A Hybrid Evaporative/ Refrigerative Air Cooler/Conditioner

The present invention relates to improvements in domestic industrial evaporative coolers that work very well in hot dry season, but are ineffective when the ambient conditions are humid.

The invention relates to the incorporation of refrigeration systems within the evaporative coolers such that it would be possible to choose either the evaporative mode or refrigerative mode of cooling by operating a switch.

Prior Art

It is generally accepted that evaporative coolers work best in hot dry climates. The coolers work on the principle of adiabatic saturation, wherein the dry air is made to contact an extended surface of water, obtained by either spraying it or absorbing it in a matrix of expanded paper. The water then evaporates, drawing the energy required from both from the air and the water, thus reducing both their temperature.

In humid weather, the condition of "wet bulb depression" is too small to cause much evaporation so the process is not effective for cooling the air. While some central systems have a refrigerated cooling coil in the airstream, the changeover is complex, since the air flows needs to be reduced and the "once through" system, has to be changed to "recirculating" system, by use of complex ducting and dampers.

No domestic coolers have this arrangement. Some air cooler suppliers suggest dumping some ice in the water tank, temporarily turning the machine into a "chilled water de-humidifier". This duplicates the air conditioning as long as the ice lasts.

This innovation, therefore, is a simple and convenient method of providing cooling in both dry and humid conditions.

Object of the invention

The primary object of the invention is to provide a hybrid air cooler that can work continuously to provide cooling in both dry and humid climate.

Another object of the invention is to provide a year round cooling system for domestic unitary air coolers, although the same idea is applicable to large central systems also. Yet another object of the invention is to provide a simple, novel method of adding refrigeration to existing air coolers without changing its size or appearances, or having to design new special shapes for accommodating the additional machinery.

Further object of the invention is to provide an evaporative/ refrigerative cooling system in which the changeover is simple.

Yet another object of the invention is to provide a system that is easy to clean and maintain.

Another important object is to provide a year round comfort system that will use much less energy per year as compared to the devices using refrigeration only.

Statement of the invention

Accordingly, in order to achieve the above objectives, the present invention provides a hybrid evaporative / refrigerative air cooler comprising:

- **A standard evporative air cooler** having a water tank, pump, evaporative cooling pads, fan, necessary appurtenances and a body.
- **A refrigeration system comprising:** A length of copper pipe shaped into a spiral shape similar to a coil spring to work as the evaporator, a refrigeration compressor, a condenser coil, a condenser fan, controls and wiring, interconnecting water and refrigerant piping and a refrigerant charge.

All of the above items are encased in a metal /plastic body as shown in Fig., wherein the indoor portion has the evaporative system with the spiral coils in the water tank and the condenser section containing the compressor, condenser coil and fan is located outdoors and connected by pipes and wires.

Operation

Please refer to Fig. A. While operating in the evaporative cooling mode, a pump (2) lifts water in the tank (1) located in the body (11) via pipe (3) and distributes it on top of the cooling pad (10) through distribution nozzles (4) A fan (7) powered by the motor (8) draws

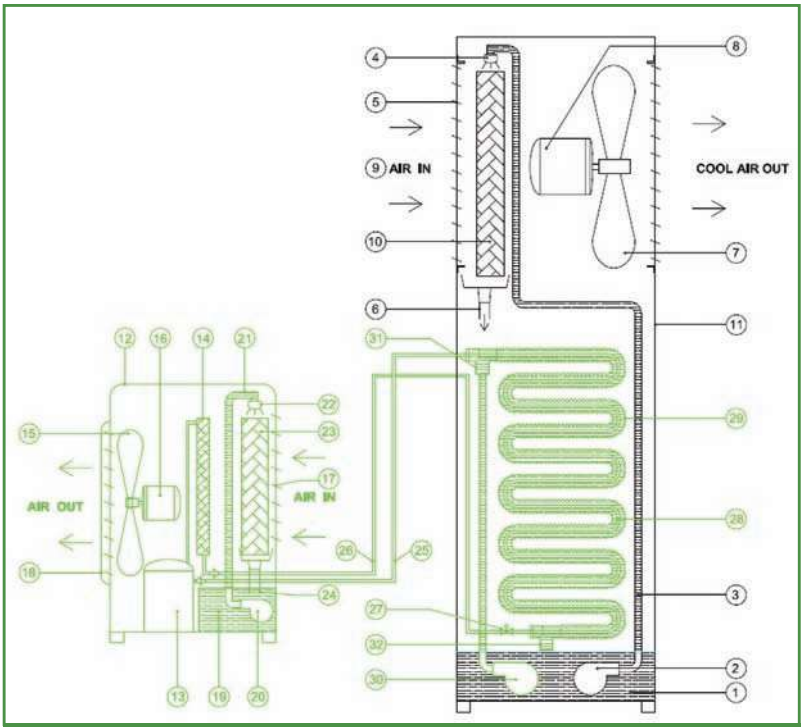

Fig. A: Evaporative Cooling Mode : (In dry weather)

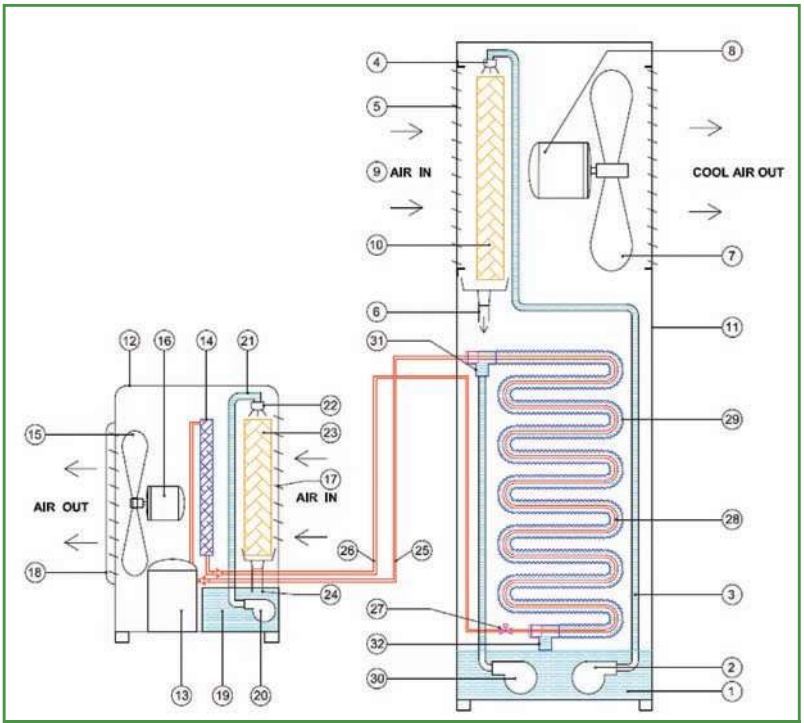

Fig. B: Refrigerative Cooling mode : (In humid weather)

outside air (9) through the inlet grille (5) and through the cooling pad (10) whereby the air is cooled by a process called "Adiabatic saturation" (to be explained later in this document) and it exits into the space to be cooled. The water returns to the tank (1) via the drain (6).

Please refer to Fig. B. While operating in the refrigerative cooling mode, some more elements become operational in addition to items (1) to (11) which continue to function normally.

The additional items are-

A condensing unit (12) comprising a compressor (13) a condensing coil (14) a condenser fan (15) driven a motor (16) Ambient air inlet (17) and a hot air outlet (18) for improving the performance of the condensing unit under high ambient temperature, a tank (19) is provided within the unit (12), a pump (20) a tube (21) and an evaporator cooling pad (23).

The condensing unit (12) is connected by refrigerant pipes (25) and (26) to a coiled length of metal tubing (28) through a throttling device (27). The whole system is then charged with appropriate quantity of a suitable refrigerant. In operation the high pressure liquid refrigerant enters the coil (29) through the throttling device (27) that drops the pressure and causes the refrigerant to evaporate, warm water pumped by pump (30) flows around the metal pipe (28) and loses its heat via conduction to the evaporating liquid refrigerant in the pipe, thus cooling down.

Then the pump (2) gets cold water, which then circulates in the same manner as in the evaporative cooling mode. The water being cold, makes the entering air (9) cooler and drier at the exit. ■

Surendra H Shah, Mechanical Engineer from Clemson University, USA, has major HVAC projects to his credit: Air India Terminal, SBI Building, Oberoi Towers, MSEB Prakashgad Mumbai, SriLanka Oberoi, a housing complex at Baghdad Iraq. He started Pan Asia Corporation, a breeding ground for his many innovative energy saving products, some of which are patented now. He designed wind towers for CII-Sohrabji Godrej Green Building Center in Hyderabad, that received country's first Platinum rated LEEDS building. He combines the techniques used in cooling of heritage structures such as the Taj Mahal with modern technology. It needs only 150 watts to extract three tons of solar heat load. In an air conditioned pharma warehouse it has reduced its cooling load from 57 tons to 24 tons. The Mumbai University Institute of Chemical Technology recognized him for heat pump air dryer that has a C.O.P. of 6.7 made for their lab. His inventions are: An AC with EER of over 15, a packaged AC with its own integral ice thermal storage. He has won a BRY-AIR award and U.S. Patent for it. He is a life member ISHRAE, IIID and SESI. He is also a visiting faculty at Rachana ansad's Institute of Environmental Architecture.