US 20090071181A1

(19) **United States**

(12) **Patent Application Publication**

Spanger

(10) **Pub. No.: US 2009/0071181 A1**

(43) **Pub. Date: Mar. 19, 2009**

(54) **EVAPORATOR UNIT**

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(21) Appl. No.: **11/902,149**

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

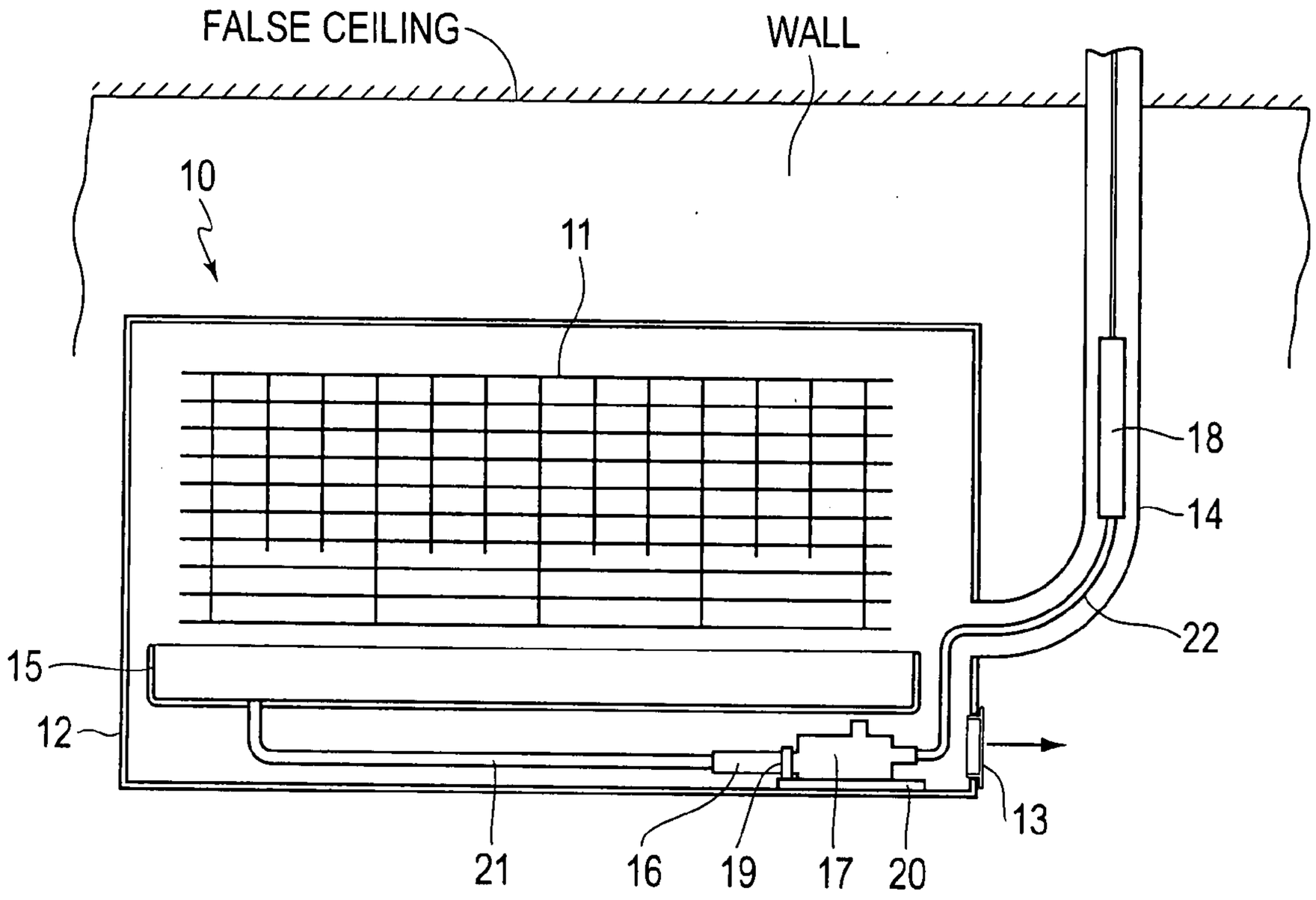
Publication Classification

(51) **Int. Cl.**
F25D 23/12 (2006.01)
F25D 21/14 (2006.01)

(52) **U.S. Cl.** **62/262**; 62/291

(57) **ABSTRACT**

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.



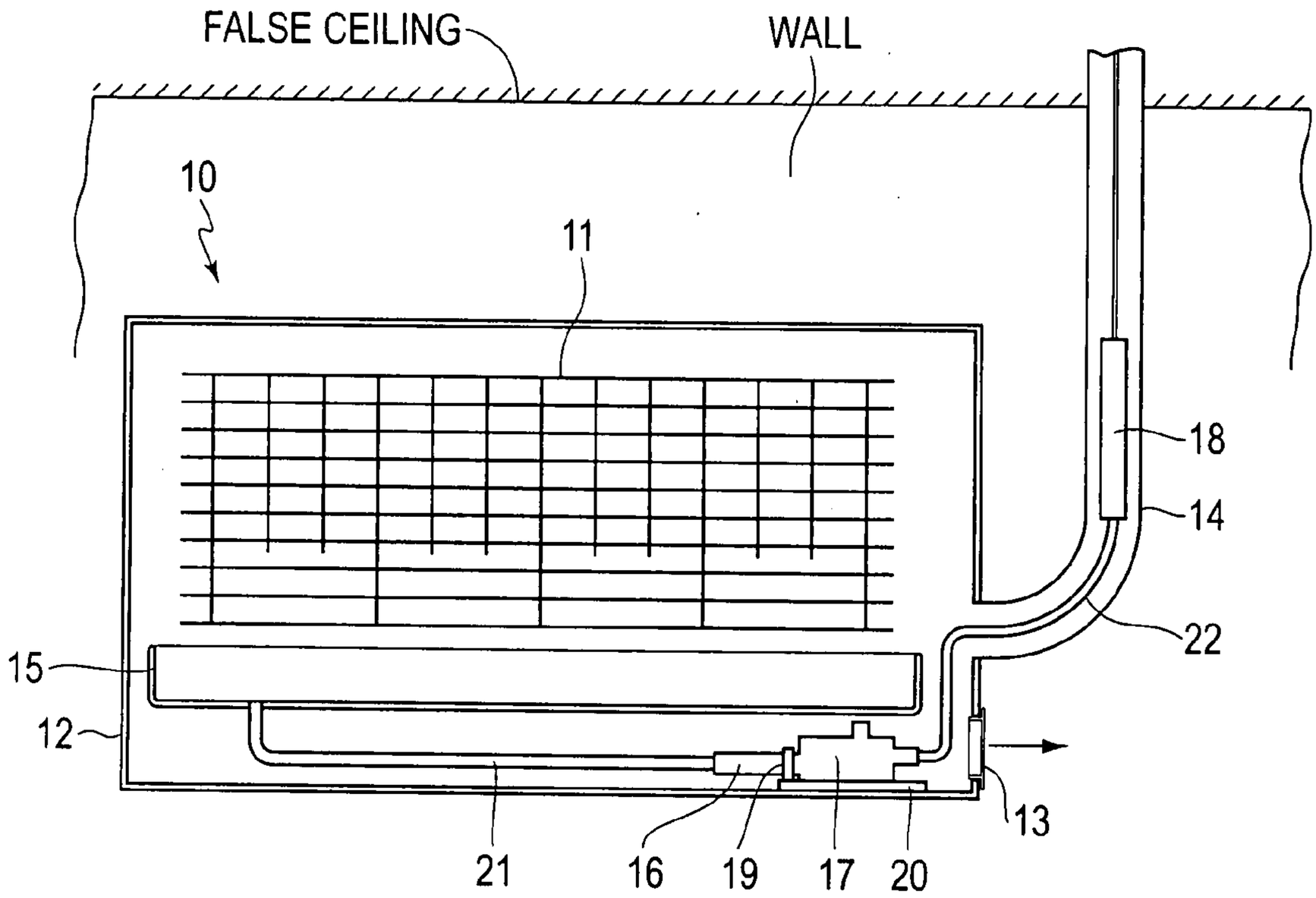

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FIG. 1A

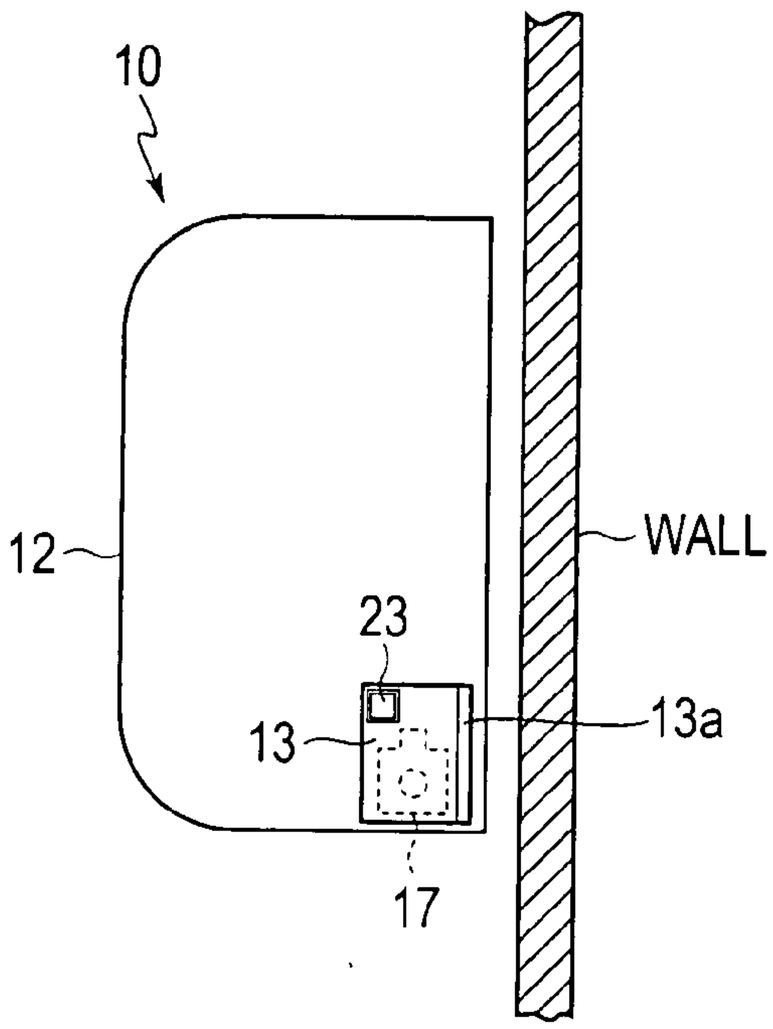
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FIG. 1B

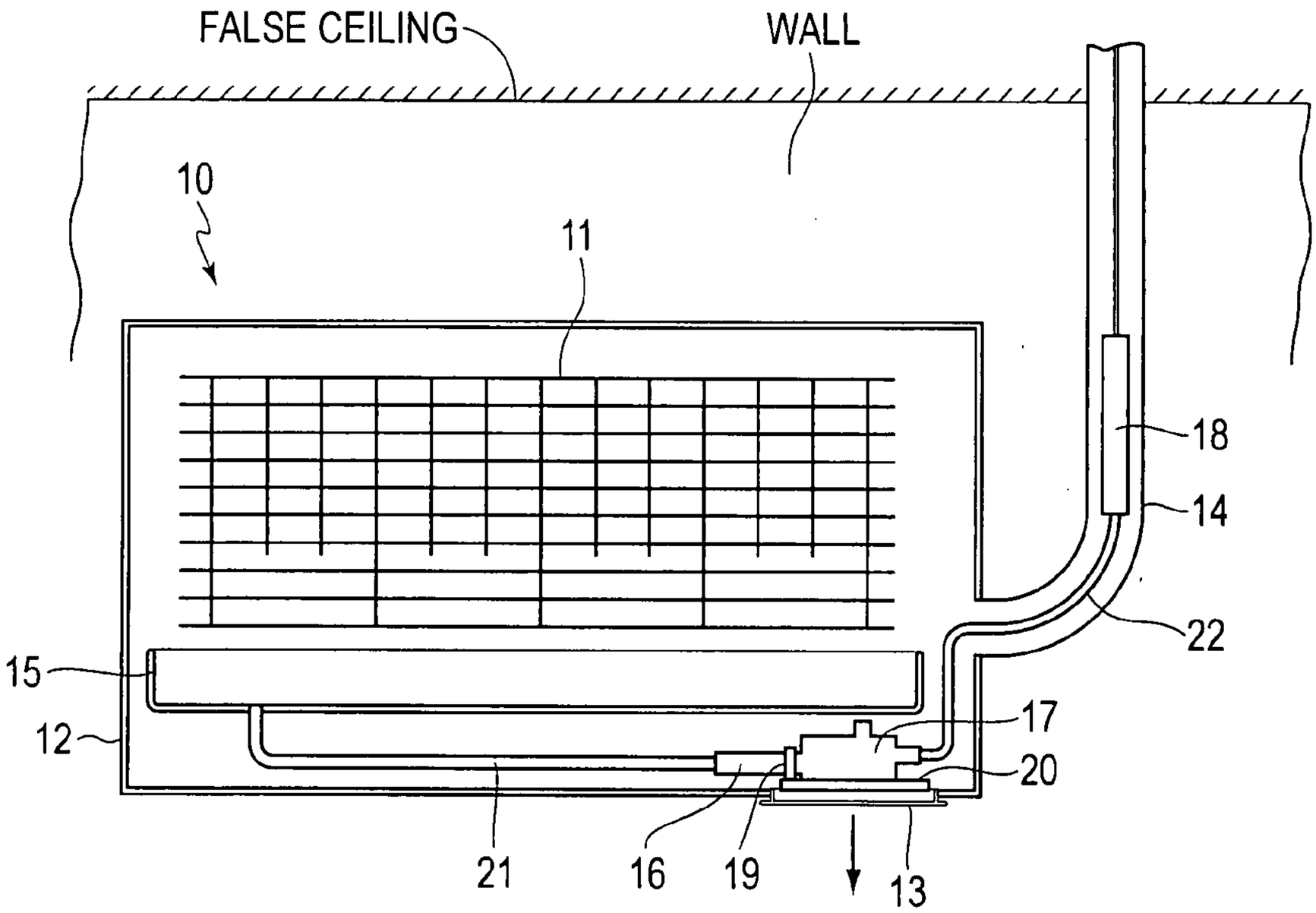
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FIG. 2A

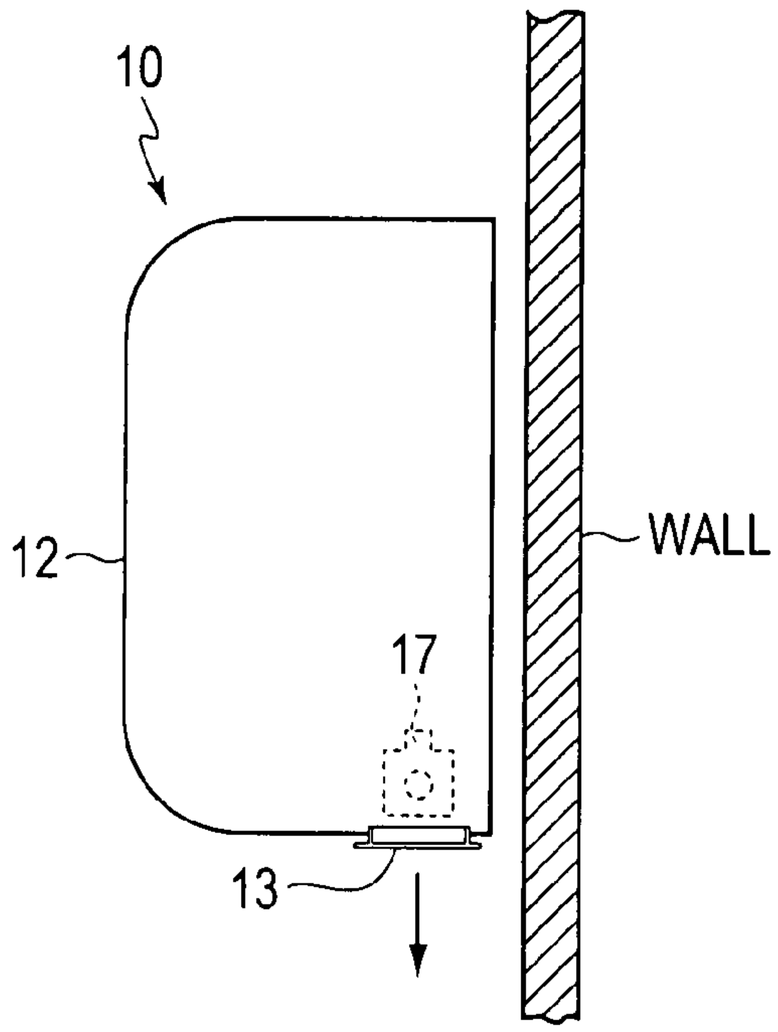
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FIG. 2B

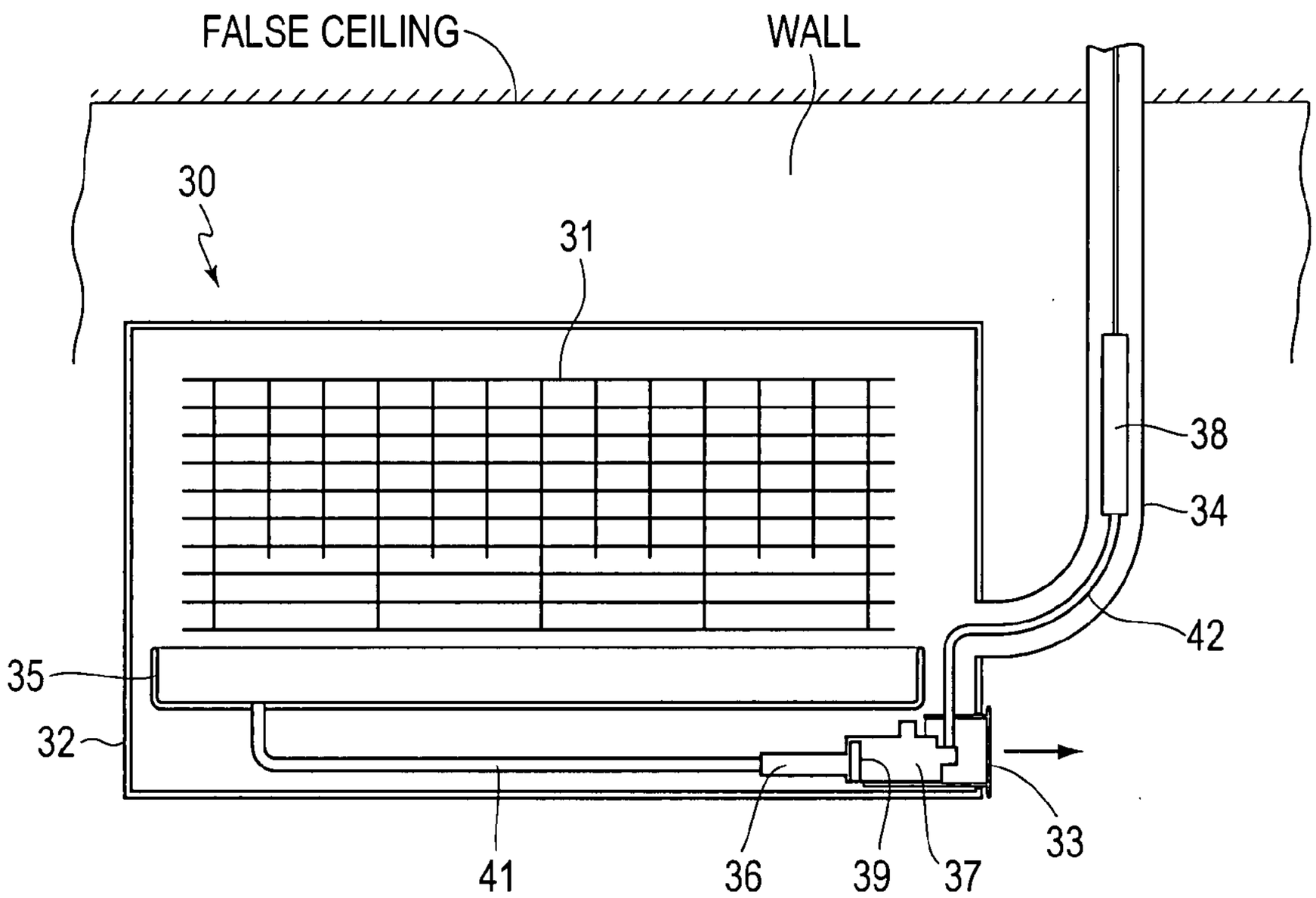
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FIG. 3A

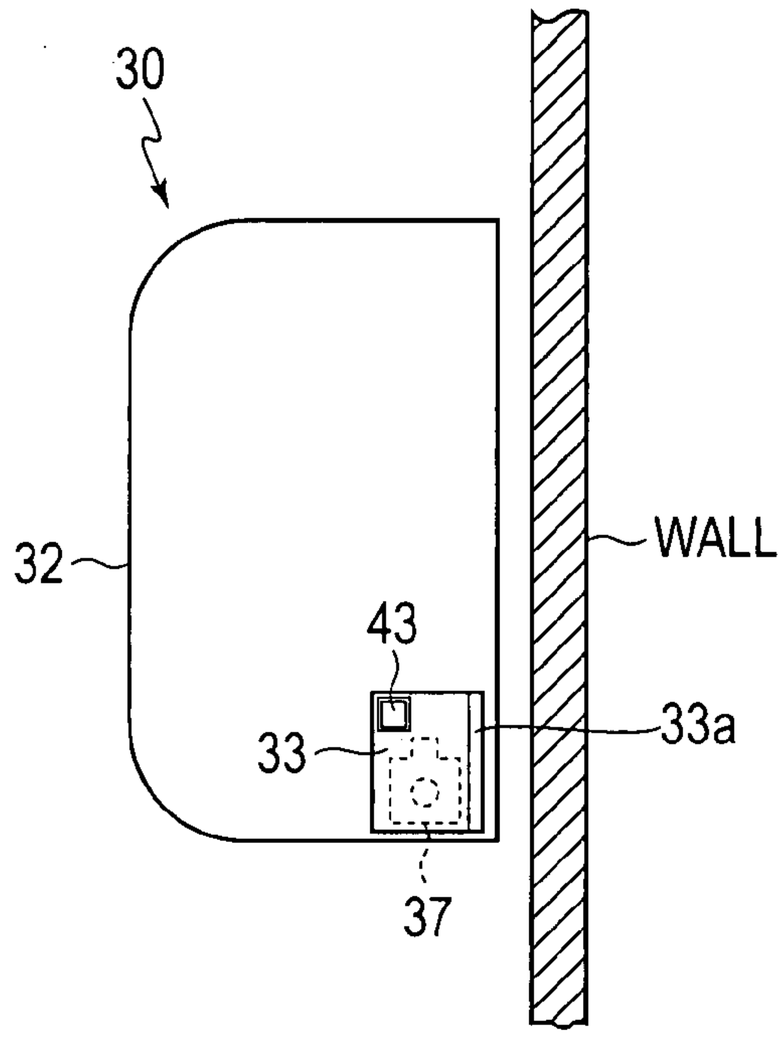
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FIG. 3B

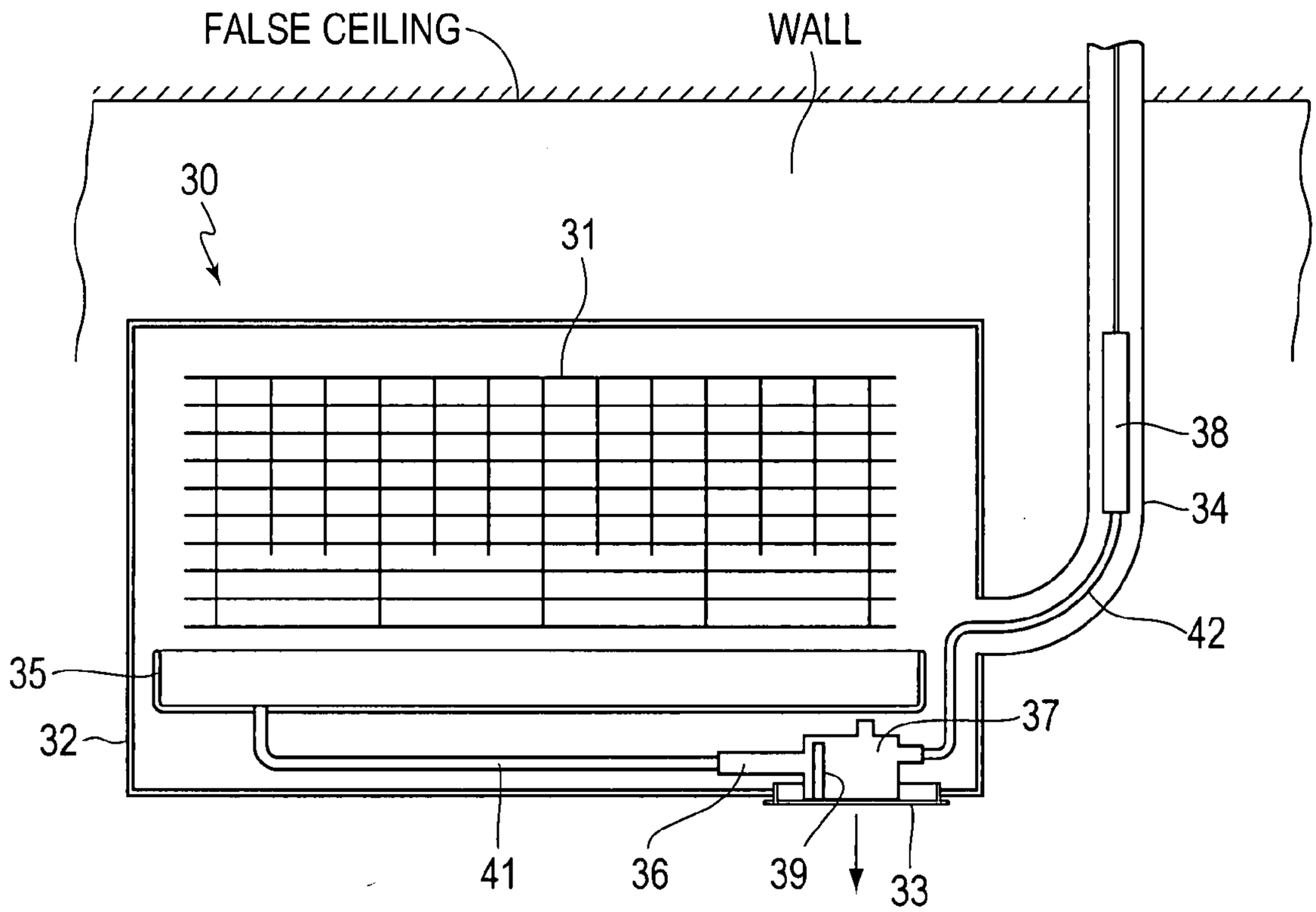
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FIG. 4A

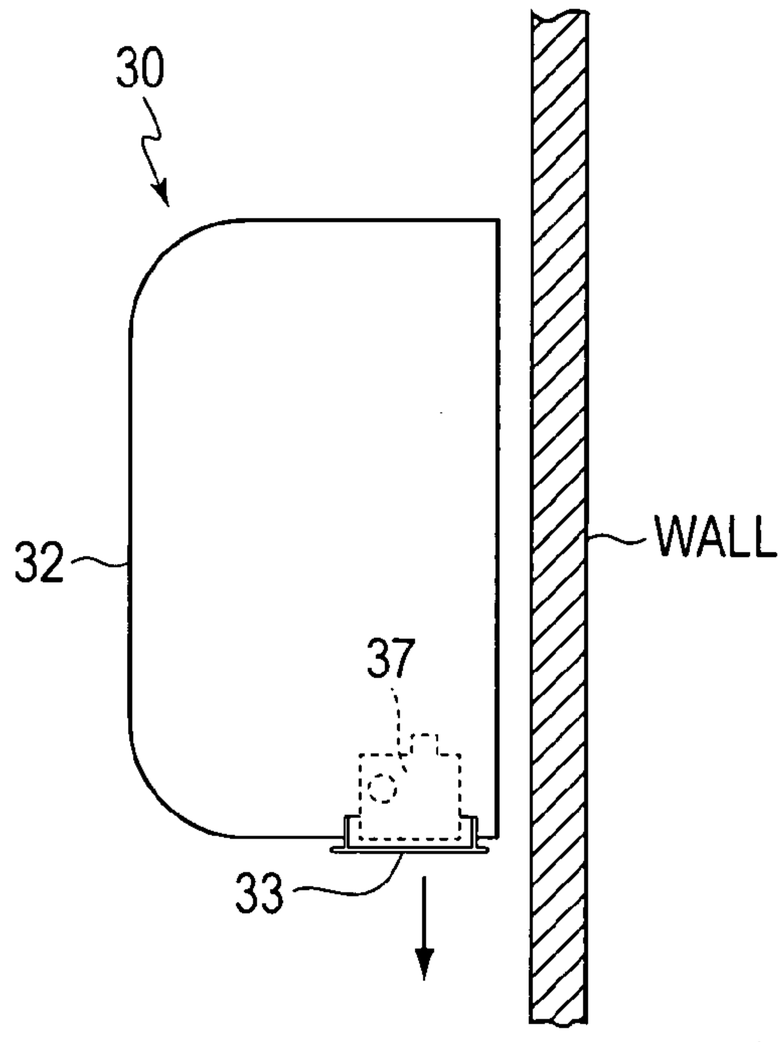
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FIG. 4B

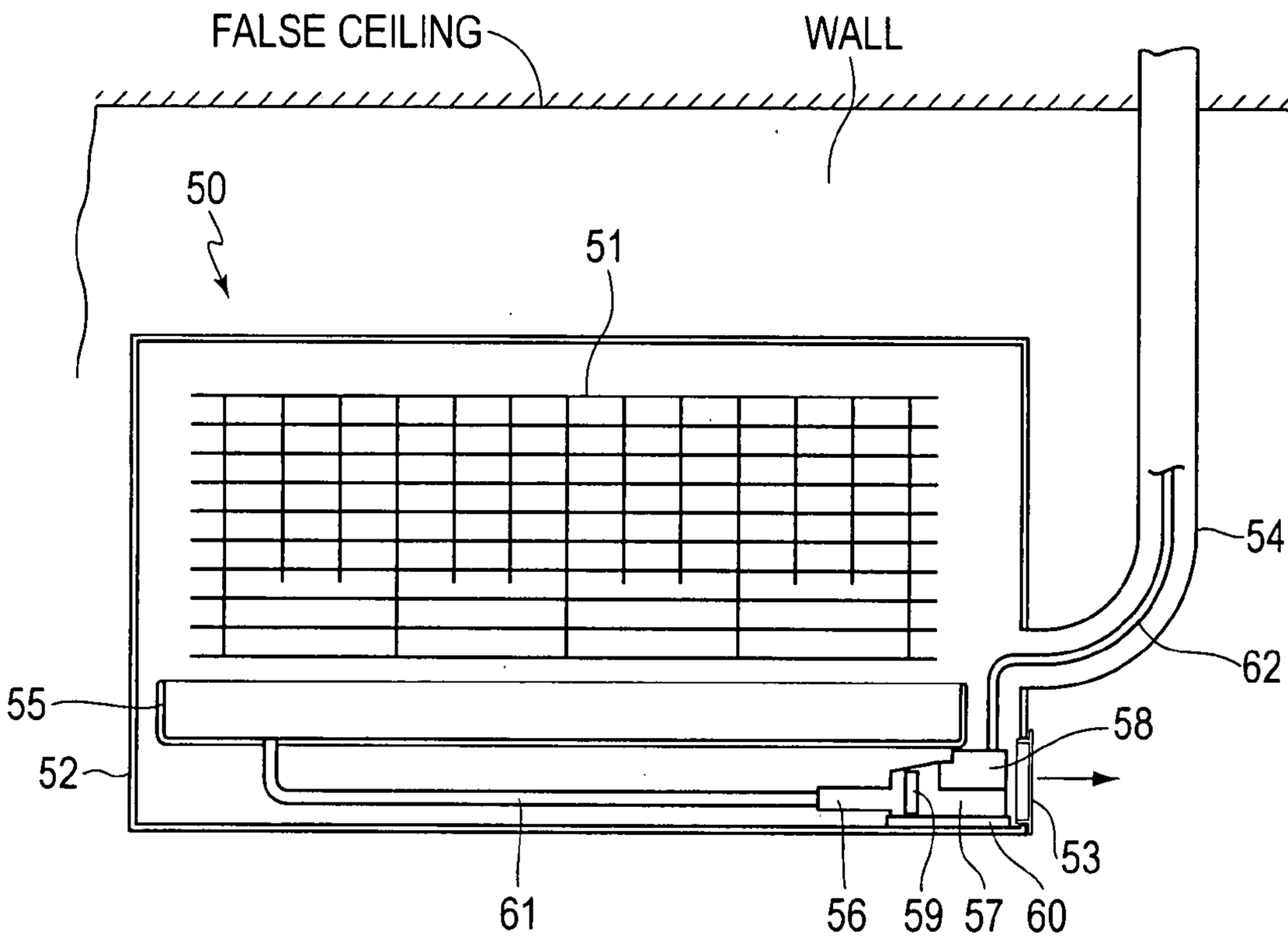
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FIG. 5A

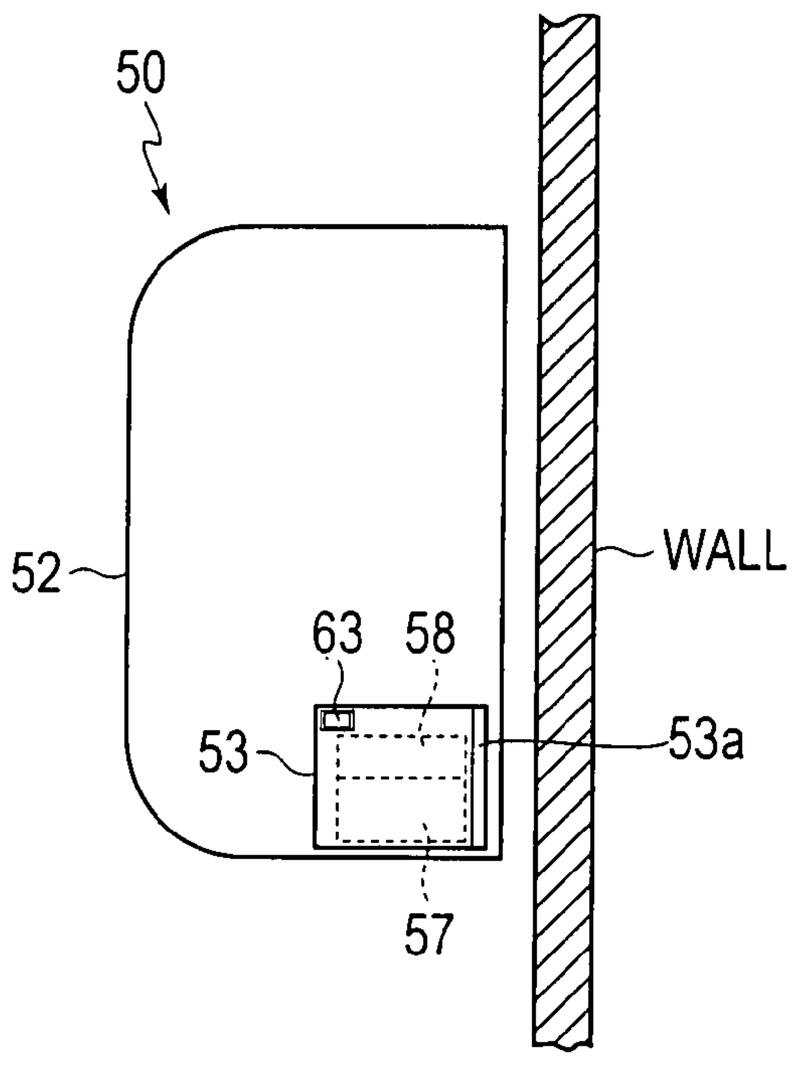
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FIG. 5B

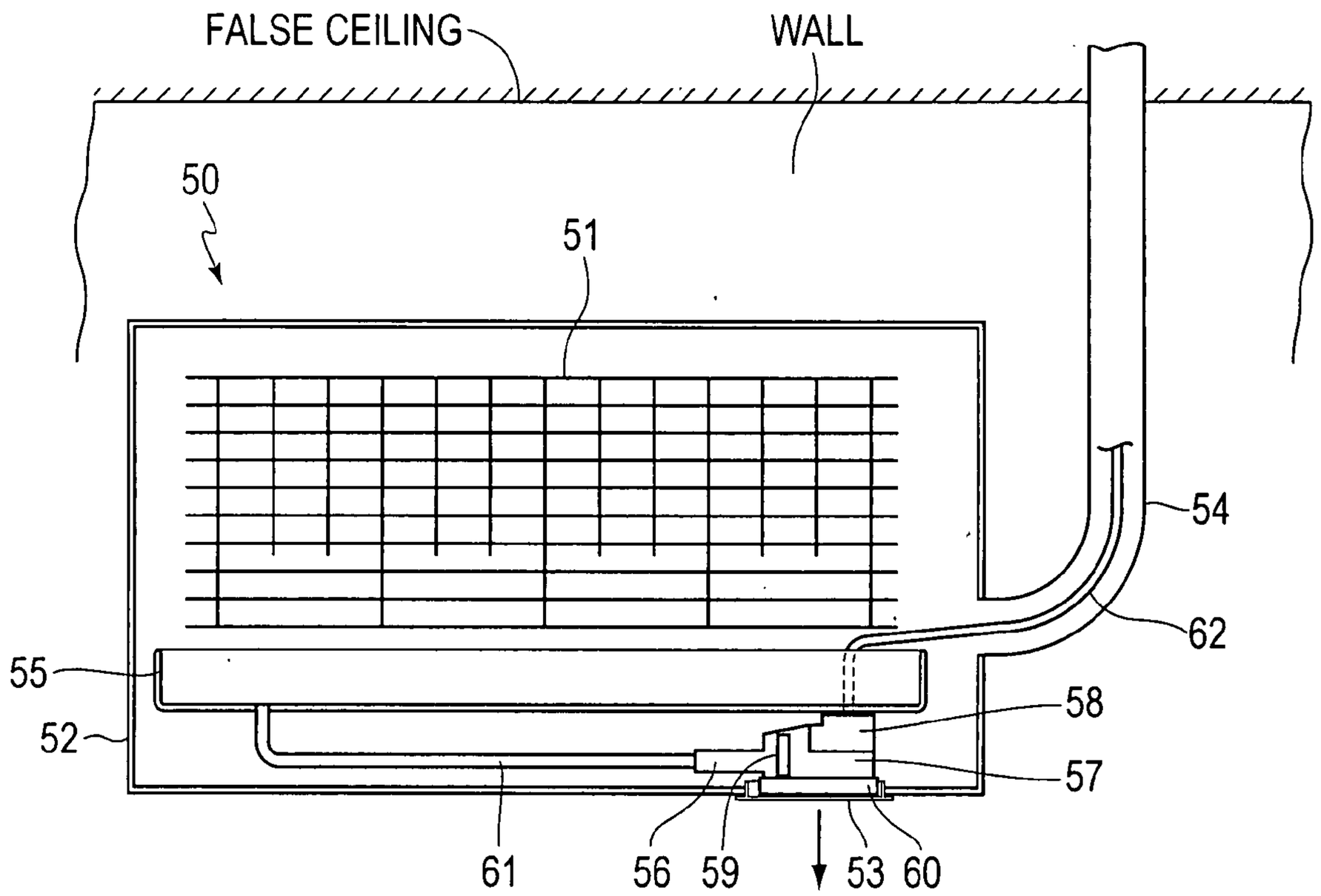
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FIG. 6A

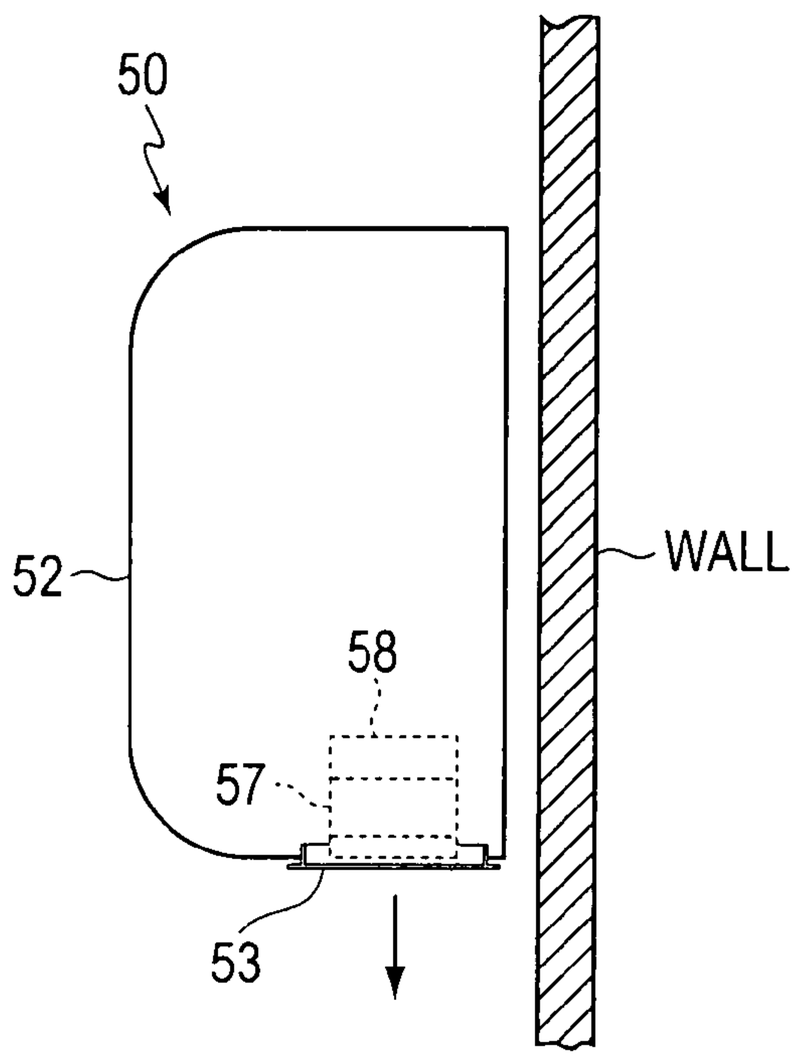
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FIG. 6B

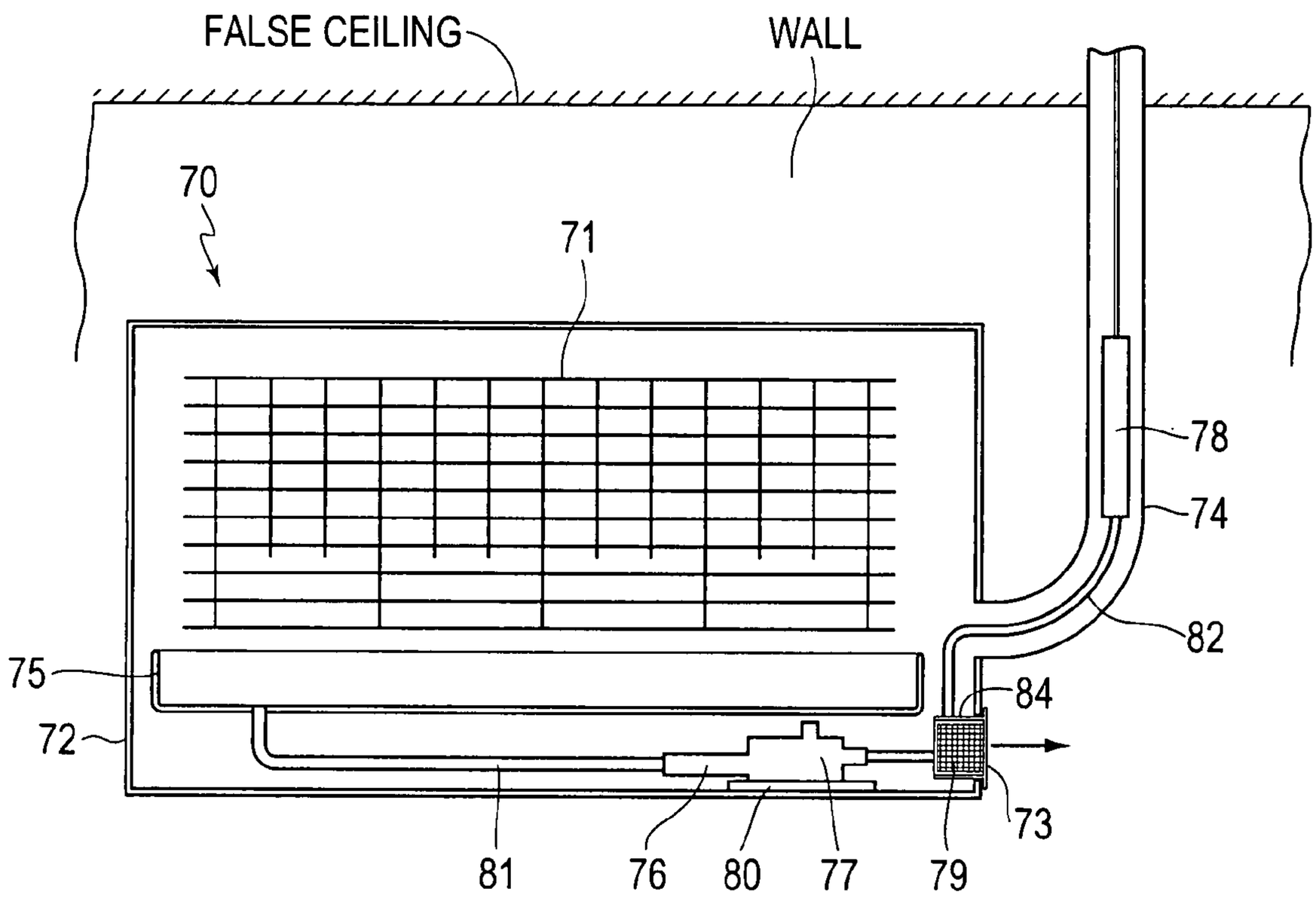
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FIG. 7A

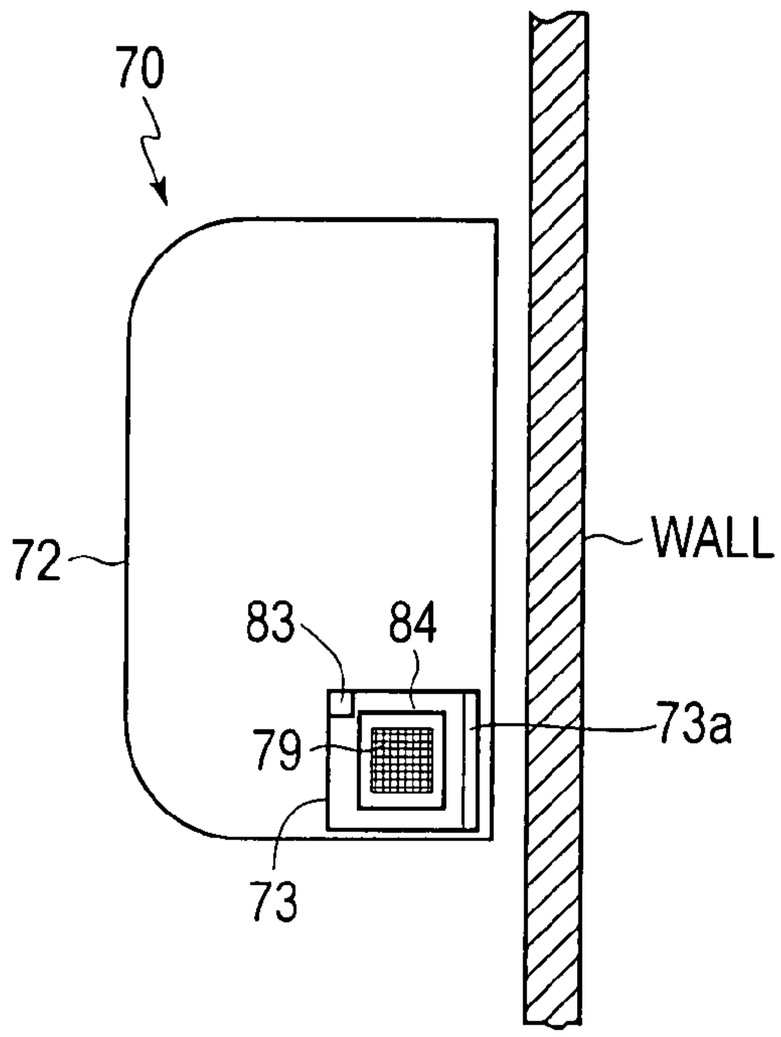
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FIG. 7B

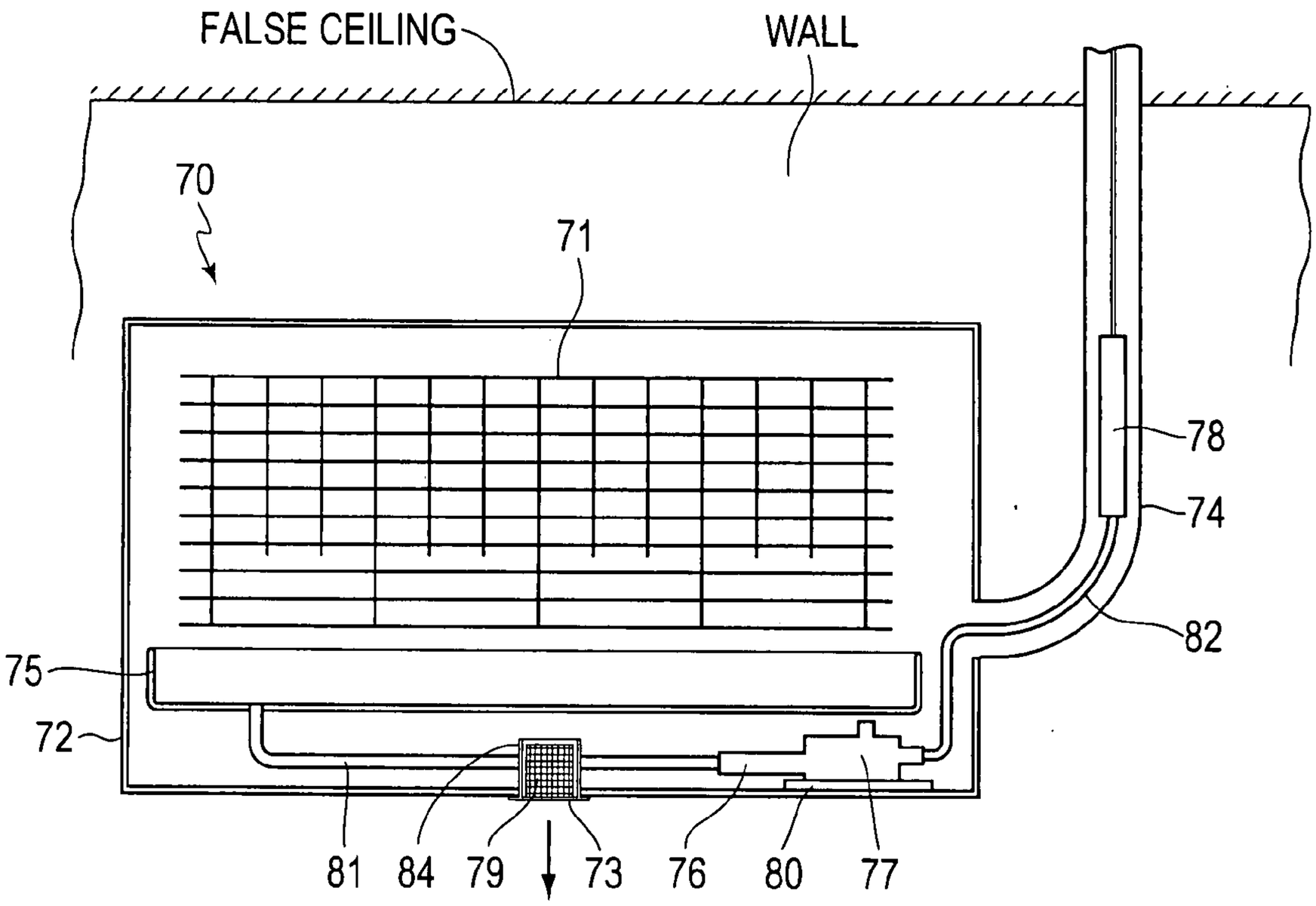
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FIG. 8A

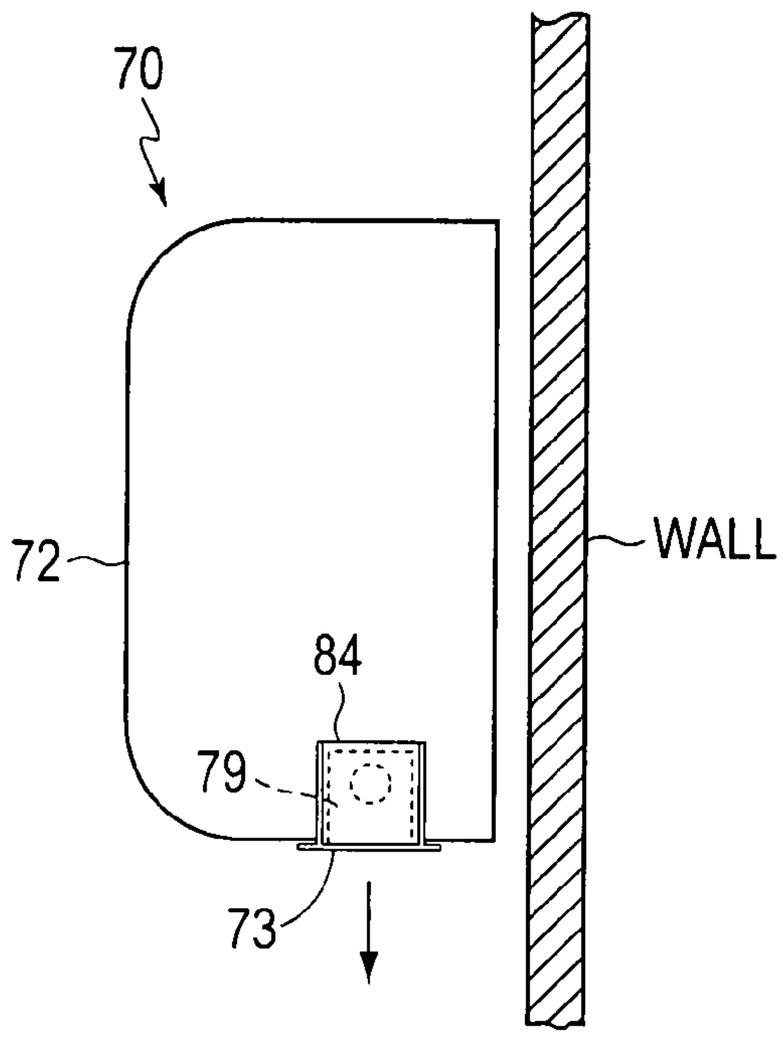
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FIG. 8B

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

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

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

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

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

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

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

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

DETAILED DESCRIPTION OF EMBODIMENTS

[0049] FIGS. **1**A and **1**B 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. **1**B). 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** though 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. **1**A, 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. **1**A, 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. **1**B, 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 **13***a* 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. **2**A and **2**B 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. **2**B) 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. **3**A and **3**B 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. **3**B). 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. **4**A and **4**B 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. **4**B) 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. **5**A and **5**B 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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