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(54) **TWO STAGE EVAPORATIVE COOLING APPARATUS**

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(57) **ABSTRACT**

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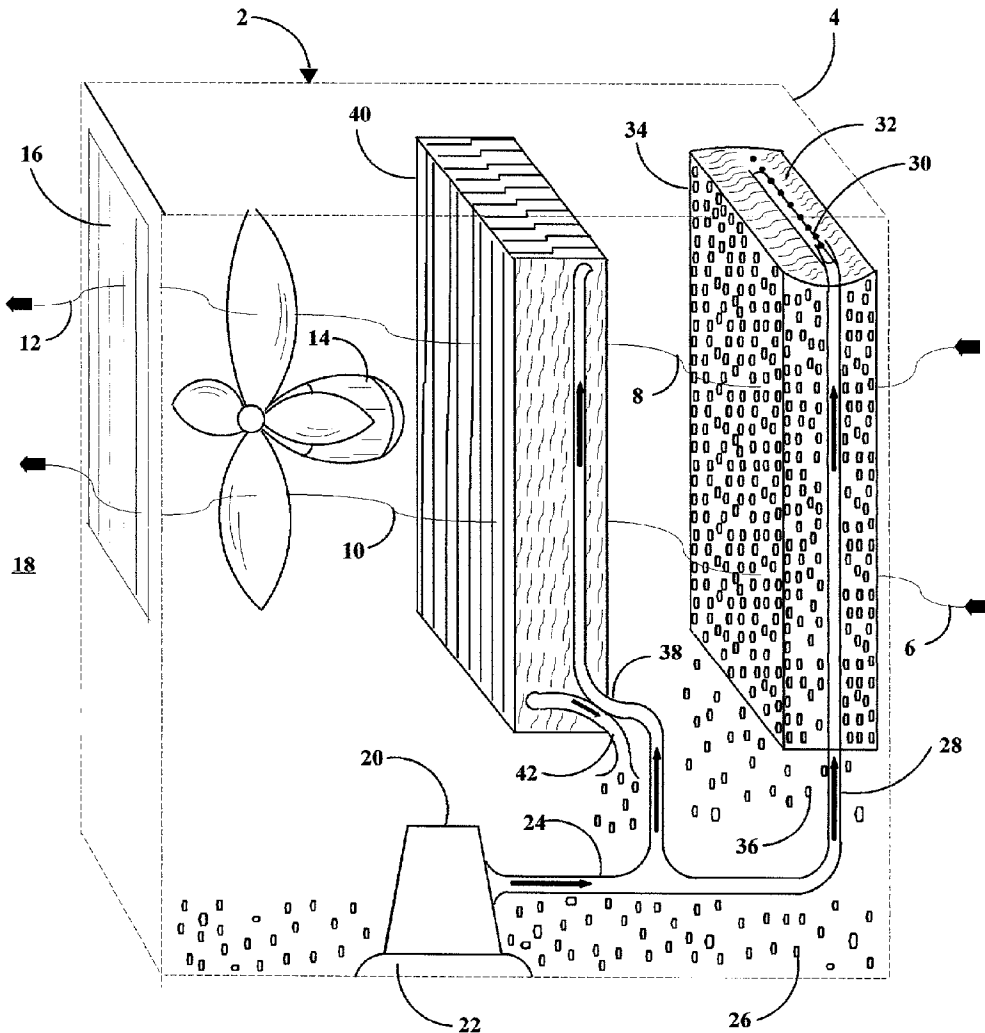
A two-phase versatile evaporative cooling heat exchange apparatus **2** for use to produce cool air for homes, factories or for use in vehicles both stationary and moving. The vessel **4** contains the components needed so ambient air **6** is drawn or forced into the evaporative pad **32** to begin the cooling process. The evaporative pad **32** is wetted by thermal liquid **26** being distributed by pump **20** for the first phase cooling **8**. The evaporation process uses a portion of the thermal liquid **26** with the remaining, now cooled, excess thermal liquid **36** being returned to the base of vessel **8**. The cooled thermal liquid **26** is pumped through the heat exchanger **40** for the second phase cooling **10**. The cooled air **12** is delivered into the occupant space **18**.

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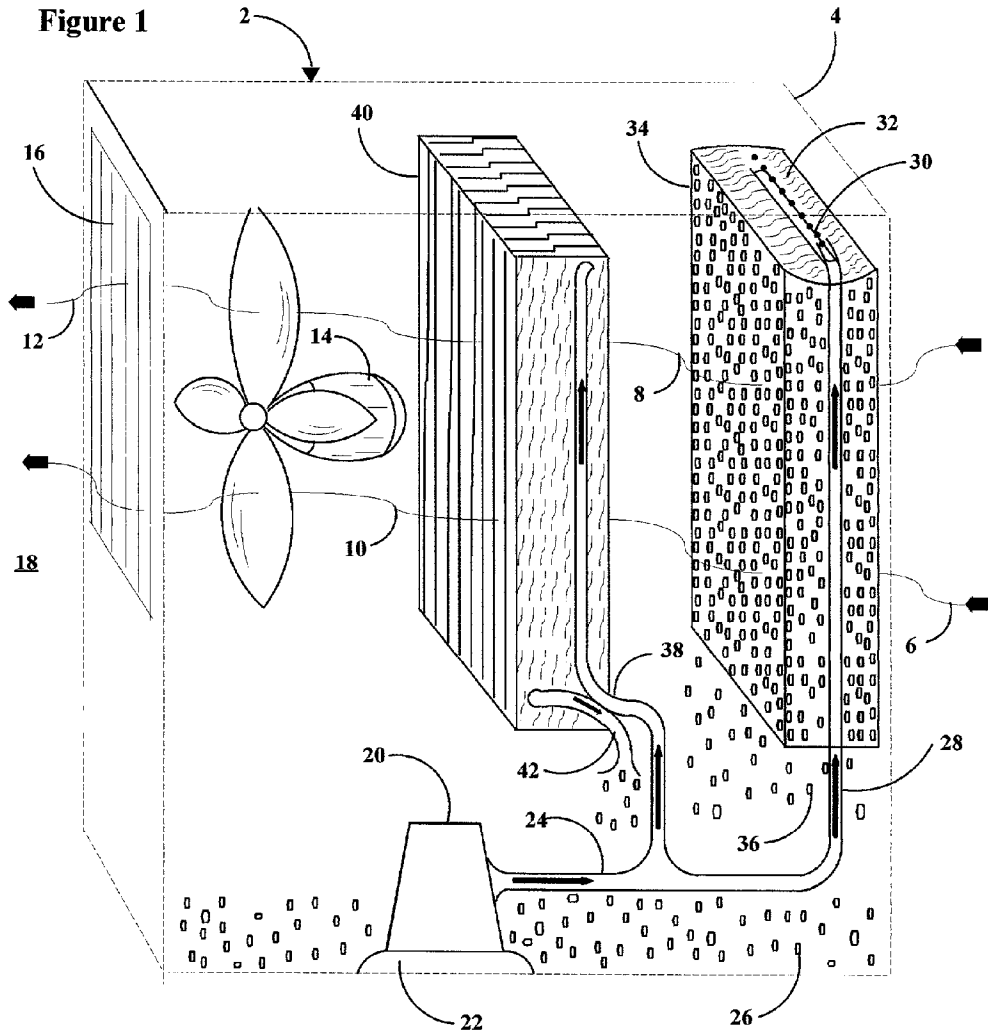
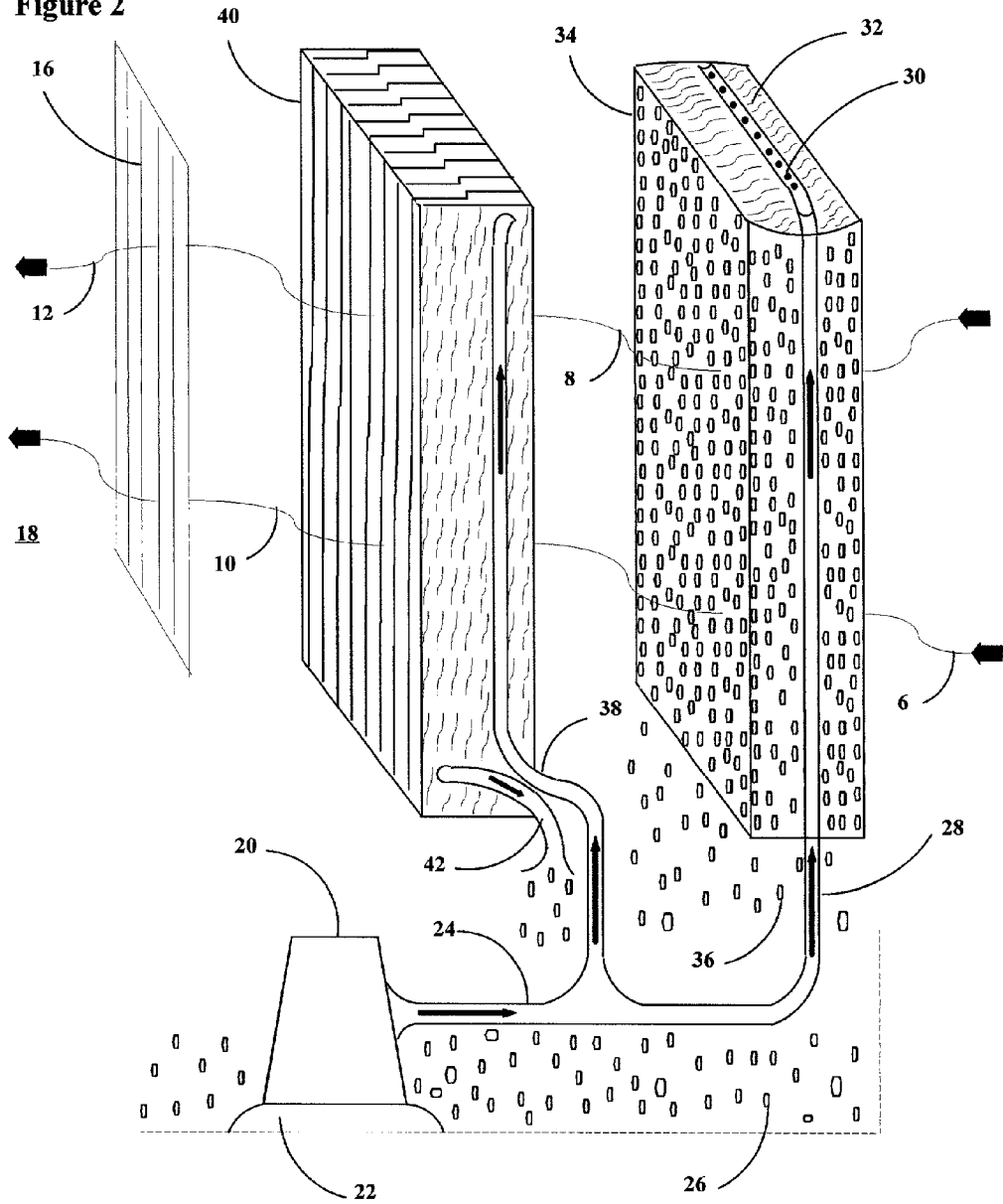


Figure 2



## TWO STAGE EVAPORATIVE COOLING APPARATUS

### BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] This invention relates to an Evaporative Cooler in combination with a Heat Exchanger to produce colder temperatures with lower humidity than the single stage evaporative coolers now available, and more specifically to a two stage cooling apparatus that is economically produced in various sizes for cooling people and spaces.

[0003] 2. Description of the Prior Art

[0004] Evaporative cooling is an age-old art of drawing or pushing ambient air through a pad material of various types, wetted with water, which results in cooling through evaporation. Improvements in this art have evolved over the years, however they have been minor, as the basic system remains very much the same by providing cooling at a very low energy cost.

[0005] Using a heat exchange system in conjunction with evaporative process improves cooling and keeps production costs reasonable and does not necessarily increase energy consumption. Prior art combining evaporative cooling with a heat exchanger have not taken full advantage of the cooling effect provided by the evaporative cooling portion of the system.

[0006] As an example; the placement of the heat exchanger in U.S. Pat. No. 4,361,525 to Leyland 1982 and U.S. Pat. No. 4,284,128 to Nelson 1981 do not take advantage of the water being cooled by the evaporative system. In Leyland the heat exchanger is subject to the full force of the ambient air instead of allowing the evaporative cooler to temper the ambient air and in Nelson the water for the heat exchanger is supplied from a separate source.

[0007] The inherent result of using evaporative cooling is the ensuing increase in humidity. The colder the water becomes the colder the temperatures and the dryer the air. It is possible to decrease the temperature of the water further with the optional use of the common picnic type freeze packs or other cooling mediums like ice which will produce colder, dryer air.

[0008] Using a heat exchange system alone without evaporative cooling does not result in the coldest air and leads to a lack of all cooling in a short period of time. In previous attempts the mechanism may produce cool air, such as claimed under U.S. Pat. No. 5,685,165 to Bigelow Jr. 1997, however when the cooling material such as ice has melted all cooling ceases.

### BRIEF SUMMARY OF THE INVENTION

[0009] It is thus an object of the present air-cooling invention to utilize two stage cooling by incorporating a heat exchanger with evaporative cooling for use as portable or permanently mounted units to cool occupants or equipment.

[0010] It is another object of the present invention to have a versatile and more powerful cooling system than is presently available with single stage evaporative cooling, which is capable of delivering cool air in areas wherever needed.

[0011] It is another object of the present invention to enable the cooling system to be safely operated in residential, commercial or even in a moving vehicle, plus simple, dependable, and reliable in construction.

[0012] It is another object of the present invention to make it economical to purchase in either an AC or DC configuration with no special skills needed for installation, except possibly in the case of some permanently mounted systems.

[0013] The present invention accomplishes the above-stated objectives, as well as others, as may be determined by a reading and interpretation of the entire specifications.

[0014] A permanently installed refrigerated air conditioner in a vehicle, home or place of business is the most precise cooling devise in a climates, however they are the most costly. In the case of a many older homes, apartments and vehicles installing an air conditioner might be impossible because of the lack of proper energy. In the case of domestic use the wiring may be inadequate and unsafe for the energy load and in the case of a vehicle there may not be enough horsepower or engine cooling capacity to safely operate an air conditioner.

[0015] Vehicles sitting in the summer sun for more than a few minutes will build up an intense heat. The operator of a vehicle without air conditioning will often dwell too much on being uncomfortable and loose focus on the safe operation of the vehicle.

[0016] The operator needs to receive cool air as soon as possible and the only way to achieve that is to have some form of portable cooling if the vehicle is not equipped with built-in air conditioning. Portable vehicle coolers must be efficient as they depend on the limited power of a battery for their source of energy.

[0017] The present invention, used in a vehicle, is strapped down in an out of the way location without hampering the safe operation of the vehicle. The power cord for the cooler is at the fingertips of the operator so they do not take their eyes off the road to control the cooling.

### BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0018] The drawings will point out the method used to comprise a versatile two stage cooling system, which is more efficient than presently available single phase evaporative cooling.

[0019] FIG. 1 is a view of the Evaporative Cooler Heat Exchange Apparatus components contained in a vessel.

[0020] FIG. 2 highlights the heat transfer method.

### REFERENCE NUMERALS IN DRAWINGS:

[0021] 2. Heat exchange apparatus designates the heat exchange system.

[0022] 4. Vessel used to contain the necessary material to produce the results.

[0023] 6. Ambient Air that will be conditioned through the heat exchanger.

[0024] 8. First phase cooling uses the evaporation principle.

- [0025] 10. Second phase cooling uses the heat exchange principle.
- [0026] 12. Cooled conditioned air is the result of using the two cooling principles.
- [0027] 14. Blower/Fan used to draw or push the ambient air through the exchanger.
- [0028] 16. Air outlet(s) through which the conditioned air is distributed outwards.
- [0029] 18. Occupants space where the conditioned air is utilized.
- [0030] 20. Pump motor pumps the thermal liquid.
- [0031] 22. Pump inlet to take in the thermal liquids for distribution outwards.
- [0032] 24. Pump outlet for outward distribution of the thermal liquids.
- [0033] 26. Thermal liquids like ice and water.
- [0034] 28. Pad inlet hose to dispense thermal liquid.
- [0035] 30. Distribution outlet for dispensing thermal liquids into the evaporative pad.
- [0036] 32. Evaporative Pad Material used to evaporate the thermal liquids rapidly.
- [0037] 34. Pad retainer designed to hold the evaporative pad material.
- [0038] 36. Spent excess thermal liquid cooled by evaporation returns for reuse.
- [0039] 38. Core inlet hose into the heat exchanger.
- [0040] 40. Heat exchanger is generally, but not limited to, a heater core in design.
- [0041] 42. Core outlet hose from the heat exchanger.

#### DETAILED DESCRIPTION OF THE INVENTION

[0042] FIG. 1 shows a diagram of the Two Stage Evaporative Cooler Heat Exchange Apparatus 2, in which components are contained in vessel 4. Ambient air 6 is drawn or forced through the vessel 4 by using any blower/fan system 14. The ambient air 6 first enters the evaporative pad material 32 where the first phase cooling 8 occurs, then travels through the heat exchanger 40 where the second & final phase of cooling 10 occurs. The conditioned air is then released through vessel 4 air outlet(s) 16 into the occupant space 18.

[0043] FIG. 2 shows a diagram of the heat transfer method. Pump motor 20 has a suction inlet 22 and an outlet 24 to distribute thermal liquids 26. Pump motor 20 pumps thermal liquids 26, such as water, outward through pump exit hose 24 for release to pad inlet hose 28 and to core inlet hose 38.

[0044] Thermal liquid 26 is pumped through pad inlet hose 28 travels into a distribution outlet 30 for release of the thermal liquids 26 into an evaporative pad material 32 contained in the pad retainer 34. The, now cooled, unspent thermal liquid 36 returns to the base of vessel 4 for redistribution through pump 20. The more times the thermal

liquids 26 are re-circulated in this manner the greater the results in maintaining colder thermal liquid 26 in the base of vessel 4 which results in producing colder dryer air into the occupant space 18.

[0045] Thermal liquids 26 are pumped through core inlet hose 38 for circulation into the heat exchanger 40 at the same time thermal liquids 26 are being circulated through the evaporative pad material 32. The thermal liquids 26 are then released from heat exchanger 40 through core hose outlet 42 to be either returned to the base of vessel 4 for reuse by pump 20 or disposed of externally.

[0046] The results of combining the efficiency of evaporative cooling with a heat exchanger to produce colder air with this two stage cooling system are very evident. Utilizing the low cost and simplicity of evaporative cooling and incorporated with a simple heat exchanger has been tried in the past. However, using the excess cooled water created by evaporation for circulation through the heat exchanger to remove more heat from the air, with this present invention, takes evaporative cooling to a new level of cooling capacity.

[0047] The present invention is adaptable to residential and commercial as is evident by the varied use of present evaporative coolers. Also, because the invention may be configured into a small portable package with DC power, it also fills the need in vehicles such as trucks, cars, tractors, campers, boats, airplanes or other vehicles that do not have the benefit of an air conditioner.

1. An air conditioning system utilizing evaporative cooling and a heat exchanger to produce cooler air than an evaporation system alone.

a primary vessel containing a means to draw ambient air first through an evaporative pad, and secondarily through said heat exchanger then disbursing the conditioned cooled air outwards;

a pump located in said vessel for pumping thermal liquid to said evaporative pad and said heat exchanger;

a downward passing of said thermal liquid through said evaporative pad is partially evaporated leaving excess said thermal fluid, now cooled, to return to the base of said primary vessel for reuse;

said thermal liquid, that has been cooled by evaporation, is pumped into said heat exchanger to add the other element of cooling before said conditioned cooled air is distributed outside of said vessel;

2. The present invention versatile enough that it may be operated on either AC or DC current and of the size that would satisfy permanent installation or portable use.

a permanently installed cooling unit of said present invention design that would be of the capacity to cool a home or industrial building.

a portable cooling unit of said present invention design that would be small enough to be transported from area to area.

a portable cooling unit of said present invention design that would be small and safe enough to be operated even in a moving vehicle.

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