters can be easily removed by cleaning, and after this cleaning, sterilization can be accomplished by hot water or super-heated steam. Therefore, heat is conducted even to a deep portion and complete sterilization becomes possible.

In the rotary aseptic filling machine of the present invention, since the filling zone is defined and localized by the rotary wall and fixed outer circumferential wall, aseptic air is blown out from the air blow-out opening formed on the wall member and a positive pressure is maintained in the filling zone by aseptic air while causing aseptic air to flow to the outside from the minute clearance between the rotary wall and the outer circumferential wall, intrusion of microorganisms or dusts presumed to contain microorganisms therein into the filling zone from the outside can be prevented and a good aseptic zone is formed in the filling zone. Moreover, since the aseptic zone is barriered by the wall member, the filling can be performed in a complete asepsis. Since a positive pressure is kept locally in the filling zone with aseptic air and the consumption of aseptic air can be reduced, it becomes possible to use a membrane filter. Therefore, a positive pressure can be maintained in the filling zone with completely aseptic air, and the stability against bacterial contamination is increased as compared with the case where an HEPA filter is sued. Since the interior of the filling zone is doubly barriered by the wall member and aseptic air, an operator can adjust the filling machine while approaching the machine sufficiently without destroying the asepsis. Moreover, since the volume of the filling zone to be rendered aseptic is small and the number of machine parts arranged in

the filling zone is small, the risk of contamination is further reduced. Especially, since the filling zone is defined by the rotary wall having the inner circumferential wall and top wall integrated with the rotary table and the fixed outer circumferential wall, any particular driving mechanism need not be disposed for delivery of vessels in the filling zone and a complicated operating mechanism is not present in the interior of the aseptic zone. Therefore, there is no risk of bacterial contamination by these mechanisms. Moreover, when the filling machine of the rotary type is used, vessels can be delivered continuously, and the risk of dropping of a filled liquid content under shaking, expected to occur in case of the intermittent delivery, is eliminated, and the continuous operation can be performed at a high speed.

Claims

1. An aseptic filling machine comprising a filling zone defined by walls, a vessel-supporting mechanism arranged in the filling zone, a content-filling nozzle arranged in the filling zone, a pipe passage for supplying the content to the filling nozzle, an air blow-out opening for producing a positive pressure locally in the filling zone with aseptic air, a fluid passage-forming connecting member for detachably connecting the filling nozzle and the air blow-out opening, and a changeover mechanism for connecting the air blow-out opening alternatively to an aseptic air supply source and a tank for recovering a cleaning liquid or a sterilizing fluid, wherein the air blow-out opening forms a part of a pipe passage for recovering the cleaning liquid or sterilizing fluid.

2. An aseptic filling machine as set forth in claim 1, wherein the filling nozzle is arranged on the top wall of the filling zone so that the nozzle is directed downward.

3. An aseptic filling machine as set forth in claim 1, wherein the air blow-out opening is arranged coaxially with the filling nozzle and annularly on the periphery thereof.

4. An aseptic filling machine as set forth in claim 1, wherein the fluid passage-forming connecting member is a cap.

5. An aseptic filling machine as set forth in claim 1, wherein the fluid passage-forming connecting member is clamped to the air blow-out opening to form a pipe for recovering the cleaning liquid or sterilizing fluid.

6. An aseptic filling machine as set forth in claim 1, wherein the changeover mechanism for connecting the air blow-out opening alternatively to the aseptic air supply source and the tank for recovering the cleaning liquid for sterilizing fluid is an automatically controlled changeover valve.

7. An aseptic filling machine as set forth in claim 1, wherein a membrane filter is used as a filter of the aseptic air supply source.

8. An aseptic filling machine as set forth in claim 1 or 7, wherein an automatically controlled changeover valve for connecting an air supply opening of an air filter of the aseptic air supply source alternatively to the air supply pipe passage and the sterilizing steam recovery opening is disposed.

9. A rotary aseptic filling machine comprising a rotary table having many vessel-supporting seats, a filling nozzle located above each vessel-supporting seat, a content feed pipe passage connected to the filling nozzle, a delivery mechanism for feeding sterilized vessels to the vessel-supporting seats and a discharge mechanism for taking out content-filled vessels from the vessel-supporting seats, wherein a filling zone is defined by a rotary wall having an inner circumferential wall and a top wall, which are formed integrally with the rotary table, and a fixed outer circumferential wall, a filling nozzle communicating with the filling zone is arranged on the top wall, an air blow-out opening for producing a positive pressure locally in the filling zone with aseptic air is arranged on at least one of the rotary wall and the fixed wall, a fluid passage-forming connecting member for detachably connecting the filling nozzle and the air blow-out opening and a changeover mechanism for connecting the air blow-out opening alternatively to an aseptic air supply source and a tank for recovering a cleaning liquid or a sterilizing liquid are disposed, and the air blow-out opening forms a part of a pipe passage for recovering the cleaning liquid or sterilizing fluid.

10. An aseptic filling machine as set forth in claim 9, wherein a minute clearance allowing blow-out of air is formed among the fixed outer periphery wall, the rotary top wall and the rotary table.

11. An aseptic filling machine as set forth in claim 9, wherein the peripheries of the delivery mechanism and discharge mechanism are covered by a fixed wall and an air blow-out opening is arranged on the fixed wall to produce a positive pressure in the interior thereof with aseptic air.

12. A linear aseptic filling machine comprising a filling zone, a vessel-supporting mechanism arranged in the filling zone, a content-filling nozzle arranged in the filling zone, a pipe passage for feeding a content tot he filling nozzle, a heat forming mechanism for sterilizing and heat-forming a vessel material sheet and feeding a sterilized formed vessel to the filling zone, a lid member-heating mechanism for sterilizing and heating a lid member and feeding the lid member to a sealing step, a sealing mechanism for sealing the lid member to the content-filled vessel, and a mechanism

for punching the lid-sealed content-filled vessel into a product, wherein the filling zone is defined by an outer circumferential wall, a filling nozzle communicating with the filling zone is arranged on a top wall of the outer circumferential wall, an air blow-out opening for producing a positive pressure locally in the filling zone with aseptic air is arranged on the outer circumferential wall, a fluid passage-forming connecting member for detachably connecting the filling nozzle and the air blow-out opening and a changeover mechanism for connecting the air blow-out opening alternatively to an aseptic air supply source and a tank for recovering a cleaning liquid or a sterilizing fluid are arranged, and the air blow-out opening forms a part of a pipe passage for recovering the cleaning liquid or sterilizing fluid.

13. An aseptic filling machine as set forth in claim 12, wherein the heat forming mechanism, lid heating mechanism and sealing mechanism are covered with the outer circumferential wall and an air blow-out opening is arranged on the outer circumferential wall to produce a positive pressure in the interior thereof with aseptic air.

14. A rotary aseptic filling machine comprising a rotary table having many vessel-supporting seats, a filling nozzle arranged above each vessel-supporting seat, a content feed pipe passage connected to the filling nozzle, a delivery mechanism for feeding sterilized vessels to the vessel-supporting seats and a discharge mechanism for taking out content-filled vessels from the vessel-supporting seats, wherein a filling zone is defined by a rotary wall having an inner circumferential wall and a top wall, which are formed integrally with the rotary table, and a fixed outer circumferential wall, a filling nozzle communicating with the filling zone is arranged on the top wall, and an air blow-out opening for producing a positive pressure locally in the filling zone with aseptic air is arranged on at least one of the rotary wall and the fixed wall.

15. A rotary aseptic filling machine as set forth in claim 14, wherein a minute clearance allowing flow-out of air is formed among the fixed outer circumferential wall, the rotary top wall and the rotary table.

16. A rotary aseptic filling machine as set forth in claim 14, wherein a annular air blow-out opening is arranged on the top wall coaxially with the filling nozzle and on the periphery thereof.

17. A rotary aseptic filling machine as set forth in claim 14, wherein the peripheries of the delivery mechanism and discharge mechanism are covered with a fixed wall and an air blow-out opening is arranged on the fixed wall to produce a positive pressure in the interior thereof with aseptic air.

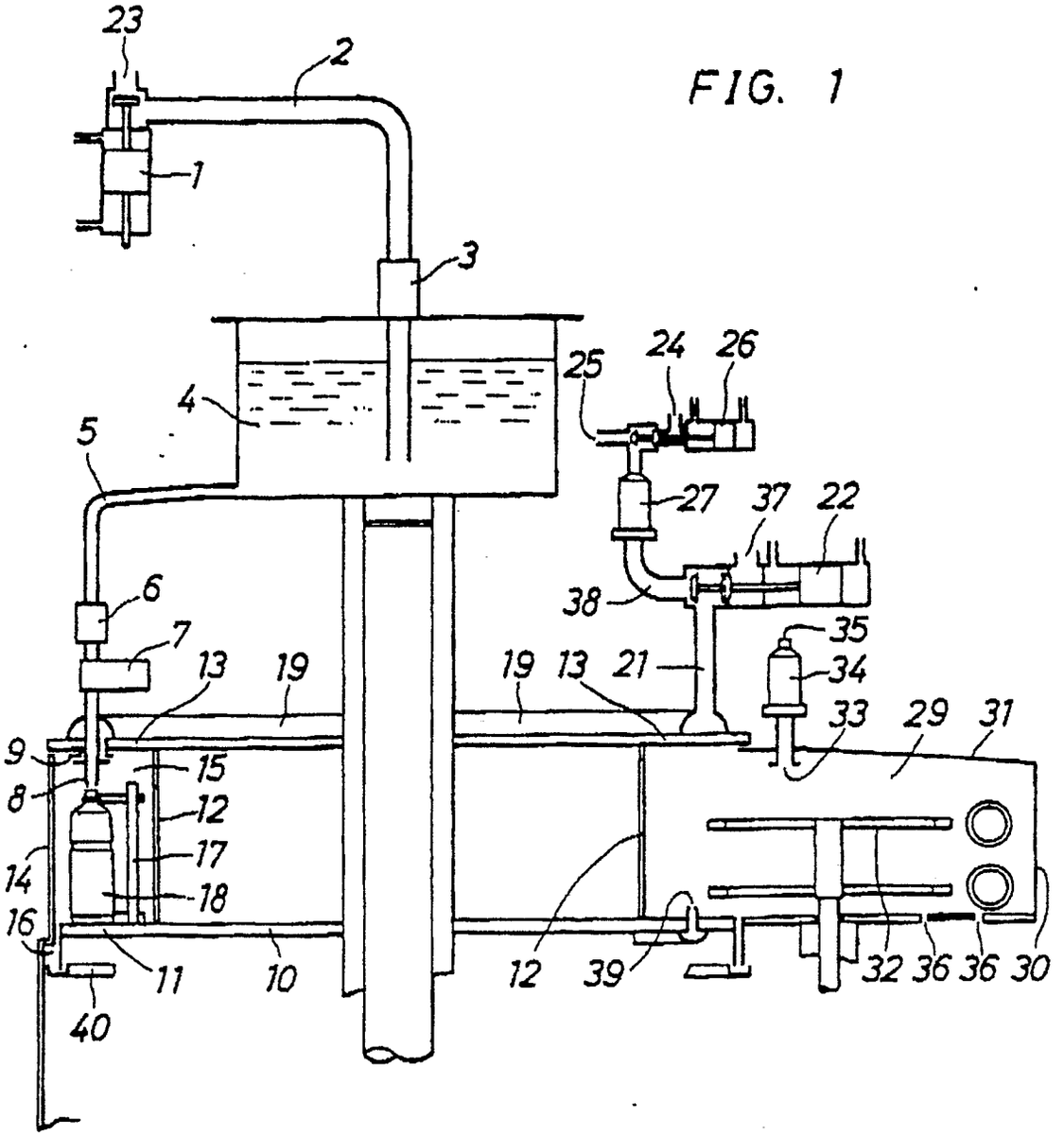
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FIG. 1

FIG. 2

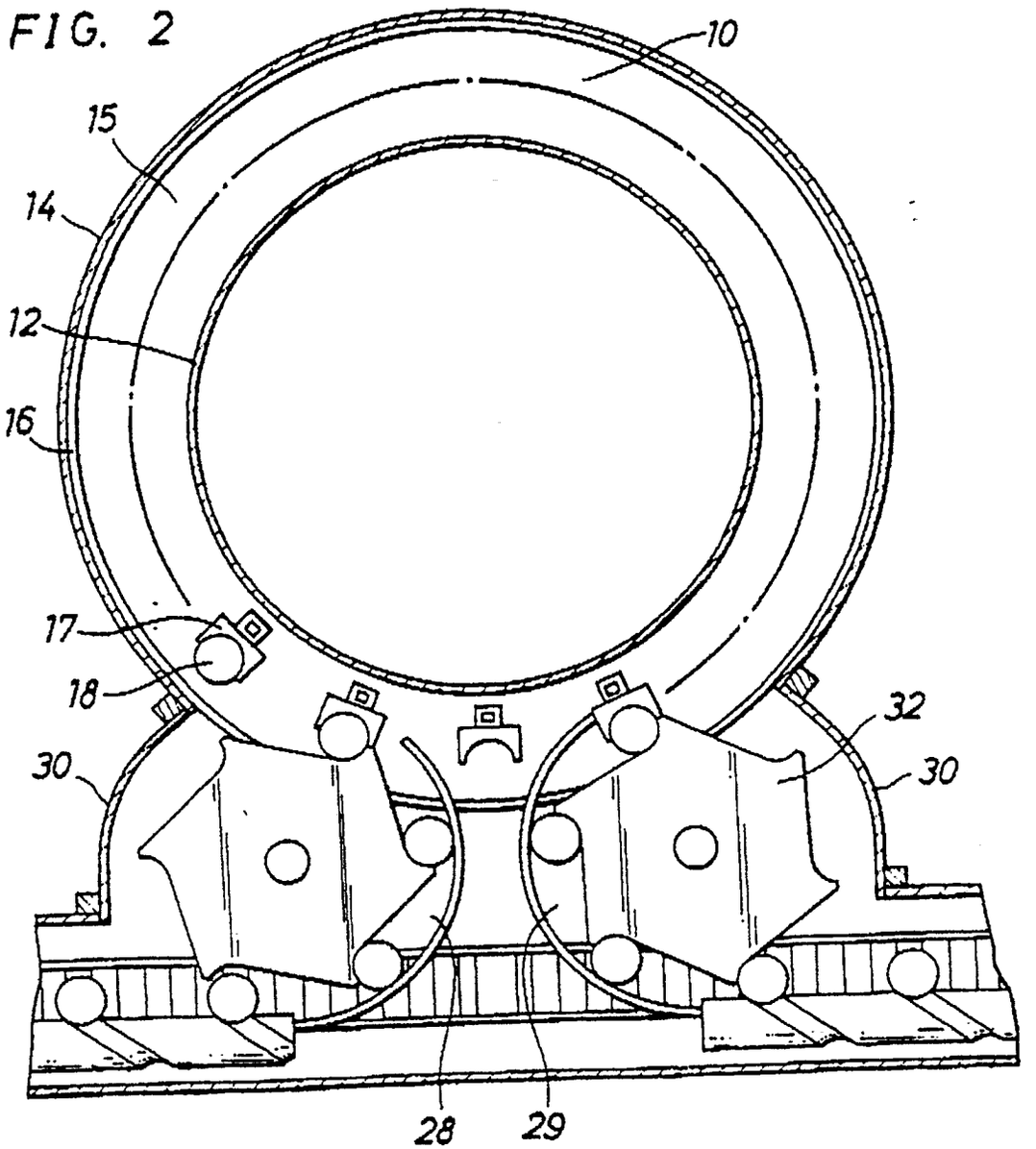


FIG. 3

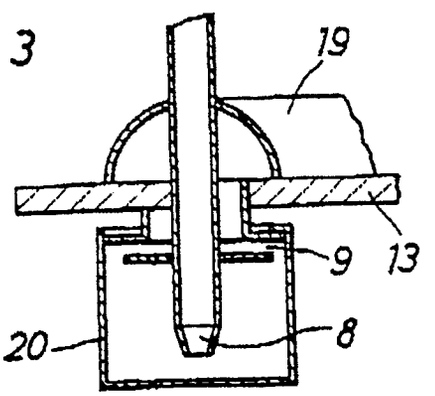
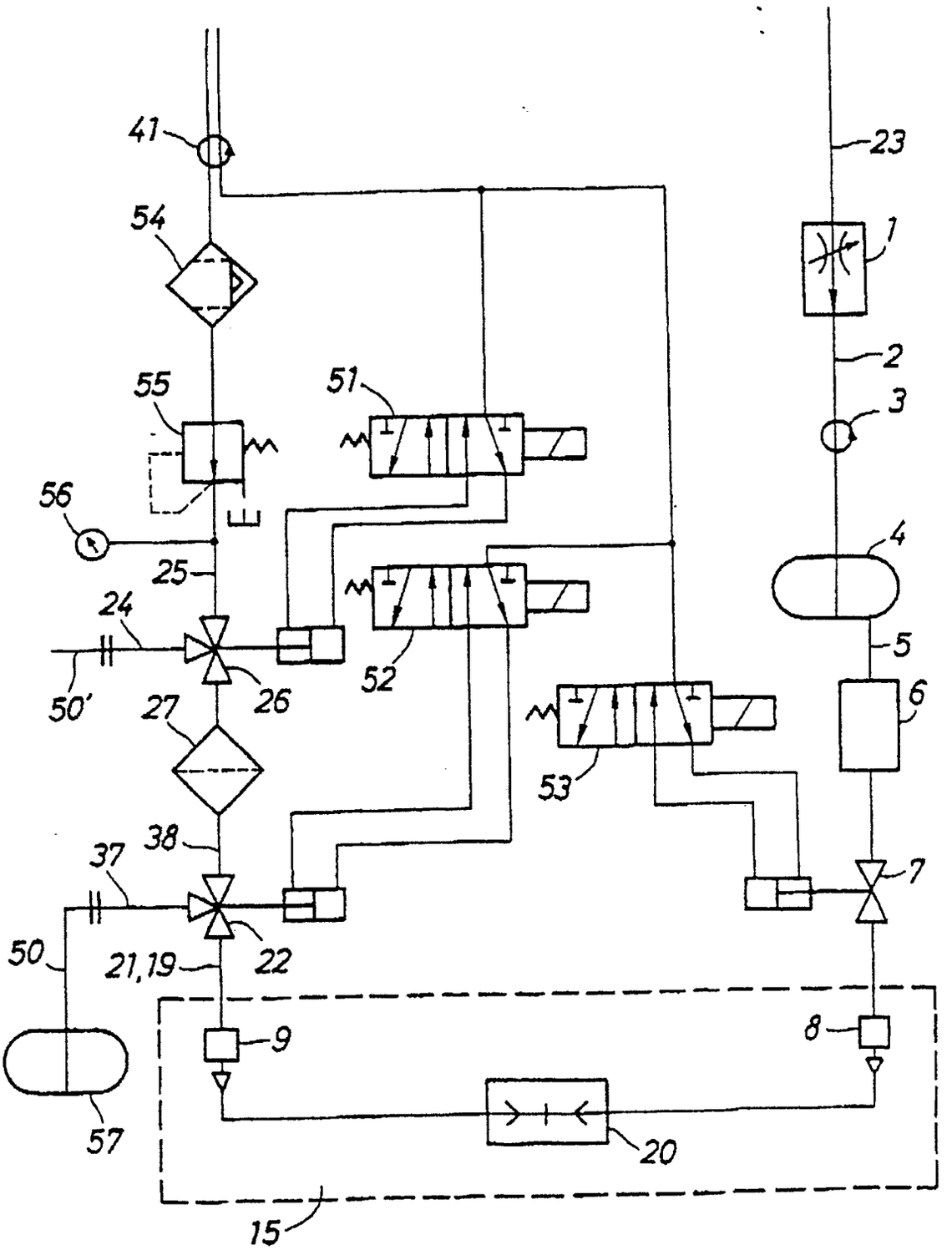


FIG. 4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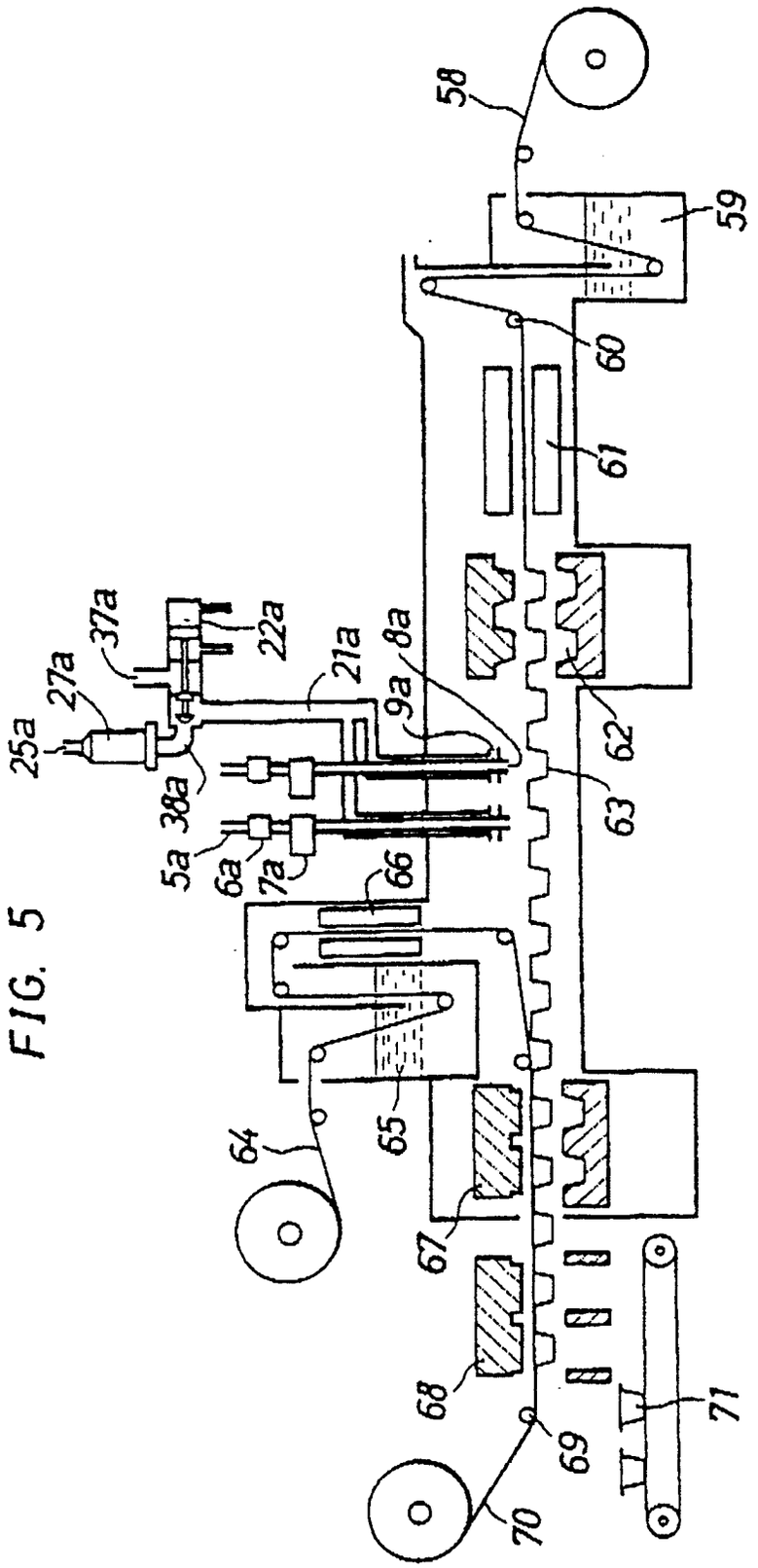
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FIG. 5

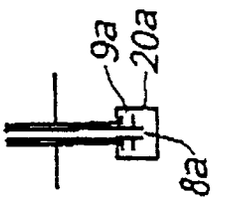
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FIG. 6