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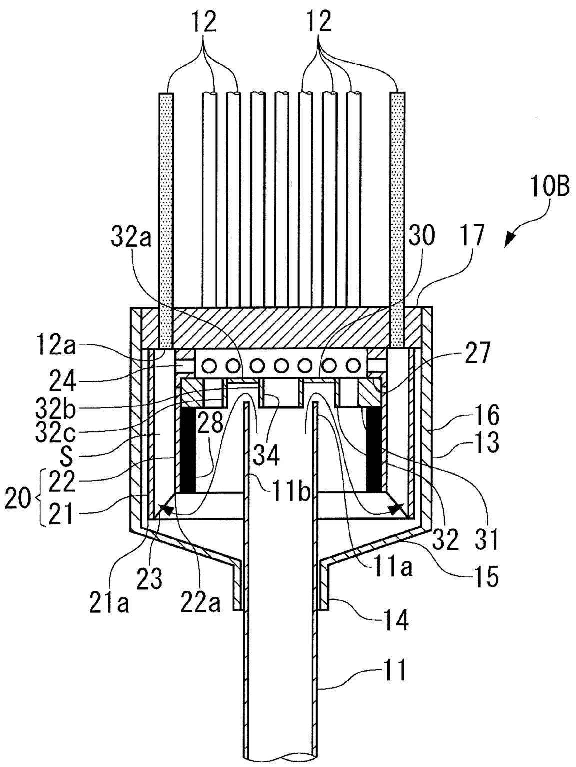
(54) **Refrigerant distributor**

(57) There is provided a refrigerant distributor that does not increase a size of an apparatus configuration and cost even when constituting a large air conditioner, and can stably distribute a refrigerant in a two-phase state in a wide flow rate range. In a refrigerant in a gas-liquid two-phase state flowing from an upper end 11a of a refrigerant tube 11 into a body 13, a liquid phase of the refrigerant having flown along an inner peripheral surface of the refrigerant tube 11 collides with an inner peripheral ring 32 of a gas-liquid separation ring 30 and returns a liquid film flow downward. A gas phase of the refrigerant mainly flowing through a center in the refrigerant tube 11 passes through a central opening 34 on an inner peripheral side of the inner peripheral ring 32 and reaches above the gas-liquid separation ring 30. Then, the liquid phase of the refrigerant is mainly sucked up from an opening 23 opening on an inner peripheral side of a lower end of a sleeve 20, and the gas phase of the refrigerant is sucked from a through hole 24 opening at an upper portion of the sleeve 20 into each capillary tube 12, and thus the refrigerant with a uniform mixing ratio between the liquid phase and the gas phase is fed into each capillary tube 12.

FIG. 2



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Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to a refrigerant distributor that distributes a refrigerant to each heat exchanger tube in a heat exchanger including a plurality of heat exchanger tubes.

Description of the Related Art

[0002] In a large air conditioner such as a commercial use air conditioner, a larger heat exchanger than that in a home or vehicle air conditioner is used. When a small diameter tube is used as a heat exchanger tube, such a large heat exchanger generally has a multi-circuit configuration including multiple sets of heat exchange circuits using a plurality of heat exchanger tubes to reduce refrigerant pressure loss in the heat exchanger and increase heat exchange performance.

[0003] When the heat exchanger is an evaporator, a refrigerant expanded at an inlet of the evaporator is in a gas-liquid two-phase state with a gas phase and a liquid phase mixed. In a tube, the refrigerant in the gas-liquid two-phase state forms an annular flow in which a liquid phase is distributed to an outer peripheral side in the tube and a gas phase is distributed to a center of the tube, which causes nonuniform distribution of a gas-liquid ratio in a sectional direction of the tube. When such a refrigerant is distributed to a plurality of heat exchanger tubes in the heat exchanger, a gas-liquid ratio between the liquid phase and the gas phase differs depending on the heat exchanger tubes. Then, efficiency of a heat exchange with the refrigerant differs between a heat exchanger tube with many liquid phases and a heat exchanger tube with many gas phases, which reduces performance of the entire heat exchanger.

[0004] Thus, various distributors have been proposed improved so as to provide uniform distribution of a gas-liquid ratio of a refrigerant in a two-phase state between a plurality of heat exchanger tubes.

[0005] For example, as shown in FIG. 9, between a refrigerant tube 1 on an upstream side and a heat exchanger 2, a refrigerant distributor 4 is provided that distributes a refrigerant in a two-phase state conveyed by a refrigerant tube 1 to each branch tube 3 of the heat exchanger 2. As shown in FIG. 10, the refrigerant distributor 4 includes an increased diameter portion 5 having an inner diameter gradually increasing from the refrigerant tube 1, a cylindrical portion 6 continuous with a large diameter side of the increased diameter portion 5, and a closing plate 7 that closes the cylindrical portion 6. In an outer peripheral portion of the closing plate 7, connection holes 8 for connection of the branch tubes 3 are provided at circumferentially spaced intervals in a concentric circular position with respect to a center of the closing plate 7. Thus, in the refrigerant distributor 4, the refrigerant is fed from the concentric circular position to each branch tube 3 to provide uniform distribution of a gas-liquid ratio of the refrigerant in the two-phase state between the plurality of branch tubes 3.

[0006] However, from a situation of a flowing path to the heat exchanger (an effect of a centrifugal force due to a curvature of a bent portion of the refrigerant tube 1, etc.) or an effect of an operation state change (dryness, flow state change), or the like, the gas-liquid ratio of the refrigerant in the two-phase state may differ even in the concentric circular position in the refrigerant distributor 4. Thus, it is difficult to cause the refrigerant to flow into the heat exchanger tubes in a constantly uniform two-phase state. In particular, it is difficult to stably distribute the refrigerant in the two-phase state in a wide flow rate range including a state with a low flow rate of the refrigerant and a state with a high flow rate.

[0007] Such a problem is noticeable for a heat exchanger including smaller diameter heat exchanger tubes and a larger number of heat exchanger tubes.

[0008] Thus, a configuration has been also proposed in which a refrigerant is subjected to gas-liquid separation before being distributed to each heat exchanger tube (for example, see Japanese Patent No. 3416963 and Japanese

Patent Laid-Open No. 2008-267689).

[0009] For example, in Japanese Patent No. 3416963, a centrifugal force is used to perform gas-liquid separation of a refrigerant, and only a liquid refrigerant is supplied to each heat exchanger tube in a heat exchanger.

[0010] Japanese Patent Laid-Open No. 2008-267689 discloses a configuration in which a groove is formed in an inner peripheral surface of a tube to generate a swirl flow of a refrigerant, and a centrifugal force thereof causes gas-liquid separation of the refrigerant.

[0011] However, the configuration in which the refrigerant is subjected to the gas-liquid separation by centrifugal separation and separated into a liquid refrigerant and a gas refrigerant, and then only the liquid refrigerant is distributed to a plurality of heat exchanger tubes increases a size of the entire apparatus configuration and increases costs.

[0012] Also, in the configuration in which the groove is formed in the inner peripheral surface of the tube for generating the centrifugal force, particularly for a large heat exchanger with a high refrigerant flow rate, the tube formed with the groove in the inner peripheral surface has a large diameter. This increases a size of an apparatus configuration and thus increases costs, and also the swirl flow of the refrigerant cannot be efficiently generated even if the groove is formed in the large diameter tube.

[0013] The present invention is achieved based on such technical problems, and has an object to provide a refrigerant distributor that does not increase a size of an apparatus configuration and cost even when constituting a large air conditioner, and can stably distribute a refrigerant in a two-phase state in a wide flow rate range.

SUMMARY OF THE INVENTION

[0014] To achieve the above-described object, the present invention provides a refrigerant distributor that is provided in a heat exchanger and distributes and feeds a refrigerant into each of a plurality of heat exchanger tubes that constitute the heat exchanger, including: a hollow body into which a refrigerant with a liquid phase and a gas phase mixed is fed from a refrigerant tube to a lower end thereof; a cap provided on an upper end of the body, and to which the plurality of heat exchanger tubes placed at circumferentially spaced intervals along an outer peripheral portion of the body are connected; and a return member that returns at least a part of the refrigerant fed from the refrigerant tube into the body downward in the body.

[0015] The return member returns the liquid phase that is at least a part of the refrigerant fed from the refrigerant tube into the body downward in the body, and thus the liquid phase can be distributed to a lower portion in the body, and the gas phase can be distributed to an upper portion.

[0016] Such a return member can be constituted by an underside of the cap.

[0017] Also, the return member may be constituted by an annular ring provided to face an upper portion of a tube wall of the refrigerant tube. In this case, the ring preferably has a guide portion that is located closer to the inner peripheral side than the tube wall of the refrigerant tube and extends downward.

[0018] Such a return member is effective when the refrigerant tube has distribution in which the liquid phase of the refrigerant flows along an inner wall surface of the refrigerant tube, and the gas phase of the refrigerant flows through a center of the refrigerant tube. The return member returns a liquid phase portion flowing through an outer peripheral portion of the refrigerant tube is returned to the lower portion, and a gas phase portion flowing through the center of the refrigerant tube is passed to the upper portion and collected in the upper portion in the body, thereby allowing the refrigerant to be vertically separated into two liquid and gas phases in the body.

[0019] A first suction port is preferably further formed that opens at the lower portion in the body and sucks and feeds the refrigerant into the heat exchanger tube. Thus, the liquid phase of the refrigerant can be sucked from the lower portion in the body and fed into the heat exchanger tube.

[0020] A second suction port may be further formed that opens at the upper portion in the body and sucks and feeds the refrigerant into the heat exchanger tube. Thus, the gas phase of the refrigerant can be sucked from the upper portion in the body and fed into the heat exchanger tube. Then, in the heat exchanger tube, the refrigerant is in a two-phase state with the liquid phase sucked from the first suction port and the gas phase sucked from the second suction port, but the liquid phase and the gas phase are vertically separated in the body, which can provide a uniform mixing ratio between the liquid phase and the gas phase of the refrigerant between the plurality of heat exchanger tubes.

[0021] Further, a bypass tube may be provided that sucks the refrigerant from the upper portion in the body and bypasses the refrigerant to an exit side of the heat exchanger. Both the second suction port and the bypass tube may be provided, or only one thereof may be provided. When the second suction port is not provided and only the bypass tube is provided, uniform gas-liquid two phases with many liquid phases are fed into the heat exchanger tube, and the same advantage can be obtained.

[0022] An increased diameter portion with a gradually increasing area of a channel through which the refrigerant flows may be provided between an upper end of the refrigerant tube and the body. In the increased diameter portion, the flow of the refrigerant becomes a jet, and thus the refrigerant becomes droplets.

[0023] The present invention may provide a refrigerant distributor that is provided in a heat exchanger and distributes and feeds a refrigerant to each of a plurality of heat exchanger tubes that constitute the heat exchanger, including: a hollow body into which a refrigerant with a liquid phase and a gas phase mixed is fed from a refrigerant tube to a lower end thereof; a cap provided on an upper end of the body, and to which a plurality of heat exchanger tubes placed at circumferentially spaced intervals along an outer peripheral portion of the body are connected; and an increased diameter portion that is provided between an upper end of the refrigerant tube and the body and has a gradually increasing area of a channel through which the refrigerant flows.

[0024] According to the present invention, a refrigerant with a uniform mixing ratio between the liquid phase and the gas phase can be fed into each heat exchanger tube. Thus, the refrigerant in the two-phase state can be stably distributed to the plurality of heat exchanger tubes, and a heat exchange with the refrigerant can be stably performed in a wide flow rate range. Heat exchange performance can be stabilized to reduce a size of the heat exchanger and thus reduce cost of the entire air conditioner. Further, the refrigerant distributor has a very simple configuration, and thus the above-described advantage can be provided at low cost without increasing the size of the air conditioner or cost.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025]

FIG. 1 is a sectional view showing a refrigerant distributor according to a first embodiment;

FIG. 2 is a sectional view showing a refrigerant distributor according to a second embodiment;

FIG. 3A is a plan view of a gas-liquid separation ring view and FIG. 3B is a sectional view thereof;

FIG. 4 is a sectional view showing a variant of the refrigerant distributor according to the second embodiment;

FIG. 5 is a sectional view showing a refrigerant distributor according to a third embodiment;

FIG. 6 is a sectional view showing a variant of the refrigerant distributor according to the third embodiment;

FIG. 7 is a sectional view showing another variant of the refrigerant distributor according to the third embodiment;

FIG. 8 is a sectional view of a configuration shown in the second embodiment being combined with the refrigerant distributor according to the third embodiment;

FIG. 9 is a perspective view of a conventional refrigerant distributor; and

FIG. 10A is a plan view of a conventional refrigerant distributor and FIG. 10B is a front sectional view thereof.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0026] Now, embodiments of the present invention will be described in detail with reference to the accompanying drawings.

[0027] FIG. 1 illustrates a configuration of a refrigerant distributor 10A according to this embodiment. The refrigerant distributor 10A is provided in a heat exchanger (evaporator) in an air conditioner.

[0028] As shown in FIG. 1, the refrigerant distributor 10A includes a body 13 having a lower end connected to a refrigerant tube 11 on an upstream side, and an upper end to which a plurality of capillary tubes 12 that constitute the heat exchanger are connected.

[0029] The body 13 is hollow, and includes at a lower end thereof a cylindrical refrigerant tube connecting portion 14 to which the refrigerant tube 11 is connected. The body 13 includes a bowl-shaped increased diameter portion 15 continuous with an upper end of the refrigerant tube connecting portion 14 and having an inner diameter gradually increasing upward, and a cylindrical portion 16 continuous with an upper end of the increased diameter portion 15 and extending upward.

[0030] The refrigerant tube 11 connected to the refrigerant tube connecting portion 14 has an upper end 11a protruding upward from the refrigerant tube connecting portion 14 and located inside the cylindrical portion 16.

[0031] In an opening at an upper end of the cylindrical portion 16, a disk-shaped cap 17 that closes the opening is fitted. In an outer peripheral portion of the cap 17, a predetermined number of capillary tubes 12 are inserted at circumferentially spaced intervals in a concentric circular position from a center of the cap 17 and pass through the cap 17 to a lower side thereof.

[0032] A cylindrical sleeve 20 is housed in the cylindrical portion 16. The sleeve 20 has a double structure including an outer cylinder 21, and an inner cylinder 22 having a smaller diameter than the outer cylinder 21, and an annular gap S is formed between the outer cylinder 21 and the inner cylinder 22. The outer cylinder 21 and the inner cylinder 22 are integrally connected at a plurality of circumferential positions by unshown connecting portions. A lower end 12a of capillary tube 12 passing through the cap 17 opens in an upper portion of the gap S.

[0033] A lower end 22a of the inner cylinder 22 is located above the lower end 21a of the outer cylinder 21. Thus, at a lower end of the sleeve 20, an opening 23 opening toward an inner peripheral side of the sleeve 20 is circumferentially formed.

[0034] A plurality of through holes 24 that pass through opposite surfaces of the inner cylinder 22 are formed in circumferential positions in an upper portion of the sleeve 20. The through hole 24 is preferably formed in a position corresponding to each capillary tube 12.

[0035] In such a refrigerant distributor 10A, when a refrigerant in a gas-liquid two-phase state flows from the refrigerant tube 11 in a lower position, the refrigerant flows from the upper end 11a of the refrigerant tube 11 located inside the cylindrical portion 16 into the body 13. In the refrigerant having flown into the cylindrical portion 16, a liquid phase of the refrigerant having mainly flown through an outer peripheral side in the refrigerant tube 11 collides with an underside of the cap 17 and returns downward to form a liquid film flow. Then, the liquid film flow reaches a bottom of the body 13 (an inner peripheral surface of a portion from the lower end of the cylindrical portion 16 to the increased diameter portion 15 below the upper end 11a of the refrigerant tube 11), while a gas phase of the refrigerant mainly flowing through a center in the refrigerant tube 11 remains in the upper portion in the body 13. Thus, in the body 13, the refrigerant is easily vertically separated into a gas phase and a liquid phase according to the difference in specific gravity. Thus, in the body 13, many liquid phases of the refrigerant accumulate in the position below the upper end 11a of the refrigerant tube 11, and many gas phases accumulate in the position above the upper end 11a of the refrigerant tube 11.

[0036] Then, from the opening 23 opening on the inner peripheral side of the lower end of the sleeve 20, the liquid phase of the refrigerant is mainly sucked up and sucked through the gap S into each capillary tube 12. At this time, the refrigerant sucked from the opening 23 may partly contain the gas phase.

[0037] From the through hole 24 opening at the upper portion of the sleeve 20, the gas phase of the refrigerant is mainly sucked into each capillary tube 12. Thus, in the capillary tube 12, the liquid phase of the refrigerant having flown through the opening 23 and the gas phase having flown through the through hole 24 are mixed, and a gas-liquid two-phase refrigerant flows.

[0038] As described above, from the refrigerant tube 11 in which the liquid phase of the refrigerant is distributed to the outer peripheral side, and the gas phase is distributed to the center, the refrigerant in the two-phase state is caused to collide with the cap 17 provided in the upper portion of the body 13 of the refrigerant distributor 10A, and thus the refrigerant can be vertically separated into the gas phase and the liquid phase in the body 13. Then, the liquid phase of the refrigerant is sucked up from the opening 23 opening at the lower end of the sleeve 20, and the gas phase of the refrigerant is sucked from the through hole 24 opening at the upper portion of the sleeve 20, and thus the refrigerant with a uniform mixing ratio between the liquid phase and the gas phase can be fed into each capillary tube 12.

[0039] Thus, in the refrigerant distributor 10A, the refrigerant in the two-phase state can be stably distributed to the plurality of capillary tube 12, and a stable heat exchange with the refrigerant can be performed in a wide flow rate range. Heat exchange performance can be stabilized to reduce a size of the heat exchanger and thus reduce cost of the entire air conditioner. Further, the refrigerant distributor 10A has a very simple configuration, and thus the above-described advantage can be provided with minimum cost increase, without increasing the size of the air conditioner or cost.

[Second embodiment]

[0040] Next, a second embodiment of the present invention will be described. In the description below, configurations different from those in the first embodiment will be mainly described, and the same configurations as those in the first embodiment will be denoted by the same reference numerals and the descriptions thereof will be omitted.

[0041] As shown in FIG. 2, a refrigerant distributor 10B in this embodiment is different from the refrigerant distributor 10A in the first embodiment in that a gas-liquid separation ring (return member, ring) 30 is provided.

[0042] The gas-liquid separation ring 30 is provided at a predetermined space below a cap 17. The gas-liquid separation ring 30 has an outer peripheral portion abutting against a step 27 from below. The step 27 is formed below a through hole 24 in a sleeve 20. A cylindrical securing member 28 is inserted from below on an inner peripheral side of an inner cylinder 22 of the sleeve 20. The gas-liquid separation ring 30 is held between the securing member 28 and the step 27 and fixed.

[0043] As shown in FIGS. 2 and 3A, 3B, the gas-liquid separation ring 30 has a disk shape with a predetermined thickness, and includes an outer peripheral ring 31 held between the securing member 28 and the step 27 as described above, an inner peripheral ring 32 concentrically placed inside the outer peripheral ring 31, and a plurality of spokes 33 that connect the outer peripheral ring 31 and the inner peripheral ring 32.

[0044] The inner peripheral ring 32 is provided vertically above a tube wall 11b of a refrigerant tube 11 protruding in a body 13. More specifically, the inner peripheral ring 32 has a smaller inner diameter than an inner diameter of the refrigerant tube 11, and includes an annular plate portion 32a having a larger outer diameter than an outer diameter of the refrigerant tube 11, an inner peripheral side cylindrical portion (guide portion) 32b extending downward from an inner peripheral side of the plate portion 32a, and an outer peripheral side cylindrical portion 32c extending downward from an outer peripheral side of the plate portion 32a. Thus, the inner peripheral ring 32 has an inverted U-shaped sectional shape opening downward. Then, above the refrigerant tube 11, in the inner peripheral ring 32, the inner peripheral side cylindrical portion 32b is located closer to the inner peripheral side than the tube wall 11b of the refrigerant tube 11, and the outer peripheral side cylindrical portion 32c is located closer to the outer peripheral side than the tube wall 11b of the refrigerant tube 11.

[0045] A central opening 34 formed at a center of the inner peripheral ring 32 is located vertically above a center of the refrigerant tube 11.

[0046] In the refrigerant distributor 10B with such a configuration, when a refrigerant in a gas-liquid two-phase state flows from the refrigerant tube 11 in a lower position, the refrigerant flows from the upper end 11a of the refrigerant tube 11 located inside the cylindrical portion 16 into the body 13. In the refrigerant having flown into the cylindrical portion 16, a liquid phase of the refrigerant having flown along an inner peripheral surface of the refrigerant tube 11 collides with the inner peripheral ring 32 of the gas-liquid separation ring 30 located above the tube wall 11b to form a liquid film flow and returns downward. Then, the liquid film flow reaches a bottom of the body 13, while a gas phase of the refrigerant mainly flowing through the center in the refrigerant tube 11 flows through the central opening 34 on the inner peripheral side of the inner peripheral ring 32 to an upper position of the gas-liquid separation ring 30.

[0047] In the inner peripheral ring 32, the inner peripheral side cylindrical portion 32b has the inverted-U shape located closer to the inner peripheral side than the tube wall 11b of the refrigerant tube 11. Thus, the liquid phase of the refrigerant having flown along the inner peripheral surface of the tube wall 11b of the refrigerant tube 11, that is, the liquid film flow is diverted as if to be torn from a flow closer to the inner peripheral side than the inner peripheral side cylindrical portion 32b, and changed in flow direction to a downward direction. Thus, the liquid phase can be more efficiently pressed into a lower portion of the body 13.

[0048] Also, the gas phase of the refrigerant having passed through the central opening 34 of the inner peripheral ring 32 collides with an underside of the cap 17 and returns, and again returns from an upper surface of the plate portion 32a of the inner peripheral ring 32. Thus, the gas phase can be more efficiently accumulated in the upper portion of the body 13.

[0049] As such, the gas-liquid separation ring 30 can be provided to more efficiently separate the liquid phase of the refrigerant from the gas phase thereof.

[0050] Then, the liquid phase of the refrigerant is mainly sucked up from the opening 23 opening on the inner peripheral side at the lower end of the sleeve 20, and the gas phase of the refrigerant is sucked from the through hole 24 opening in the upper portion of the refrigerant sleeve 20 into each capillary tube 12. Thus, the refrigerant with a uniform mixing ratio between the liquid phase and the gas phase can be fed into each capillary tube 12.

[0051] Thus, as in the first embodiment, the refrigerant in the two-phase state can be stably distributed, and a stable heat exchange with the refrigerant can be performed in a wide flow rate range to reduce a size of the heat exchanger and thus reduce cost. Further, the refrigerant distributor 10B has a very simple configuration as in the first embodiment, and the above-described advantage can be provided at low cost without increasing the size of the air conditioner or cost.

[0052] In the first and second embodiments, variants described below may be adopted. Specifically, as shown in FIG. 4, a refrigerant distributor 10C may include a bypass tube 35 that sucks out the gas phase of the refrigerant accumulated in the upper portion in the body 13 to the cap 17, and bypasses the gas phase to an exit side of the heat exchanger. With such a configuration, the gas phase of the refrigerant is bypassed to the exit side, and thus the refrigerant can be fed from the capillary tube 12 into the heat exchanger as the liquid phase (single phase).

[0053] This can further increase heat exchange efficiency in the heat exchanger. Thus, even with a light load in the heat exchanger and a low flow rate of the refrigerant flowing through the heat capillary tube 12, the heat exchange can be reliably performed. Such a configuration is particularly effective for reducing a size of the heat exchanger, and adopting such a configuration can reduce a size of the air conditioner and cost.

[Third embodiment]

[0054] Next, a third embodiment of the present invention will be described. In the description below, configurations different from those in the first embodiment will be mainly described, and the same configurations as those in the first embodiment will be denoted by the same reference numerals and the descriptions thereof will be omitted.

[0055] As shown in FIG. 5, a refrigerant distributor 10D in this embodiment includes a body 41 having a lower end to which a refrigerant tube 11 on an upstream side is connected via a diffusion tube 40, and an upper end to which a plurality of capillary tube 12 that constitute a heat exchanger are connected.

[0056] The body 41 is hollow, and includes a cylindrical refrigerant tube connecting portion 14, a bowl-shaped increased diameter portion 15 continuous with an upper end of the refrigerant tube connecting portion 14 and having an inner diameter gradually increasing upward, and a cylindrical portion 16 continuous with an upper end of the increased diameter portion 15 and extending upward.

[0057] In an opening at an upper end of the cylindrical portion 16, a disk-shaped cap 17 that closes the opening is fitted. In an outer peripheral portion of the cap 17, a predetermined number of capillary tube 12 are inserted at circumferentially spaced intervals in a concentric circular position from a center of the cap 17 and pass through the cap 17 to a lower side thereof.

[0058] The diffusion tube 40 includes a diffusion tube member 45 including a tube holding portion 42 into which an upper end 11a of the refrigerant tube 11 is inserted, a bowl-shaped increased diameter portion 43 continuous with an upper end of the tube holding portion 42 and having an inner diameter gradually increasing upward, and a cylindrical straight tube portion 44 continuous with an upper end of the increased diameter portion 43 and extending upward. In an example in FIG. 5, between the refrigerant tube 11 and the body 41, diffusion tube members 45 are connected in two steps. The number of steps of the diffusion tube member 45 is not limited to two, but only one step or three or more steps may be allowed. A diffusion tube member 45 of the second step or thereafter is connected by inserting a straight tube portion 44 of a diffusion tube member 45 on the lower step side into a tube holding portion 42.

[0059] Such diffusion tube members 45 are connected so that the refrigerant tube 11 or the straight tube portion 44 of the diffusion tube member 45 protrudes upward from the tube holding portion 42 of the diffusion tube member 45 on the upper step side or the refrigerant tube connecting portion 14.

[0060] Such a diffusion tube 40 is provided, and thus an inner diameter of a channel thereof is suddenly increased at an upper end of the refrigerant tube 11 or an upper end 45a of the diffusion tube member 45, a flow of the refrigerant that is an annular flow in which a liquid phase is distributed to an outer peripheral portion and a gas phase is distributed to a center becomes a jet, and the liquid phase refrigerant becomes droplets. Thus, a thickness of a liquid film flow L along an inner peripheral surface of the diffusion tube 40 becomes smaller than a thickness of a liquid film flow L along the refrigerant tube 11.

[0061] Conventionally, the gas phase is sometimes separated from the liquid phase in the body due to an operation state (dryness due to a load change, flow state change) to prevent uniform distribution in a concentric circular shape. For this case, the liquid phase of the refrigerant in droplets is sucked by the capillary tube 12 connected to the upper portion of the body 41, and thus the liquid film of the annular flow can be made uniform to splash a uniform droplet flow. Thus, the refrigerant with a uniform mixing ratio between the liquid phase and the gas phase can be fed into the plurality of capillary tube 12 connected to the body 41.

[0062] Thus, in the refrigerant distributor 10D, the refrigerant in the two-phase state can be stably distributed to the plurality of capillary tubes 12, and a heat exchange with the refrigerant can be stably performed in a wide flow rate range. Heat exchange performance can be stabilized to reduce a size of the heat exchanger and thus reduce cost of the entire air conditioner. Further, the refrigerant distributor 10D has a very simple configuration, and thus the above-described advantage can be provided at low cost without increasing the size of the air conditioner or cost.

[0063] In the third embodiment, a variant as described below may be adopted.

[0064] First, as shown in FIG. 6, the lower end 12a of the capillary tube 12 connected to the body 41 may have a downward increasing diameter. This can increase an opening area of the capillary tube 12 facing the inside of the body 41, and allows droplets of the refrigerant to be collected from a wider range, and thus the above-described advantage is obtained in a more noticeably manner.

[0065] Also, as shown in FIG. 7, a guide portion 47 that protrudes downward and can guide a flow of droplets to the capillary tube 12 placed in the outer peripheral portion of the cap 17 may be formed in an underside of the cap 17. Such a guide portion 47 may have, for example, a conical shape having a sectional area gradually decreasing downward.

[0066] With such a guide portion 47, the droplets can be guided to the capillary tube 12 on the outer peripheral side, thus can be more efficiently collected in the capillary tube 12, and thus the above-described advantage is obtained in a more noticeably manner.

[0067] As shown in FIG. 8, a gas-liquid separation ring 30 may be provided above the diffusion tube 40 in the body 41 as in the configuration in FIG. 2. In this case, the diffusion tube 40 reduces a thickness of the liquid film flow, and thus as in the second embodiment, the ring 30 can divert the liquid film of the tube wall downward to suck the liquid phase from a lower portion of the body 41, and can more reliably supply a uniform droplet flow.

[0068] In the above-described embodiments, the configuration of the heat exchanger itself or the configuration of the entire air conditioning apparatus is not limited.

[0069] Further, the configurations described in the embodiments may be chosen or changed to other configurations without departing from the gist of the present invention.

Claims

1. A refrigerant distributor that is provided in a heat exchanger and distributes and feeds a refrigerant into each of a plurality of heat exchanger tubes that constitute the heat exchanger, comprising:

   a hollow body into which the refrigerant with a liquid phase and a gas phase mixed is fed from a refrigerant tube to a lower end thereof;

   a cap provided on an upper end of the body, and to which the plurality of heat exchanger tubes placed at circumferentially spaced intervals along an outer peripheral portion of the body are connected; and

   a return member that returns at least a part of the refrigerant fed from the refrigerant tube into the body downward in the body.

2. The refrigerant distributor according to claim 1, wherein the return member is constituted by an underside of the cap.

3. The refrigerant distributor according to claim 1, wherein the return member is constituted by an annular ring provided to face an upper portion of a tube wall of the refrigerant tube.

4. The refrigerant distributor according to claim 3, wherein the ring has a guide portion extending downward on an inner peripheral side of the tube wall of the refrigerant tube.

5. The refrigerant distributor according to any one of claims 1 to 4, wherein the refrigerant tube has distribution in which the liquid phase of the refrigerant flows along an inner wall surface of the refrigerant tube, and the gas phase of the refrigerant flows through a center of the refrigerant tube.

6. The refrigerant distributor according to any one of claims 1 to 5, further comprising a first suction port that opens at the lower portion in the body and sucks and feeds the refrigerant into the heat exchanger tube.

7. The refrigerant distributor according to claim 6, further comprising a second suction port that opens at the upper portion in the body and sucks and feeds the refrigerant into the heat exchanger tube.

8. The refrigerant distributor according to claim 6 or 7, further comprising a bypass tube that sucks the refrigerant from the upper portion in the body and bypasses the refrigerant to an exit side of the heat exchanger.

9. The refrigerant distributor according to any one of claims 1 to 8, wherein an increased diameter portion with a gradually increasing area of a channel through which the refrigerant flows is provided between an upper end of the refrigerant tube and the body.

10. A refrigerant distributor that is provided in a heat exchanger and distributes and feeds a refrigerant to each of a plurality of heat exchanger tubes that constitute the heat exchanger, comprising:

a hollow body into which the refrigerant with a liquid phase and a gas phase mixed is fed from a refrigerant tube to a lower end thereof;
a cap provided on an upper end of the body, and to which a plurality of the heat exchanger tubes placed at circumferentially spaced intervals along an outer peripheral portion of the body are connected; and
an increased diameter portion that is provided between an upper end of the refrigerant tube and the body and has a gradually increasing area of a channel through which the refrigerant flows.

FIG. 1

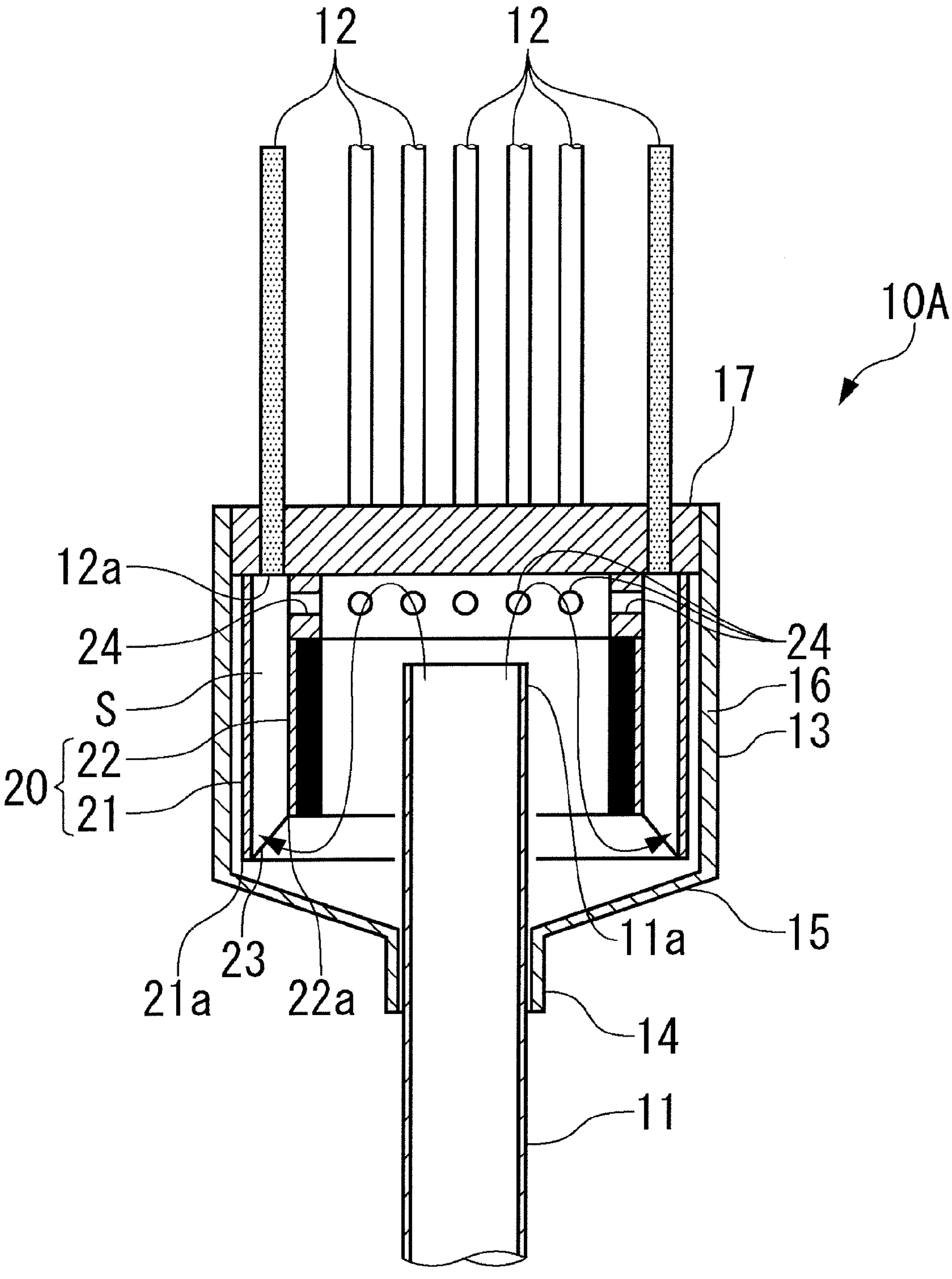
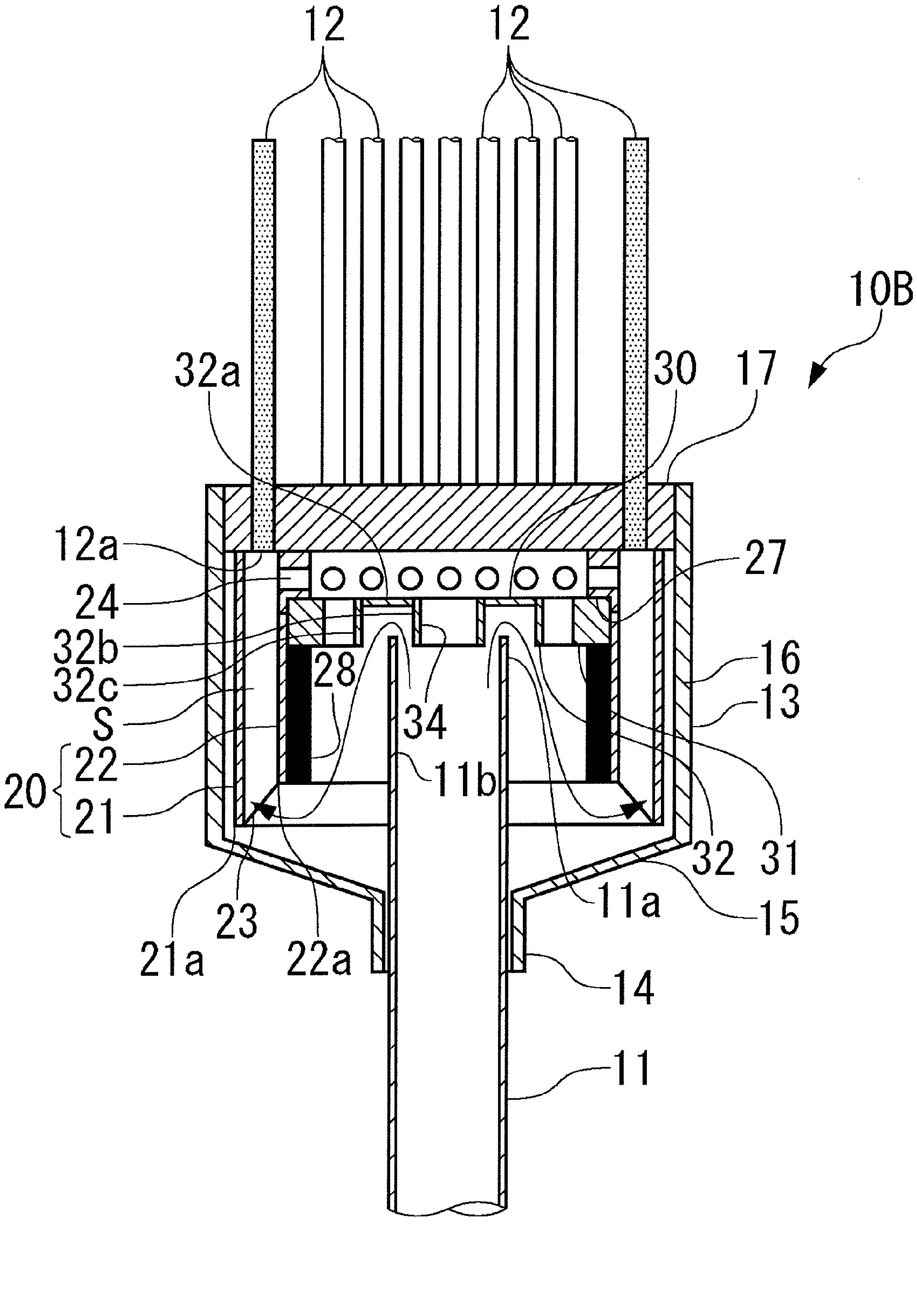


FIG. 2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32a
30
17
12a
27
24
32b
16
32c
28
13
S
34
22
20
11b
21
32
31
11a
15
23
21a
22a
14
11

FIG. 3A

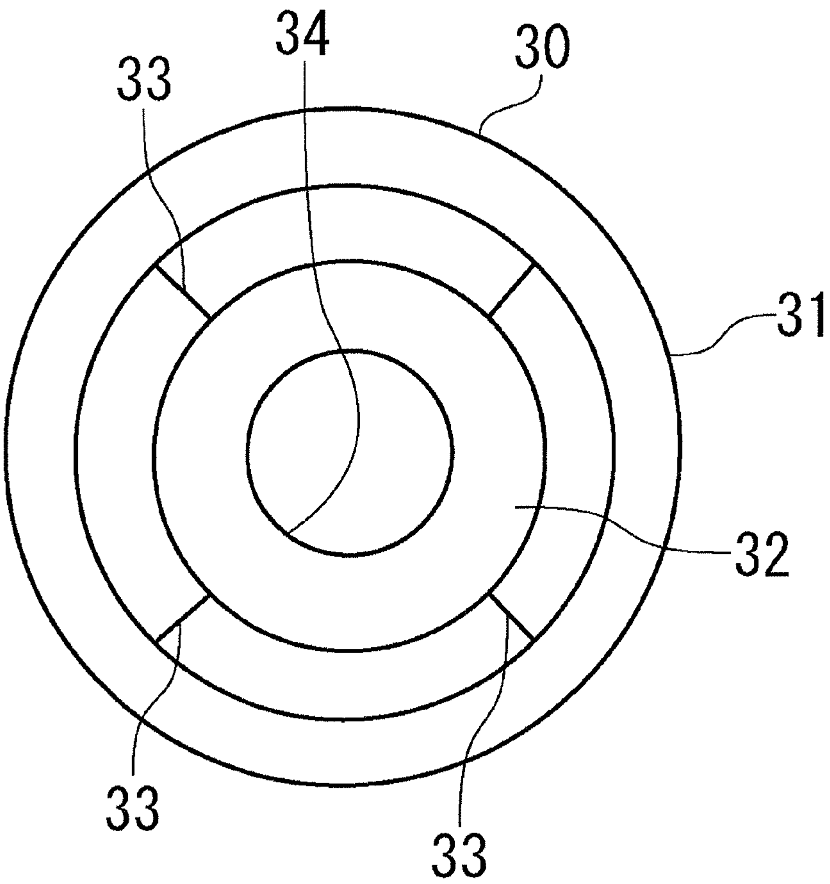


FIG. 3B

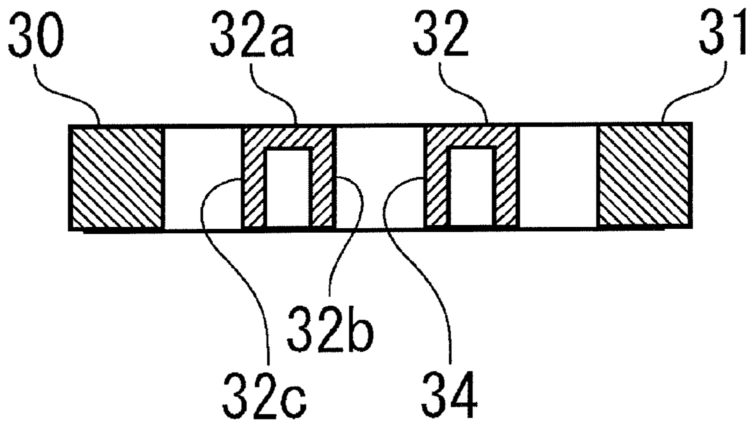
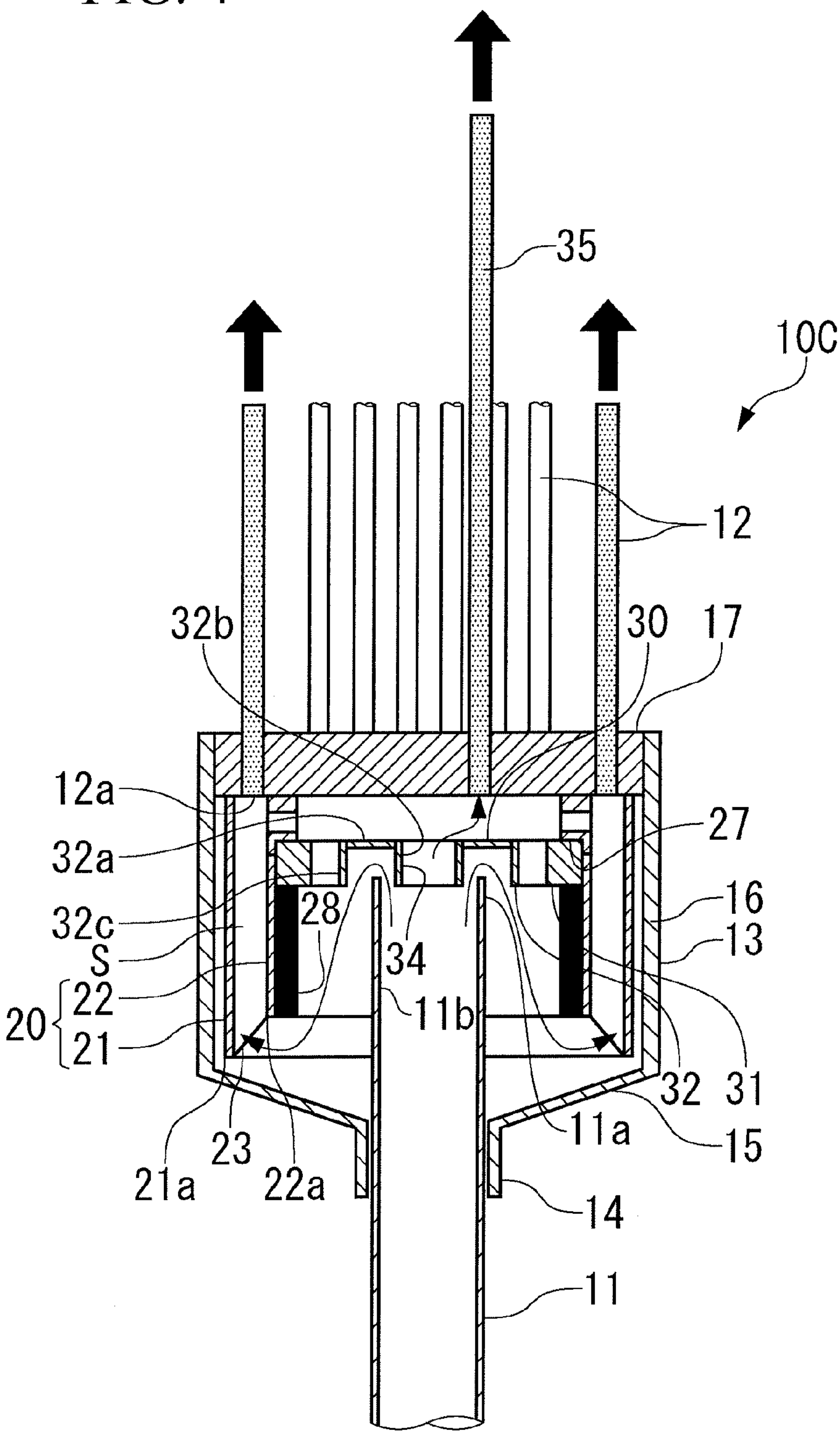


FIG. 4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32c
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S
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11b
21
32
31
23
11a
15
21a
22a
14
11

FIG. 5

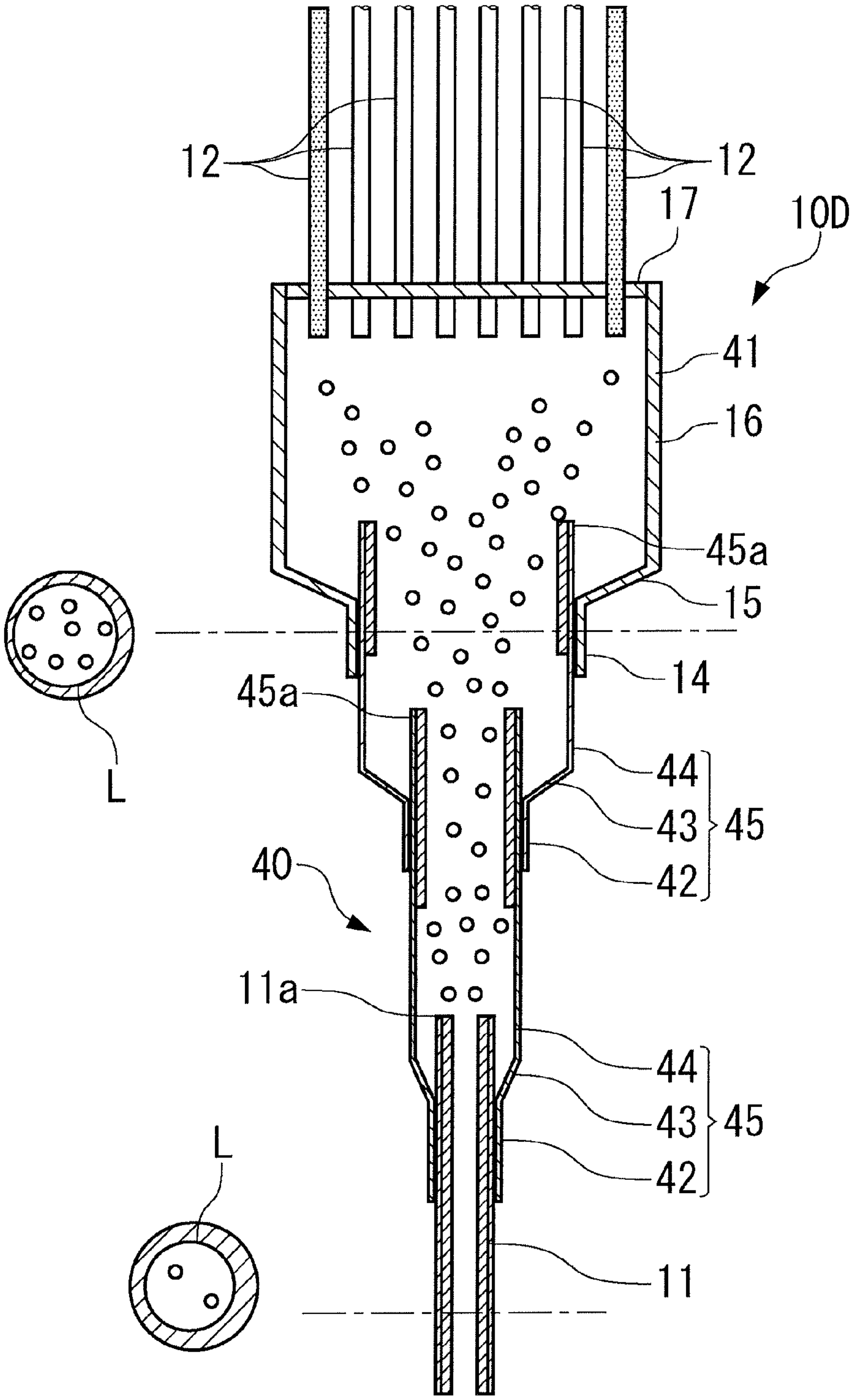
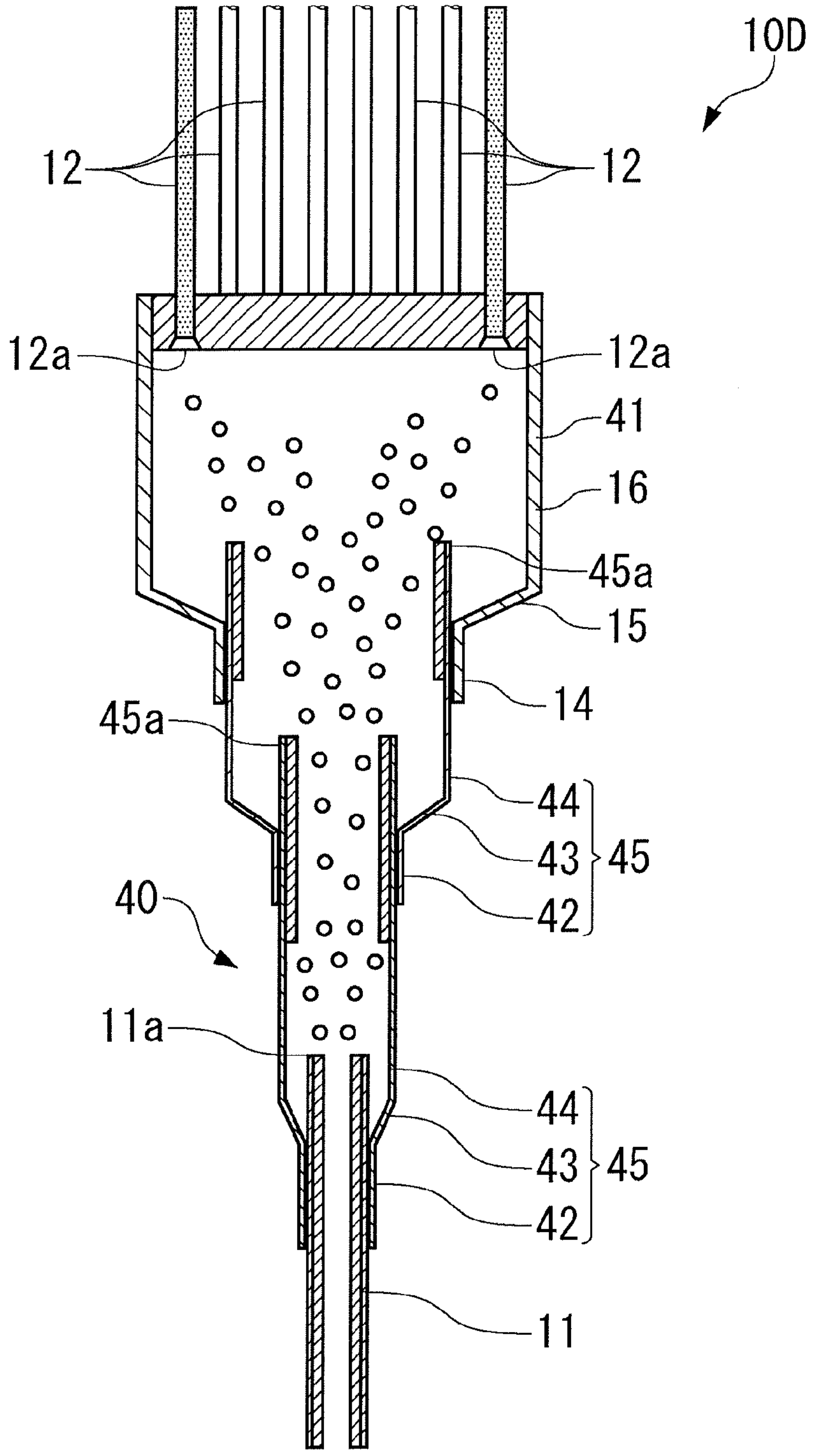


FIG. 6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12a
12a
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16
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15
14
45a
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45
42
40
11a
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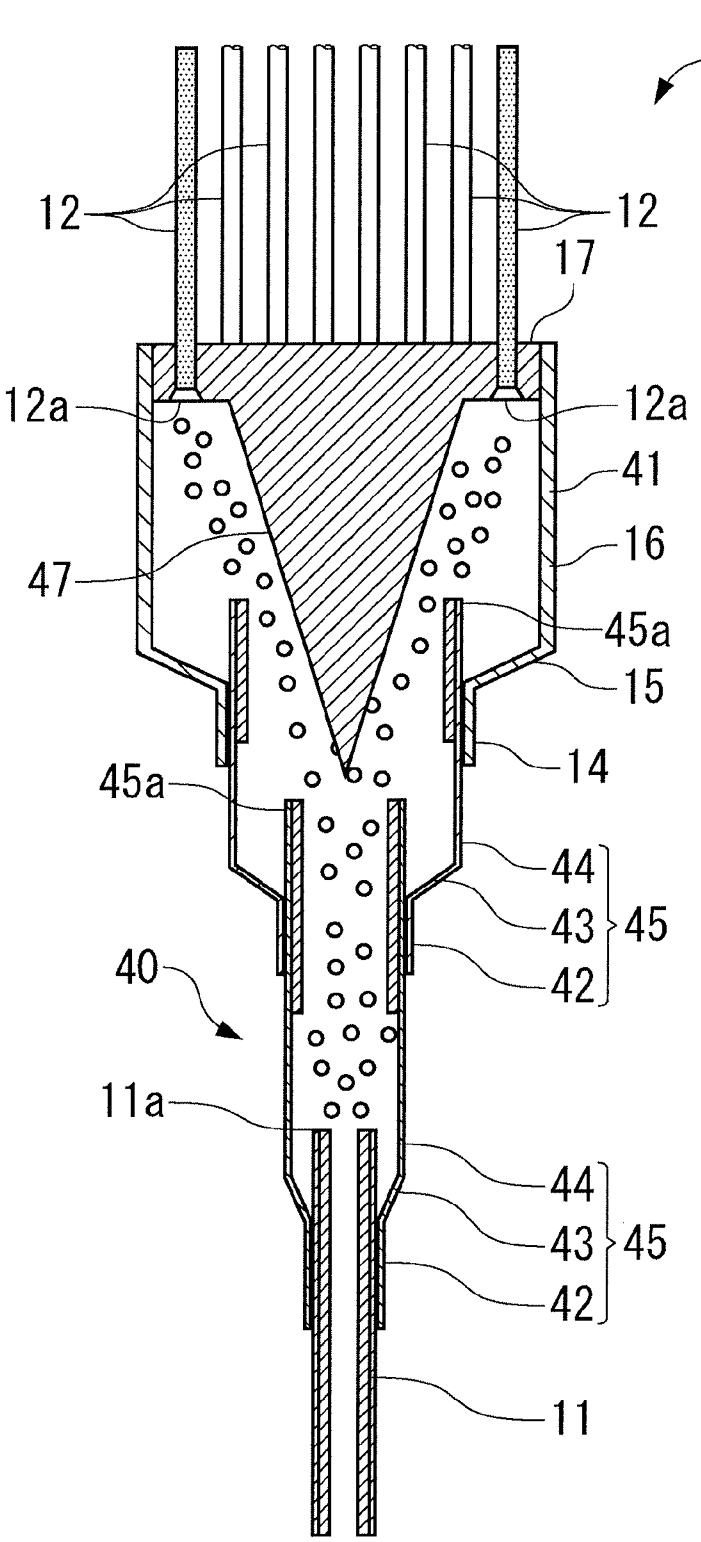
43
45
42
11

FIG. 7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12a
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11a
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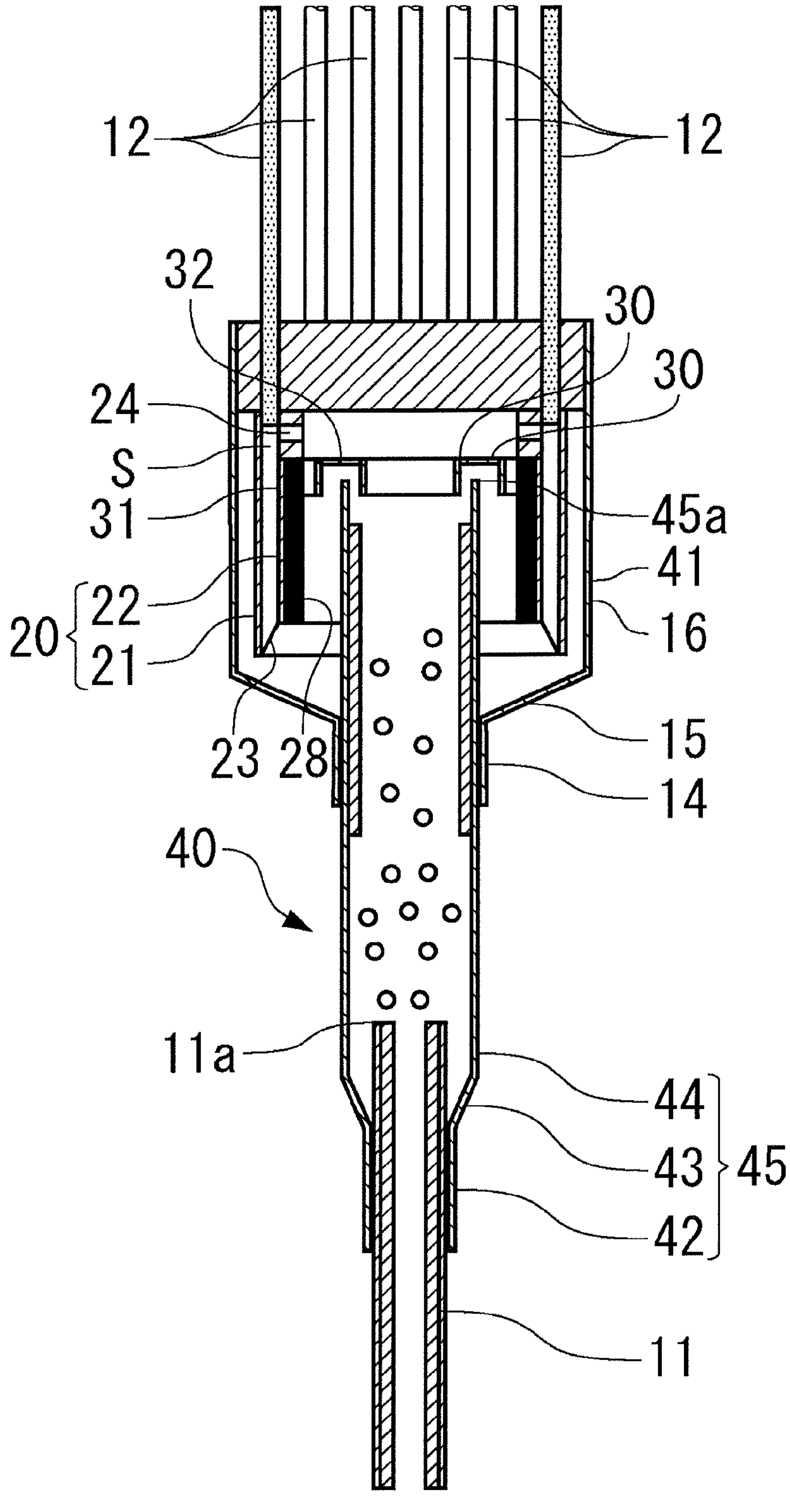
42
11

FIG. 8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S
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11a
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43
45
42
11

FIG. 9

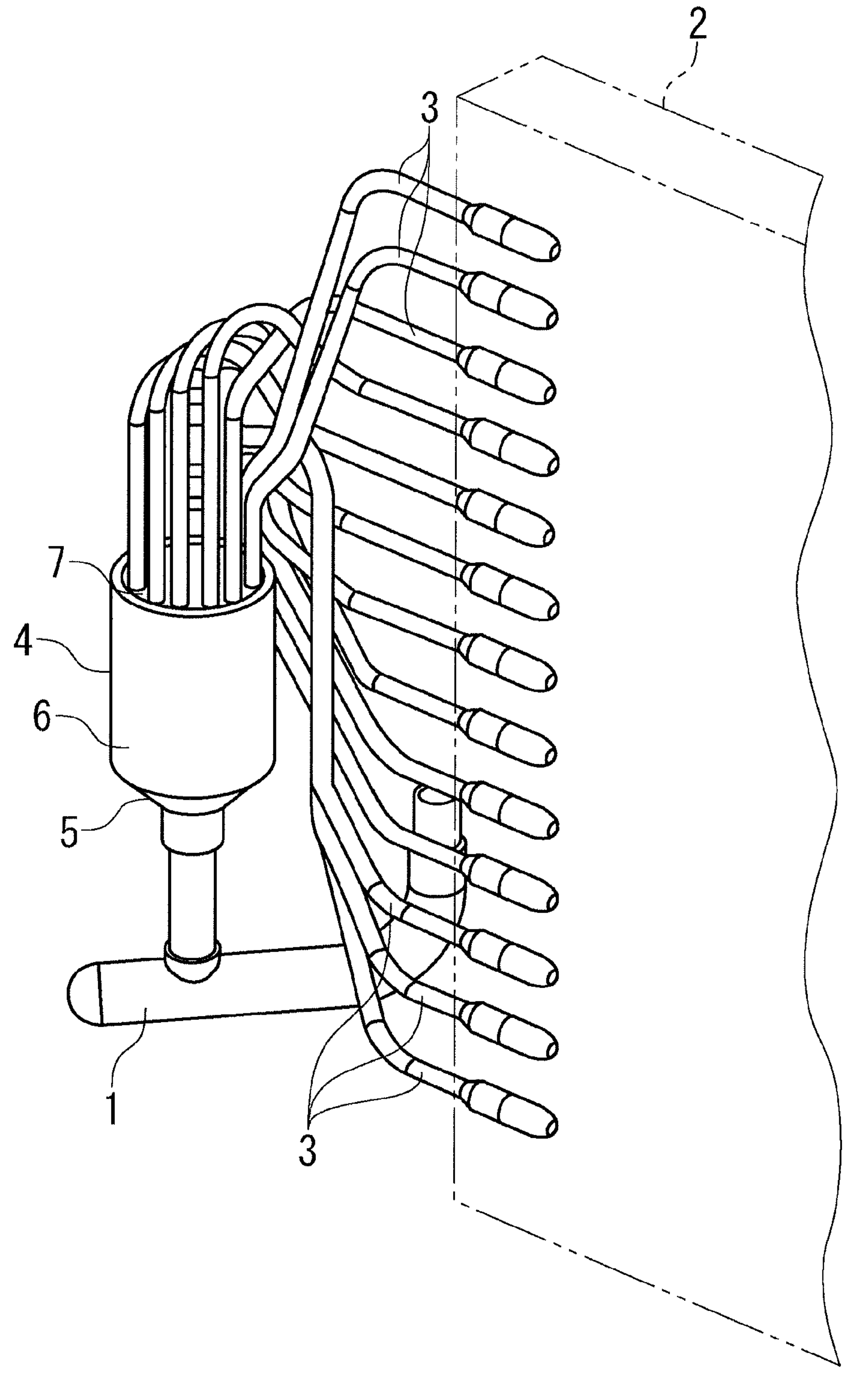


FIG. 10A

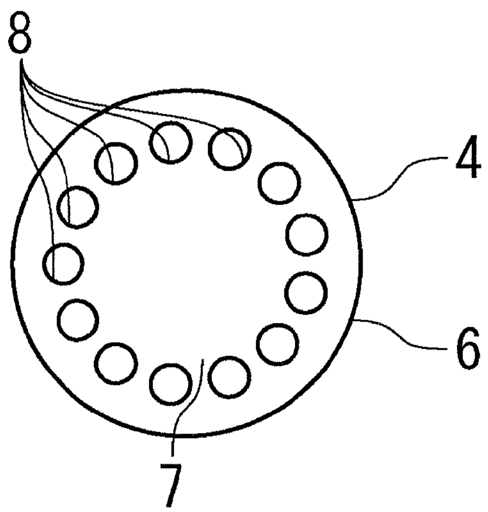
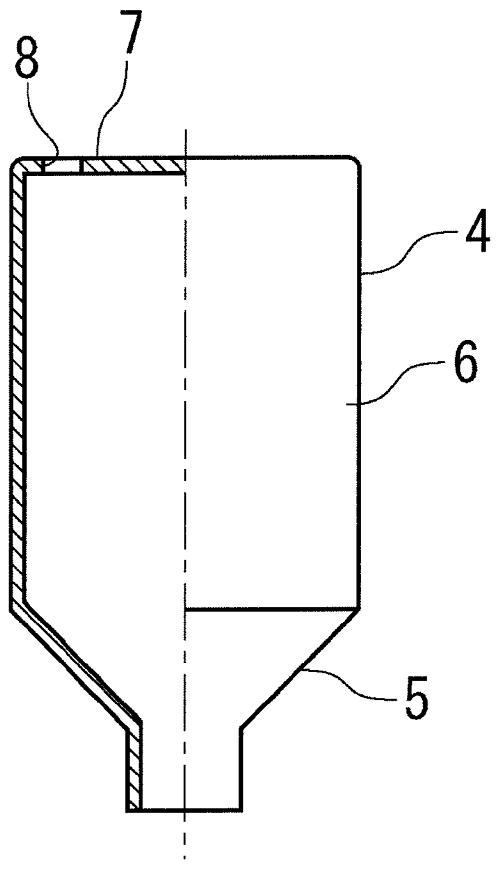


FIG. 10B



REFERENCES CITED IN THE DESCRIPTION

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- JP 3416963 B **[0008] [0009]**
- JP 2008267689 A **[0008] [0010]**