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(54) **EVAPORATOR UNIT**

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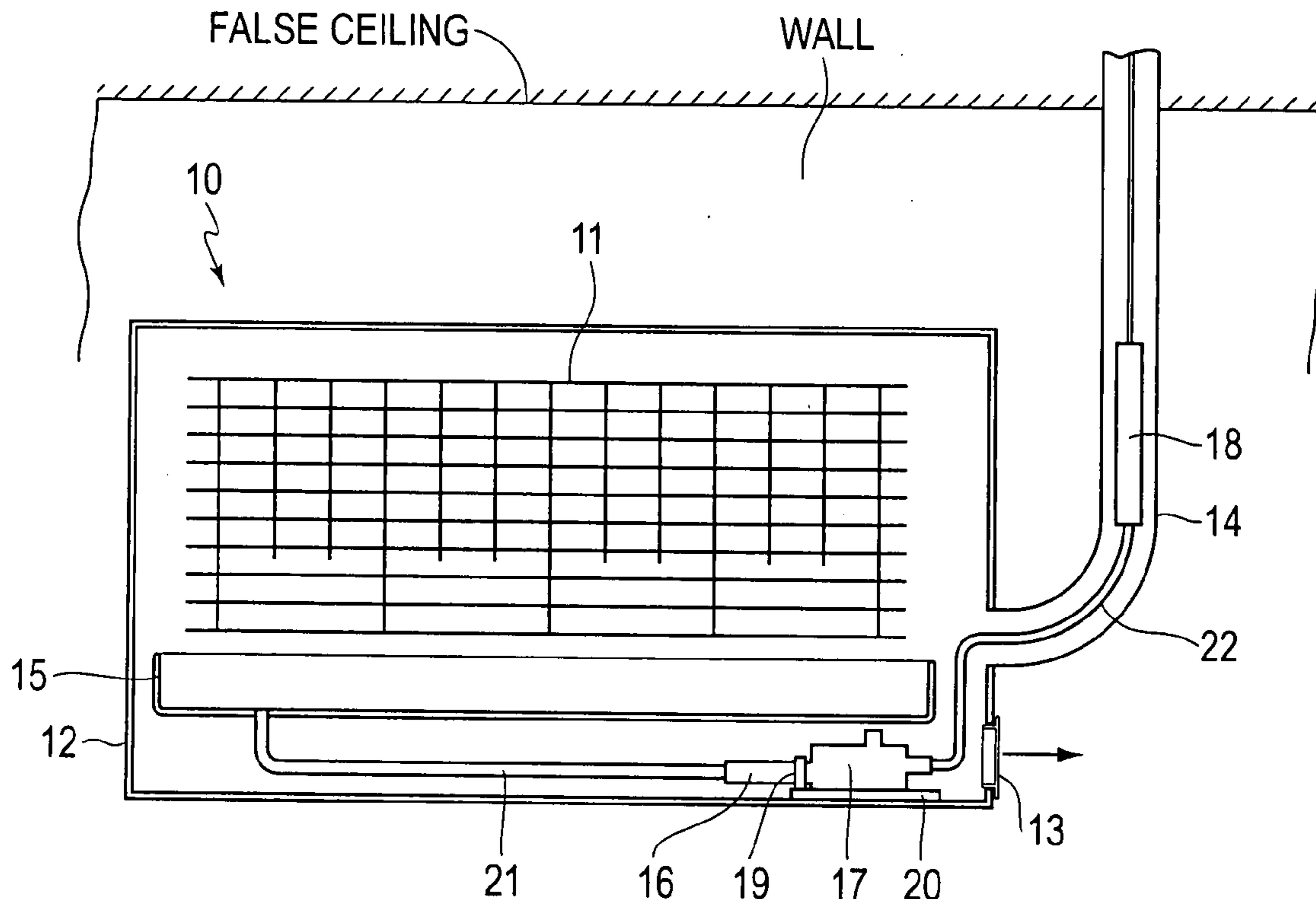
(57) **ABSTRACT**

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An evaporator unit produces condensate liquid in an air cooling system. The evaporator unit includes a reservoir that receives the condensate liquid, and a pump that communicates with the reservoir to pump the condensate liquid out of the reservoir. The evaporator unit also includes a filter to filter the condensate liquid. Further, the evaporator unit includes an outer casing that includes an opening panel adjacent to the reservoir, so that the reservoir is accessible when the opening panel is in an open position. The evaporator unit includes a filter in the reservoir or upstream of the pump.

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(22) Filed: **Sep. 19, 2007**



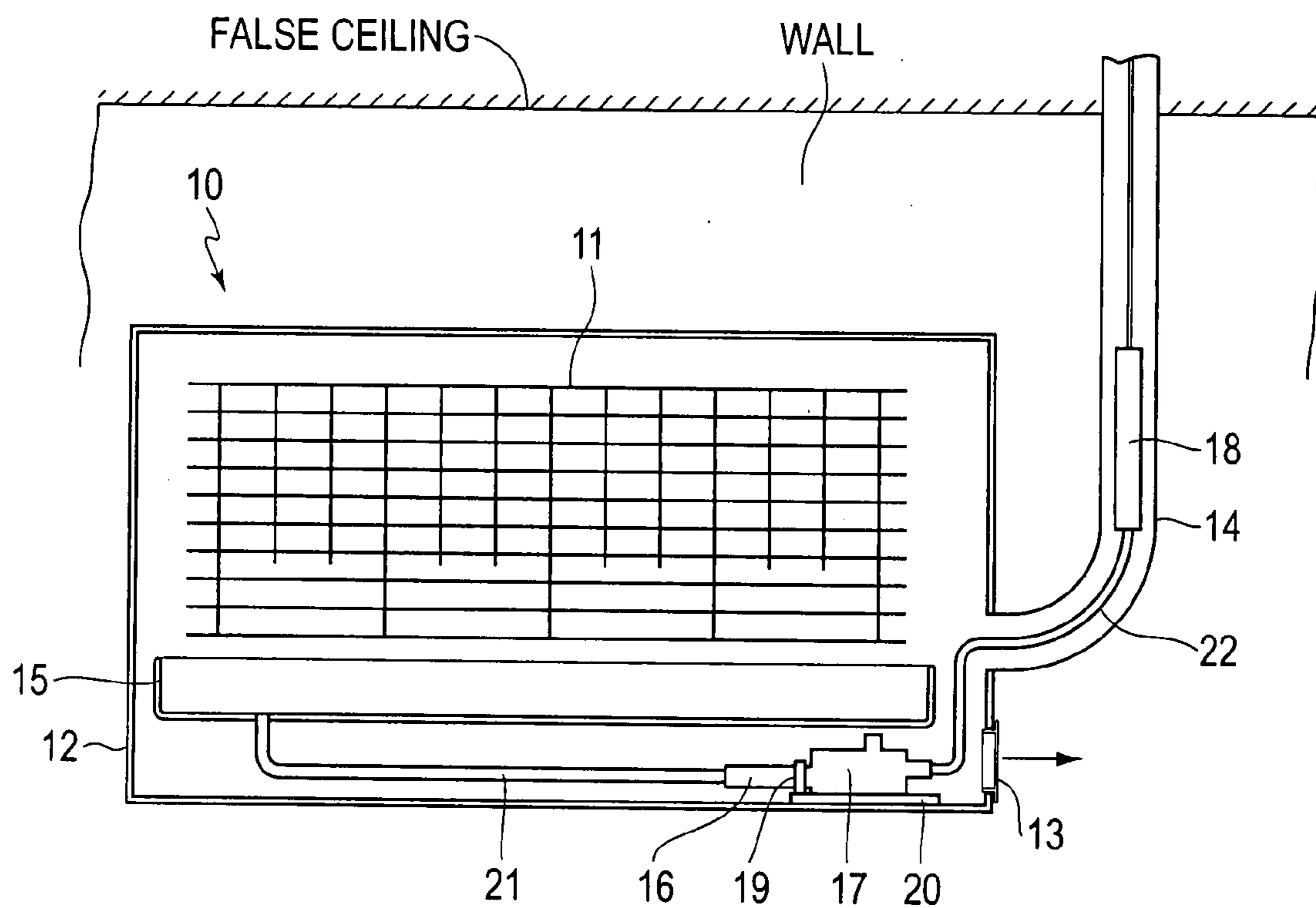


FIG. 1A

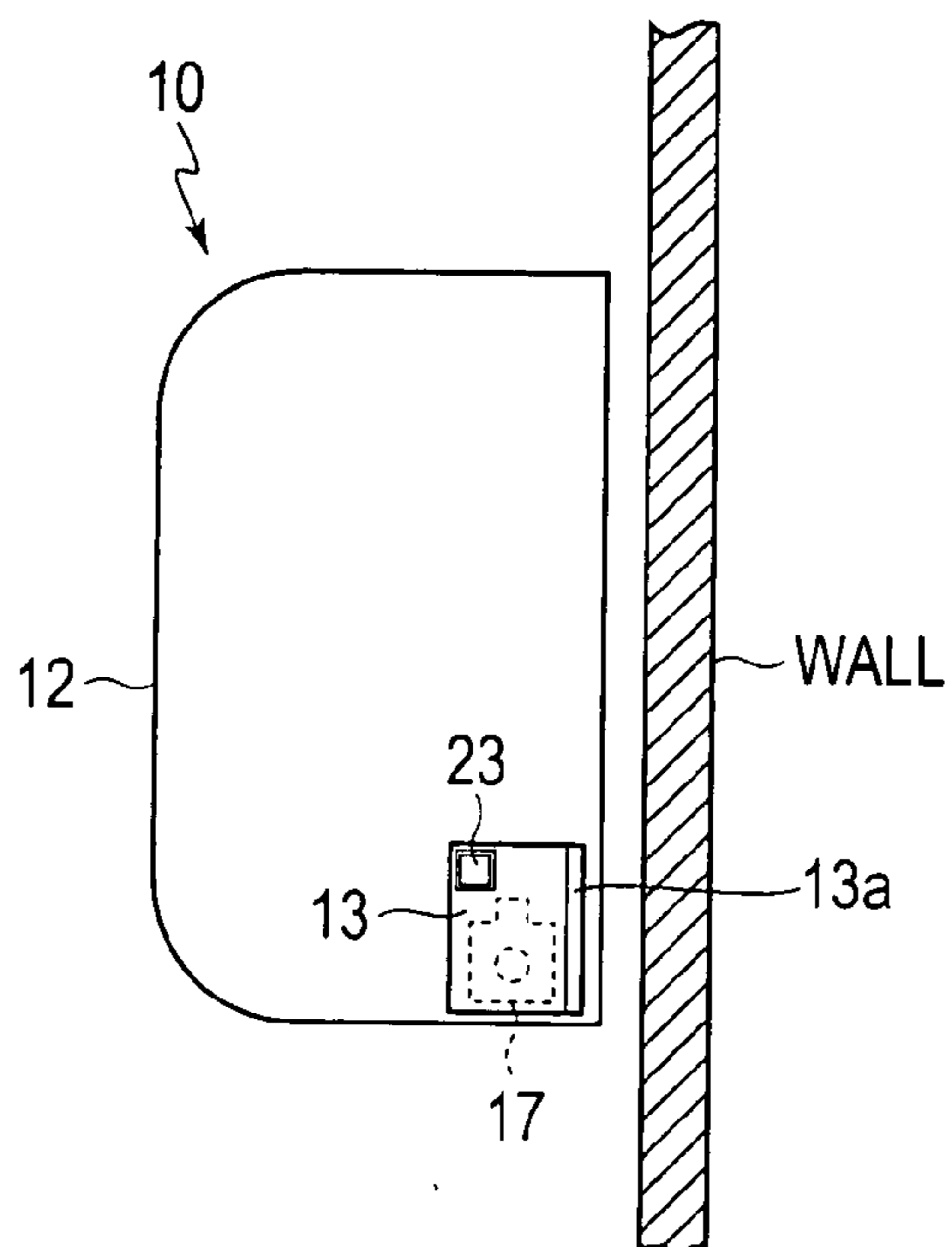


FIG. 1B

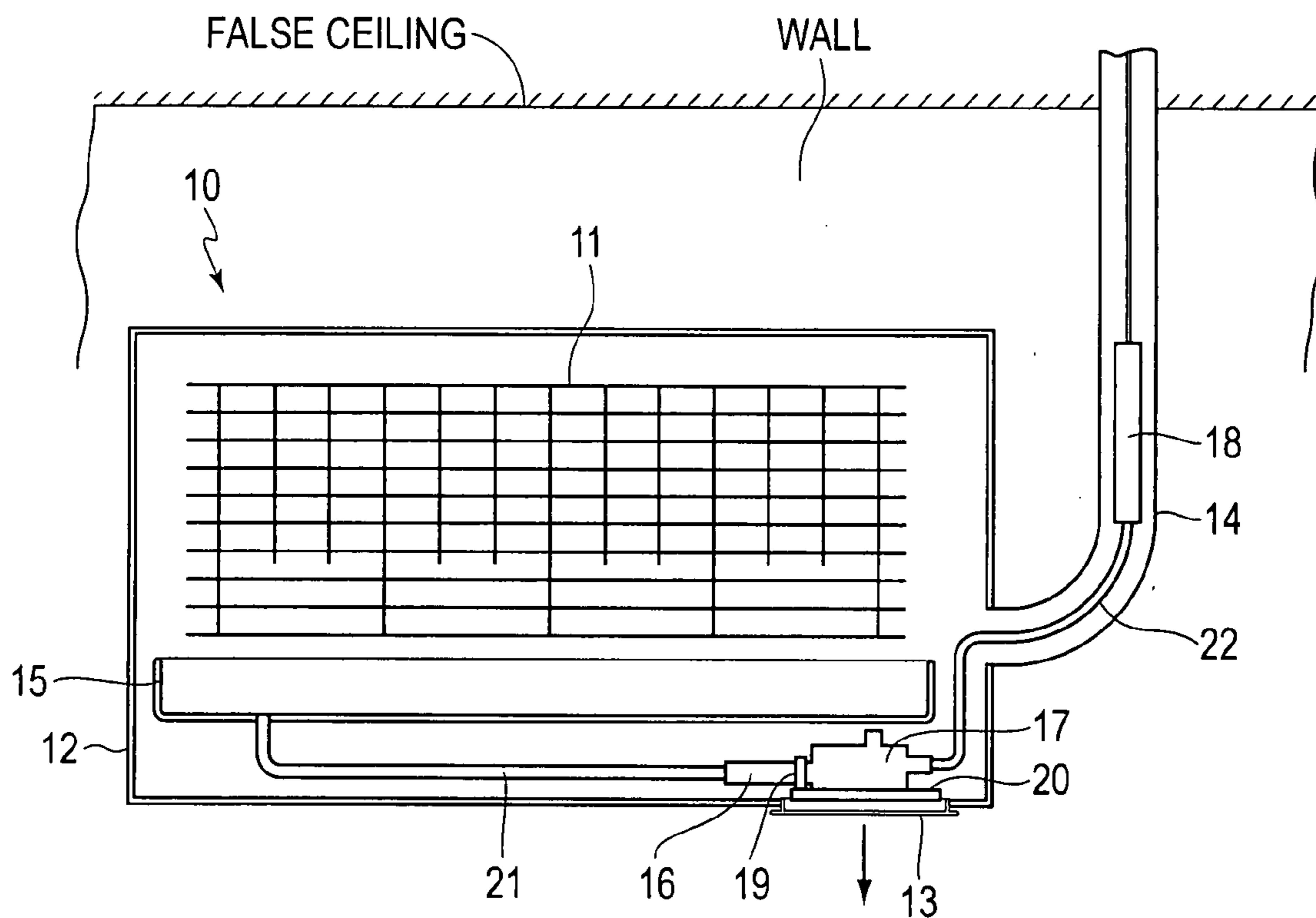


FIG. 2A

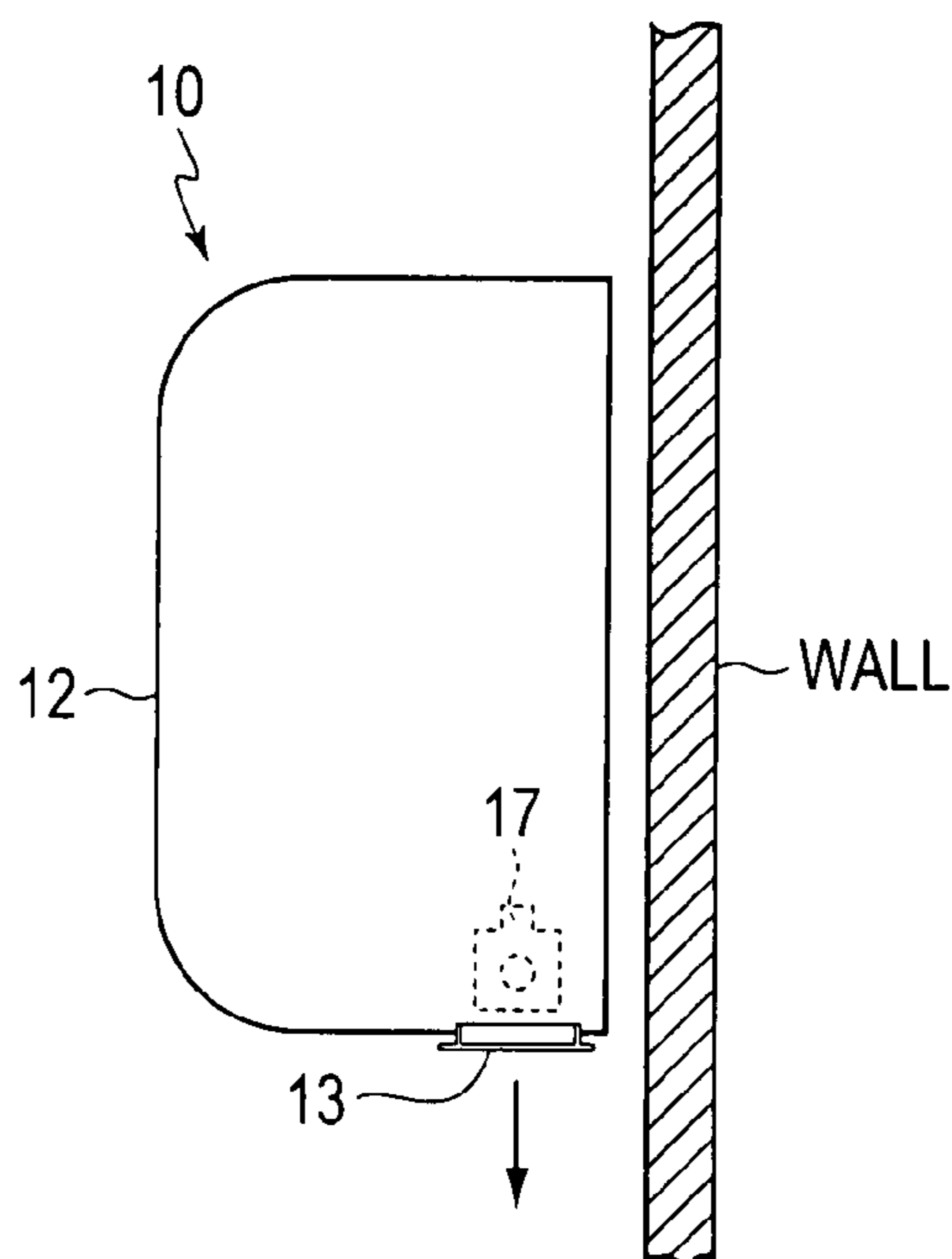


FIG. 2B

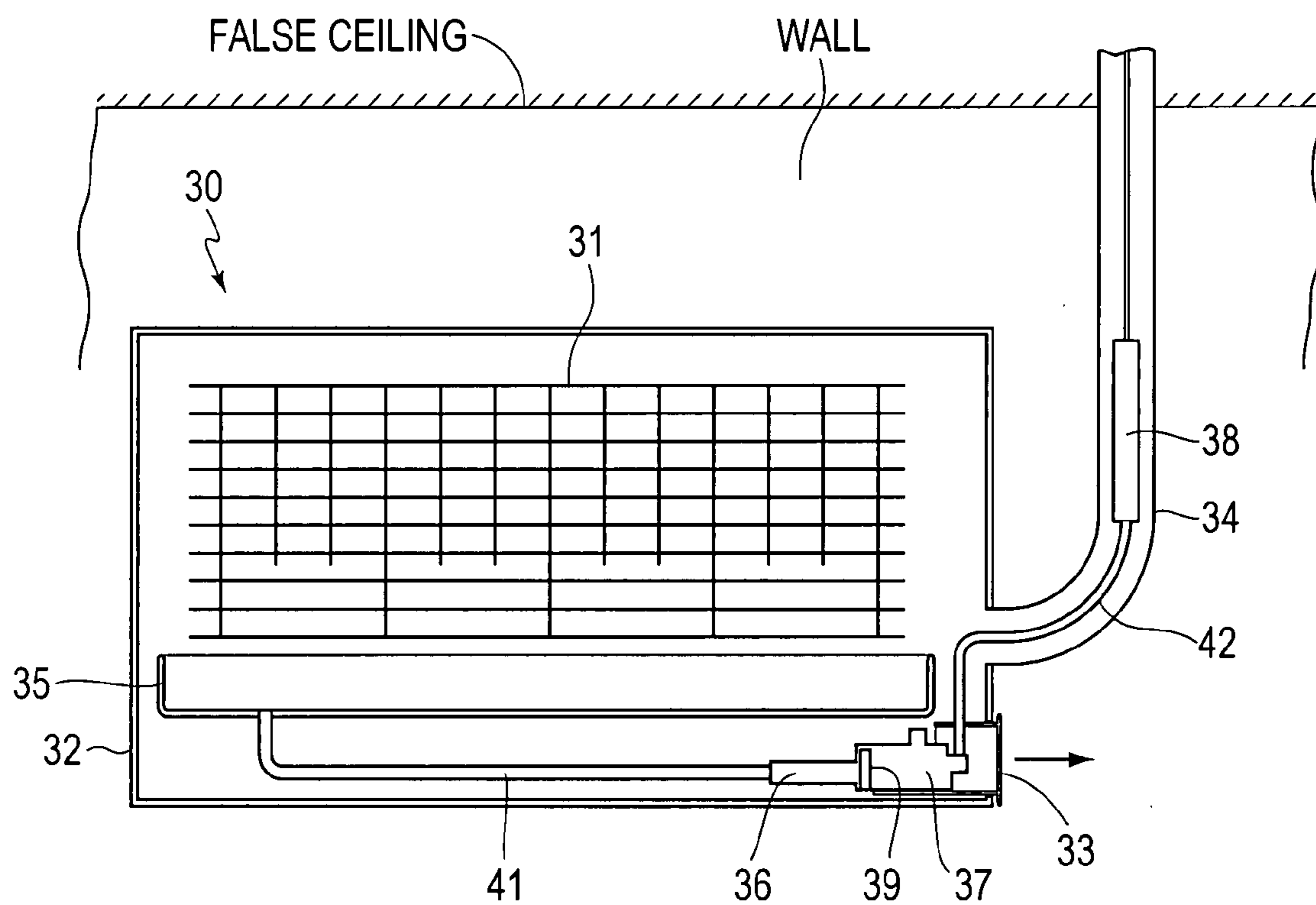


FIG. 3A

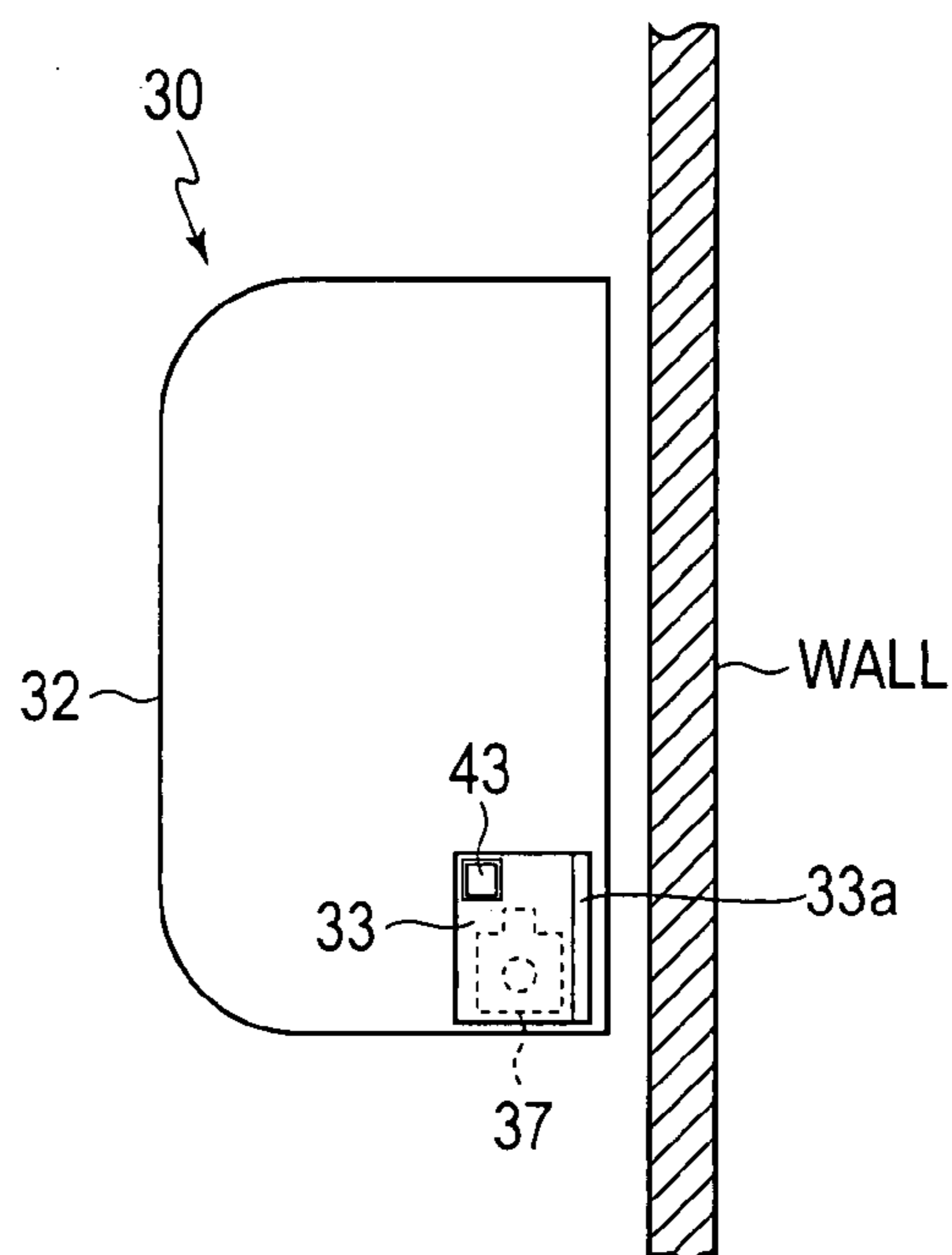


FIG. 3B

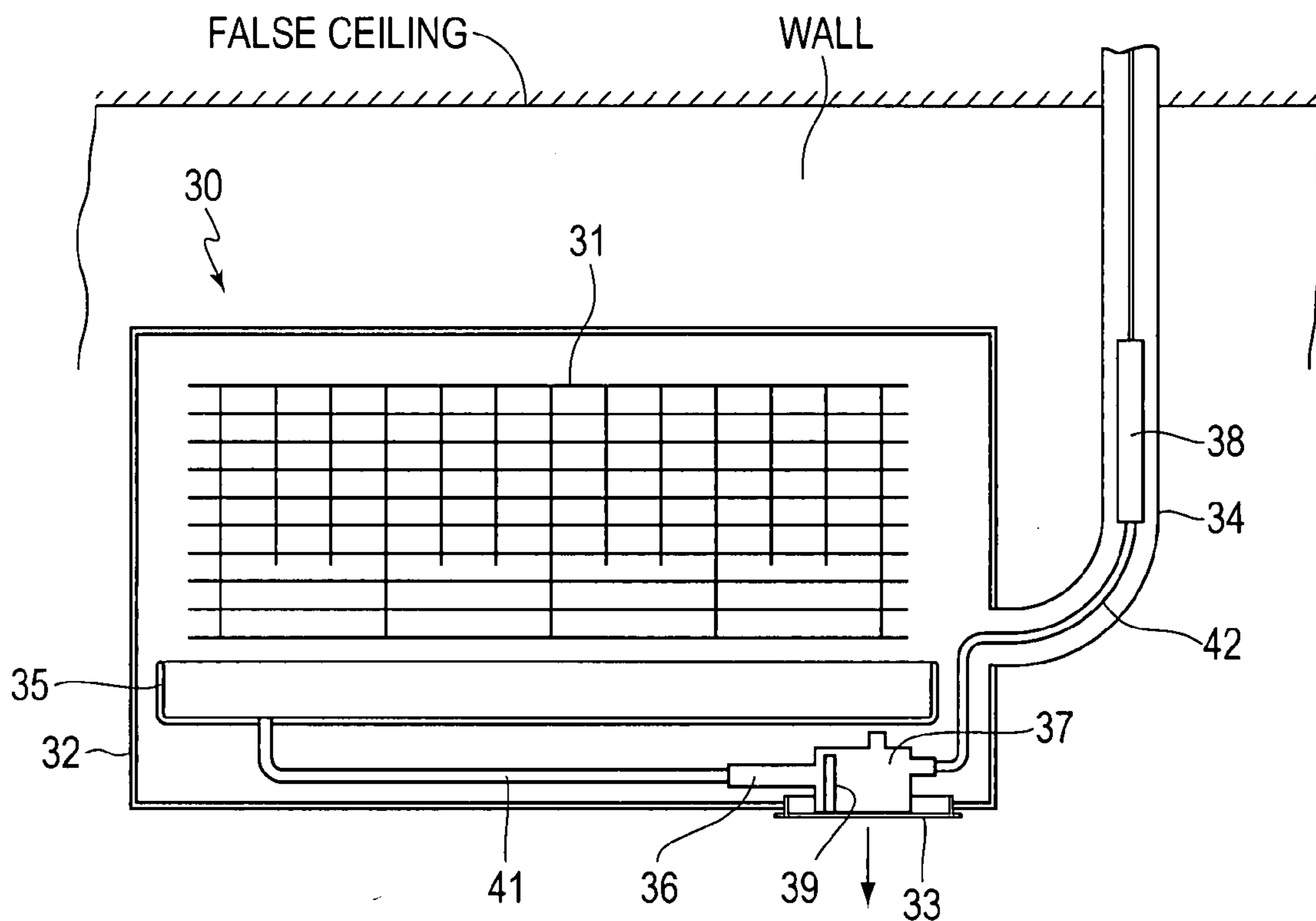


FIG. 4A

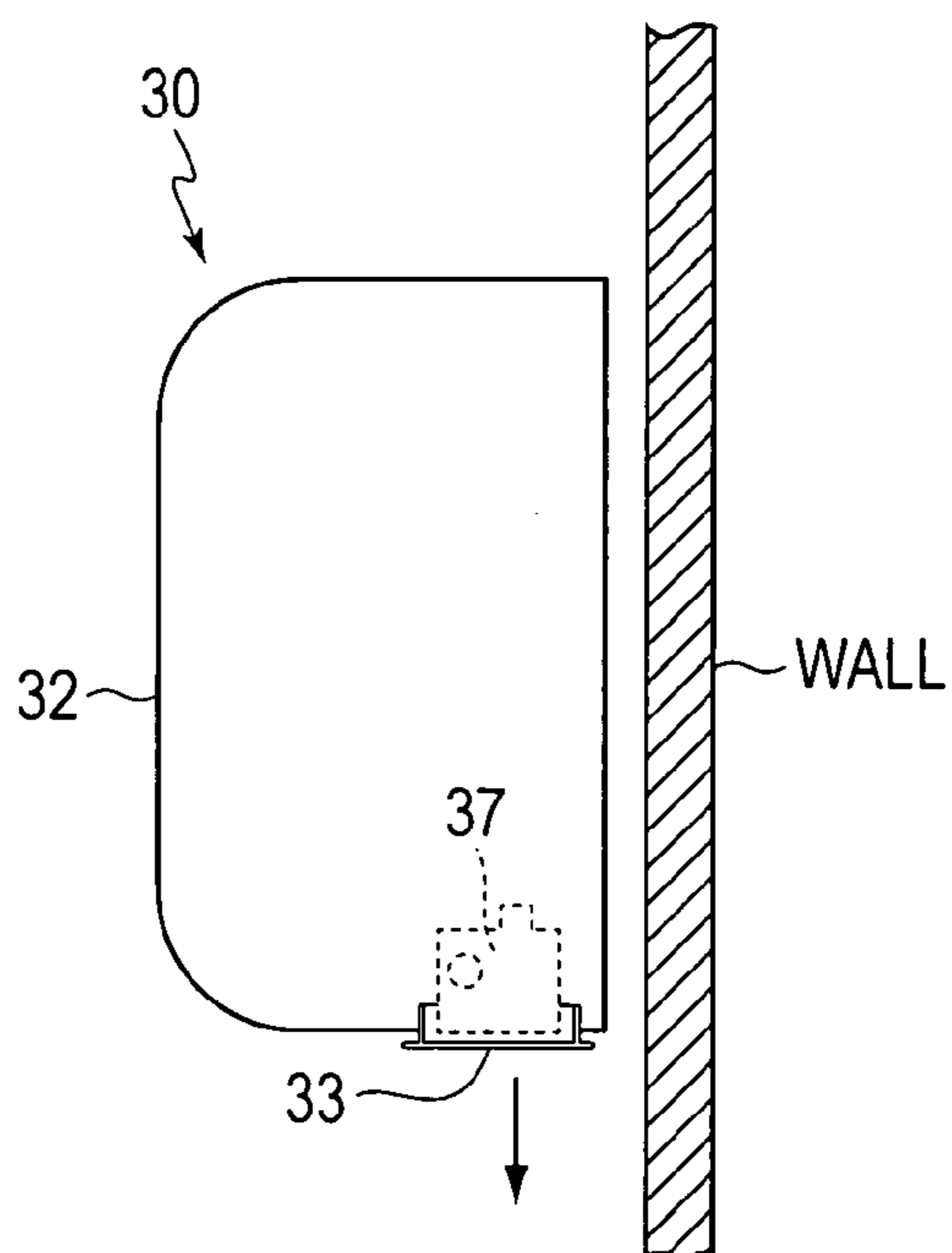


FIG. 4B

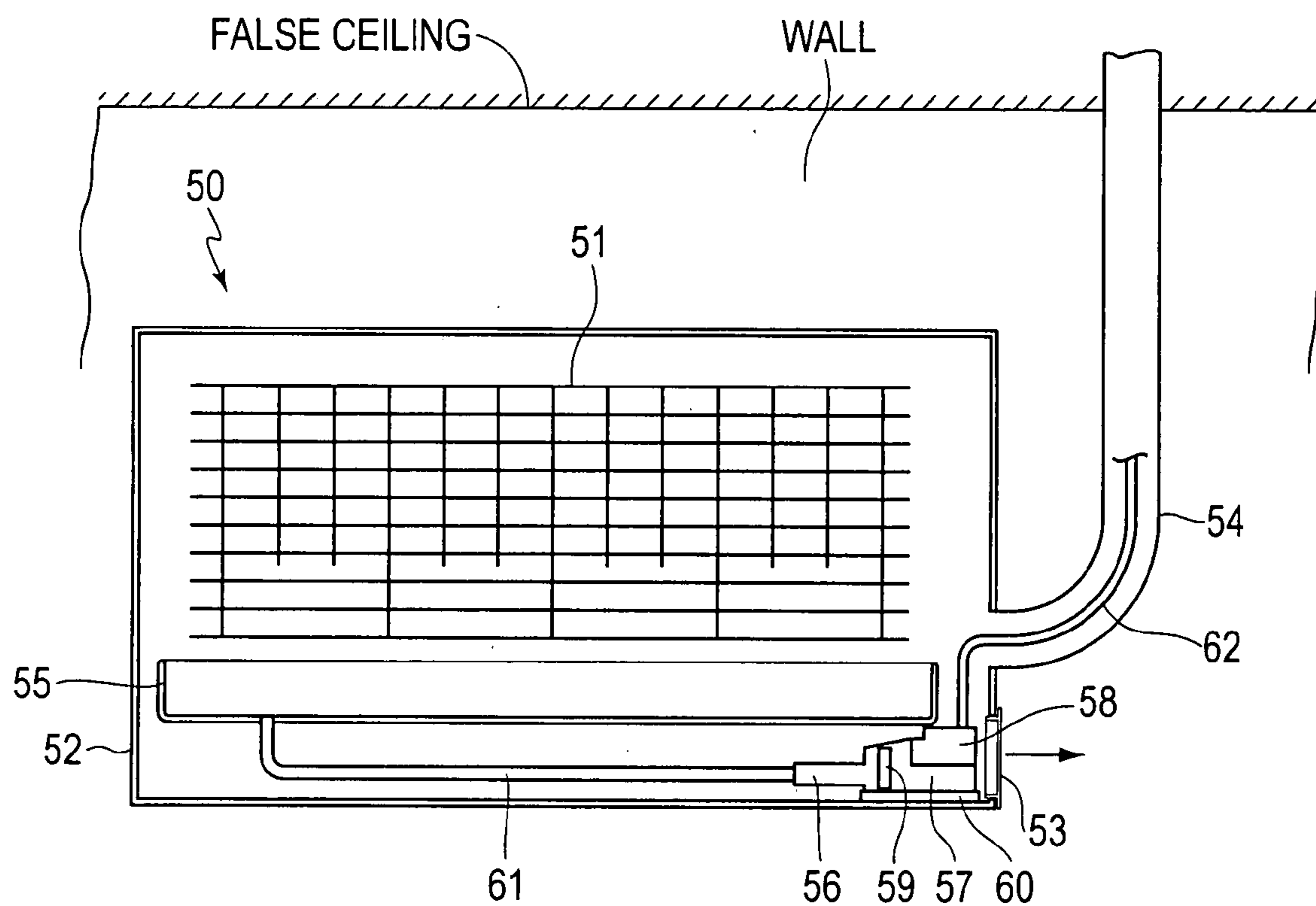


FIG. 5A

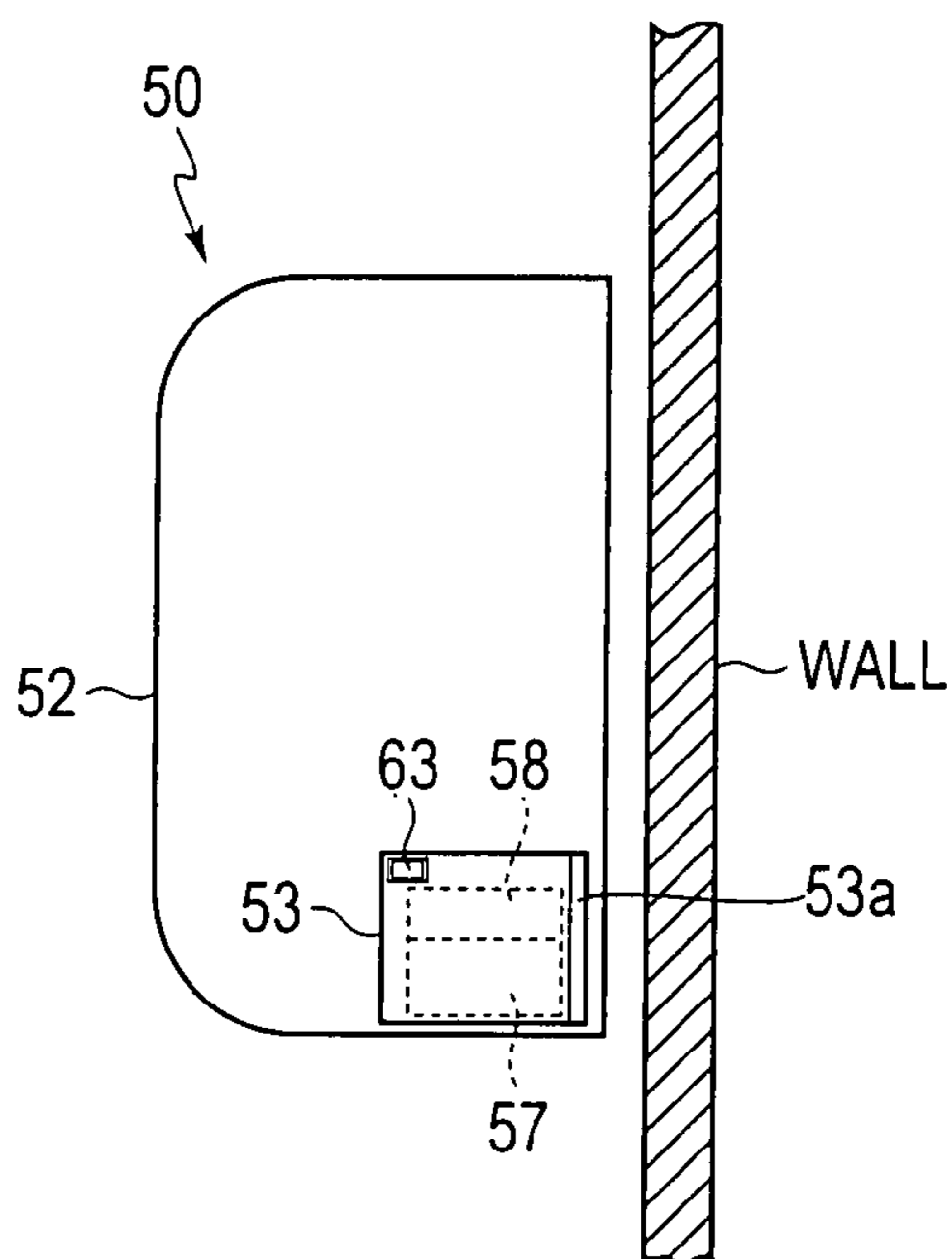


FIG. 5B

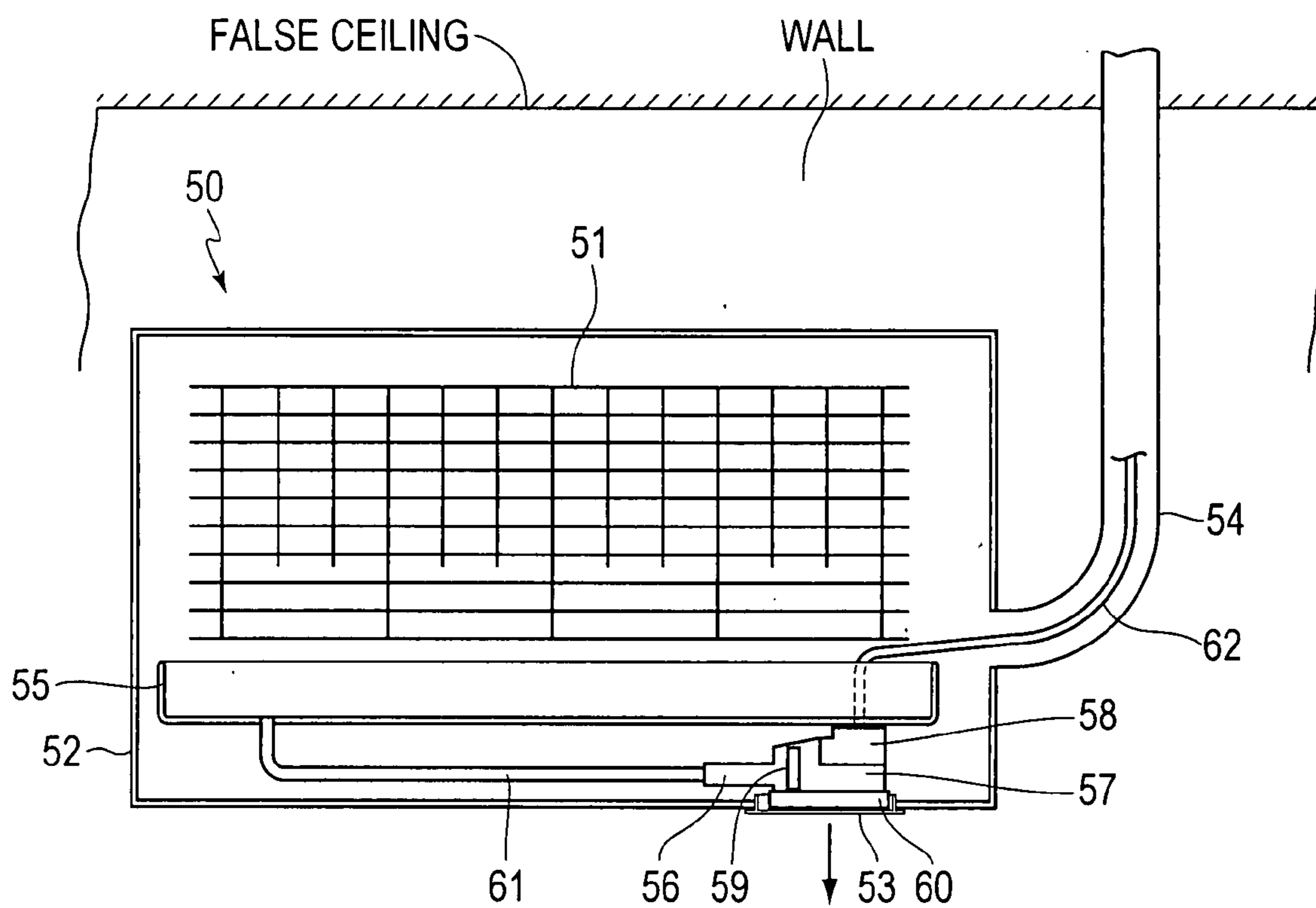


FIG. 6A

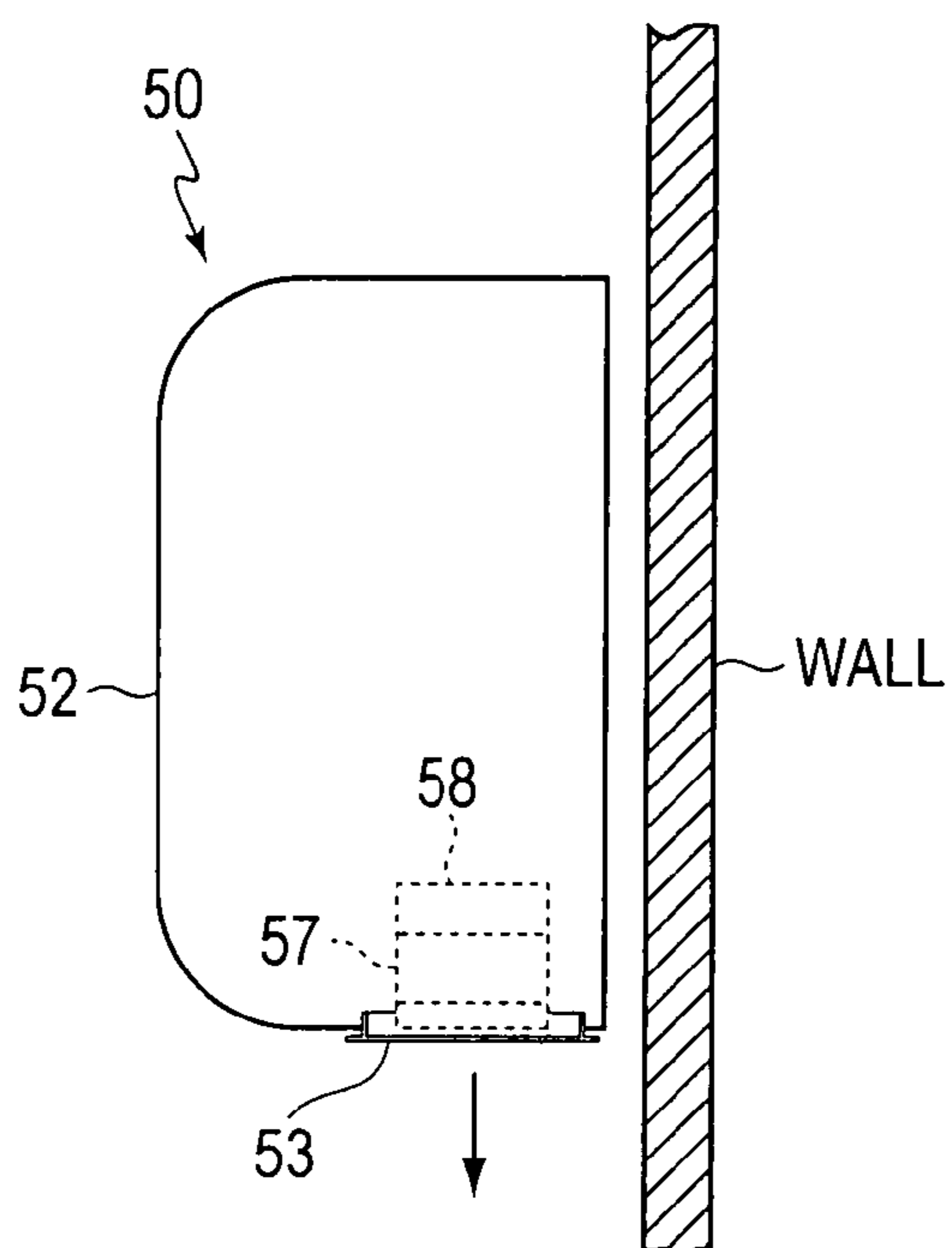


FIG. 6B



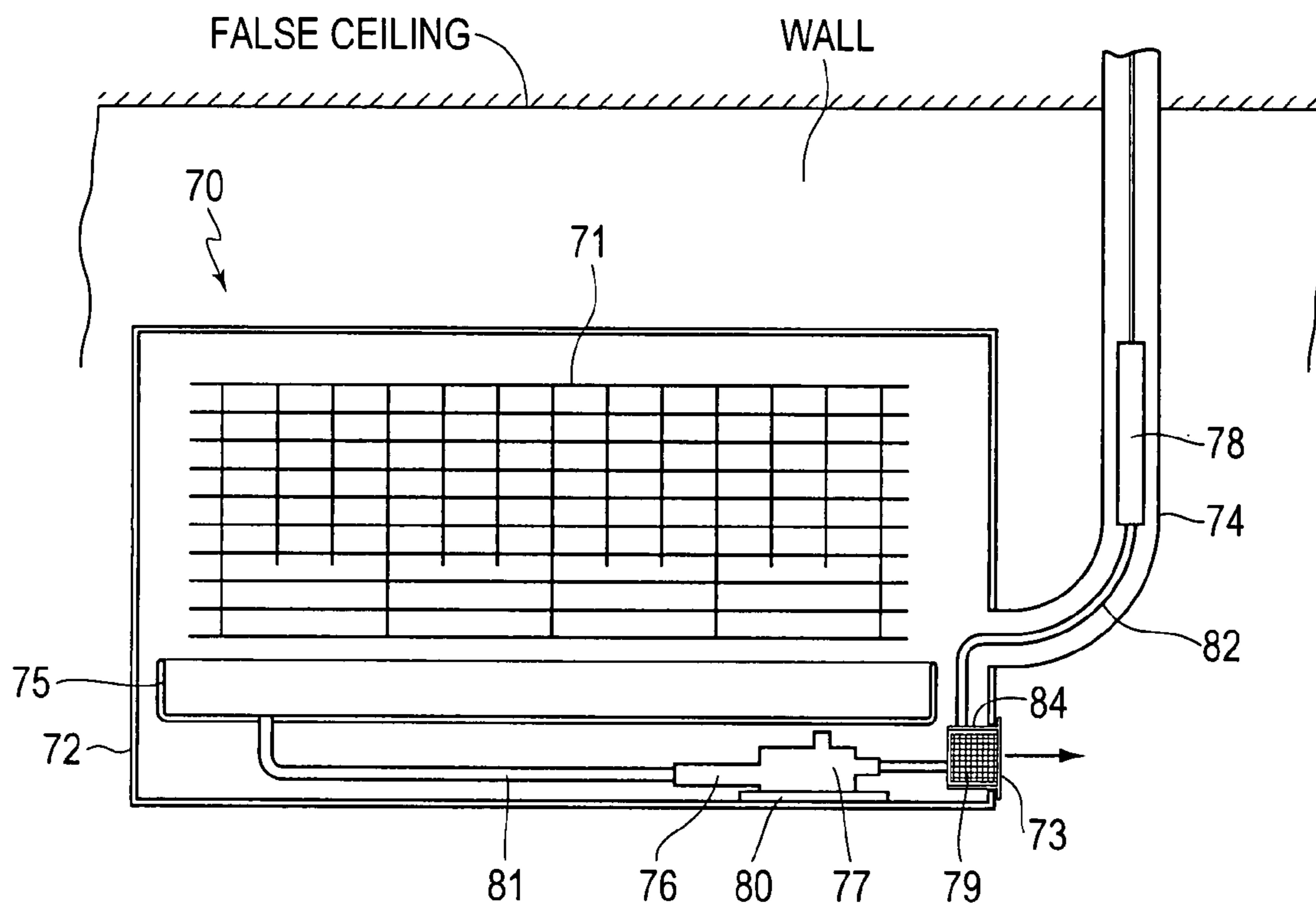


FIG. 7A

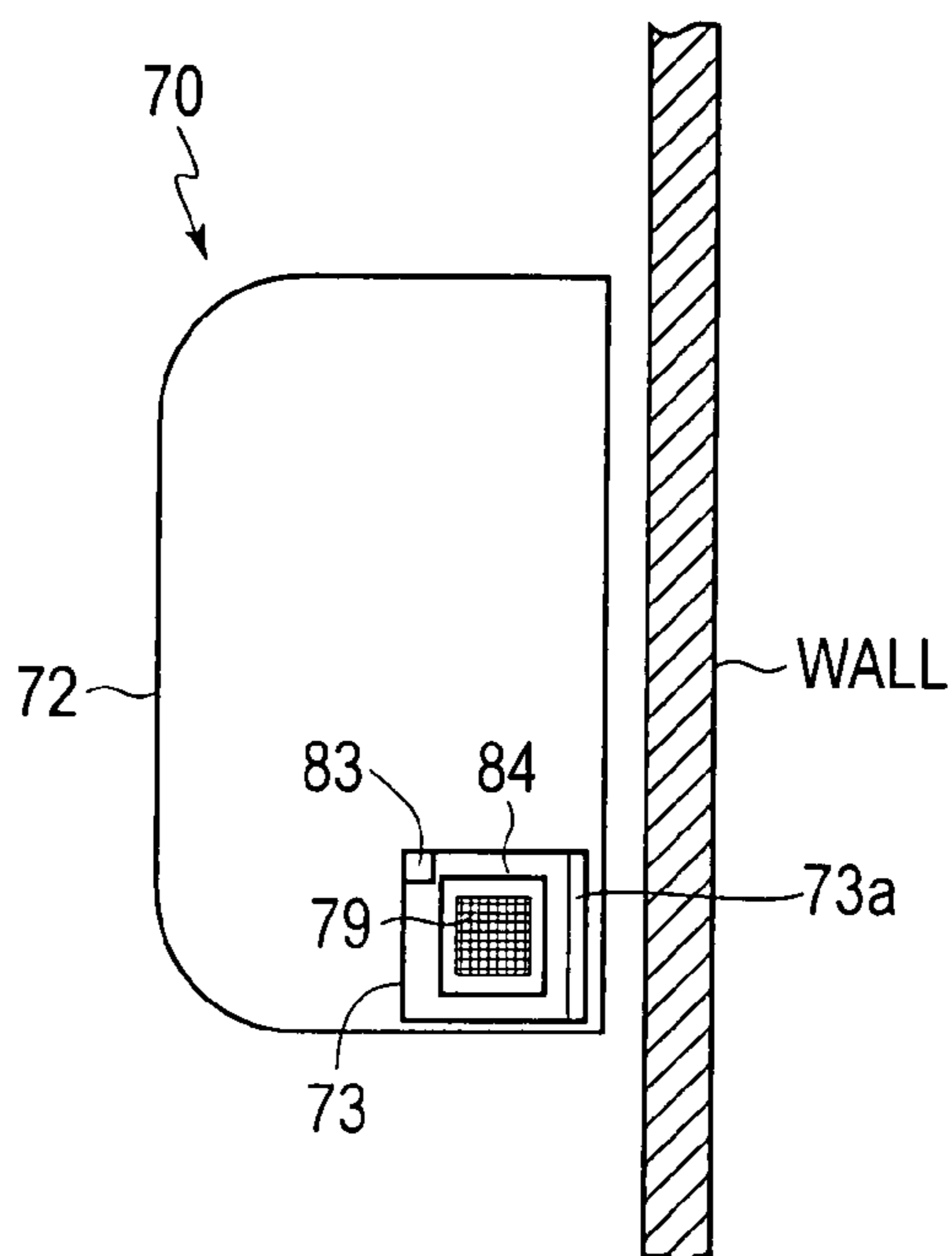


FIG. 7B



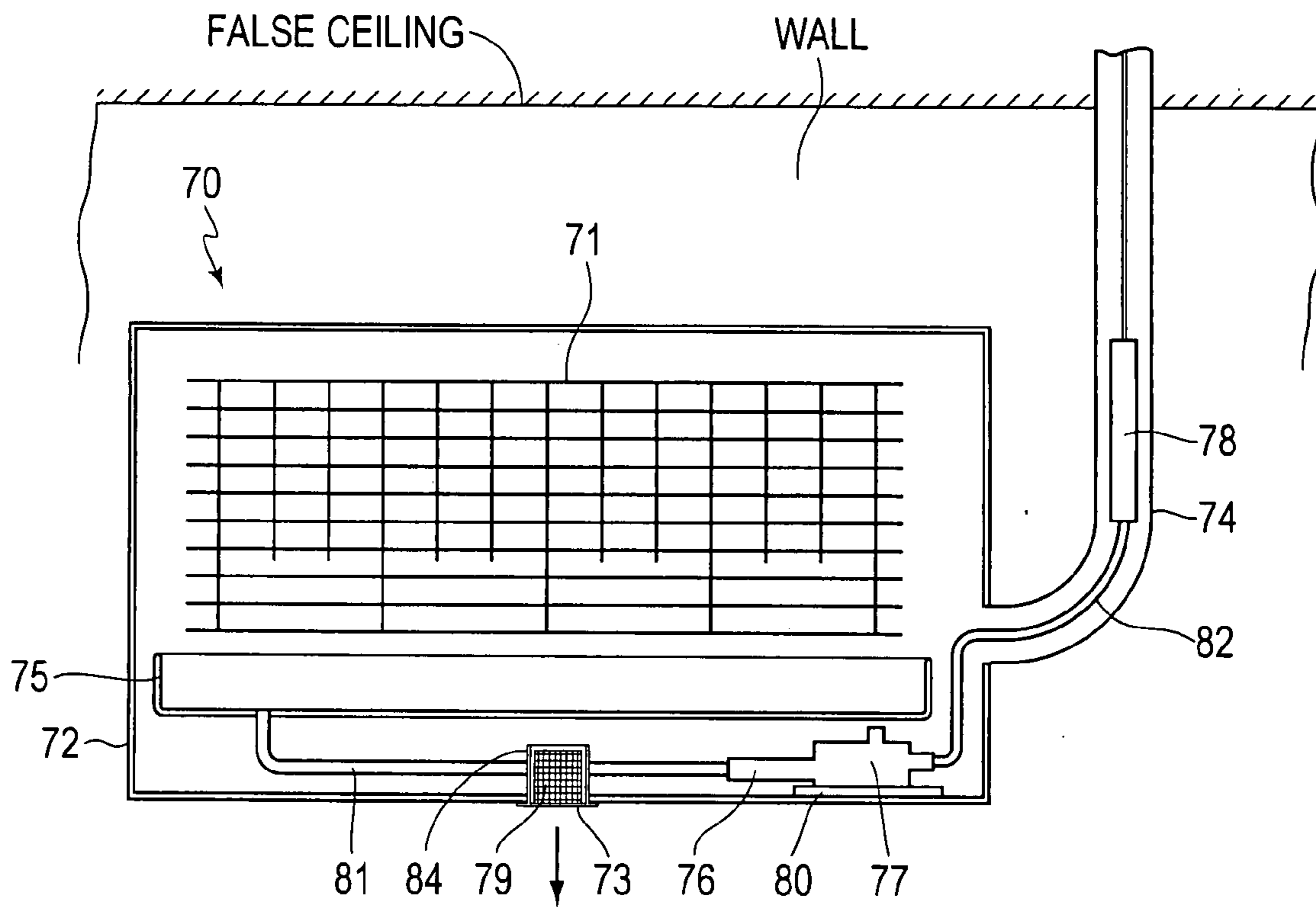


FIG. 8A

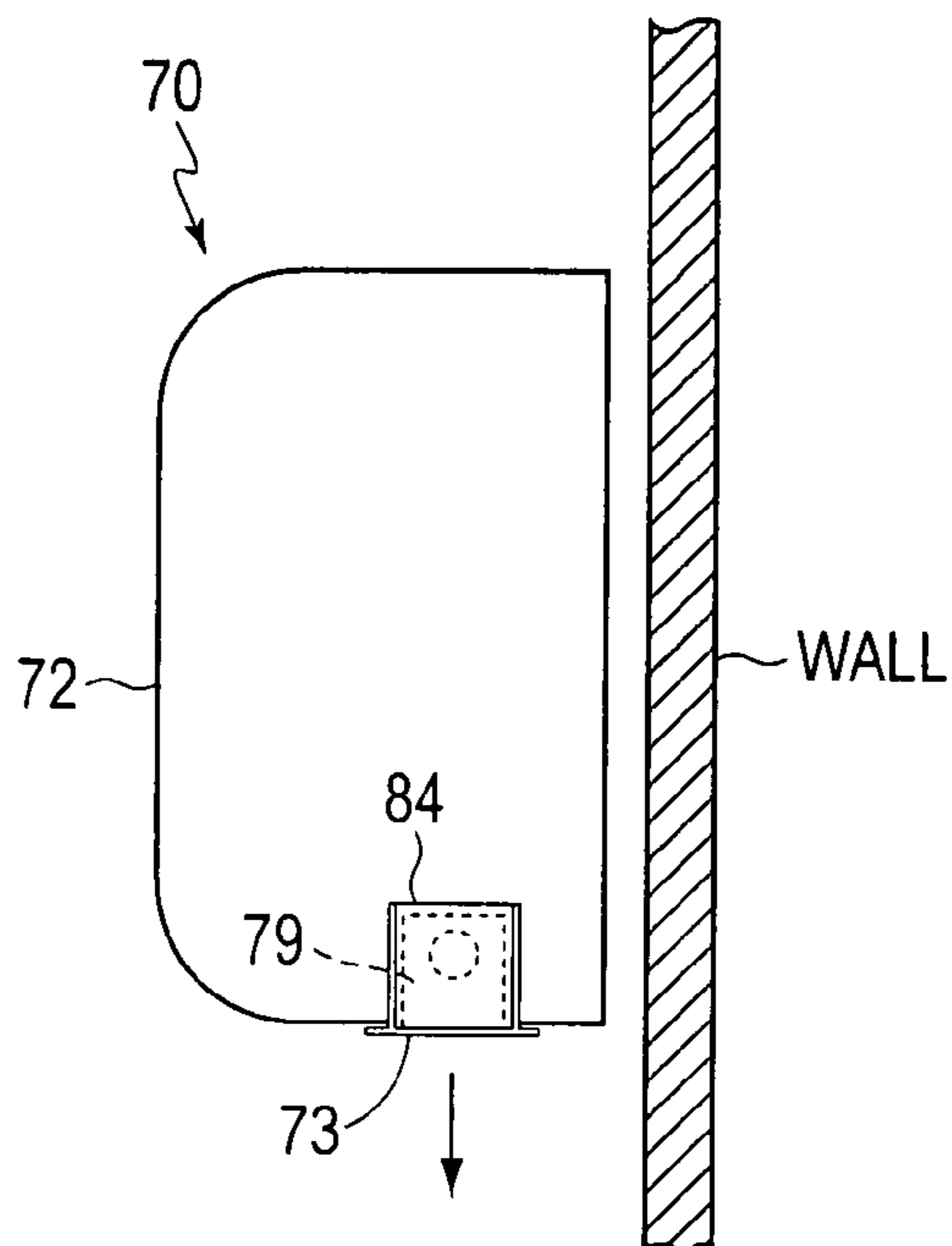


FIG. 8B

## EVAPORATOR UNIT

### BACKGROUND

[0001] The present invention relates to evaporator units that produce condensate liquid in air cooling systems, and in particular to evaporator units that include an internal liquid filter that is subject to clogging and thus should be inspected.

[0002] As a fundamental part of the physics of cooling, all air conditioners extract water from the air when they are in the cooling mode. An air cooling system, such as an air conditioner or a heat pump, typically has heat exchange coils in an evaporator that produce water as the system cools the air in a building. This water, known as condensate, is typically collected in a drain pan usually placed below the heat exchange coils, and is transported away through a drain line connected to the drain pan. The overflow of condensate can cause damage to structures within the building, such as dry walls, ceilings, wooden supports, etc. The overflow also can provide ideal conditions for the growth of mold in those areas that are continually wetted and can seriously compromise the air quality inside the building, as well as possibly have adverse effects on the health of the occupants.

[0003] Thus, condensate must be removed from the evaporator and piped to outside the building. If this is not adequately or correctly done, the condensate will overflow the drain pan of the air conditioner and cause extensive water damage and/or pose health risks. Accordingly, there have been developed methods for preventing condensate overflow, such as providing a condensate trap that includes a mechanical switch and a float. When the condensate accumulates in the trap due to a blockage, the float rises with the rising level of the condensate. Eventually, the float activates the mechanical switch to shut off the air cooling system to prevent further condensate from being produced by the system. In other methods, a pump is activated by the mechanical switch to pump the condensate from the trap when the float rises to a predetermined level.

[0004] One type of air cooling system is a “minisplit” air conditioner. A minisplit air conditioner is similar to a wall unit air conditioner, except that it is split into two parts. The first part is the cooling/blowing part which is mounted in the wall of the room to be cooled. The cooling/blowing part includes an evaporator. The second part is the condenser which is mounted outside of the building. The two parts are connected to each other by wire cables and pipes that conduct the cooling fluid (for example, Freon). There may be up to four cooling/blowing parts (e.g., for up to four different rooms) for each condenser.

[0005] The “minisplit” system often requires specialized pumps to pump the condensate liquid out of the cooling/blowing part, as the system may not always be able to rely on gravity for condensate drainage. For example, if the cooling/blowing unit is mounted in an internal wall of the building, the condensate often must be led upward through the internal wall and out of the building. A pump is thus used to pump the water upward. The pump may be relatively small, for example, having a flow line diameter of about 1 mm. The pump is connected to an outlet of a reservoir. The reservoir receives condensate flow from the drain pan in the wall-mounted portion of the air conditioning unit. The reservoir contains a sensing mechanism, such as a float switch, that activates the pump when an increase in the condensate level is sensed, and that deactivates the pump once the condensate level decreases. One example of a pump that is used in such

minisplit systems is described in U.S. Pat. No. 5,562,003, the disclosure of which is incorporated herein by reference in its entirety.

### SUMMARY

[0006] The invention is directed to evaporator units that can be used with various air cooling systems, such as air conditioners (as used herein “air conditioner” refers to standard air conditioners, heat pumps and to any type of de-humidifying unit) and refrigeration units. For example, the invention is directed to evaporator units that can be used in minisplit air conditioners.

[0007] Because the condensate water is dirty (i.e., contains particles of dirt or biological masses), a filter is required to prevent the flow line of the pump from becoming blocked when a pump is provided to pump the condensate liquid from the cooling unit. This is particularly important in minisplit systems because the pump flow lines are often very small, for example, 1 mm in diameter. Current designs of minisplit pumps have the filter disposed at the inlet of the reservoir that receives liquid from a drain pan. The filter prevents large particles from entering the pump orifice. When condensate reaches a predetermined level in the reservoir (determined by the sensing mechanism), the pump is activated. However, if the filter becomes clogged, condensate does not flow into the reservoir. Instead, the condensate backs up in the drain hose and the drain pan until it overflows and causes water damage.

[0008] Thus, to prevent overflow from clogging of the filter, the filter should to be inspected and cleaned on a regular basis. If the air quality inside the air-conditioned space is such that it precipitates a higher than normal amount of particulates on the coil surface, which will eventually wash down into the filter, the filter should to be inspected and cleaned very often. However, there is currently no way of easily and conveniently cleaning the filter on a regular basis. The filter is generally in a very inaccessible place inside the evaporator or in the reservoir inside the evaporator. A person is therefore required to disassemble the evaporator unit to access the filter or reservoir, and to disconnect tubing in the evaporator to allow the filter or reservoir to be removed so that the filter can be inspected and/or cleaned. Further, access to the filter, or to a reservoir having a filter (e.g., “reservoir/filter assembly”), is extremely limited in many minisplit systems because of the compact nature of these systems. Minisplit systems are normally mounted to the wall on a metal bracket and are connected to an outside condenser with rigid copper refrigerant pipes known as a lineset. The filter or reservoir/filter assembly is disposed inside an evaporator casing, and must be installed underneath the drain pan so that condensate water will flow from the drain pan into the filter or reservoir/filter assembly by gravity. However, the space underneath the drain pan also is the space normally occupied by the connections between the rigid lineset and the evaporator, so that access to the filter or the reservoir/filter assembly is severely restricted. Additionally, the method of mounting the evaporator combined with the rigidity of the lineset makes it extremely difficult to pry the bottom edge of the evaporator casing away from the wall to gain access to the filter or reservoir/filter assembly without disturbing the lineset. Because of these difficulties, there is a tendency to neglect inspection and cleaning of the filter.

[0009] Thus, it will be useful to provide an evaporator unit that ensures easy access at all times to the filter or reservoir/filter assembly, thereby promoting regular inspection and



cleaning of the filter and substantially reducing the risk of flooding, water damage and mold potential due to a blocked filter.

**[0010]** One aspect of the invention provides an evaporator unit that includes an outer casing that has an opening panel adjacent to a reservoir assembly, so that the reservoir assembly is accessible when the opening panel is in an open position. With this arrangement, the reservoir assembly can be mounted inside the evaporator and disposed in a position such that the reservoir assembly can be easily accessed without having to remove or otherwise open the evaporator casing, disturb the lineset or remove the evaporator unit from the wall.

**[0011]** Another aspect of the invention provides an evaporator unit that includes an outer casing that has a removable panel and a filter that is attached to the removable panel so as to be withdrawn from the evaporator unit when the removable panel is removed. With this arrangement, the filter is easily accessible from outside of the evaporator unit and is easily withdrawn from the casing of the evaporator unit for inspection and cleaning without disturbing the reservoir.

**[0012]** Thus, according to some aspects of the invention, there is provided an evaporator unit that produces condensate liquid. The evaporator unit includes a reservoir that receives the condensate liquid, and a pump that communicates with the reservoir to pump the condensate liquid out of the reservoir. The evaporator unit also includes a filter to filter the condensate liquid. Further, the evaporator unit includes an outer casing that includes an opening panel adjacent to the reservoir, so that the reservoir and filter are accessible when the opening panel is in an open position.

**[0013]** According to some embodiments, the opening panel is disposed on a bottom, downwardly-facing surface of the outer casing, so that the reservoir and filter are accessible from under the evaporator unit.

**[0014]** According to some embodiments, the opening panel is disposed on a side surface of the outer casing, so that the reservoir and filter are accessible from a side of the evaporator unit.

**[0015]** According to further embodiments, the side is orthogonal to a wall on which the evaporator unit is mounted.

**[0016]** According to some embodiments, the opening panel is fully detachable from the outer casing.

**[0017]** According to some embodiments, an edge of the opening panel is pivotally attached to the outer casing.

**[0018]** According to some embodiments, the opening panel is transparent so that the reservoir is visible when the opening panel is closed.

**[0019]** According to some embodiments, the reservoir includes a filter.

**[0020]** According to some embodiments, the opening panel includes an indicator to indicate at least one of a blocked filter and a predetermined level of condensate in the reservoir.

**[0021]** According to some embodiments, the evaporator unit further includes a shelf inside the casing upon which the reservoir is disposed.

**[0022]** According to further embodiments, the reservoir is attached to the shelf via at least one of a clip, friction fit, a screw and a hook-and-loop type fastener.

**[0023]** According to some embodiments, the reservoir is attached to an inside surface of the opening panel so as to be accessible when the opening panel is in the open position.

**[0024]** According to some embodiments, there is provided a minisplit air conditioner that includes the evaporator units described above.

**[0025]** According to other aspects of the invention, the evaporator unit includes a reservoir assembly that receives the condensate liquid, and an outer casing that includes an opening panel adjacent to the reservoir assembly, so that the reservoir assembly is accessible when the opening panel is in an open position. The reservoir assembly also includes a pump to pump the condensate liquid out of the reservoir assembly, and a filter upstream of the pump to filter the condensate liquid.

**[0026]** According to some embodiments, the opening panel is disposed on a bottom, downwardly-facing surface of the outer casing, so that the reservoir assembly is accessible from under the evaporator unit.

**[0027]** According to some embodiments, the opening panel is disposed on a side surface of the outer casing, so that the reservoir assembly is accessible from a side of the evaporator unit.

**[0028]** According to further embodiments, the side is orthogonal to a wall on which the evaporator unit is mounted.

**[0029]** According to some embodiments, the opening panel is fully detachable from the outer casing.

**[0030]** According to some embodiments, the opening panel is transparent so that the reservoir assembly is visible when the opening panel is closed.

**[0031]** According to some embodiments, the opening panel includes an indicator to indicate at least one of a blocked filter and a predetermined level of condensate in the reservoir.

**[0032]** According to some embodiments, the evaporator unit further includes a shelf inside the casing upon which the reservoir assembly is disposed.

**[0033]** According to some embodiments, the reservoir assembly is attached to an inside surface of the opening panel so as to be accessible when the opening panel is in the open position.

**[0034]** According to other aspects of the invention, the evaporator unit includes an outer casing that includes a removable panel, a reservoir that receives the condensate liquid, and a pump that communicates with the reservoir to pump the condensate liquid out of the reservoir. The evaporator unit also includes a filter disposed between the reservoir and the pump to filter the condensate liquid. The filter is attached to the removable panel so as to be withdrawn from the evaporator unit when the removable panel is removed.

**[0035]** According to some embodiments, the removable panel is disposed on a bottom, downwardly-facing surface of the outer casing, so that the filter is withdrawn from under the evaporator unit.

**[0036]** According to some embodiments, the removable panel is disposed on a side surface of the outer casing, so that the filter is withdrawn from the side of the evaporator unit.

**[0037]** According to further embodiments, the side is orthogonal to a wall on which the evaporator unit is mounted.

**[0038]** According to some embodiments, the opening panel includes an indicator to indicate at least one of a blocked filter and a predetermined level of condensate in the reservoir.

**[0039]** These and other features and advantages of the invention are described in, or are apparent from, the following description of various exemplary embodiments of the invention.

#### BRIEF DESCRIPTION OF THE DRAWINGS

**[0040]** Various exemplary embodiments of the invention are described in detail with reference to the following figures in which:



[0041] FIGS. 1A and 1B illustrate exemplary embodiments of an evaporator unit incorporating an opening panel according to a first embodiment of the present invention;

[0042] FIGS. 2A and 2B illustrate variations of the first embodiment of the present invention;

[0043] FIGS. 3A and 3B illustrate exemplary embodiments of an evaporator unit incorporating an opening panel according to a second embodiment of the present invention;

[0044] FIGS. 4A and 4B illustrate variations of the second embodiment of the present invention;

[0045] FIGS. 5A and 5B illustrate exemplary embodiments of an evaporator unit incorporating an opening panel according to a third embodiment of the present invention;

[0046] FIGS. 6A and 6B illustrate variations of the third embodiment of the present invention;

[0047] FIGS. 7A and 7B illustrate exemplary embodiments of an evaporator unit incorporating an opening panel according to a fourth embodiment of the present invention; and

[0048] FIGS. 8A and 8B illustrate variations of the fourth embodiment of the present invention.

#### DETAILED DESCRIPTION OF EMBODIMENTS

[0049] FIGS. 1A and 1B illustrate an evaporator unit 10 including an outer casing 12 according to a first embodiment of the present invention. The evaporator unit 10 may be used in an air cooling system, such as an air conditioner or a heat pump. The air cooling system circulates and cools a coolant passing through the evaporator unit 10. The evaporator unit 10 includes heat exchange coils 11 (hereinafter referred to as an evaporator coil 11) through which the cold coolant circulates. Warm air conveyed to the air cooling system is cooled as it makes contact with the evaporator coil 11. The cool air is then transported out of the air cooling system to cool the air in a building or room of the building. When the warm air is cooled, moisture in the air condenses on the evaporator coil 11 as liquid droplets or condensate. The condensate liquid is collected in a drain pan 15 positioned below the evaporator coil 11, and is transported out of the drain pan 15 through a drain line 21 connected to the drain pan 15.

[0050] The drain line 21 includes an inlet tube 16 connected to a reservoir 17. The reservoir 17 may be of a multi-sided rectangular, triangular (such as an “elbow” shape), trapezoidal or circular structure. The reservoir 17 may be made of: plastic, such as polyvinyl chloride (PVC), thermoplastic, etc.; metal, such as brass, aluminum, steel, etc.; or ceramic, etc. In some embodiments, the reservoir 17 is transparent to allow a person to see (inspect) the interior of the reservoir 17. The reservoir 17 includes an inlet connected to the inlet tube 16 and an outlet connected to a discharge tube 22 so that condensate liquid from the evaporator 10 passes to the reservoir 17 and exits the reservoir 17 through the discharge tube 22 (due to pumping of a pump to be described below). The inlet and the outlet of the reservoir 17 may protrude from respective walls of the reservoir 17, or either one or both of the inlet and the outlet may be flush with the respective wall of the reservoir 17 so as to provide a more compact configuration. Further, the inlet may be adapted to snap fit with an end of the inlet tube 16. In another example, the inner surface of the inlet may be smooth or roughened, glued and slip fitted to the end of the inlet tube 16. Various methods of attaching the inlet of the reservoir 17 to the inlet tube 16 can be used. For example, in further embodiments, the inlet is threaded to mate with an end of the inlet tube 16, which also may be threaded. The outlet of the reservoir 17 may have similar properties as those

of the inlet. In all cases, the reservoir 17 is completely level inside the outer casing 12 of the evaporator unit 10 so that the reservoir 17 functions correctly to accommodate the condensate liquid.

[0051] The reservoir 17 further includes a filter 19 that filters the condensate liquid received from the drain pan 15. The filter 19 may be attached to the reservoir inlet or may be located inside the reservoir 17 upstream of the reservoir outlet. The filter 19 may be formed, for example, of metal, plastic mesh, a slotted plate, a fiber cartridge or a plastic cartridge.

[0052] In the exemplary embodiments, the evaporator coil 11, the drain pan 15, the drain line 21, the inlet tube 16, the reservoir 17 and the filter 19 are all disposed within the outer casing 12 of the evaporator unit 10. In minisplit systems, the evaporator unit 10 is mounted to a wall (as shown in FIG. 1B). The minisplit system is connected to a condenser unit (not shown) outside of the building with two copper refrigerant pipes known as a lineset disposed in a lineset cover 14. In minisplit systems, the reservoir 17 is installed underneath the drain pan 15 so that condensate liquid will flow into the reservoir 17 through gravity. Thus, the drain line 21, inlet tube 16, reservoir 17 and discharge tube 22 normally occupy the same space inside the outer casing 12 in which the connections between the lineset and the evaporator unit 10 are disposed. Accordingly, space at this location (e.g., at the bottom of the evaporator unit) inside the outer casing 12 is at a premium, and access to the reservoir is restricted.

[0053] The discharge tube 22, which also is disposed (at least partially) inside the outer casing 12, is connected to a pump 18. The pump 18 pumps the condensate liquid out of the reservoir 17 via the discharge tube 22. The pump 18 may be a self priming pump, and may operate automatically when the condensate liquid level in the reservoir 17 rises. The pump 18 may include push-in electrical terminals for quick connection of power and alarm wires. The pump 18 may operate on a battery, a 6 volt, a 12 volt, a 24 volt, a 120 volt, a 220 volt, or any other voltage AC or DC, which may prove to be practical, for example, for the purpose of connecting into an electrical building monitoring system or meeting current or future building codes. Further, the pump 18 may be disposed in any location downstream of the reservoir 17 inside the outer casing 12 of the evaporator unit 10. Alternatively, as shown in FIG. 1A, the pump 18 may be disposed in the lineset cover 14. In a minisplit system, the discharge tube 22 and the pump flow path within the pump 18 typically have a diameter of about 1 mm.

[0054] The outer casing 12 includes an opening panel 13. The opening panel 13 is adjacent to the reservoir 17 so that the reservoir 17 is accessible when the opening panel 13 is in an open position. In this configuration, because the opening panel 13 is adjacent to the reservoir 17, easy access to the reservoir 17 is ensured. Because the reservoir 17 includes the filter 19 either attached to the reservoir inlet or disposed inside the reservoir 17, the above configuration of the opening panel 13 adjacent to the reservoir 17 enables regular inspection of the filter 19 and/or reservoir 17 without having to remove or otherwise open the outer casing 12, disturb the lineset or lineset cover 14, or remove the evaporator unit 10 from the wall. This easy access to the filter 19 and reservoir 17 for inspection and cleaning substantially reduces the risk of flooding, water damage and mold potential due to a blocked filter because a person can easily regularly determine if the filter 19 attached to the reservoir 17 should be cleaned or replaced.



[0055] As shown in FIG. 1A, the opening panel 13 may be disposed on a side surface of the outer casing 12, so that the reservoir 17 is accessible from the side of the evaporator unit 10. As shown in FIG. 1B, which is a side view of the evaporator unit 10 mounted to a wall, the side of the evaporator unit 10 having the opening panel 13 may be orthogonal to the wall on which the evaporator unit is mounted. In some embodiments, the opening panel 13 is fully detachable from the outer casing 12. In other embodiments, an edge 13a of the opening panel 13 is pivotally attached to the outer casing 12, so that the opening panel 13 swings open like a door. In further embodiments, the opening panel 13 is transparent so that the reservoir 17 is visible when the opening panel 13 is closed. This feature allows visual inspection of the reservoir 17 without even opening the opening panel 13. The opening panel 13 may be made from plastic, metal or another material compatible with the outer casing 12. Optionally, the opening panel 13 may be part of or attached to a removable cover that provides access to the electrical connections of the evaporator unit 10. In some embodiments, the opening panel 13 may be molded into the outer casing 12 during manufacture or could be attached to the outer casing 12 by integral clips during the course of manufacture or assembly of the outer casing 12 and/or evaporator unit 10. Alternatively, the opening panel 13 subsequently may be attached to the outer casing 12 as part of the installation of the evaporator unit 10.

[0056] Further, the opening panel 13 may include an indicator 23, such as a warning light, to indicate that the filter 19 is blocked or that the level of condensate in the reservoir 17 is risen to a predetermined level indicating a blockage of the filter 19. In some embodiments, the indicator may emit an audio signal. In further embodiments, when the indicator is triggered, the evaporator unit 10 shuts off the air cooling system and deactivates the pump 18 to prevent further production and build-up of the condensate liquid and to prevent overheating damage to the pump 18.

[0057] The evaporator unit 10 also may include a level shelf 20 inside the outer casing 12 upon which the reservoir 17 is disposed. The reservoir 17 may be attached to the shelf 20 via, for example, a clip, friction fit, a screw, or a hook-and-loop type fastener (such as VELCRO). Accordingly, after the reservoir 17 is easily removed for inspection/cleaning, the reservoir 17 can be securely replaced on the shelf 20 in the same position it was before removal. As a result, the drain line 21, the inlet tube 16, the discharge tube 22 and the lineset connection do not need to be adjusted when the reservoir 17 is replaced on the shelf 20. Because the shelf 20 is level, the shelf 20 ensures that the reservoir 17 is level inside of the evaporator unit 10.

[0058] FIGS. 2A and 2B illustrate variations of the first embodiment of the evaporator unit 10 discussed above. The evaporator unit 10 in these embodiments includes all of the components of the first embodiment, and may include any of the various features of the first embodiment described above. In the variations of the first embodiment, the opening panel 13 is disposed on a bottom, downwardly-facing surface of the outer casing 12, so that the reservoir 17 is accessible from under the evaporator unit 10. This configuration enables easy access to the filter 19 and reservoir 17 for inspection and cleaning when the evaporator unit 10 is disposed on a wall (as shown in FIG. 2B) such that access from the sides of the evaporator unit 10 is not available. Further, the opening panel 13 may be incorporated into any part of the outer casing 12 of the evaporator unit 10 including the bottom, front or either

end which is practical for accessibility to the reservoir 17 and/or filter 19, as well as practical for aesthetic appearance.

[0059] FIGS. 3A and 3B illustrate an evaporator unit 30 including an outer casing 32 according to a second embodiment of the present invention. The evaporator unit 30 is similar to the evaporator unit 10 discussed above, and includes an evaporator coil 31, a drain pan 35 positioned below the evaporator coil 31, a drain line 41, inlet tube 36, reservoir 37, filter 39, discharge tube 42, lineset cover 34, pump 38, opening panel 33 and indicator 43. The evaporator unit 30 of the second embodiment may incorporate any of the various features described above with respect to the first embodiment. In addition, in the second embodiment, the reservoir 37 is attached to an inside surface of the opening panel 33, so that the reservoir 37 is withdrawn from the evaporator unit 30 by removing or otherwise opening the opening panel 33 (i.e., when the opening panel 33 is in the open position). Accordingly, the inlet of the reservoir 37 may be adapted to snap fit or slip fit with an end of the inlet tube 36 and the discharge tube 42. Various methods of attaching the inlet and outlet of the reservoir 37 to the inlet tube 36 and the discharge tube 42 can be used.

[0060] In further embodiments, the filter 39 is attached to the reservoir inlet or is located inside the reservoir 37 such that the reservoir 37 and the filter 39 comprise a reservoir/filter assembly that is attached to an inside surface of the opening panel 33. In this way, the entire reservoir/filter assembly is withdrawn from the evaporator unit 30 by removing or otherwise opening the opening panel 33 (i.e., when the opening panel 33 is in the open position). Thus, easy access to the reservoir/filter assembly is ensured. The above configuration enables regular inspection of the filter 39 and/or reservoir 37 without having to open the outer casing 32, disturb the lineset or lineset cover 34, or remove the evaporator unit 30 from the wall (shown in FIG. 3B). This easy access to the reservoir/filter assembly for inspection and cleaning substantially reduces the risk of flooding, water damage and mold potential due to a blocked filter because a person can easily regularly determine if the filter 39 attached to the reservoir 37 should be cleaned or replaced.

[0061] FIGS. 4A and 4B illustrate variations of the second embodiment of the evaporator unit 30 discussed above. The evaporator unit 30 in these embodiments includes all of the components of the second embodiment, and may include any of the various first and second embodiments described above, where applicable. In the variations of the second embodiment, the opening panel 33 is disposed on a bottom, downwardly-facing surface of the outer casing 32, so that the reservoir 37 is accessible from under the evaporator unit 30. This configuration enables easy access to the reservoir/filter assembly for inspection and cleaning when the evaporator unit 30 is disposed on a wall (as shown in FIG. 4B) such that access from the sides of the evaporator unit 30 is not available. Further, the opening panel 33 may be incorporated into any part of the outer casing 32 of the evaporator unit 30 including the bottom, front or either end which is practical for accessibility to the reservoir/filter assembly, as well as practical for aesthetic appearance.

[0062] FIGS. 5A and 5B illustrate an evaporator unit 50 including an outer casing 52 according to a third embodiment of the present invention. The evaporator unit 50 is similar to the evaporator unit 10 discussed above, and includes an evaporator coil 51, a drain pan 55 positioned below the evaporator coil 51, a drain line 61, inlet tube 56, reservoir 57, filter



59, pump 58, level shelf 60, discharge tube 62, lineset cover 54, opening panel 53 and indicator 63. The evaporator unit 50 of the third embodiment may incorporate any of the various embodiments described above with respect to either or both of the first and second embodiments. In addition, in the third embodiment, the reservoir 57, the filter 59 and the pump 58 are one integral assembly. Thus, as shown in FIG. 5A, the opening panel 53 is adjacent to the integral assembly so that the filter 59, reservoir 57 and pump 58 are accessible when the opening panel 53 is in an open position. In this configuration, because the opening panel 53 is adjacent to the integral assembly of the filter 59, reservoir 57 and pump 58, easy access to, inspection and/or replacement of these components is ensured. This configuration of the opening panel 53 adjacent to the integral assembly enables regular inspection of the filter 59, reservoir 57 and pump 58 without having to remove or otherwise open the outer casing 52, disturb the lineset or lineset cover 54, or remove the evaporator unit 50 from the wall (as shown in FIG. 5B). This easy access to the filter 59 and reservoir 57 for inspection and cleaning substantially reduces the risk of flooding, water damage and mold potential due to a blocked filter because a person can easily regularly determine if the filter 59 attached to the reservoir 57 should be cleaned or replaced. Further, this configuration allows for quick and easy replacement of the pump 58 without having to open the outer casing 52, disturb the lineset or lineset cover 54, or remove the evaporator unit 50 from the wall. In some embodiments, the integral assembly may be attached to an inside surface of the opening panel 53 so as to be accessible when the opening panel 53 is in the open position, as in the second embodiment.

[0063] FIGS. 6A and 6B illustrate variations of the third embodiment of the evaporator unit 50 discussed above. The evaporator unit 50 in these embodiments includes all of the components of the third embodiment, and may include any of the various features of the first through third embodiments described above, where applicable. In the variations of the third embodiment, the opening panel 53 is disposed on a bottom, downwardly-facing surface of the outer casing 52, so that the integral assembly of the filter 59, reservoir 57 and pump 58 is accessible from under the evaporator unit 50. This configuration enables easy access to the filter 59, reservoir 57 and pump 58 for inspection, cleaning and/or replacement when the evaporator unit 50 is disposed on a wall (as shown in FIG. 6B) such that access from the sides of the evaporator unit 50 is not available. Further, the opening panel 53 may be incorporated into any part of the outer casing 52 of the evaporator unit 50 including the bottom, front or either end which is practical for accessibility to the filter 59, reservoir 57 and pump 58, as well as practical for aesthetic appearance.

[0064] FIGS. 7A and 7B illustrate an evaporator unit 70 including an outer casing 72 according to a fourth embodiment of the present invention. The evaporator unit 70 is similar to the evaporator unit 10 discussed above, and includes an evaporator coil 71, a drain pan 75 positioned below the evaporator coil 71, a drain line 81, inlet tube 76, level shelf 80, reservoir 77, filter 79, discharge tube 82, lineset cover 74, pump 78, opening panel 73 and indicator 83. The evaporator unit 70 in the fourth embodiment may incorporate any of the various features described above with respect to the first, second and third embodiments, where applicable. A difference between the fourth embodiment and the first through third embodiments is that, in the fourth embodiment, the filter 79 is a separate component from the reservoir 77, and is

disposed in a filter cartridge 84 between the reservoir 77 and the pump 78. Further, the filter 79 is attached to an inside surface of the removable panel 73 so as to be withdrawn from the filter cartridge 84 in the evaporator unit 70 when the removable panel 73 is removed. Thus, the filter 79 is withdrawn from the evaporator unit 70 by removing the opening panel 73 (i.e., when the opening panel 73 is in the open position). Accordingly, the filter 79 may be adapted to releasably snap fit or slip fit into the filter cartridge 84. Various methods of fitting the filter 79 into the filter cartridge 84 can be used. In this configuration, the filter 79 can be easily withdrawn from the outer casing 72 of the evaporator unit 70 without having to access the reservoir 77 when the opening panel 73 is in an open position. Thus, easy access to the filter 79 is ensured. Accordingly, regular inspection of the filter 79 is possible without having to open the outer casing 72, disturb the lineset or lineset cover 74, or remove the evaporator unit 70 from the wall (as shown in FIG. 7B). This easy access to the filter 79 for inspection and cleaning substantially reduces the risk of flooding, water damage and mold potential due to a blocked filter because a person can easily regularly determine if the filter 79 should be cleaned or replaced.

[0065] In some embodiments, the opening cover 73 may be simply a removable cover plate which can be removed to expose behind it an extractable filter 79 which can be removed from the reservoir body for inspection and/or cleaning.

[0066] In other embodiments, the reservoir 77 may be removably mounted on the level shelf 80 inside the outer casing 72 so that the reservoir 77 can be easily withdrawn from the evaporator unit 70, inspected, and replaced, if necessary. Further, the filter cartridge 84 may include a sealing device to make the cartridge 84 water tight with the filter 79. The filter cartridge 84 may be attached to the filter 79 by a connecting device such as integral clips, an integral thread or bayonet pins so that the filter 79 is fitted in the cartridge 84 and rotated to lock (seal) the filter 79 into position within the cartridge.

[0067] FIGS. 8A and 8B illustrate variations of the fourth embodiment of the evaporator unit 70 discussed above. The evaporator unit 70 in these embodiments includes all of the components of the fourth embodiment, and may include features of any of the various first to fourth embodiments described above, where applicable. In the variations of the fourth embodiment, the opening panel 73 is disposed on a bottom, downwardly-facing surface of the outer casing 72, so that the filter 79 is accessible from under the evaporator unit 70. This configuration enables easy access to the filter 79 for inspection, cleaning and/or replacement when the evaporator unit 70 is disposed on a wall (as shown in FIG. 8B) such that access from the sides of the evaporator unit 70 is not available. Further, the opening panel 73 may be incorporated into any part of the outer casing 72 of the evaporator unit 70 including the bottom, front or either end which is practical for accessibility to the filter 79, as well as practical for aesthetic appearance.

[0068] While the invention has been described with reference to preferred embodiments thereof, it is to be understood that the invention is not limited to the preferred embodiments or constructions. To the contrary, the invention is intended to cover various modifications and equivalent arrangements. In addition, while the various elements of the preferred embodiments are shown in various combinations and configurations, which are exemplary, other combinations and configurations,



including more, less or only a single light emitting element, are also within the spirit and scope of the invention.

What is claimed is:

**1.** An evaporator unit that produces condensate liquid, the evaporator unit comprising:

- a reservoir that receives the condensate liquid;
- a pump that communicates with the reservoir to pump the condensate liquid out of the reservoir;
- a filter to filter the condensate liquid; and
- an outer casing that includes an opening panel adjacent to the reservoir, so that the reservoir and filter are accessible when the opening panel is in an open position.

**2.** The evaporator unit of claim **1**, wherein the opening panel is disposed on a bottom, downwardly-facing surface of the outer casing, so that the reservoir and filter are accessible from under the evaporator unit.

**3.** The evaporator unit of claim **1**, wherein the opening panel is disposed on a side surface of the outer casing, so that the reservoir and filter are accessible from a side of the evaporator unit.

**4.** The evaporator unit of claim **3**, wherein the side is orthogonal to a wall on which the evaporator unit is mounted.

**5.** The evaporator unit of claim **1**, wherein the opening panel is fully detachable from the outer casing.

**6.** The evaporator unit of claim **1**, wherein an edge of the opening panel is pivotally attached to the outer casing.

**7.** The evaporator unit of claim **1**, wherein the opening panel is transparent so that the reservoir is visible when the opening panel is closed.

**8.** The evaporator unit of claim **1**, wherein the opening panel includes an indicator to indicate at least one of a blocked filter and a predetermined level of condensate in the reservoir.

**9.** The evaporator unit of claim **1**, further comprising:  
a shelf inside the casing upon which the reservoir is disposed.

**10.** The evaporator unit of claim **9**, wherein the reservoir is attached to the shelf via at least one of a clip, friction fit, a screw and a hook-and-loop type fastener.

**11.** The evaporator unit of claim **1**, wherein the reservoir is attached to an inside surface of the opening panel so as to be accessible when the opening panel is in the open position.

**12.** A mini-split air conditioner comprising the evaporator unit of claim **1**.

**13.** An evaporator unit that produces condensate liquid, the evaporator unit comprising:

- a reservoir assembly that receives the condensate liquid;
- and
- an outer casing that includes an opening panel adjacent to the reservoir assembly, so that the reservoir assembly is accessible when the opening panel is in an open position, wherein

the reservoir assembly includes a pump to pump the condensate liquid out of the reservoir assembly, and a filter upstream of the pump to filter the condensate liquid.

**14.** The evaporator unit of claim **13**, wherein the opening panel is disposed on a bottom, downwardly-facing surface of the outer casing, so that the reservoir assembly is accessible from under the evaporator unit.

**15.** The evaporator unit of claim **13**, wherein the opening panel is disposed on a side surface of the outer casing, so that the reservoir assembly is accessible from a side of the evaporator unit.

**16.** The evaporator unit of claim **15**, wherein the side is orthogonal to a wall on which the evaporator unit is mounted.

**17.** The evaporator unit of claim **13**, wherein the opening panel is fully detachable from the outer casing.

**18.** The evaporator unit of claim **13**, wherein the opening panel includes an indicator to indicate at least one of a blocked filter and a predetermined level of condensate in the reservoir.

**19.** The evaporator unit of claim **13**, further comprising:  
a shelf inside the casing upon which the reservoir assembly is disposed.

**20.** The evaporator unit of claim **13**, wherein the reservoir assembly is attached to an inside surface of the opening panel so as to be accessible when the opening panel is in the open position.

**21.** An evaporator unit that produces condensate liquid, the evaporator unit comprising:

- an outer casing that includes a removable panel;
- a reservoir that receives the condensate liquid;
- a pump that communicates with the reservoir to pump the condensate liquid out of the reservoir; and
- a filter disposed between the reservoir and the pump to filter the condensate liquid, wherein the filter is attached to an inside surface of the removable panel so as to be withdrawn from the evaporator unit when the removable panel is removed.

**22.** The evaporator unit of claim **21**, wherein the removable panel is disposed on a bottom, downwardly-facing surface of the outer casing, so that the filter is withdrawn from under the evaporator unit.

**23.** The evaporator unit of claim **21**, wherein the removable panel is disposed on a side surface of the outer casing, so that the filter is withdrawn from the side of the evaporator unit.

**24.** The evaporator unit of claim **23**, wherein the side is orthogonal to a wall on which the evaporator unit is mounted.

**25.** The evaporator unit of claim **21**, wherein the opening panel includes an indicator to indicate at least one of a blocked filter and a predetermined level of condensate in the reservoir.

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