

IMPROVED AIR-CONDITIONER UNIT

FIELD OF THE INVENTION

The invention relates to an improved air-conditioner unit. The improved air-conditioner unit may include, but is not limited to, a portable air-conditioner capable of providing multiple functions, and will be described in such context.

BACKGROUND ART

The following discussion of the background to the invention is intended to facilitate an understanding of the present invention only. It should be appreciated that the discussion is not an acknowledgement or admission that any of the material referred to was published, known or part of the common general knowledge of the person skilled in the art in any jurisdiction as at the priority date of the invention.

Air-conditioner units or air-conditioning systems are used primarily to regulate or adjust temperature in an enclosed area, such as a room. In the operation of such air-conditioner units or air-conditioning systems, heat energy, amongst others, is generated, dissipated to the environment and can contribute to global warming. In addition, the heat energy generated and dissipated is wasted because it is not utilized to do any useful work.

One of the problems associated with global warming and industrialization is the rapid decrease in the supply of drinkable water. Such decrease in drinkable water poses a huge problem especially to remote or rural regions where delivery of drinkable water is difficult.

Increasingly, there exists multi-functional air-conditioner units, some of which claim to be able to produce drinkable water. However, such multi-functional air-conditioner units are typically de-humidifiers and do not regulate temperature. In addition, even if the water produced is fit for drinking, there appears to be no proper maintenance to consistently ensure the quality of the water produced, especially when tubes/pipes within the air-conditioner units may accumulate impurities over time.

Typically, air-conditioner units require exhaust pipes or conduits as an outlet to remove excess condensate water. In recent improvements, air-conditioner units comprise models that do not require an exhaust pipe. However, such models

typically have limited cooling capabilities of 3000 British Thermal Unit (BTU) and below. Moreover, these models blow out cold air and the heat is dissipated to the environment via good ventilation or rapid dissipation of the heat into the surrounding air. However, for relatively smaller spaces, where the ventilation conditions are not ideal, an exhaust pipe will still be required for the hot air to be pumped out of the room.

In light of the above, there therefore exists a need to provide an air-conditioner unit that is more environmentally friendly in the sense that it is at least able to harness part of the heat energy dissipated and mitigate the problem of drinkable water supply or supply of water that is fit for consumption, and/or improve on existing air-conditioner units at least in part.

SUMMARY OF THE INVENTION

Throughout the specification, unless the context requires otherwise, the word “comprise” or variations such as “comprises” or “comprising”, will be understood to imply the inclusion of a stated integer or group of integers but not the exclusion of any other integer or group of integers.

Furthermore, throughout the specification, unless the context requires otherwise, the word “include” or variations such as “includes” or “including”, will be understood to imply the inclusion of a stated integer or group of integers but not the exclusion of any other integer or group of integers.

The invention seeks to provide a multi-functional air-conditioner, which may be portable. In some embodiments the air-conditioner unit comprises a temperature regulation unit integrated with a water filtration or a water purifier unit, wherein the water filtration or purification unit utilizes at least the condensed water obtained from the condenser of the temperature regulation unit for filtration and purification. The air-conditioner unit further comprises a water dispenser for storage of filtered water that is deemed fit for human consumption. Depending on environmental and operating conditions, the filtered water may be fit for human drinking.

Control of the multi-functional portable air-conditioner may be realized in the form of one or more electronic controllers. In the implementation of logic for control of the air-conditioner unit, the different functions associated with heating, cooling or refrigeration, filtration of water, may be implemented with different priority associated with it. Further, control of such functions may be optimized. Non-exhaustive factors

that may affect the prioritization and optimization include: temperature of the environment, temperature of the condenser, temperature of the evaporator coils, water temperature at various locations, flow rate of condensed water etc.

5 In accordance with an aspect of the invention there is provided an air-conditioner unit comprising a temperature regulation unit having a condenser; a tray for collecting a condensate from the condenser; a condensate filtration unit comprising at least one conduit connected to the tray and arranged to receive the condensate from the tray; a dispenser arranged to receive filtered condensate from the condensate filtration unit; wherein the air-conditioner unit comprises a controller
10 to switch the condensate filtration unit between a purging state and a dispensing state.

In some embodiments, the temperature regulation unit and condensate filtration unit are shaped and dimensioned such that the condensate filtration unit is arranged below the temperature regulation unit.

15 In some embodiments, the condensate filtration unit comprises a collection tank to store received condensate from the tray.

In some embodiments, the condensate filtration unit comprises a dispensing tank for storage of filtered condensate.

20 In some embodiments, the condensate filtration unit may be a water filtration unit and comprises a plurality of filters arranged to receive water from the collection tank and direct filtered water to the dispensing tank.

In some embodiments, the water filtration unit is switchable between a first state wherein water from the collection tank is sent directly to a dispenser pump bypassing the plurality of filters, and a second state wherein condensate is sent to
25 the plurality of filters. In some embodiments, the collection tank comprises a first outlet and a second outlet, wherein in the first state, water from the collection tank is sent directly to the dispenser pump for purging via the first outlet, and wherein in the second state, water from the collection tank is directed to a plurality of filters via the second outlet.

30 In some embodiments, the controller is an electronic controller that operates to receive the following as inputs:

- a. the level of condensate stored in the collection tank; and
- b. the level of filtered condensate stored in the dispensing tank

the electronic controller operable to provide an output corresponding to the activation or opening of at least one valve.

5 In some embodiments, the condensate filtration unit comprises a flow meter operable to obtain a total volume of condensate passing through the flow meter from a preset time as the input.

In some embodiments, the inputs are binary inputs.

In some embodiments, the output is a binary output.

In some embodiments, the purging state comprises a start-up purging mode and a filter cleaning purging mode.

10 In some embodiments, the air-conditioner unit further comprises a first ultra-violet source that operates to disinfect the condensate in the collection tank.

In some embodiments, the air-conditioner unit further comprises a second ultra-violet source that operates to disinfect the filtered condensate in the dispensing tank.

15 In some embodiments, the temperature regulation unit comprises a second electronic controller and an electronic expansion valve throttling device, the second electronic controller operates to regulate the amount and state of refrigerant flowing pass the expansion valve throttling device.

20 In some embodiments, the second electronic controller is operable to switch the temperature regulation unit between a full feature mode and a priority mode.

In some embodiments, the priority mode comprises a cooling priority mode, a water dispensing priority mode, and a refrigeration priority mode.

25 In some embodiments, the temperature regulation unit comprises an evaporator and a refrigerator, the evaporator arranged to be connected to the refrigerator such that heat energy absorbed by the evaporator results in the cooling of the refrigerator.

In some embodiments, the evaporator and condenser are arranged such that a portion of the heat energy generated by the condenser is passed to the evaporator.

30 In some embodiments, the dispenser comprises a first compartment for storage of hot water and a second compartment for storage of cold water.

In some embodiments, the first compartment comprises a humidifier.

In accordance with another aspect of the invention there is provided a condensate filtration unit for use with a portable air-conditioner unit, comprising at least one conduit connected to a condensate container and arranged to receive condensate from the condensate container; the condensate filtration unit further comprising a dispenser arranged to receive filtered condensate from the condensate filtration unit; wherein the condensate filtration unit comprises an controller to switch the condensate filtration unit between a purging state and a dispensing state.

In accordance with another aspect of the invention there is provided an air-conditioner unit comprising a compressor for compressing a refrigerant; a condenser interface arranged to receive compressed refrigerant from the compressor; a water source arranged to pass water to the condenser interface to remove heat from the compressed refrigerant; the water source further comprising a compartment arranged to store water heated by the compressed refrigerant; an electronic expansion valve-throttling device arranged to receive compressed refrigerant flowing out of the condenser interface; and an electronic controller operable to control the electronic expansion valve-throttling device to regulate the quantity of compressed refrigerant flowing through the expansion valve throttling device via adjustments of pressure and temperature.

In some embodiments, the electronic controller is pre-programmed to regulate the compressed refrigerant based on a plurality of modes depending on different priority.

In some embodiments, the plurality of modes comprise two or more of the following: a temperature regulation mode, a water dispensing mode, a refrigeration mode.

In some embodiments, the air-conditioner unit further comprises an evaporator arranged at the output of the expansion valve-throttling device.

In some embodiments, the air-conditioner unit further comprises a refrigerator arranged to be connected to an outlet of the evaporator.

In some embodiments an outlet of the refrigerator is connected to an inlet of the condenser interface.

In accordance with another aspect of the invention there is provided a method for obtaining water from an air-conditioner unit comprising the steps of: a. collecting a condensate from a condenser; b. directing the condensate via at least

one conduit to a condensate filtration unit; c. storing the condensate in a collection tank; wherein upon receipt of an electronic signal, d. passing the condensate through a plurality of filters or directing the condensate to a dispenser pump; wherein the dispenser pump is positioned at an output of the water filtration unit to pump filtered water to be stored or purge the condensate.

BRIEF DESCRIPTION OF DRAWINGS

The present invention will be described, by way of example only, with reference to the accompanying drawings, in which:

Fig. 1a to 1c illustrate an air-conditioner unit in various perspective views in accordance with various embodiments. In particular, Fig. 1b and Fig. 1c are the side views with respect to Fig. 1a;

Fig. 2a and 2b are exploded views of the air-conditioner unit showing the temperature regulation unit and the water filtration unit and how they are connected;

Fig. 3 illustrates a system diagram of the water filtration unit;

Fig. 4 is a table correlating the input and output devices of the water filtration unit for electronic control;

Fig. 5 is a table illustrating various output control conditions;

Fig. 6 is a flowchart showing the logic associated with the electronic controller for controlling the air-conditioner unit based on various output control conditions; and

Fig. 7 is a system block diagram of the air-conditioner unit in accordance with various embodiments.

Other arrangements of the invention are possible and, consequently, the accompanying drawing is not to be understood as superseding the generality of the preceding description of the invention.

PREFERRED EMBODIMENTS OF THE INVENTION

Throughout the specification, the term 'consumption' refers to filtered water that can be utilized by humans for a variety of purposes, including, but not limited to, drinking. Accordingly, consumption may include filtered water utilized for washing, cleaning, bathing etc.

Further throughout the specification, the term 'temperature regulation unit' may be understood to comprise a conventional air-conditioner unit having heating and cooling functions.

Further, throughout the specification, the term 'water' is understood to include liquids comprising water as its major constituent.

In accordance with an embodiment of the invention and with reference to Fig. 1, there is an air-conditioner unit 10 comprising a temperature regulation unit 12 having a condenser 14. The air-conditioner unit 10 may be, but is not limited to, a portable air-conditioner unit. The condenser 14 may comprise one or more condenser coils.

A condensate container such as a tray 16 is positioned at a suitable location relative to the condenser 14 to collect condensed liquid (such as water) from the condenser coils that arise from the operation of the temperature regulation unit 12. Condensed water may be collected via return pipe to a compressor (shown in Fig. 7). The tray 16 may comprise an outlet having one or more valves disposed therein, such that when a pre-determined amount of water has been stored in the tray, the valve(s) open to direct the condensed water from the tray 16 to a condensate filtration unit 18. The condensate filtration unit 18 may be in the form of a water filtration unit 18.

The water filtration unit 18 is arranged to receive the condensate (which may be in the form of condensed water) from the tray 16 for filtration or purification. At least one conduit 20 may run between the water filtration unit 18 to the tray 16, the at least one conduit 20 arranged to receive condensed water from the tray 16. In some embodiments, the at least one conduit 20 may be a metallic pipe, such as a stainless steel pipe that complies with the necessary regulatory requirements such as the Food and Drug Administration (FDA) to ensure that the condensed water passing through the conduit 20 is not contaminated by any impurity/impurities in an inner surface of the conduit 20, such as rust. In other embodiments, the at least one conduit 20 may be made of polytetrafluoroethylene (PTFE). In general, the at least one conduit 20 is non-corrosive and preferably lightweight and durable.

A dispenser pump 22 may be positioned at an output of the water filtration unit 18 to pump filtered water back to the temperature regulation unit 12 for storage and dispensation. In some embodiments, the filtered water may be fit for consumption. A water dispenser 24 is arranged to receive filtered water from the dispenser pump for storage and dispensation.

With reference to Fig. 1a to Fig. 1c and Fig. 2a and Fig. 2b, which shows an embodiment of the invention in different perspective views, the temperature regulation unit 12 and water filtration unit 18 are shaped and dimensioned such that the water filtration unit 18 is arranged below the temperature regulation unit 12. Such an arrangement of the temperature regulation unit 12 and water filtration unit 18 achieves regularity in shape for ease of deployment and transportation. The tray 16 is arranged at the bottom of the condenser coils 14. A dimension of the tray 16, for example the length or width of tray 16, may correspond to a dimension of the condenser coils 14 such as to maximize the collection of condensed water.

The interface and joint between the temperature regulation unit 12 and water filtration unit 18 may be via snug fit arrangements as known to a skilled person and will not be elaborated further. In some embodiments, the temperature regulation unit 12 and water filtration unit 18 may be welded or joined together permanently as a single integrated unit.

The water filtration unit 18 may comprise a collection tank 30 to store received condensed water from the at least one conduit 20. In some embodiments, the collection tank 30 may comprise a water quality sensor to measure the quality of water collected in the collection tank 30. The water filtration unit 18 may further comprise a dispensing tank 32 for storage of filtered water before pumping to the water dispenser 24. In some embodiments, the dispensing tank 32 may also comprise sensors to measure the quality of the filtered water stored in the dispensing tank 32.

In various embodiments, the air-conditioner unit 10 comprises a controller 34 to switch the condensate (water) filtration unit 18 between a purging state and a dispensing state. The controller 34 further controls the flow of condensed water within the water filtration unit 18. Such control may be achieved with the deployment of valves to direct the flow of the condensate. The at least one controller 34 may be an electronic controller 34 with necessary circuitry to implement control logic such as to control the flow of water within the water filtration unit 18. The circuitry may be housed within a box so that it is isolated from the rest of the water filtration unit 18.

In some embodiments, the collection tank 30 has a capacity of 5 to 15 litres.

A ultra-violet source (UV source) 35 may be arranged to remove bacteria, germs and other organisms in the condensed water stored in the collection tank 30.

Such an arrangement provides a disinfectant function after filtration via a filter unit 36, which may be in the form of a water filter unit 36. The UV source 35 may be positioned adjacent to the filter unit 36. Where UV source 35 is deployed, care should be taken to ensure that the material forming the collection tank 30, dispensing tank 32 and filter unit 36 can withstand UV radiation without corrosion. An example of a material for forming the collection tank 30, dispensing tank 32 and/or the filter unit 36 is stainless steel.

To achieve compactness and a desired form factor, some components of the air-conditioner unit 10 may be stacked above other components. As illustrated in Fig. 1 and Fig. 2, the collection tank 30, electronic controller 34, and UV source 35 may be arranged to be stacked on top of the dispensing tank 32 and filters 36.

In some embodiments, an additional UV source 39 may be positioned in the dispensing tank 32. In such an arrangement, the additional UV source 39 is a submersible UV source. The arrangement with the UV source 39 seeks to minimize or prevent build-up of bacteria in the filtered water stored within the dispensing tank 32.

As shown in Fig. 1 and Fig. 2, the air-conditioner unit 10 may comprise rollers 42 for enhancing mobility of the air-conditioner unit 10. Such rollers 42 may be attached or affixed to the base of the air-conditioner unit 10.

Referring to Fig. 3, the condensed water passing through the at least one conduit 20 is output to the collection tank 30 for storage. Depending on purging or dispensing operation modes which will be subsequently elaborated, condensed water collected in the collection tank 30 may be either directed to a plurality of water filter unit 36 via a filter pump 38 and valve 37, or may be directed to the dispenser pump 22, by-passing the plurality of water filters 36. The opening/activation and closing/deactivation of the valve 37 and filter pump 38 are controlled by the electronic controller 34. The dispenser pump 22 may be connected to a flow meter or flow sensor 50. The flow meter 50 is in turn connected to a dispensing purge valve (DPV) and a dispensing valve (DV). When the dispensing purge valve DPV is activated, water from the collection tank 30 or dispensing tank 32 is purged and not pumped to the dispensing tank 32. When the dispensing valve is activated or opened, filtered water, which may be fit for consumption and/or drinking, is directed from the dispensing tank 32 and pumped via the dispenser pump 22 to the water dispenser

24 for storage pending consumption. The plurality of filters or filter unit 36 should preferably be able to filter the condensed water to an extent that the water is fit for a certain level of consumption. In some embodiments, the filtered water is fit for drinking. In the embodiments where filtered water is fit for drinking, the electronic controller 34 may operate to purge the water not fit for drinking such that the water will not be directed back to the water dispenser 24. The purged water may however be utilized for one or more other purpose(s).

The electronic controller 34 operates to receive input electronic signals from a plurality of sensors and provide corresponding output(s). The plurality of sensors may include sensors for measuring the water level of the controller tank 30 and dispensing tank 32; flow rate/ total volume of water dispensed and/or purged obtained from the flow meter 50; and manual input obtained from a user of the air-conditioner unit 10 via push buttons.

Fig. 4 shows a correlation table between the inputs provided to the electronic controller 34 and the output generated by the electronic controller 34. The inputs and outputs may be in the form of binary electronic signals having off state corresponding to a state '0'; and an on state corresponding to a state '1'. As an example, when the collection tank high level (CH) is detected to be '1', i.e. when water in the collection tank high level (CH) is at or above a predetermined level, the dispenser pump (DP) 22 is activated. When the collection tank level is at a low level (CL), the collection tank purge valve (TPV) is opened. Another input that can be taken is the mid-level of the dispensing (storage) tank 32. When the storage tank mid-level (SM) is detected to be '1', i.e. when water in the dispensing tank 32 is at or above a predetermined level, the dispensing valve (DV) is activated to allow water to be pumped to the water dispenser 24.

The electronic controller 34 controls the condensate filtration unit 18 to operate between one or more purging states, and a dispensing state. The electronic controller 34 comprises a processor unit and the necessary circuitry (not shown) to implement the logical control associated with switching on or off the valves, pumps and UV sources 35, 39. Examples of the one or more purging states include:

- a. purging of water in the collection tank 30;
- b. purging of filtered water in the dispensing tank 32;

The dispensing state corresponds to the filtered water, which is stored in the dispensing tank 32, being directed to the water dispenser 24 via the dispenser pump 22 and dispensing valve DV. The purging states are utilized for the first usage of the air-conditioner units where condensed water (the condensate) is utilized to remove impurities or particles in the collection tank 30, and in a maintenance mode where the collection tank 30, dispensing tank 32 and the filters are cleaned.

Fig. 5 and Fig. 6 show a control flow chart and a table of detailed output control conditions for the control of the condensate filtration unit 18. The table of output control conditions detail how each output component can be switched between the 'ON' and 'OFF' state via one or a combination of inputs.

Condition 1.1 to condition 1.3 correspond to the conditions for switching on or off the filter pump 38 and UV source 35; condition 2.1 to condition 2.7 correspond to the conditions for switching on or off the dispensing pump 22; condition 3.1 and 3.2 correspond to the conditions for switching on or off the UV source 39; conditions 4.1 to 4.3 correspond to the conditions for switching on or off the collection purging solenoid valve TPV; conditions 5.1 to 5.5 correspond to the conditions for switching on or off dispensing purge valve DPV/PR; conditions 6.1 to 6.4 correspond to the conditions for switching on or off a water dispensing valve DV; conditions 7.1 and 7.2 correspond to the conditions for switching on or off the empty tank signal for the dispensing tank 32; conditions 8.1 and 8.2 correspond to the conditions for switching on or off the overflow/full tank signal of the collection tank 30 or dispensing tank 32; conditions 9.1 to 9.3 correspond to the conditions for switching on or off the ready to dispense indicator; and conditions 10.1 to 10.5 correspond to the triggering of the different purging states.

Using the dispenser pump 22 as an example, the output 'ON' state of the dispenser pump 22 may correspond to the following three input conditions:

Input condition 1: A dispensing push button (BN) being activated or 'ON', empty tank signal (ES) is 'OFF' and purging state equals to 0 which signifies that the condensate filtration unit is at a normal dispensing state and filtered water is sent to the water dispenser 24;

Input condition 2: The collection tank 30 water level corresponds to high is detected (i.e. CH=1) and start-up purging has been completed (i.e. purging state=1); or

Input condition 3: The dispensing tank 30 water level corresponds to high (SH=1) and filter purging has been completed (i.e. purging state=2).

The one or more purging states as mentioned earlier can comprise four purging stages, hereinafter referred to as purging stages 0 to 3. The purging stages 0 to 3 are elaborated as follows:

Purging stage 0: Corresponds to normal dispensing and no purging;

Purging stage 1: Corresponds to a 'start-up' purging where the air-conditioner is operated for the first time or first instance. The first time or first instance may also refer to the first time or first instance after any manual reset of the air-conditioner unit 10.

Purging stage 2: Corresponds to 'filter' purging where the filter unit 36 is required to be cleaned and maintained; or where a new filter is replaced; and

Purging stage 3: Corresponds to a need to replace the filter unit 36 (e.g. after the air-conditioner unit 10 has been operated for more than a predetermined time period in hours or where the flow meter 50 reads a total volume of more than a predetermined volume, e.g. six-thousand (6000) litres).

Purging is performed primarily for cleaning and maintenance of certain components in the water filtration unit 18. In one operation example, when the air-conditioner unit 10 is turned on, the flow meter 50 operates to read or obtain the total volume of water that has been purged and dispensed. If the volume of the water purged and dispensed is less than a pre-fixed amount, say X cubic centimeters, it will continue to run at purging stage 1 which purge water from the collection tank 30 (i.e. 'start-up' purging). As the amount of water dispenses more than X cubic centimeters, the system switches to purging stage 2 to clean up the plurality of filters 36 and the dispensing tank 32 ('filter purging'). The purging operation stops when the amount of water dispensed is more than Y cubic centimeters. The system will switch into maintenance mode, denoted by purging stage 3 as the system has dispensed more than volume Z cubic centimeters. In purging stage 3, the user will be prompted to change the filter 36. Once changed, the user will be prompted to and press the purging button, which toggle the purging stage back to 1 to repeat the 'start up' purging procedure.

In some embodiments, the flow meter 50 may be reset. A reset of the flow meter 50 may trigger purging stage 1.

In Fig. 5, with reference to the conditions “10.1” to “10.5”, a purging state of 0 corresponds to the situation where the flow meter 50 reads a total volume of water dispensed to be above Y cubic centimeters and corresponds to the normal dispensing stage. The purging state 1 corresponds to either: (a) the flow meter 50
5 reads a total volume of water dispensed to be less than X cubic centimeters (where X is a pre-determined start-up purging volume).

A purging state 2 corresponds to the situation where the purging push button (PBN) is pushed (i.e. state of PBN = 1) OR where the flow meter 50 reads a total volume of water dispensed to be above X cubic centimeters AND the flow meter 50
10 reads a total volume of water dispensed to be less than Y cubic centimeters AND current purging state is equals to 1. Purging state 2 also corresponds to the state where new filter(s) are added and water flowing pass the new filters for the first time or instance is purged.

Finally, a purging state 3 corresponds to the situation where the total volume
15 of water dispensed is more than Z cubic centimeters and the purging state is equals to 0. Purging state 3 is triggered when the life span of filters is reached and the current purging stage is 0. An indicator may be displayed on the air-conditioner unit 10 to highlight purging state 3 so as to prompt a user to replace one or more of the plurality of filters.

In general, the water filtration unit 18 is switchable between a first state where
20 water from the collection tank is purged without filtration, and a second state where water from the dispensing tank 32 is filtered and then pumped to the water dispenser 24. Purging is necessary in situations where the air-conditioner unit 10 is used for the first time or when impurities have accumulated and some form of maintenance is
25 required. In one purging state, condensed water stored in the collection tank 30 may be directly purged without going through the filters. In another purging state, the filtered water stored in the dispensing tank 32 may be purged. In the dispensing state, instead of being purged, the filtered water is directed to the water dispenser 24.

Whether or not to activate purging depends on whether the filters and
30 dispensing tank 32 require cleaning and maintenance. One example where purging is essential would be the first usage of the air-conditioner unit 10.

In some embodiments, the filtered water stored in the dispensing tank 32 will be pumped to the water dispenser 24 after the quality of the filtered water has been checked and measured.

5 In various embodiments, and with reference to an arrangement shown in Fig. 7, the air-conditioner unit 10 comprises additional components to recover heat generated from the compression of the refrigerant for various usage and purpose. Through the arrangement of heat exchangers such as evaporator coils and condenser coils, heat gain from a component such as evaporator, which lead to reduction in temperature around the component, could be used to cool other
10 components. The arrangement shown in Fig. 7 may be used in implemented in the temperature regulation unit 12 and may be used conjunction with the condensate filtration unit 18. In alternative embodiments, the arrangement shown in Fig. 7 may be implemented in other air-conditioner units (not shown).

The components are connected as shown in Fig. 7 and comprise an electronic
15 controller (not shown), hereinafter referred to as a second electronic controller for clarity purposes, operable to control an electronic expansion valve-throttling device 104 to regulate the quantity of refrigerant flowing through the electronic expansion valve- throttling device 104 via adjustments of pressure and temperature. The second electronic controller may be integrated with the electronic controller 34 or
20 may be a separate and independent electronic controller. The second electronic controller is in data communication with at least one temperature sensor for sensing the environment (typically indoor) that the air-conditioner unit 10 is placed in, for example to sense the temperature of the condensed water, condenser coils, exhaust, and/or return gas temperature etc. In some embodiments, the input of the electronic
25 controller 34 may also be utilized. In some embodiments, multiple temperature sensors may be used. The second electronic controller may be pre-programmed to operate in at least four different modes depending on different priority(ies), including:

- a. Full feature mode (with hot water and cold water dispenser, cooling and refrigeration);
- 30 b. Temperature regulation mode (where cooling of environment is the main priority);
- c. Water dispensing mode (where dispensing drinkable water is the main priority); and

d. Refrigeration mode (where the provision of cold water is the main priority).

The arrangement of Fig. 7 seeks to provide a multi-functional air-conditioner system and comprises a compressor 101, condenser tubes/conduits 102, an evaporator 105, a condenser 103, a refrigerator or water-cooling apparatus 106, an electronic expansion valve-throttling device 104, condensed water purification system 207, and a humidifier/atomizer 203 suitable to humidify excess water. The condensed water purification system 207 may include the condensate filtration unit 18 as described in other embodiments. The condenser tubes/conduits 102 may be also referred to as a condenser interface.

In various embodiments, the condenser tubes/conduits 102 may be a heat exchanger at the inlet side of the condenser 103 for transferring heat from the compressed refrigerant to a water stream. The water stream for heating may be pumped from a condensed water tank 205. The water stream that is heated may be directed back to the hot water tank 203. In various embodiments, the compressed refrigerant may be in superheated state. In various embodiments, the compressed refrigerant at the outlet of the condenser tubes/conduits 102 may not be fully condensed (i.e. not saturated liquid). As such, condensation of the non-saturated liquid at the outlet of the condenser tubes/conduits 102 may be further performed.

In various embodiments, compressed refrigerant at the outlet of the condenser tubes/conduits 102 may be passed through the condenser 103, wherein the condenser 103 may be a heat exchanger for transferring or extracting heat from the compressed refrigerant to the environment or ambient air (dumping heat and entropy to the ambient air) as in a typical operation of a refrigerant cycle. As heat is removed or dumped to the ambient air, the compressed refrigerant may either condense from gaseous state to be in a substantially saturated liquid state or from non-saturated liquid state to substantially saturated liquid state depending on the amount of heat transferred to the water stream at the condenser tubes/conduits 102. In this case, the environment or ambient air may be the air that is outside of the room. In various embodiments, the heat that is removed from the compressed refrigerant may be referred to as the latent heat of vaporization.

At least one technical advantage for positioning the condenser tubes/conduits 102 at the inlet side of the condenser 103 may be to utilize the full heating capacity of the compressed refrigerant for heating the water stream and the condenser 103

may be used at the outlet of the condenser tubes/conduits 102 to complete the condensation of the refrigerant if it is in non-saturated liquid state.

In various embodiments, the condensed refrigerant at the outlet of the condenser 103 may be passed through the evaporator 105, wherein the evaporator 105 may be a heat exchanger for absorbing heat from the air to be cooled, for example the air inside the room. In various embodiment, the refrigerant may absorb heat form the air to be cooled and evaporate in the evaporator 105. The heat that is absorbed may be the latent heat of vaporization of the refrigerant. In various embodiments, the air to be cooled may contain water vapor or moisture (i.e. the air has a non-zero humidity) such that the said water vapor may condense as the air becomes cooled. In various embodiments, the condensed water vapor or condensate 2010 may be collected in a tray and directed or pumped to a condensed water tank 205 for recycling and further uses. In various embodiments, the condensate may be purified to drinkable standards or water fit for consumption via the water filtration unit 18 in the condensed water purification system 207. The purified water may then be pumped or channeled into the condenser tubes/conduits 102 for heating (as described above) or the refrigerator or water-cooling apparatus 106 for cooling (as described below).

In various embodiments, the refrigerant at the outlet of the evaporator 105 may have excess cooling capacity. A non-limiting example in which the refrigerant may have excess cooling capacity is when the refrigerant is not completely evaporated to gaseous state (i.e. the refrigerant vapor quality factor is not 100% or is not a saturated vapor). In this case, a refrigerator or water-cooling apparatus 106 may be located at the outlet of the evaporator for cooling water. In various embodiments, the refrigerator or water-cooling apparatus 106 may be a heat exchanger from transferring heat from a water stream to the refrigerant such that the water stream is cooled in the process. In various embodiments, the water stream for cooling may be pumped from a condensed water tank 205. The cooled water stream may be directed back to and stored in the cold water tank 204 for other uses. Therefore, at least one technical advantage for positioning the refrigerator or water-cooling apparatus 106 at the outlet side of the evaporator 105 may be to utilize the excess cooling capacity of the non-saturated gaseous refrigerant and also to

complete the evaporation of the refrigerant to a substantially or near or fully saturated gaseous state.

Thereafter, the refrigerant at the outlet of the refrigerator or water-cooling apparatus 106 may be directed or channeled back to the inlet of the compressor 101 to be compressed for the next cycle. In the foregoing, the refrigerant at the inlet of the compressor 101 may be substantially a saturated vapor state.

Non-limiting examples of heat exchangers that may be used include Shell and tube heat exchanger, Plate heat exchanger, Plate and shell heat exchanger, Adiabatic wheel heat exchanger, Plate fin heat exchanger, Pillow plate heat exchanger, Fluid heat exchangers, Waste heat recovery units, Dynamic scraped surface heat exchanger, Phase-change heat exchangers, Direct contact heat exchangers or Microchannel heat exchangers. Non-limiting examples of the flow arrangements in the heat exchangers may be counter-flow or parallel flow.

In the embodiment of Fig. 7, an air-conditioner compressor 101, which has an exhaust port, is connected to a condenser conduit/pipes 102 in a manner such that an outlet of the compressor 101 is connected to the inlet of the condenser conduit/pipes 102. The outlet of condenser conduit/pipes 102 is in turn connected to the inlet of the condenser 103. The outlet of condenser 103 is fed to the inlet of the electronic expansion valve-throttling device or expander 104, which is controlled by the second electronic controller to regulate the pressure and temperature of the refrigerant, the regulated refrigerant is in turn fed to the inlet of the evaporator 105. The outlet of the evaporator 105 may be fed to a refrigerator or water-cooling apparatus 106 for cooling of the same. The refrigerator or water-cooling unit 106 may be compact so as to form part of the temperature regulation unit 12.

The return air inlet of the compressor 101 is connected to a return pipe, such that after the condensate is collected via the return pipe, the condensate will then be purified to drinkable standards or water fit for consumption via the water filtration unit 18. The purified or filtered water will then pass through the condenser tube to be heated up and it can also pass through the cooling apparatus to be cooled down. The water dispenser 24 may comprise different water tanks for storage of water at different temperatures. When each of the respective water tanks of the water dispenser 24 are full or when the hot water tank is full, the humidifier 203 that is installed in the hot water tank will be activated in order to humidify the excess hot

water. This will help to maintain the humidity in the external environment and will bring greater comfort such that the cooling process does not cause the surrounding air to be too dry.

The at least four modes as highlighted will be described and elaborated as follows:

In the full feature mode, the compressor 101 compresses the air-conditioner refrigerant into a gaseous state at a high temperature and a high pressure, and passes the refrigerant through the condenser tubes/pipes 102. Upon receipt of the purified drinking water, the purified water is passed through the condenser interface 102 that takes away a large portion of heat energy, resulting in cooling of the refrigerant and heating of the purified water. The purified water then becomes drinkable hot water. When the hot water tank 202 is full, and there is a need to operate the cooling system to achieve cooling, the excess hot water will be humidified so as to ensure that there is sufficient water that is taking away the heat). The refrigerant then passes through the condenser (which turns the high temperature high pressure gaseous refrigerant into liquid state at medium temperatures and medium pressure). Using the second electronic controller, the electronic expansion valve-throttling device 104 issues electronic signals for dynamic adjustments, and processes the refrigerant at medium temperature and medium pressure to become a liquid state at low temperatures and low pressure. The low temperature and low pressure refrigerant then enters the evaporator 105. The evaporator 105 releases the cooling capacity of the refrigerant and the refrigerant becomes a liquid state or a mixed liquid-gaseous state at low temperatures and low pressure, when this then passes through the refrigerator or water-cooling apparatus 106, the excess cooling capacity will be absorbed by the water and the refrigerator (to become cold drinking water and/or to create a low temperature refrigeration environment). The gaseous refrigerant (at low temperature and low pressure) then returns to the compressor and the work cycle can be repeated.

In the air-conditioning (temperature regulation) mode (where cooling of temperature is of priority): the compressor 101 compresses the refrigerant into a gaseous state at high temperatures and high pressure, and passes this through the condenser tubes (the purified drinking water takes away a large amount of heat and becomes drinkable hot water, when the hot water tank 202 is full, and due to the

need to operate the temperature regulation function, the hot water will be humidified so as to ensure that there is sufficient water that is taking away the heat energy), the refrigerant then passes through the condenser 103 (which turns the high temperature high pressure refrigerant into liquid state at medium temperatures and medium pressure). Based on the electronic control input received from the second electronic controller (the electronic control senses the temperature indoors, and sets the temperature, the temperature of the evaporator coil, condensing temperature, condenser coil temperature, exhaust gas and return gas temperatures etc.), the electronic expansion valve-throttling device 104 issues commands for dynamic adjustments, and processes the refrigerant at medium temperature and medium pressure to become a liquid state at low temperatures and low pressure, this then enters the evaporator 105 (the evaporator 105 releases the cooling capacity of the refrigerant, and in addition a wind generator will be activated and set at low speed, although the user can adjust the wind speed if need be). The refrigerant next becomes a liquid state or a mixed liquid-gaseous state at low temperatures and low pressure, when this then passes through the refrigerator or water-cooling apparatus 106, the excess cooling capacity will be absorbed by the water and the refrigerator (to become cold drinking water and to create a low temperature refrigeration environment). The gaseous refrigerant then returns to the compressor and the work cycle can be repeated. Due to the need for cooling as priority, when there is insufficient condensate to take away the heat, a suitable amount of cold water should be added timely into the water tanks.

In the water dispenser mode, where the provision of drinkable water is of priority, the work flow is similar to the air-conditioner mode except that the air-conditioner unit 10 operates to maximize the filling up of the water dispenser 24 and tanks 20 and the wind generator may be turned on/off to maximize the formation of condensate.

Where the formation of cold water is the main priority, the workflow is similar to the full feature mode except that the wind circulation will be set to a 'breeze mode' which is suitable for both cooling and formation of the condensate.

In the described embodiment in Fig. 7, check valves 206, 208 and 209 may be provided and positioned at the outlet of water tanks 202, 204 and 205 to prevent backflow of water.

In various embodiments, non-limiting examples of refrigerant or working fluid that may be used include R-22, R-410A, R-407C, R-134a, ammonia, sulfur dioxide and non-halogenated hydrocarbons such as propane. The choice of refrigerant may be optimized based on at least the temperature required for hot and cold water as well as the ambient and room temperatures since every refrigerant may have different operating temperatures and pressures depending on their phase transition (liquid to gas and vice versa) characteristics.

The invention seeks to provide a multi-purpose system that serves as a portable air conditioner and a hot (cold) drinking water dispenser. Through the utilization of electronic controlling mechanisms to adjust the electronic expansion valve-throttling device 104 and the switching between different operation modes such as purging and dispensation, such a system also increases the efficiency of the air conditioner and the water dispenser, decreases the use of electricity, decreases the amount of heat that is released into the environment. This is in part due to the utilization of water condensate by purifying the condensate to drinkable standards, and to heat up or cool down purified water, such that any excess cold energy can be utilized in a small refrigerator or water-cooling apparatus or refrigerator equipment 106, and can be used to control the refrigerator temperatures to be between 5 degrees to 15 degrees Celsius (with stable performance).

In addition, the purified condensate may be heated to a suitable temperature so as to provide drinking water. The system will also reduce heat released into the environment, reduce condensing pressure, and reduce the electricity required by the equipment. The quantity of the refrigerant is controlled automatically through the electronic expansion valves according to the temperatures in the cooling system. This will help to save electricity, increase efficiency and allow the system to perform stably and reliably.

In some embodiments, the electronic controller 34 may be implemented on one printed circuit board (PCB) for compactness. Alternatively, the electronic controller 34 may be implemented on multiple PCBs. In the implementation of logic for control, the different functions associated with heating, cooling or refrigeration, filtration of water, may be implemented with different priority associated with it. Further, control of such functions may be optimized. Non-exhaustive factors that may affect the prioritization and optimization include: temperature of the environment,

temperature of the condenser, temperature of the evaporator coils, water temperature at various locations, flow rate of condensed water etc.

5 In some embodiments, when the air-conditioner or condensate filtration unit is first used, so as to maximize the cooling ability, and to wash the drinkable water tubes most efficiently, a suitable amount of cold water can be manually added according to the size of the water tanks. Furthermore, to ensure that the water is safe for drinking, the user can run an extra cycle of the washing (purging) function in the water dispenser system.

10 In some embodiments, the air-conditioner and water filtration system may be separated.

While the embodiments have been described using water as the condensate, it is to be appreciated that other condensate obtainable from an air-conditioner could be purified and stored.

15 The above is a description of embodiments of systems and methods in accordance with the present invention. It is envisioned that those skilled in the art can design alternative embodiments of this invention that falls within the scope of the invention. In particular, it is to be appreciated that features from various embodiment(s) may be combined to form one or more additional embodiments.

CLAIMS

1. An air-conditioner unit comprising:
 - a temperature regulation unit having a condenser;
 - 5 a tray for collecting a condensate from the condenser;
 - a condensate filtration unit comprising
 - at least one conduit connected to the tray and arranged to receive the condensate from the tray;
 - a collection tank to store received condensate from the tray;
 - 10 a dispensing tank for storage of filtered condensate;
 - a filter unit arranged to receive condensate from the collection tank and direct filtered condensate to the dispensing tank;
 - a dispenser arranged to receive filtered condensate from the dispensing tank;
- 15 wherein the air-conditioner unit comprises a controller to operate the condensate filtration unit between a plurality of purging states, the plurality of purging states comprises a first purging state wherein condensate stored in the collection tank is purged bypassing the filter unit and a second purging state wherein filtered condensate from the dispensing tank is purged.
- 20 2. The air-conditioner unit according to claim 1, wherein the temperature regulation unit and condensate filtration unit are shaped and dimensioned such that the condensate filtration unit is arranged below the temperature regulation unit.
- 25 3. The air-conditioner unit according to claims 1 or 2, wherein the condensate filtration unit is a water filtration unit and comprises a plurality of filters arranged to receive condensate from the collection tank and direct filtered condensate to the dispensing tank.
- 30 4. The air-conditioner unit according to claim 3, wherein in the first purging state, condensate from the collection tank is sent

directly to a dispenser pump bypassing the plurality of filters, and in the second purging state condensate is sent to the plurality of filters.

5. The air-conditioner unit according to claim 3 or 4, wherein the collection tank comprises a first outlet and a second outlet, such that in the first purging state, condensate from the collection tank is sent directly to a dispenser pump for purging via the first outlet, and in the second purging state, condensate from the collection tank is directed to the plurality of filters via the second outlet.
6. The air-conditioner unit according to any one of the preceding claims, wherein the controller is an electronic controller that operates to receive the following as inputs:
 - a. the level of condensate stored in the collection tank; and
 - b. the level of filtered condensate stored in the dispensing tankthe electronic controller operable to provide an output corresponding to the activation or opening of at least one valve.
7. The air-conditioner unit according to claim 6, wherein the condensate filtration unit comprises a flow meter operable to obtain a total volume of condensate passing through the flow meter from a preset time as another input.
8. The air-conditioner unit according to claim 6 or 7, wherein the inputs are binary inputs.
9. The air-conditioner unit according to claim 8, wherein the output is a binary output.
10. The air-conditioner unit according to claim 7, wherein if the total volume of condensate passing through the flow meter is less than a first pre-fixed amount X, the controller operates the condensate filtration unit in the first purging state.
11. The air-conditioner unit according to claim 10, wherein if the total volume of condensate passing through the flow meter is more than the first pre-fixed

amount X but less than a second pre-fixed amount Y, the controller operates the condensate filtration unit in the second purging state.

- 5 12. The air-conditioner unit according to claim 11, wherein if the total volume of condensate passing through the flow meter is more than a third pre-fixed amount Z, the controller operates the condensate filtration unit in the third purging state corresponding to a maintenance mode and a prompt to a user to change the filter unit.
- 10 13. The air-conditioner unit according to claim 12, wherein if the total volume of condensate passing through the flow meter is more than the second pre-fixed amount Y but less than the third pre-fixed amount Z, the controller operates the condensate filtration unit in a dispensing state.
- 15 14. The air-conditioner unit according to any one of the preceding claims, further comprising a first ultra-violet source that operates to disinfect the condensate in the collection tank.

15. The air-conditioner unit according to any one of the preceding claims, further comprising a second ultra-violet source that operates to disinfect the filtered condensate in the dispensing tank.
- 5 16. The air-conditioner unit according to claim 1, wherein the temperature regulation unit comprises a second electronic controller and an electronic expansion valve throttling device, the second electronic controller operates to regulate the amount and state of refrigerant flowing pass the expansion valve throttling device.
- 10 17. The air-conditioner unit according to claim 16, wherein the second electronic controller is operable to switch the temperature regulation unit between a full feature mode and a priority mode.
- 15 18. The air-conditioner unit according to claim 17, wherein the priority mode comprises a cooling priority mode, a water dispensing priority mode, and a refrigeration priority mode.
- 20 19. The air-conditioner unit according to any one of claims 16 to 18, wherein the temperature regulation unit comprises an evaporator and a refrigerator, the evaporator arranged to be connected to the refrigerator such that heat energy absorbed by the evaporator results in the cooling of the refrigerator.
- 25 20. The air-conditioner unit according to claim 19, wherein the evaporator and condenser are arranged such that a portion of the heat energy generated by the condenser is passed to the evaporator.
- 30 21. The air-conditioner unit according to any one of the preceding claims, comprising a dispenser having a first compartment for storage of hot water and a second compartment for storage of cold water.
22. The air-conditioner unit according to claim 21, wherein the first compartment comprises a humidifier.

23. A condensate filtration unit for use with a portable air-conditioner unit, comprising at least one conduit connected to a condensate container and arranged to receive condensate from the condensate container; the condensate filtration unit further comprising a collection tank to store received condensate from the condensate container; a dispensing tank for storage of filtered condensate; a filter unit arranged to receive condensate from the collection tank and direct filtered condensate to the dispensing tank; a dispenser arranged to receive filtered condensate from the dispensing tank; wherein the condensate filtration unit comprises a controller to operate the condensate filtration unit between a plurality of purging states, the plurality of purging states comprises a first purging state wherein condensate stored in the collection tank is purged bypassing the filter unit and a second purging state wherein filtered condensate from the dispensing tank is purged.
24. A method for obtaining condensate from an air-conditioner unit comprising the steps of:
- a. collecting a condensate from a condenser;
 - b. directing the condensate via at least one conduit to a condensate filtration unit, the condensate filtration unit comprises a filter unit;
 - c. storing the condensate in a collection tank;
- wherein upon receipt of an electronic signal,
- d. operating the condensate filtration unit between a first purging state and a second purging state;
- wherein in the first purging state, condensate stored in the collection tank is purged bypassing the filter unit;
- and wherein in the second purging state, condensate in the collection tank is directed pass the filter unit to a dispensing tank; and condensate in the dispensing tank is purged.