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(54) Liquid filling nozzle

(57) A liquid filling nozzle comprises a vertical tubular nozzle body 11 having a discharge opening 27 at a lower end thereof, and an upwardly or downwardly movable plug 41 for opening or closing the discharge opening 27. The plug 41 is provided with a seal portion 51 disposed at the lower end of an outer peripheral wall thereof and shaped in conformity with the shape of the discharge opening 27. The seal portion 51 is provided with a spreader portion 52 positioned thereabove and tapered upward. The spreader portion 52 is so shaped that the liquid to be filled and discharged from the opening 27 is cause to spread by the spreader portion 52 toward a direction closer to a horizontal and as shifted from a direction close to a vertical, as the seal portion 51 is moved away from the discharge opening 27.

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Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to liquid filling devices for use in filling containers with fluid food such as milk.

[0002] Liquid filling nozzles of the type mentioned are already known which comprise a vertical tubular nozzle body having a discharge opening at the lower end thereof, and an upwardly or downwardly movable plug for opening or closing the discharge opening, the plug being provided with a seal portion disposed at the lower end of an outer peripheral wall thereof and shaped in conformity with the shape of the discharge opening, the seal portion being provided with a spreader portion positioned thereabove and tapered upward, the spreader portion being in the form of a cone having a tapered part (see, for example, the publication of JP-U No. 4-65709).

[0003] The liquid to be filled is discharged from the filling nozzle in a direction substantially along the spreader portion. If the spreader portion is given a relatively small taper angle with a vertical, the liquid to be filled is discharged downward to impinge directly on the liquid surface in the container and markedly bubble up the liquid. Further since it is difficult to give a large area to the discharge opening, there is a need to increase the upward and downward stroke of the plug. An increased stroke results in a prolonged operation control time and gives increased weight to the plug.

[0004] Conversely if the spreader portion is tapered at a relatively large angle with a vertical, the impingement of the liquid on the liquid surface is easily avoidable, but the liquid impinges on the wall of the container with a great impact, entailing the problem of causing marked bubbling and resulting in a lower filling capacity. Especially if the liquid is splashed on the upper edge portions of inner surface of the container to be sealed, there arises the problem of producing a faulty seal.

SUMMARY OF THE INVENTION

[0005] An object of the present invention is to provide a liquid filling nozzle which ensures an efficient filling operation by preventing the bubbling of the liquid to be filled or splashing of the liquid on the container portions to be sealed and wherein the plug need not be given an increased upward and downward stroke.

[0006] The present invention provides a liquid filling nozzle comprising a vertical tubular nozzle body having a discharge opening at a lower end thereof, and an upwardly or downwardly movable plug for opening or closing the discharge opening, the plug being provided with a seal portion disposed at a lower end of an outer peripheral wall thereof and shaped in conformity with the shape of the discharge opening, the seal portion being provided with a spreader portion positioned thereabove and tapered upward, the spreader portion being so shaped that the liquid to be filled and discharged from the opening is cause to spread by the spreader portion toward a direction closer to a horizontal and as shifted from a direction close to a vertical, as the seal portion is moved away from the discharge opening.

[0007] With the liquid filling nozzle of the invention, the liquid to be filled is discharged in a direction close to a vertical at the start of the filling operation, so that the liquid is unlikely to impinge on the wall of the container. With the progress of the filling operation, the liquid is guided toward a direction closer to a horizontal and as shifted from the direction close to a vertical. The liquid is therefore prevented from impinging on the ascending liquid surface and from bubbling up to ensure an efficient filling operation. Furthermore, the liquid is unlikely to splash on the upper edge portions of inner surface of the container to be sealed at the start or upon completion of the filling operation, while the plug need not be given an increased upward and downward stroke.

[0008] In the contour of one side of a vertical longitudinal section of the spreader portion, tangent lines at respective reference points arranged on the spreader portion from above downward are preferably positioned closer to a vertical from point to point downward.

[0009] When the reference points are two in number, and if the contour is defined by two straight lines, the plug can be of a relative simple shape.

[0010] The plug may be in the form of a cone having two tapered parts positioned one above the other.

[0011] If the reference points are infinite in number to define the contour by a curve, the plug can be given a desired shape.

[0012] The plug may be in the form of a paraboloid of revolution.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013]

FIG. 1 is a view in vertical longitudinal section of a filling nozzle according to the invention;
FIG. 2 is a view in section taken along the line II-II in FIG. 1;
FIG. 3 includes diagrams showing the shape of a plug for use in the filling nozzle in detail; and
FIG. 4 includes diagrams corresponding to those of FIG.

3 and showing another example of plug.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0014] Embodiments of the invention will be described below with reference to the drawings.

[0015] Referring to FIG. 1, a liquid filling nozzle comprises a vertical tubular nozzle body 11, a check valve

12 disposed inside the nozzle body 11 at an intermediate portion of the height thereof, and a shutoff valve 13 provided at the lower end of the nozzle body 11.

[0016] A hydraulic cylinder 22 facing vertically downward is mounted by a vertical tubular yoke 21 on the upper end of the nozzle body 11. The hydraulic cylinder 22 has a piston rod 23 extending into the nozzle body 11 through a top wall of the nozzle body 11. The piston rod 23 has a portion positioned inside the nozzle body 11 and sealed off by bellows 24. The nozzle body 11 has a peripheral wall provided with an inlet 25 close to the upper end of the wall. The inlet 25 is connected to an unillustrated metering cylinder by a connecting duct 26. The liquid to be filled is fed to the nozzle body 11 intermittently in a specified amount at a time. The nozzle body 11 has a discharge opening 27 at its lower end.

[0017] The check valve 12 comprises a seat ring 31 provided on the inner surface of the nozzle body 11 at an intermediate portion of the height thereof, a valve element 33 resembling the combination of two cones with their bases fitting to each other, having an 0-ring 32 attached to an outer peripheral edge of the element and vertically movable into intimate contact with the seat ring 31 from below, a vertical stem 35 extending straight upward from the center of the top wall of the valve element 33 and provided at its upper end with a spring retainer 34 which is opposed to the lower end of the piston rod 23 and spaced therefrom by a small distance, a stem guide 37 provided around the stem 35 and attached to the seat ring 31 by arms 36 extending from circumferential portions of the ring 31 obliquely upwardly inward, and a compression coil spring 38 fitted around the stem 35 and provided between the spring retainer 34 and the upper ends of the arms 36.

[0018] The shutoff valve 13 comprises a generally conical plug 41 movable into or out of the discharge opening 27, and a vertical stem 42 extending straight upward from the upper end of the plug 41 and having an upper end integral with the lower end of the valve element 33.

[0019] The stem 42 is provided with three radial guide vanes 43 extending from a lower portion of the stem 42 to the outer peripheral wall of the plug 41 and positioned at three locations dividing the plug 41 into three equal portions along the circumference thereof. As shown in detail in FIG. 2, each of the guide vanes 43 is provided at its outer end with a circular-arc guide face 44 in sliding contact with the inner surface of the nozzle body 11.

[0020] When the liquid to be filled is sent into the nozzle body 11 from the metering cylinder, the check valve 12 is opened with the pressure of the liquid. Simultaneously with this, the plug 41 is pushed down, discharging the liquid from the opening 27.

[0021] When the piston rod 23 of the hydraulic cylinder 22 is advanced to depress the stem 35 of the check valve 12, the valve element 33 is moved away from the seat ring 31 and the plug 41 is moved away from the discharge opening 27, whereby both the check valve 12 and the shutoff valve 13 are held open. The filling nozzle is cleaned and sterilized by causing a cleaning disinfectant solution to flow through the nozzle in this state.

[0022] FIG. 3 shows the shape of the plug 41 in detail. The plug 41 is provided at the lower end of its outer peripheral wall with an annular seal portion 51 shaped in conformity with the shape of the discharge opening 27. Extending upward from the seal portion 51 is an upwardly tapered spreader portion 52. The spreader portion 52 is in the form of a cone comprising an upper tapered part 61 and a lower tapered part 62.

[0023] Suppose the upper tapered part 61 has an upper end diameter D1, the upper tapered part 61 and the lower tapered part 62 have a boundary diameter D2, the lower tapered part 62 has a lower end diameter D3, the upper tapered part 61 has a height L1, and the lower tapered part 62 has a height L2. The taper (D2-D1)/L1 of the upper tapered part 61 is greater than the taper (D3-D2)/L2 of the lower tapered part 62, When the contour of one side of a vertical longitudinal section of the spreader portion 52 is observed to describe the shape of the spreader portion 52 in another way, the contour has an upper straight line M1 and a lower straight line M2. The angle $\theta 1$ the upper line M1 makes with a vertical is greater than the angle $\theta 2$ the lower line M2 makes with a vertical.

[0024] FIG. 3(a) shows the state of the discharge opening 27 immediately after the start of a filling operation. In this state, the lower edge of the nozzle body 11 defining the discharge opening 27 is opposed to the lower tapered part 62. The liquid to be filled is discharged from between the lower edge defining the opening 27 and the lower tapered part 62 and spread along the outer surface of the lower tapered part 62.

[0025] FIG. 3 (b) shows the discharge opening 27 as almost fully opened. In this state, the lower edge defining the discharge opening 27 is opposed to the upper tapered part 61 instead of the lower tapered part 62. While the liquid to be filled spreads along the outer surface of the upper tapered part 61, the liquid is spread in a direction closer to a horizontal and as shifted from a direction close to a vertical. In other words, the liquid flow is guided closer to the downward direction in the state of FIG. 3(a) than in the state of FIG. 3(b). For this reason, the liquid to be filled is less likely to be directed toward the wall of the container, and the upper edge portions of inner surface of the container to be sealed are unlikely to become wet with the liquid to be filled. The liquid is guided closer to a direction toward the container wall in the state of FIG. 3(b) than in the state of FIG. 3 (a). Consequently, the liquid is prevented from impinging on the liquid surface gradually ascending with the progress of the filling operation.

[0026] FIG. 4 shows a plug 41 of different shape. Like the plug already described, this plug 41 comprises a seal portion 51 and a spreader portion 52. The spreader portion 52 comprises a paraboloid of revolution.

[0027] FIG. 4 shows an upper straight line N1 and a

lower straight line N2. The upper line N1 is a tangent line at an upper reference point 01. The lower line N2 is a tangent line at a lower reference point 02. The upper line N1 and the lower line N2 correspond to the lines M1, M2, respectively. The angle θ1 the upper line N1 makes with a vertical is greater than the angle θ2 the lower line N2 makes with a vertical.

[0028] When reference points are provided in succession from above downward along the spreader portion 52, the angle the tangent lines at the respective reference points make with vertical lines gradually decreases from point to point downward.

[0029] It will be understood that when the plug 41 shown in FIG. 41 is used, the liquid to be filled, as directed downward at the start of filling operation, is guided in a direction closer to a horizontal and as shifted from a direction close to a vertical with the progress of the filling operation.

Claims

1. A liquid filling nozzle comprising a vertical tubular nozzle body having a discharge opening at a lower end thereof, and an upwardly or downwardly movable plug for opening or closing the discharge opening, the plug being provided with a seal portion disposed at a lower end of an outer peripheral wall thereof and shaped in conformity with the shape of the discharge opening, the seal portion being provided with a spreader portion positioned thereabove and tapered upward, the spreader portion being so shaped that the liquid to be filled and discharged from the opening is cause to spread by the spreader portion toward a direction closer to a horizontal and as shifted from a direction close to a vertical, as the seal portion is moved away from the discharge opening.

2. A liquid filling nozzle according to claim 1 wherein in the contour of one side of a vertical longitudinal section of the spreader portion, tangent lines at respective reference points arranged on the spreader portion from above downward are positioned closer to a vertical from point to point downward.

3. A liquid filling nozzle according to claim 2 wherein the reference points are two in number, and the contour is defined by two straight lines.

4. A liquid filling nozzle according to claim 3 wherein the plug is in the form of a cone having two tapered parts positioned one above the other.

5. A liquid filling nozzle according to claim 2 wherein the reference points are infinite in number, and the contour is defined by a curve.

6. A liquid filling nozzle according to claim 5 wherein the plug is in the form of a paraboloid of revolution.

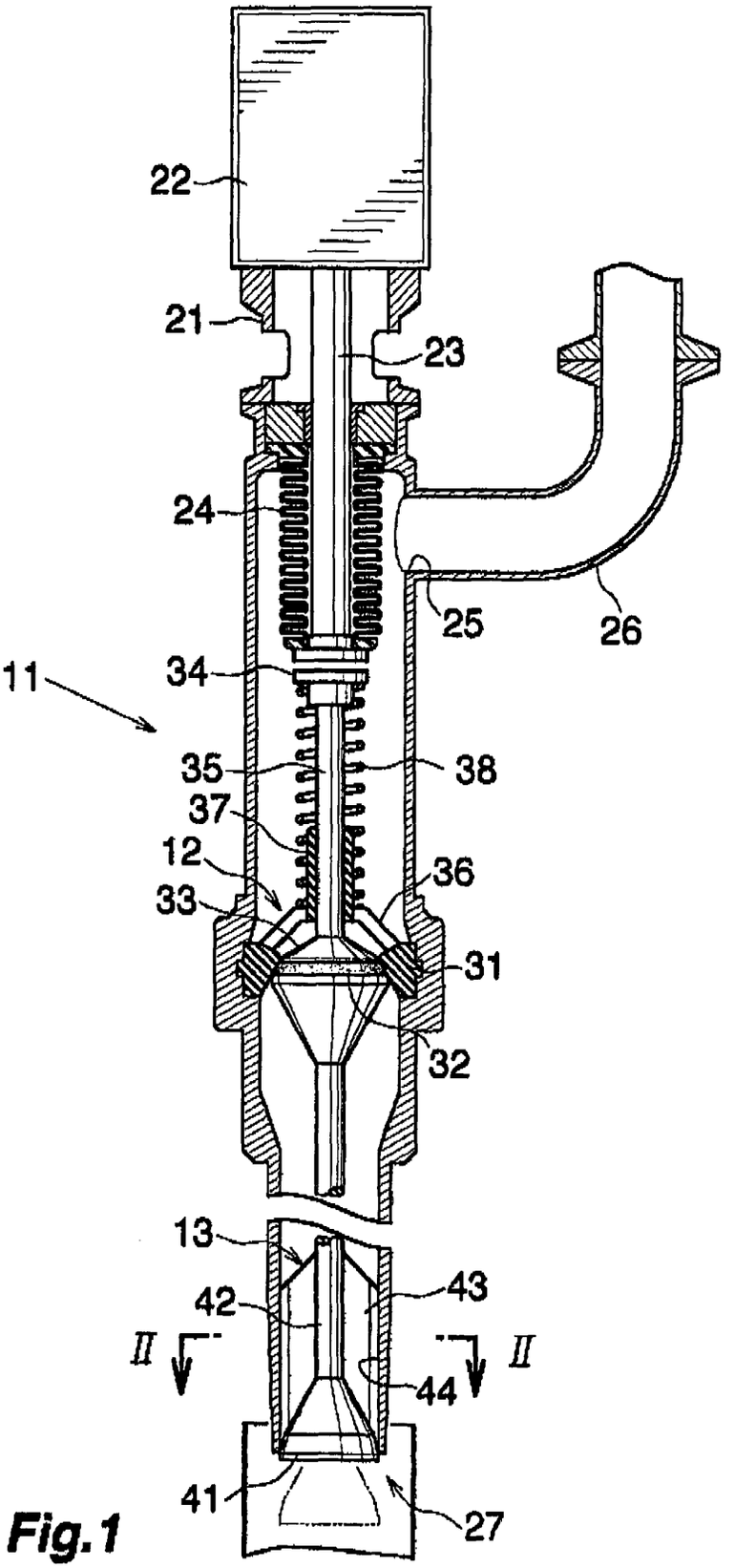


Fig.1

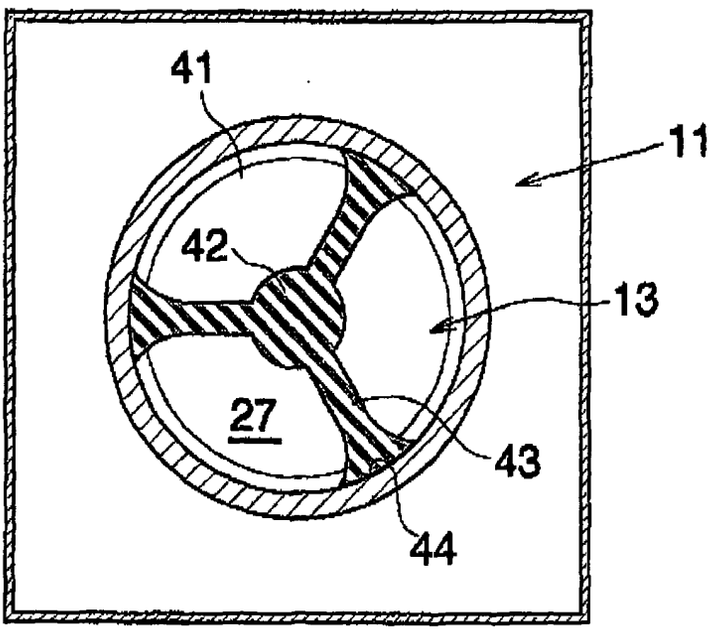
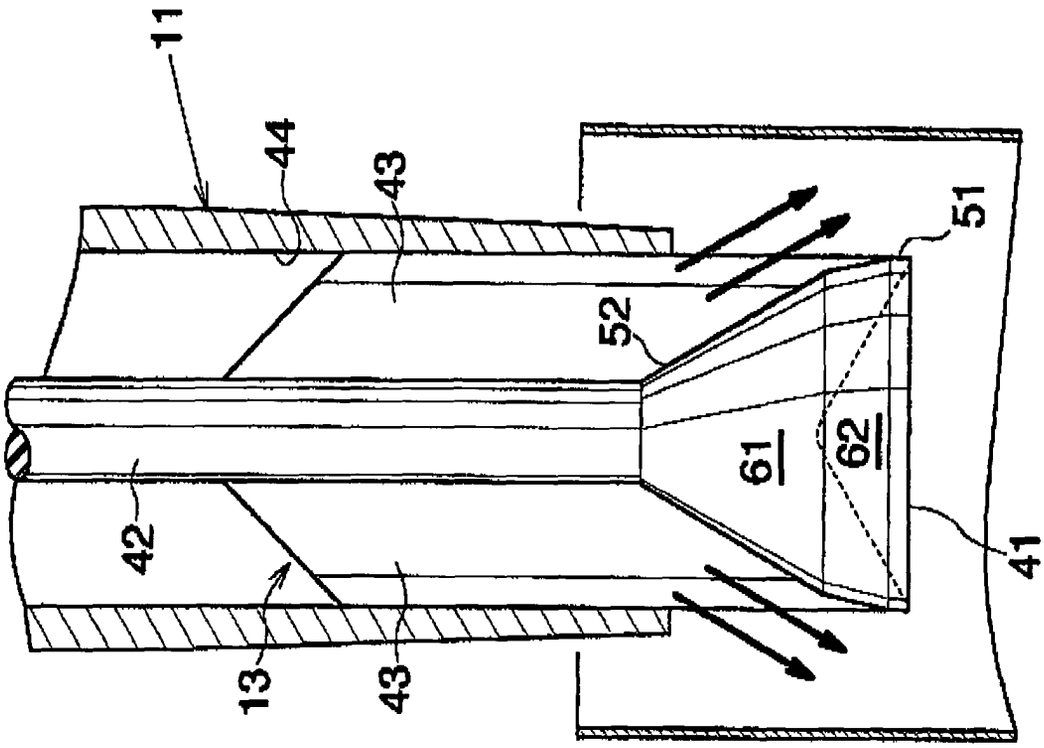
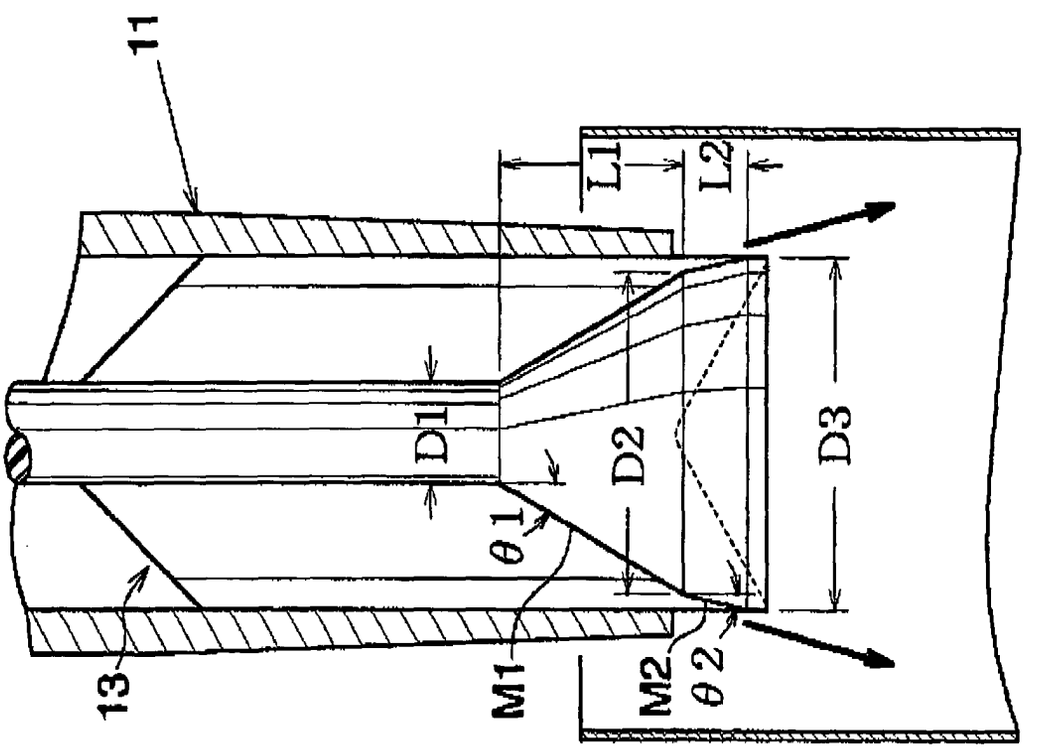


Fig.2



(b)



(a)

Fig.3

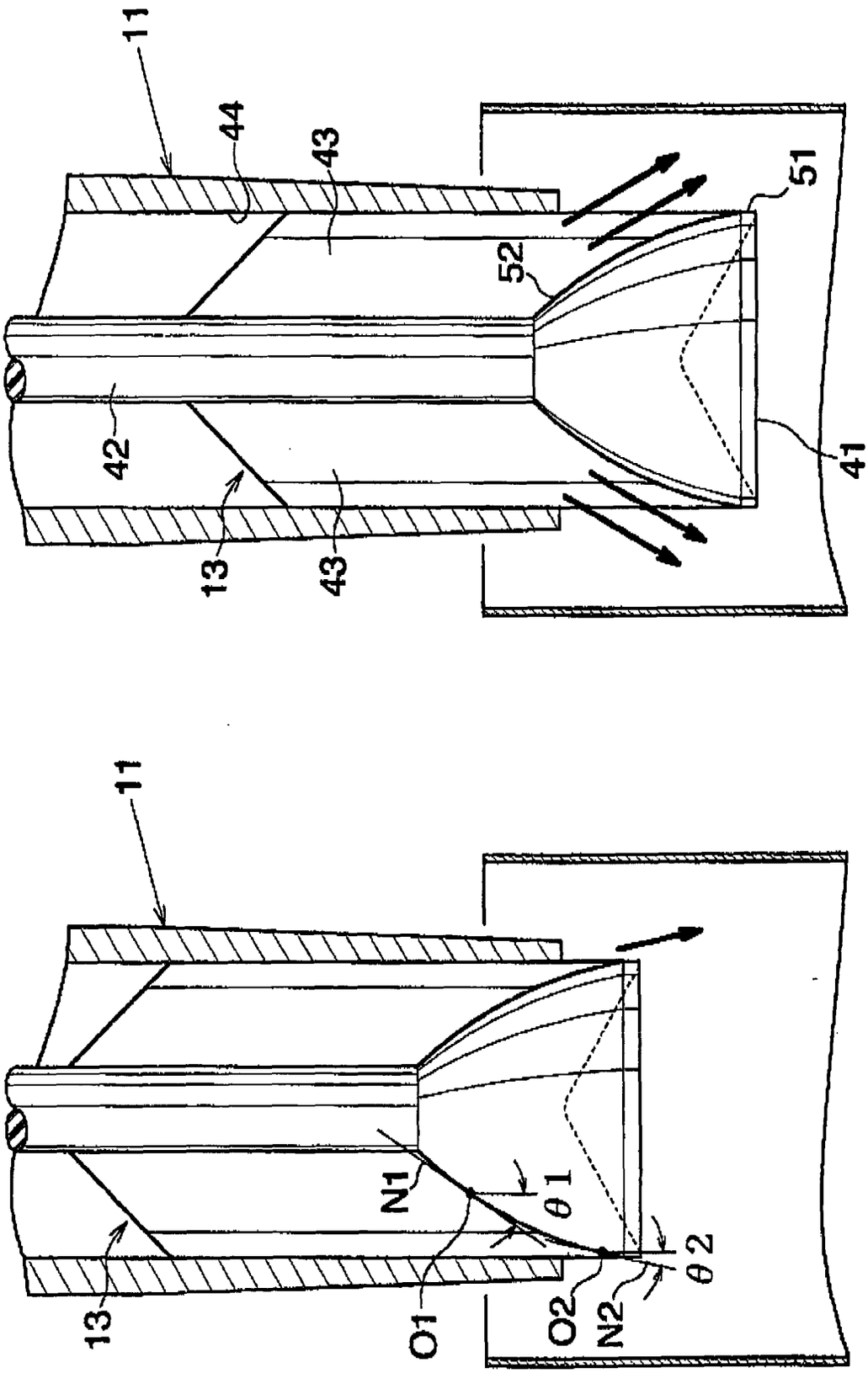


Fig.4