

PORTABLE COOLER

[0001] The present application relates to a portable cooler with cooling means. The application also relates to methods for making, modifying, installing, assembling, maintaining, configuring and using the portable cooler.

[0002] Food centres in Singapore provide a venue for purchasing and consuming food and beverages. A typical food centre usually has hot environment where diners have to dine in discomfort, especially during lunch time. Heat in the food centres is generated by many stalls who prepare food and beverages by stoves, ovens, machineries and even refrigerators. The heat is also contributed by natural heat propagated from the sun on a hot day. Heat in the food centres is aggravated by high humidity and poor air circulation causing the diners to perspire and feel grimy on their skin.

[0003] The present application aims to provide a portable cooler for providing cooling or pleasant environment to diners. The application also aims to present new and useful methods for making, modifying, installing, maintaining, configuring and using the portable cooler. Essential features of the application are provided by one or more independent claims, whilst advantageous features are presented by their dependent claims.

[0004] In one aspect, the present application provides a portable cooler that comprises a supporting fixture (e.g. baseplate, railing) for upholding or supporting an object (e.g. user) on top of the supporting fixture. The supporting fixture is optionally a plate, a platform, a bed or any other base, buttress, column, prop, pole, or shaft. The portable cooler also comprises a supporting stand (e.g. table stand or hollow cylinder) that is connected to the supporting fixture for raising the supporting fixture above the ground to a predetermined height. Advantageously, the supporting stand is adjustable in height so that the supporting fixture is able to be fixed at a desired height. For example, the supporting stand is telescopically extendable in its length or height so that the supporting fixture is kept away from dust, pest, wheels or human feet on the ground. The portable cooler comprises one or more ducts, tubes or tunnels connected to the supporting structure or the supporting stand for channelling a cooling stream to a side of the portable cooler. For example, the one or more ducts, tubes or tunnels have openings at one or more edges, sides or surfaces of the portable cooler so that the cool stream is directed

to one or more users of the portable cooler, especially at the portable cooler's proximity (e.g. near an edge of the supporting fixture).

[0005] Particularly, the supporting structure, the supporting stand or both are optionally
5 integrated into one or more pieces of furniture items such that the portable cooler has an
outlook of a piece of furniture, such as a chair, a stool, a table, a bed, a cupboard. For
example, the supporting base or supporting fixture comprises a tabletop (e.g. countertop,
counter top, counter, benchtop, worktop, or kitchen bench) for keeping tableware or
10 tableware items on top of the tabletop or the supporting fixture, which has the appearance
of a table having the portable cooler. Alternatively, the supporting fixture comprises a
plank or board of a cupboard so that cool streams of air may be discharged from side
edges or top surfaces of the plank or board, cooling the cupboard and its surroundings.
A diner who sits next to the "table" is able to enjoy cool stream of air that is discharged
15 from a circular edge of the table, which is actually delivered by the supporting fixture with
one or more ducts at its sides or peripheral edge.

[0006] The supporting fixture can alternatively comprise one or more seats (e.g. stool,
chair) for supporting a person. In other words, the portable cooler becomes a stool or
chair that is able to deliver the cool stream of air or other cooling media (e.g. mist, dry
20 ice). In contrast or addition to the supporting structure as a tabletop, the supporting stand
of a seat has one or more orifices or nozzles that are connected to the one or more ducts,
discharging cool streams of air to legs of diners sitting on the seat. Hence, one or more
of the fan assemblies can be installed in a food centre, provide effective and efficient
cooling to diners.

25 [0007] The supporting fixture, the supporting stand or both optionally comprise one or
more rails, bars, shafts, pillars, panels or walls that have orifices, openings or nozzles for
discharging the cool streams of air or other cooling media. For example, the rail includes
a hand-rail at a bus stop, a bus terminal or a public transport interchange station (known
30 as interchange) so that passengers at the bus stop, the bus terminal or the interchange
are able to enjoy the cool streams of air when waiting for their buses. Energy
consumption of the rail-type portable cooler is much lower than ordinary electric fan, which
blows hot air almost aimlessly from a distance.

[0008] The portable cooler may further comprise one or more nozzles on a surface or edge of the portable cooler (e.g. supporting fixture or stand). The one or more nozzles are connected to the one or more ducts for directing the cool stream towards one or more users of the portable cooler or to a close proximity of a user. The one or more nozzles are able to be regulated for adjusting flow rate of the cool stream through the one or more nozzles, whether automatically or manually. Users of the portable cooler is able to adjust direct, opening size, flow rate or even temperature the cool stream by controlling the portable cooler. The one or more nozzles may additionally comprise one or more valves for regulating (e.g. changing flow rate, opening size or direction of) the cool stream from the nozzle.

[0009] The one or more nozzles can be configured to shut off or open automatically. For example, a door of the one or more nozzles is activated by the seat of the supporting fixture or base so that the one or more nozzles of a stool with the portable cooler discharge cool streams of air if seated by a diner, as triggering or activation. Cool streams of air are conserved from wasteful usage, especially when diners are not present on or next to the portable cooler.

[0010] Embodiments of the portable cooler further comprise an electric fan or automatic fan that is connected to the one or more ducts, nozzles or both for driving the cooling stream through the duct. The electric fan is able to accelerate or propel air stream in the one or more ducts so that diners or users are able to feel strong air stream when desired. The portable cooler optionally comprises one or more sensor or ambient sensors (e.g. temperature, humidity, light, proximity sensors) or timers that are connected to a controller or computer. The portable cooler becomes able to respond to surrounding situations (e.g. temperature, people, time) in order to provide customised or optimised cooling. For example, the portable cooler is able to accelerate or propel more air stream if detecting hot ambient temperature (e.g. $>35^{\circ}\text{C}$). The sensor is alternatively known as a detector for operating the portable cooler or observing ambient of the portable cooler automatically.

[0011] The one or more ducts optionally comprises multiple channels in the supporting fixture or the supporting stand for guiding the cooling stream to a lateral edge of the supporting fixture. For example, the one or more ducts include tunnels or tubes that are radially connected at their ends and the tunnels are provided in the tabletop, between a

top surface and a bottom surface of the tabletop. The common ends of the ducts, channels or tunnels are connected to an inlet, or further to the electric fan so that nozzles or openings at opposite ends of the ducts, tunnels or tubes are able to deliver multiple cool streams of air radially, providing thermal comfort to diners at the portable cooler or tabletop.

[0012] The portable cooler may further comprise a heat exchanger (e.g. air conditioning device or air-conditioner) that is connected to the one or more ducts for providing the cooling stream having temperature lower than an ambient temperature of the portable cooler. The heat exchanger not only is able to deliver cool air to the diners, but also is able to provide hot water to kitchens or stalls. Energy consumption or effectiveness of the heat exchanger becomes much lower than merely providing cool air (e.g. cooling by refrigerant) or hot water (e.g. heating by coal) alone. For example, the heat exchanger comprises a heat pump or an air source heat pump for providing both hot water up to 55~60°C and the cool stream of air.

[0013] Particularly, the heat exchanger can comprise an evaporative cooler for drawing water automatically, without or without a pump. The evaporative cooler consumes less energy as compared to air-conditioners, and also offer cool air of reasonable comfort. For example, the evaporative cooler is able to deliver cool air stream of 2~5°C lower than its ambient air temperature.

[0014] The evaporative cooler optionally comprises a concealed or automatic water collector for keeping freshwater for the evaporative cooler. Pest or external disturbance (e.g. by kids playing) is effectively prevented, making maintenance of the evaporative cooler easier. For example, the water collector of the evaporative cooler has an automatic feeder of freshwater (e.g. by water level sensor) so that the water collector is automatically kept full or at a predetermined level if connected to a water source (e.g. water tap).

[0015] Embodiments of the portable cooler provide the evaporative cooler that comprises a capillary material or porous material for drawing water automatically without a pump, opposite to the direction of gravity. Alternatively, the portable cooler includes the capillary material or porous material directly such that the cool streams are able to flow over the

capillary material or porous material, providing additional cooling by evaporation of cooling fluid(s) or refrigerant(s), such as water.

5 [0016] Since drawing of freshwater by the capillary material does not require a pump, the evaporative cooler becomes quiet and optionally requires much less electric power consumption. For example, the capillary material comprises a foam (e.g. silicon carbide ceramic foam filter, metal foam) that has a pore size of 10mm (millimetres), 8mm, 6mm, 10 5mm, 4.5mm, 3.5mm, 2.8mm, 2.1mm, 1.8mm, 1.4mm, 1.2mm, 1mm, 08mm, 0.6mm, 0.4mm, 0.2mm or smaller. The capillary material alternatively includes one or more cluster of thin tubes for drawing water. Diameters of the tubes range from 10mm (millimetres), 8mm, 6mm, 5mm, 4.5mm, 3.5mm, 2.8mm, 2.1mm, 1.8mm, 1.4mm, 1.2mm, 1mm, 08mm, 0.6mm, 0.4mm, 0.2mm or smaller. The capillary or porous material further includes aerated concrete, gypsum plaster, clay brick, mortar, concrete brick or cured concrete and sponge.

15 [0017] The heat exchanger may comprise a thermal energy storage material (i.e. thermic material) for absorbing heat from the cooling stream. The thermal energy storage material may include one or more materials with latent heat or high heat capacity so that the thermal energy storage material is used to absorb heat of air stream when flowing 20 over it, offering the cool air stream.

[0018] The portable cooler optionally comprises a renewable energy harvester (e.g. solar panel) for powering the portable cooler. The renewable energy harvester includes wind turbine, geothermal energy collector, bio energy harvester (e.g. waste food composter) 25 that possibly provides auxiliary power source to the portable cooler.

[0019] In the present application, the portable cooler optionally comprises one or more dinning furniture (e.g. dining table, stool, chair, kitchen top) having its supporting stand on the ground, and one or more ducts are connected to an external source of the cool 30 stream. The one or more dining furniture items may be independently operated, mutually connected or centrally powered.

[0020] Embodiments of the portable cooler or any of its components are mobile, permanent or detachable (e.g. the supporting stand has wheels). For example, a nozzle

of the portable cooler has a catch so that a technician is able to click or snap a replacement nozzle when repairing.

[0021] The present application provides a residence for providing a cooling ambient to
 5 diners. Example of the residence includes office, building, eating place, hawker centre, coffee shop, bar, cafeteria, dining room, canteen, chophouse, pizzeria, night club, soda fountain, saloon, restaurant and inn. The residence comprises a first portable cooler that comprises the supporting fixture and the supporting stand. The residence also comprises a second portable cooler that include the supporting fixture and the supporting stand.
 10 The first portable cooler and the second portable cooler share the same source of cool stream or power supply. Hence, the two fan assemblies can be coordinated, synchronised or complement each other.

[0022] In another aspect, the present application provides a fixture (i.e. portable cooler)
 15 with cooling means for proximal cooling of a user. The fixture comprises one or more perforations along a surface of the fixture and one or more channels within the fixture, which are connected to the one or more perforations. In use, cool streams of air are able to flow through the channels and the perforations.

[0023] The fixture (i.e. portable cooler) optionally further comprises a supporting structure
 20 (e.g. horizontal top, tabletop or stool top) with the channels; a supporting stand (e.g. hollow vertical support, table stand, stool stand) orthogonally fastened to the horizontal top, and a base support coupled to the vertical support. The fixture optionally has a receptacle for storing a liquid (e.g. freshwater) is installed in the vertical support, advantageously at the bottom of the table/stool stand. The fixture can additionally include
 25 a capillary medium for being partially submerged in the receptacle for drawing the liquid.

[0024] The fixture (i.e. portable cooler) may include a pump in the receptacle for drawing
 liquid to a ring with evenly distributed perforations at a high position for moistening the
 30 capillary medium. The (i.e. portable cooler) can moreover include a ventilator (e.g. electric fan) is installed in the channel for driving the air flow therein. The fixture or portable cooler may have a base support with a concentric bore for flowing of the air into the vertical support and into the channels within the horizontal top.

35 [0025] The portable cooler comprises following features:

- 1) the portable cooler is portable;
- 2) the portable cooler is slimmer or flatter;
- 3) the capillary material in the portable cooler comprises a ceramic membrane, which is easily replaceable, re-washable and reusable;
- 5 4) the capillary material in the portable cooler is of an antibacterial material. For example, silicon carbide treated with nano silver ion particles etc.;
- 5) the capillary material in the portable cooler may have a varied porous size for coolness and dust filtering;
- 10 6) the capillary material (ceramic membrane) in the portable cooler can be placed in parallel or perpendicular to a direction of airflow therefore saving space and being compact means more efficient and minimising water usage;
- 7) the portable cooler may optionally have a bluetooth speaker, a FM (frequency modulation) radio transceiver, a torchlight/LED light, a clock, and a fan speed control;
- 15 8) the portable cooler may optionally have a mosquito repellent. The mosquito repellent can comprise of an audio frequency (sound), an optical frequency (light), an olfactory means (odour) or a combination of all which are targeting the mosquitoes;
- 9) a compartment at the air vent for placing a fragrance cartridge of different fragrances;
- 20 10) a temperature reading of ingoing and out-going fluid, a Relative Humidity display, a water level sensor, a cartridge cleaning or replacement alert;
- 11) a battery level indicator, a solar panel;
- 12) a non-dripping portable cooler;
- 25 13) possibility of membrane perimeter having water storage compartment instead of a separate water holding tank;
- 14) a Wi-Fi for wireless communication. Having a mobile phone app;
- 15) a carrying handle or a clutch; and
- 30 16) an ambient air enters one side and out the other side which is similar to under the table design of the current application. Additionally, the air intake from surrounding 360 degrees at base and then expel the cool air upwards. The cool air will sink and hence cool the surrounding.

[0026] The accompanying figures (Figs.) illustrate embodiments and serve to explain principles of the disclosed embodiments. It is to be understood, however, that these

figures are presented for purposes of illustration only, and not for defining limits of relevant inventions.

Fig. 1 illustrates a plurality of application of fixtures with cooling means installed at a food centre;

5 Fig. 2 illustrates the schematic of a cooling device;

Fig. 3 illustrates a first embodiment of a table with the cooling means;

Fig. 4 illustrates a second embodiment of the table with the cooling means;

Fig. 5 illustrates a third embodiment of the table with the cooling means; and

Fig. 6 illustrates a fourth embodiment of the cooling means.

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[0027] Exemplary, non-limiting embodiment of the present application will now be described with references to the above-mentioned figure.

[0028] Fig. 1 illustrates a plurality of application of fixtures with cooling means installed
15 at a food centre 80. A diner 82 is seated on a first stool with a nozzle 92 ejecting a steady airstream at a stool stand. The diner 82 with his elbow resting on a table tap has also a nozzle 92 ejecting the airstream from a table stand 134. A second stool is located opposite the first stool and unoccupied. The two stools and the one table are erected on a horizontal ground (not shown) with the ends contacting the floor coupled to a first
20 insulated conduit 88. The first insulated conduit 88 is attached to a cooling device 94. A second insulated conduit 90 from the cooling device 94 is guided to a wall fan 84 and a ceiling fan 86. A plurality of nozzle 92 is introduced along the second insulated conduit 90 specifically at a position of the wall fan 84 and a position of the ceiling fan 86. The rotating blades of the fans 84,86 accelerate the airstream from the nozzles 92 to the
25 directions of the fans 84,86.

[0029] The cooling device 94 herein is a heat pump 94 which transfers heat energy from a source of heat to a destination called a "heat sink". The heat pump 94 is designed to move thermal energy in the opposite direction (usually is from hot to cold places) of
30 spontaneous heat transfer by absorbing heat from a cold space and releasing it to a warmer one. Depending on the weather and the time of the day, the source of heat and the heat sink area interchangeable.

[0030] For example, on a hot noon day, the source of heat is the ambient heat outside
35 the food centre 80 whilst the heat sink is the cooler indoor ambient environment of the

food centre 80. On a rainy noon day, the source of heat is from the indoor ambient environment and the heat sink is the cooler outdoor.

[0031] The cooling device 94 is powered by a battery solar power system 98. The battery solar power system comprises a charge controller, a battery bank, a system meter and a main DC (Direct Current) disconnect. The battery solar power system 98 is connected to an electrical grid 97 and to a plurality of photovoltaic solar panel 96.

[0032] Fig. 2 illustrates a schematic of the cooling device 94 or a heat pump. The cooling device 94 has an evaporator 100, a pressure lowering device 101, a condenser 102 and a compressor 108. The cooling device 94 is in an enclosure (not shown). An inflow air 104 enters the cooling device 94 from an inlet (not shown). The evaporator 100 absorbs the heat from the inflow air 104. An outflow air 106 exits the cooling device at an outlet (not shown). The outflow air 106 has a higher temperature than the inflow air 104. This outflow air 106 is not used to ventilate the indoor food centre 80. In practice, the outflow air 106 is used to heat a container of water or a boiler 116 (not shown). The boiler 116 is made of metal, for example aluminium which is non-corrosive at ambient temperature and relatively a good conductor of heat. Alternatively, the condenser 102 can be placed in the boiler directly 116 to heat the water. The condenser 102 in this case must be made of corrosion resistant metal at high temperature like bronze which is a good conductor of heat. The heated water can be channelled through water pipe to a dishwasher 118.

[0033] The heat pump 94 exploits the physical properties of a volatile evaporating and condensing fluid known as a refrigerant. The heat pump 94 specifically the compressor 108 compresses the refrigerant to make it hotter on the side to be warmed, and releases the pressure at the side where heat is absorbed. In the case of the food centre 80, the heat to be absorbed is the outdoor environment assuming it is hotter than the indoor environment as described previously.

[0034] The refrigerant, in its gaseous state, is pressurized and circulated through the system by the compressor 108. On the discharge side of the compressor 108, the now hot and highly pressurized vapor 110 is cooled in a heat exchanger, called a condenser 102, until it condenses into a high pressure, moderate temperature liquid 112 or a condensed refrigerant 112. The condensed refrigerant 112 then passes through a pressure-lowering device 101 also called a metering device. This may be an expansion

valve, capillary tube, or possibly a work-extracting device such as a turbine 120. The turbine 120 is used in the current embodiment. The turbine 120 propels a cool air 107 from the cooling device 94 and into the indoor food centre 80 through the conduits 88,90 as shown in Fig. 1.

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[0035] The low-pressure liquid refrigerant 114 then enters another heat exchanger, the evaporator 100, in which the low-pressure liquid refrigerant 114 absorbs heat and boils. The low-pressure liquid refrigerant 114 then returns to the compressor 108 and the cycle is repeated.

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[0036] It is essential that the refrigerant reach a sufficiently high temperature, when compressed, to release heat through the "hot" heat exchanger (the condenser). Similarly, the fluid must reach a sufficiently low temperature when allowed to expand, or else heat cannot flow from the ambient cold region into the fluid in the cold heat exchanger (the evaporator). In particular, the pressure difference must be great enough for the fluid to condense at the hot side and still evaporate in the lower pressure region at the cold side. The greater the temperature difference, the greater the required pressure difference, and consequently the more energy needed to compress the fluid. Thus, as with all heat pumps, the coefficient of performance (amount of thermal energy moved per unit of input work required) decreases with increasing temperature difference.

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[0037] Insulation is used to reduce the work and energy required to achieve a low enough temperature in the space to be cooled. The space is the indoor of the food centre 80.

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[0038] Fig. 3 illustrates a first embodiment 130 of a fixture with the cooling means specifically for the table top 132 with the table stand 134. The table stand 134 has a base support 136 that is fastened to the horizontal ground 196 by at least two bolts and nuts 140. The table stand 134 is orthogonally erected and joined (welded) to the base support 136. The base support 136 is a circular disc with a bore 138 in the centre. The bore 138 has a diameter about thirty millimetres (30 mm).

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[0039] The table stand 134 is a hollow cylinder 134 with the two ends exposed. A bottom end of the hollow cylinder 134 is joined to the base support 136 circumscribing the bore 138 in the centre. A top end of the hollow cylinder 134 is joined to the table top 132. At a top section is a three-bladed fan 142 driven by a DC (direct current) motor. The DC motor

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is attached to a tripod 144. The three legs of the tripod 144 are supported by the inner periphery of the hollow cylinder 134 at the top section. The tripod 144 is positioned within the hollow cylinder 134 just below the top end of the hollow cylinder 134.

5 [0040] The DC motor is energised by at least one electrical wire (positive and negative wires). The at least one electrical wire extends in the hollow cylinder 134 and to a power source (not shown). The power source can be a dry cell battery or electricity from the utility grid, or from renewable energy sources. If a dry cell battery were used, an access point is provided along the hollow cylinder 134 to replace the battery.

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[0041] Along a body of the hollow cylinder 134, there are two spouts 146 on a left side and on a right side. The two spouts 146 puncture through the wall of the hollow cylinder 134 and are aligned horizontally across each other. Along the inner periphery of the hollow cylinder 134 specifically above the two punctured holes (leading to the spouts 15 146), is a bevel 148 that circumscribes the inner periphery.

[0042] Alternatively, the spouts 146 can be angled or pointing upwards towards the table top 132. Still, the spouts 146 can be nozzles 92 that are directionally rotatable and possess rotational air volume control.

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[0043] The table top 132 has a thickness of forty millimetres (40 mm) and a diameter of one thousand millimetres (1,000 mm). The erected table stand 134 has a height of seven hundred millimetres (700 mm). An outer diameter of the table stand 134 (as a supporting stand) is sixty millimetres (60 mm) with an inner diameter of fifty millimetres (50 mm).

25 The spout 146 which is circular has a diameter of ten millimetres (10 mm). The table top 132 is made of fibreglass which possesses water resistant property whilst the table stand 134 is made of steel which is durable.

[0044] A circular hole 150 underneath the table top 132 or a bottom surface 30 communicates with the top end of the erected table stand 134. The circular hole 150 fits onto the top end of the table stand 134 or the hollow cylinder 134. The circular hole 150 also has a diameter of sixty millimetres (60 mm). Additional fasteners are in place to secure the coupling between the table top 132 and the table stand 134.

[0045] Within the table top 132 are air channels 152 as shown in broken lines that extend from the centre to a circumference of the table top 132. The table top 132 in Fig. 3 has four air channels 152 that diverges from the centre to the circumference forming an orthogonal cross. The four air channels 152 terminate along the circumference with four
 5 funnel-like vents 156. The one vent 156 has a rectangular profile with a length of forty millimetres (40 mm) and a height of twenty millimetres (20 mm). Underneath the table top 132, along the four air channels 152 are visible holes 154. Three visible holes 154 are along each air channel 152.

10 [0046] Fig. 4 illustrates a second embodiment 160 of the table with the cooling means used on the table top 132 with the table stand 134. The table top 132 is similar to the first embodiment 130. The table stand 134 is perforated with perforations 162 around the periphery thereof.

15 [0047] Fig. 5 illustrates a third embodiment 170 of the table with the cooling means used on the table top 132 with the table stand 134. The cooling means of the second embodiment 160 include the perforations along the periphery of the table stand 134 and the three-bladed fan 142 at the top section of the table stand 134. The third embodiment 170 has a hollow cylindrical water tank 172 placed at the bottom end of the table stand
 20 134. The hollow cylindrical water tank 172 having a trough at its bottom and an exposed brim. A hollow cylindrical membrane 178 is inserted into the hollow cylindrical water tank 172 at the exposed brim. An electric water pump 174 is placed inside the hollow cylindrical water tank 172. A water hose 176 is connected to the electric water pump 174 with an opposite end connected to a hollow ring 180 with perforations along the hollow
 25 ring 180. The water hose 176 can either be on an outer periphery or an inner periphery extending from a bottom end to a top end of the hollow cylindrical membrane 178. The hollow ring 180 is placed at a top end of the hollow cylindrical membrane 178.

[0048] The outer diameter of the hollow cylindrical water tank 172 is about fifty millimetres
 30 (50 mm). the inner diameter of the hollow cylindrical water tank 172 is about twenty-five millimetres (25 mm). The height of the hollow cylindrical water tank 172 is about one hundred millimetres (100 mm). The height of the hollow cylindrical membrane 178 is about seven hundred millimetres (700 mm) with 100 mm of the bottom part immersed in the hollow cylindrical water tank 172.

[0049] The water in the hollow cylindrical water tank 172 travels upwards on the hollow cylindrical membrane 178 through capillary action moistening itself. The top end of the hollow cylindrical membrane 178 is moistened by the hollow coil having water trickling down the inner surface thereof. The air coming from the bore 138 at the base support 136 travels upwards through the hollow cylindrical membrane 178.

[0050] Alternatively, the hollow cylindrical membrane 178 can be a hollow hexagonal membrane. An increase surface area helps in the evaporative process which removes the heat and creating cooler air. Alternative liquid may be used instead of water.

[0051] The fixture with cooling means can also be used for the stool as well. The stool has the same structure as the table. The stool includes a stool stand (as a supporting stand) and a stool top (as a supporting fixture).

[0052] Fig.6 illustrates a fourth embodiment 190 of the cooling means relating to a hand rail 192. The figure depicts a partial view of the hand rail 192 revealing the inner periphery on a left side and the hand rail 192 extends to a right bend towards the ground 196. Similar to the first, second and the third embodiments, the cooled air is introduced into the hand rail 192 from a connecting conduit 88. A first terminal end of the hand rail 192 on the right end is joined to the base support 136. The base support 136 is screwed to the ground 196 by two bolts and secured by two nuts 140. The second terminal end of the hand rail 192 on the left side is also joined to another base support 136. The air flow goes back to the conduit 88 underground.

[0053] The hand rail 192 has a plurality of perforation 162 as shown by the shaded circles along the periphery thereof. A right human hand 194 is shown to grip the hand rail 192. The arrows in the figure shows the direction of air flow 198 from the conduit 88 to the ground 196 and into the handrail 192. The air flow 198 is driven by the cooling device 94 located remotely. The cooled air from the cooling device 94 is then transported through the conduit 88 and to the hand rail 192.

[0054] The fixtures described in Fig. 1 relates to the table, the stool, the wall fan 84 and the ceiling fan 86.

[0055] Functionally, the fixtures by themselves are unable to provide any cooling means. A fixture that is able to provide the means to cool a diner 82 is sought after especially the table and the stool as they are in close proximity to the diner 82.

5 [0056] The table stand 134 and the stool stand have nozzles 92 constructed to provide the cool air. The cool air is provided by the first insulated conduit 88. The second insulated conduit 90 is specially routed to the wall fan 84 and the ceiling fan 86. The routed second insulated conduit 90 has nozzles 92 that provide the cool air to the two fans 84,86. The two insulated conduit 88 are coupled to the cooling device 94 that
10 provides a centralised air cooling means.

[0057] The cooling device 94 is a heat pump that is able to transfer heat energy from a source of heat (temperature above 10°C would contain heat) to a heat sink. The principle of vapor compression refrigeration, uses a refrigerant R134a involving a compressor and
15 a condenser to absorb heat at one place and release it at another. The R134a (1,1,1,2-tetrafluoroethane, R-134a, Freon 134a, Forane 134a, Genetron 134a, Florasol 134a, Suva 134a or HFC-134a) also known as norflurane is a haloalkane refrigerant with thermodynamic properties similar to R12 (dichlorodifluoromethane) but with insignificant ozone depletion potential and a somewhat lower global warming potential (1,430,
20 compared to R-12's GWP of 10,900).

[0058] The heat pump 94 absorbs heat from a cold space (evaporator coil, which extracts heat from ambient air) and releasing it to a warmer space (inner heat exchanger coil, which transfer the heat into a water tank). The heat pump 94 provides free cool air,
25 environmentally friendly and low cost of operation.

[0059] Heat pump 94 is used to transfer heat because less high-grade energy is required than is released as heat. Most of the energy for heating comes from the external environment, only a fraction of which comes from electricity (or some other high-grade
30 energy source required to run a compressor 108). In the electrically-powered heat pump 94, the heat transferred can be three or four times larger than the electrical power consumed, giving the system a coefficient of performance (COP) of 3 or 4, as opposed to a COP of 1 for a conventional electrical resistance heater, in which all heat is produced from input electrical energy.

[0060] The heat pump 94 uses a refrigerant as an intermediate fluid to absorb heat where it vaporizes, in the evaporator 100, and then to release heat where the refrigerant condenses, in the condenser 102. The refrigerant flows through insulated pipes between the evaporator 100 and the condenser 102, allowing for efficient thermal energy transfer at relatively long distances.

[0061] The heat pump 94 which is powered by the battery solar power system 98 charge provides further energy conservation so as not to solely rely on the electrical grid 97. The charge controller prevents the battery from overcharging by interrupting the flow of electricity from the photovoltaic (PV) solar panels 96 when the battery bank is full. The battery bank connects a group of batteries together. The batteries are similar to car batteries but designed specifically to endure the type of charging and discharging that is required to handle in a solar power system. The system meter provides a measurement and display of the solar PV system performance and status. The main DC disconnect is a DC rated breaker between the batteries and the inverter (Direct Current to Alternating Current) providing a rapid disconnecting from the battery bank for servicing.

[0062] The battery solar power system 98 is also connected to the electrical grid 97 also known as a grid-tied PV system. The grid-tied PV system inverters are designed to shut down when the grid experiences a power outage so as to protect the utility repair workers from being shocked by electricity coming from the PV array. As a result, during a power outage, the electricity coming from the PV array cannot be utilized. However, if the PV system includes a battery bank, during a power outage the energy produced by the PV system can be utilized and stored in the batteries which is shown in Fig. 1.

[0063] A grid-tied PV system with battery backup is ideal if you live in an area that has unreliable power from the grid or that experiences power outages due to natural disasters.

[0064] The base support 136 provides the support of the table stand 134 and the table top 132. The bore 138 at the base support 136 provides a channel for the cool air to flow into the table stand 134 and table top 132. The cylindrical structure of the table stand 134 provides a uniform structural strength. The table stand 134 is hollow so as to provide unobstructed air flow to the table top 132. The bore 138 at the base support 136 is circumscribed by the table stand 134 or also known as the hollow cylinder 134 so that the air from the cooling device 94 is delivered into the hollow cylinder 134.

[0065] In the first embodiment 130 as shown in Fig. 3, at the top section of the hollow cylinder 134 is a three-bladed fan 142 driven by a D.C. (direct current) motor. The three-bladed fan 142 provides a propulsion of cool air from the bottom end to the top end of the hollow cylinder 134. Therefore, the blades are angled to provide an upward flow of air. The three-bladed fan 142 also serves to increase the air flow speed through the hollow cylinder 134.

[0066] The spouts 146 along the periphery of the hollow cylinder 134 provides lateral air flow to the diner 82 sitting around the table so that the air flow reaches the lower parts of the diner(s) 82. The bevel 148 along the inner periphery of the hollow cylinder 134 specifically above the two spouts 146, is to channel the air flow from the bottom end thereof to the spouts 146.

[0067] The channelled air driven upwards by the three-bladed fan 142 goes to the table top 132 through the circular hole 150. The four air channels 152 in the table top 132 allow the cool air to flow to the funnel-like vents 156 at the circumference. Along the four air channels 152 in the table top 132, beneath the table top 132 are perforations which provides cool air to the diner 82.

[0068] In the second embodiment 160 as shown in Fig. 4, the table stand 134 is perforated around the periphery. The perforations provide more cool air to be purged from the table stand 134.

[0069] The third embodiment 170 as shown in Fig. 5 uses the principle of evaporation to cool the air further. The hollow cylindrical membrane 178 provides a medium for the absorption of water from the hollow cylindrical water tank 172. However, only part of the hollow cylindrical membrane 178 is moistened based on capillary action of the water. Therefore, the electric water pump 174 is used to pump the water through the water hose 176 and into a hollow ring 180 at the top end. The water will trickle on to the hollow cylindrical membrane 178 from the perforations around the hollow ring 180. The cool air introduced through the bore 138 at the base support 136 provides a low humidity cool air (dry cool air) which provides accelerated rate of evaporation of the moisture on the hollow cylindrical membrane 178. In other words, cooler air purge from the table stand 134 and the table top 132.

[0070] The hollow cylindrical membrane 178 also provides filtration for the air as well as the water. The membrane must be permeable to air so that the flow of air is not obstructed. The permeability can be altered by either increasing or decreasing the layers of membrane. Alternatively, a less expensive medium to use can be a fabric like a cloth.

[0071] The fixture with cooling means relating specifically to the table and the stool with cooling means.

[0072] A method of constructing the table top 132 comprising the steps of first forming a mould. The mould takes the shape of a circle. Secondly, a channel-vent structure which is laid in the mould which is within the table top 132. Thirdly, a resin typically a two-part thermoset polyester, vinyl or epoxy which is mixed with its hardener in the mould and the channel-vent structure is applied thereon. Fourthly, sheets of fibreglass matting are laid into the mould and the channel-vent structure. Then more resin mixture is applied. The resin mixture and the fibreglass must conform to the mould, and air must not be trapped between the fibreglass, the channel-vent structure and the mould. The table top 132 may be covered with a plastic sheets and vacuum is drawn on the table to remove air bubbles and press the fibreglass to the shape of the mould. Finally, the moulded table top 132 is cured in an oven.

[0073] A method of constructing the table stand 134 comprising the steps of first, acquiring a metal hollow cylindrical tube. Secondly, drilling a plurality of hole around the hollow cylindrical tube. The holes made can either be for the installation of the spouts 146 at the outer periphery of the hollow cylindrical tube or simply perforations for the out flowing of cool air from within. Optionally, the three-bladed fan 142 can be installed at the top end of the table stand 134.

[0074] Finally, joining the base support 136 to the bottom end of the table stand 134 by welding.

[0075] The assembly of the table top 132 and the table stand 134 is achieved by inserting the top end of the table stand 134 into the circular hole 150 underneath the table top 132.

[0076] The same method of construction is applicable for the stool i.e. the stool top and the stool stand.

5 [0077] Relating to the cooling device 94 which is a reversible heat pump 94 work in either direction to provide heating or cooling indoors. A reversing valve is used to reverse the flow of refrigerant from the compressor through the condenser and evaporation coils.

10 [0078] The cooling device 94 provides two modes of operation, a heating mode and a cooling mode. In the heating mode, the outdoor coil is an evaporator, while the indoor coil is a condenser. The refrigerant flowing from the evaporator (outdoor coil) carries the thermal energy from outside air indoors. Vapour (refrigerant) temperature is augmented within the pump by compressing it. The indoor coil then transfers the thermal energy (including energy from the compression) to the indoor air, which is then conveyed indoors by conduits 88,90 as shown in Fig. 1 where the conduits 88,90 are routed to the fixtures.

15 [0079] Alternatively, the thermal energy is transferred to the water, which is then used to heat the indoor environment via radiators. The heated water may also be used for domestic hot water consumption like dishwashing. The refrigerant is then allowed to expand, cool, and absorb heat from the outdoor temperature in the outside evaporator, and the cycle repeats. The "cold" side of the refrigerator (the evaporator coil) is positioned so it is the outdoor environment where is colder.

20 [0080] In a cold weather, the outdoor unit of an air source heat pump 94 needs to be intermittently defrosted. This will cause the auxiliary or emergency heating elements (located in the air-handler) to be activated. At the same time, the frost on the outdoor coil will quickly be melted due to the warm refrigerant. The condenser/evaporator fan ceases to run during defrost mode.

25 [0081] In the cooling mode, the cycle is similar, but the outdoor coil is now the condenser and the indoor coil (which reaches a lower temperature) is the evaporator. This is the familiar mode in which air conditioners operate.

30 [0082] In the application, unless specified otherwise, the terms "comprising", "comprise", and grammatical variants thereof, intended to represent "open" or "inclusive" language

such that they include recited elements but also permit inclusion of additional, non-explicitly recited elements.

[0083] As used herein, the term "about", in the context of concentrations of components of the formulations, typically means +/- 5% of the stated value, more typically +/- 4% of the stated value, more typically +/- 3% of the stated value, more typically, +/- 2% of the stated value, even more typically +/- 1% of the stated value, and even more typically +/- 0.5% of the stated value.

[0084] Throughout this disclosure, certain embodiments may be disclosed in a range format. The description in range format is merely for convenience and brevity and should not be construed as an inflexible limitation on the scope of the disclosed ranges. Accordingly, the description of a range should be considered to have specifically disclosed all the possible sub-ranges as well as individual numerical values within that range. For example, description of a range such as from 1 to 6 should be considered to have specifically disclosed sub-ranges such as from 1 to 3, from 1 to 4, from 1 to 5, from 2 to 4, from 2 to 6, from 3 to 6 etc., as well as individual numbers within that range, for example, 1, 2, 3, 4, 5, and 6. This applies regardless of the breadth of the range.

[0085] It will be apparent that various other modifications and adaptations of the application will be apparent to the person skilled in the art after reading the foregoing disclosure without departing from the spirit and scope of the application and it is intended that all such modifications and adaptations come within the scope of the appended claims.

Reference Numerals

	80	food centre
	82	diner
5	84	wall fan
	86	ceiling fan
	88	first insulated conduit
	90	second insulated conduit
	92	nozzle
10	94	cooling device or heat pump
	96	photovoltaic solar panel
	97	electrical grid
	98	battery solar power system
	100	evaporator
15	101	pressure lowering device or metering device
	102	condenser
	104	inflow air
	106	outflow air
	107	cool air
20	108	compressor
	110	highly pressurized vapour
	112	high pressure moderate temperature liquid or condensed refrigerant
	114	low-pressure liquid refrigerant
	116	boiler
25	118	dishwasher
	120	turbine
	130	first embodiment
	132	table top
	134	table stand or hollow cylinder
30	136	base support
	138	bore
	140	bolts and nuts
	142	three-bladed fan
	144	tripod
35	146	spout

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- 148 bevel
- 150 circular hole
- 152 air channel
- 154 visible holes
- 5 156 funnel-like vent
- 160 second embodiment
- 162 perforations
- 170 third embodiment
- 172 hollow cylindrical water tank
- 10 174 electric water pump
- 176 water hose
- 178 hollow cylindrical membrane
- 180 hollow ring
- 190 fourth embodiment
- 15 192 hand rail
- 194 right human hand
- 196 ground
- 198 direction of air flow

Claims

1. A portable cooler comprising:

- a supporting fixture for holding an object on the supporting fixture; and
 - a supporting stand connected to the supporting fixture for raising the supporting fixture above the ground;
- wherein the portable cooler comprises at least one duct for channelling a cooling stream to a side of the portable cooler.

2. The portable cooler of claim 1, wherein the supporting fixture comprises a tabletop for keeping a tableware on top.

3. The portable cooler of claim 1, wherein the supporting fixture comprises a seat for supporting a person.

4. The portable cooler of any of the preceding claims further comprising at least one nozzle on a surface of the portable cooler, the at least one nozzle connected to the at least one duct for directing the cool stream towards a user of the portable cooler.

5. The portable cooler of claim 4, wherein the at least one nozzle is configured to operate automatically.

6. The portable cooler of claim 4 or 5, wherein the at least one nozzle comprises a valve for regulating the cool stream from the nozzle.

7. The portable cooler of any of the preceding claims further comprising an automatic fan for driving the cooling stream through the duct.

8. The portable cooler of any of the preceding claims, wherein the at least one duct comprises multiple channels in the supporting fixture for guiding the cooling stream to a lateral edge of the supporting fixture.

9. The portable cooler of any of the preceding claims further comprising a heat exchanger that is connected to the at least one duct for providing the cooling stream having temperature lower than an ambient temperature of the portable cooler.

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10. The portable cooler of claim 8, wherein the heat exchanger comprises an evaporative cooler for drawing water automatically.

- 10 11. The portable cooler of claim 10, wherein the evaporative cooler comprises a concealed water collector for keeping freshwater for the evaporative cooler.

12. The portable cooler of claim 9, wherein
15 the evaporative cooler comprises a capillary material for drawing water automatically.

13. The portable cooler of claim 10, wherein the capillary material comprises a foam.

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14. The portable cooler of claim 8, wherein the heat exchanger comprises a thermal energy storage material for absorbing heat from the cooling stream.

- 25 15. The portable cooler of any of the preceding claims 9 to 14, wherein the heat exchanger comprises a heat pump.

16. The portable cooler of any of the preceding claims further comprising a renewable energy harvester for powering the portable cooler.

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17. The portable cooler of any of the preceding claims further comprising at least one dinning furniture having its supporting stand on the ground, and the at least one duct is connected to an external source of the cool stream.

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18. The portable cooler of any of the preceding claims, wherein the portable cooler is mobile, permanent or detachable.
- 5 19. The portable cooler of any of the preceding claims further comprising a detector for operating the portable cooler automatically.
- 10 20. A residence for providing a cooling ambient to diners, the eating place comprising a first portable cooler according to any of the preceding claims; and a second portable cooler according to any of the preceding claims; wherein the first portable cooler and the second portable cooler share the same source of cool stream.