

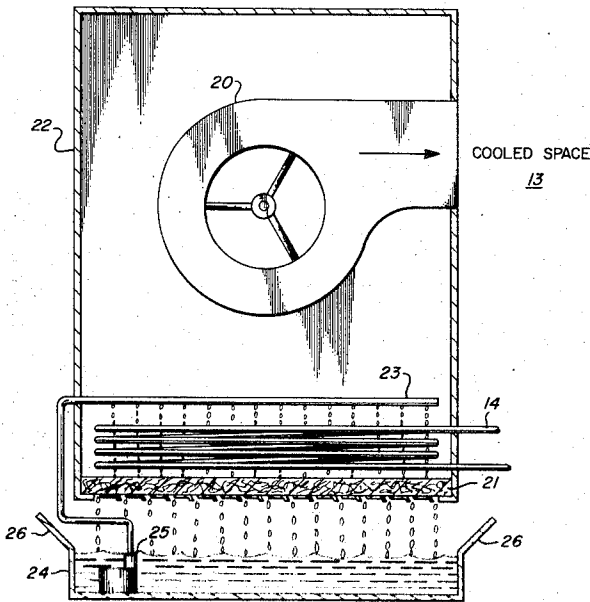
[54] **SPACE COOLING SYSTEM**
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[51] **Int. Cl.**..... F28d 3/00
[58] **Field of Search**..... 62/171, 176, 311, 62/314, 309, 310, 121

[56] **References Cited**
UNITED STATES PATENTS
2,165,979 7/1939 Nicholson 62/311
2,259,541 10/1941 Ballard 62/171
2,654,232 10/1953 Galazzi 62/311 X
2,672,024 3/1954 McGrath 62/171
2,703,228 3/1955 Fleisher 62/311 X
3,153,332 10/1964 Goettl 62/176

FOREIGN PATENTS OR APPLICATIONS
444,342 3/1936 Great Britain 62/311
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[57] **ABSTRACT**
In order to combine the advantages of the well known evaporative cooler with the advantages of the equally well known conventional refrigeration system, the water recirculated over the pads of the cooler is refrigerated sufficiently to dehumidify the outside air drawn through the cooling pads. The evaporator coils may be placed directly in the cooler reservoir, in the return water flow path between the pads and the reservoir, or in the supply water path above a single pad. The refrigeration sub-system may be operated under control of a humidistat such that the cooling system may function as an ordinary evaporative cooler when the ambient humidity is sufficiently low.

3 Claims, 3 Drawing Figures



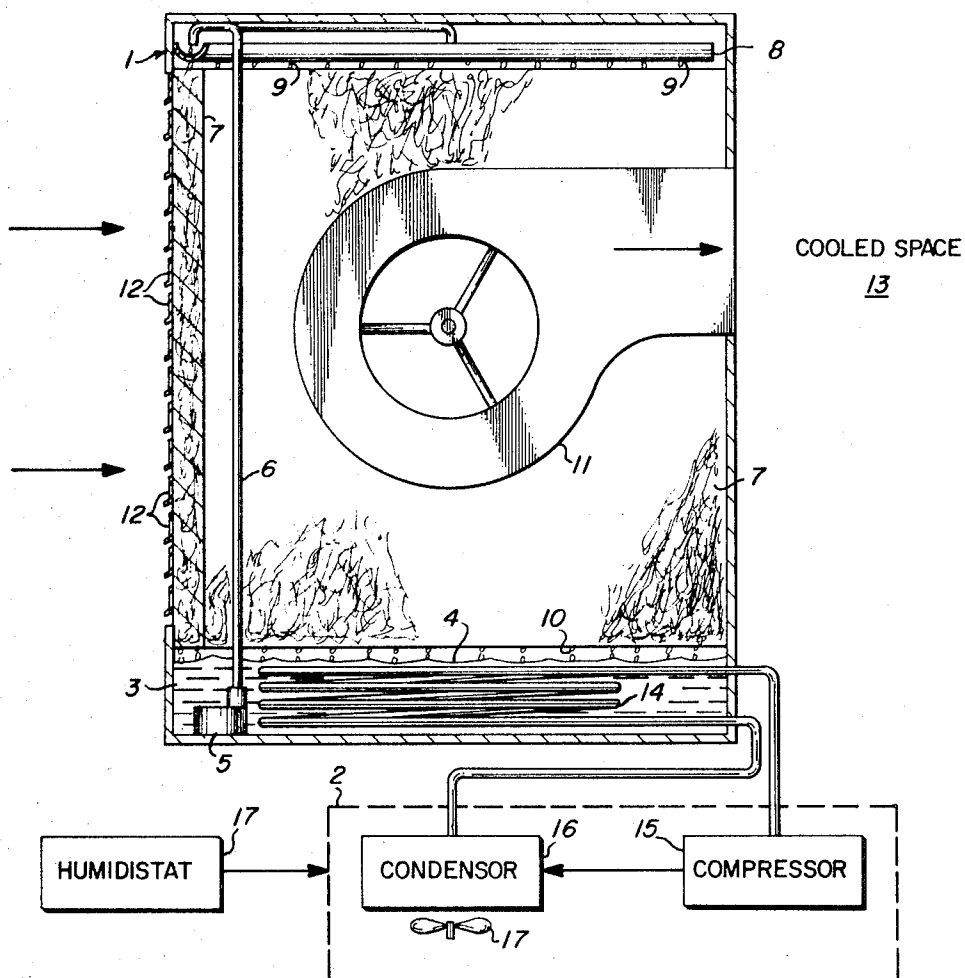


FIG. 1

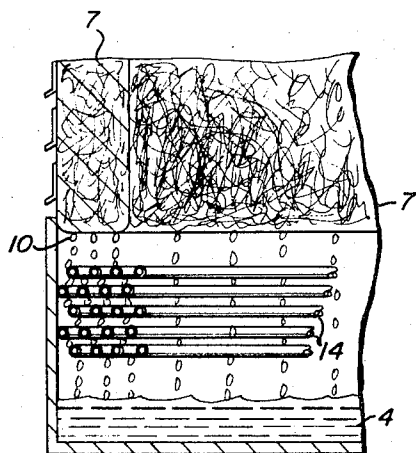


FIG. 2

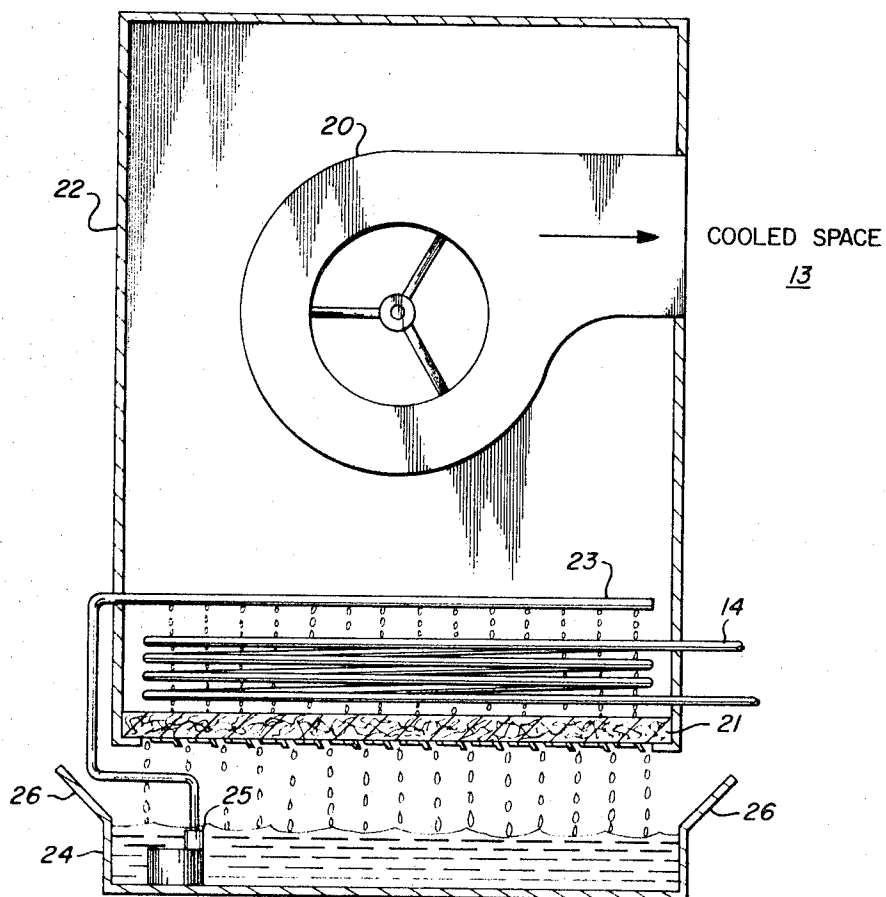


FIG. 3

SPACE COOLING SYSTEM

This invention relates to the space cooling arts and, more particularly, to a space cooling system which combines the advantages of evaporative coolers and refrigeration units without the disadvantages of either.

Two types of space cooling systems have evolved for lowering the temperature within space in which it is desirable, for one reason or another, to lower the temperature. The first of the well known prior art systems is the evaporative cooler which still enjoys considerable use in the more arid regions such as the Southwestern United States. With the evaporative cooling system, ambient air is drawn through pads which are kept constantly damp by a pump which simply distributes water along the top of the vertically oriented pads. In accordance with well known physical laws, a substantial amount of heat energy is consumed as a portion of the water evaporates. As a result, the air passing through the pads is cooled and its moisture content is increased. A clear advantage of the evaporative type of space cooling system is that ambient air is constantly being brought into the space, in which windows and other exhaust areas are left open, such that the air within the cooled space is "fresh." However, as very well known in the art, the evaporative cooler becomes inadequate and the space condition thereby very uncomfortable when the humidity of the ambient air rises. The reason for this problem is two fold; viz.: the rate of evaporation decreases as the humidity increases, and the high humidity within the space coupled with a somewhat higher temperature causes the temperature-humidity "comfort-factor" to become excessive. Thus, in certain of the hottest months, even in the more arid regions, the natural seasonal increase in ambient humidity brings a period of great discomfort within a space cooled by a conventional evaporative cooler.

The second well known system for cooling spaces is by means of a refrigeration system in which air within the space is constantly recirculated over evaporator coils which are cooled by the expansion of a refrigerant which has previously been passed through a power driven compressor and a condenser which functions as a heat exchanger in the ambient. The nature of the refrigeration cooling cycle is such that dehumidification occurs in conjunction with cooling, and therefore, a refrigeration system can maintain the comfort factor of a space within a desirable range even when the ambient humidity rises beyond a value at which an evaporative cooler would function satisfactorily. However, the conventional refrigeration system also suffers from certain well known drawbacks. One of the most notable is the very considerable amount of power consumed as well as very high initial cost as compared, in both aspects, to an evaporative cooler. Additionally, to realize even modest efficiency from a refrigeration system, it is necessary to completely close the cooled space off whereby the only "fresh" air introduced is by leakage.

Thus, those skilled in the art will appreciate that it would be highly desirable to provide a cooling system which combines the virtues of both an evaporative cooling system and a refrigeration system without the disadvantages of either.

It is therefore a broad object of my invention to provide an improved space cooling system.

It is a more specific object of my invention to provide a space cooling system which combines the advantage

of an evaporative cooler with the advantages of a refrigeration cooling system.

It is a further object of my invention to provide such a system in which the cooled space is constantly replenished with freshened air.

It is yet another object of my invention to provide a cooling system which provides freshened air without inordinantly raising the humidity to create an unacceptable comfort factor.

Still another object of my invention is to provide such a cooling system which is simple and relatively inexpensive to operate.

The subject matter of the invention is particularly pointed out and distinctly claimed in the concluding portion of the specification. The invention, however, both as to organization and method of operation, may best be understood by reference to the following description taken in connection with the accompanying drawing of which:

FIG. 1 is a partially pictorial, partially schematic view illustrating a first embodiment of my invention;

FIG. 2 is a partially cutaway detail illustrating an alternative position of the evaporator coils of my invention with respect to other elements thereof; and

FIG. 3 is a cutaway view illustrating a presently preferred position of the evaporator coils of my invention with respect to other elements thereof.

Attention is now directed to FIG. 1 which illustrates a cooling system comprising an evaporative cooler 1 modified in accordance with my invention to function in conjunction with a refrigeration sub-system 2. In accordance with normal evaporative cooling practice, a reservoir 3 is provided for containing a supply of water 4. A recirculating pump 5 serves to pump the water 4 through a conduit 6 for distribution across the upper ends of porous pads 7. Merely by way of example, the conduit 6 may conduct the pumped water to a distribution trough 8 which function in conjunction with a refrigeration sub-system around the top edges of the porous pads 7 and has a number of apertures 9 distributed along the length thereof to permit the pumped water to controllably drip onto the pads. The water introduced in this manner onto the upper ends of the pads 7 flows downwardly under the influence of gravity to keep the pads wet and unevaporated surplus water 10 simply drips back into the reservoir 3.

A motor driven fan 11 draws ambient air through the wetted pads 7 for discharge into the cooled space 13.

Those skilled in the art will understand that the cooling system components thus far described constitute a conventional evaporative cooler. However, I have discovered that the well known drawbacks of evaporative coolers associated with relatively high humidity can be completely overcome by chilling the water introduced at the upper ends of the pads 7. I have determined that, even with high ambient humidity, the air drawn through the pads 7 will be dehumidified rather than having its moisture content increased. Hence, ambient air brought into the cooled space 13 through the pads 7 may be used to constantly replenish the cooled space with conditioned air which does not increase the humidity (and hence the comfort factor) even under conditions of high ambient humidity.

This result is achieved by controllably refrigerating the water 4 by means of refrigeration sub-system 2. In the configurations shown in FIG. 1, the evaporator coils 14 of the refrigeration sub-system are disposed di-

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rectly within the reservoir 3 immersed in the water 4. The refrigeration sub-system also comprises the usual compressor 15 and condenser heat exchanger 16 in which heat is discharged to the ambient with the aid of a blower 17. The refrigeration sub-system is quite conventional and is therefore shown only in a schematic representation. It will be understood that variant configurations, such as gase refrigeration systems, are contemplated and, indeed, work quite well so long as the evaporator coils 14 are capable of chilling the water 4 sufficiently to achieve the dehumidifying effect previously noted. Inasmuch as dehumidification occurs to the air drawn through the pads 7, it is apparent that some water is distilled from this air rendering the usual requirement for constantly adding make-up water virtually unnecessary once the process has been instituted. Distilled water, of course, is very soft and contributes significantly to extended life of the various components.

It has been previously observed that a conventional evaporative cooler functions quite satisfactorily until the humidity becomes somewhat elevated, and it has also been pointed out that a refrigeration system consumes a considerable amount of power. For that reason, the refrigeration sub-system 2 may conveniently be placed under the control of a humidistat 17 which responds to ambient humidity by energizing the refrigeration sub-system only when the humidity exceeds a predetermined maxim. Thus, my system may function as a simple evaporative cooler when the humidity is sufficiently low to make such operation effective. When the refrigeration sub-system is operating to chill the water 4, which wets the pads 7, it is not clear whether any cooling effect is realized from evaporation since condensation is taking place at the same time. Nonetheless, the effectiveness of the system operating in this mode has been clearly demonstrated, and the efficiency appears to be at least as high as a refrigeration system operating alone and recirculating air within a cooled space.

I have found that the system's efficiency can be increased somewhat by altering the position of the evaporator coils 14 in the system. Attention is directed to FIG. 2 which illustrates a preferred position of the evaporator coils 14 above the water 4 in the reservoir and beneath the pads 7. The surplus water 10 drips from the lower ends of the pads, falling directly on the evaporator coils 14, for chilling before collection in the reservoir. With this configuration, a larger volume of the water is directly in contact with the evaporator coils 14, and coil icing is less likely to take place since the chilling is more uniformly distributed to the total water volume in the system.

In order to achieve a still higher degree of efficiency and to completely avoid icing problems, the configuration illustrated in FIG. 3 is preferred. It will be observed that motor driven fan 20 exhausts into cooled space 13 conditioned air drawn through horizontally disposed porous pad 21 positioned at the bottom of an otherwise

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impervious housing 22. The evaporator coils 14 are placed above the pad 21 and below water distribution trough 23 to which water is supplied from reservoir 24 by means of a recirculating pump 25. Outwardly extending lip portions 26 about the periphery of the reservoir 24 permit ambient air to be drawn through the pad 21 and past the coils 14. Thus, the distribution trough 23 distributes water from the reservoir directly onto the coils 14 which chill the water prior to its wetting the pad 21. With this arrangement, the water impinging upon the coils 14 is somewhat warmer than in the previously described arrangements and, additionally, the coils 14 are directly in the air flow path, both factors contributing to the superior cooling and non-icing characteristics observed in this configuration.

While the principles of the invention have now been made clear in an illustrative embodiment, there will be immediately obvious to those skilled in the art many modifications of structure, arrangement, proportions, the elements, materials, and components, used in the practice of the invention which are particularly adapted for specific environments and operating requirements without departing from those principles.

I claim:

1. A system for cooling a space comprising:

- a. a housing, said housing having an air inlet disposed at the bottom thereof for receiving ambient air to be conditioned and an air outlet for issuing conditioned air into the space;
- b. a horizontally oriented, air permeable pad disposed across said air inlet;
- c. a water reservoir disposed beneath said pad;
- d. a refrigeration subsystem including evaporator coils, said refrigeration subsystem being conventionally configured to cool said evaporator coils,
 1. said evaporator coils being disposed within said housing above said pad;
- e. a pump for withdrawing water from said reservoir;
- f. liquid conduit means coupled to said pump and discharging within said housing and above said evaporator coils such that water pumped from said reservoir flows downwardly to contact said coils and then wet said pad; and
- g. fan means for forcing air from outside said housing, serially:
 1. through said inlet,
 2. across said pad,
 3. across said coils, and
 4. through said outlet.

2. The cooling system of claim 1 in which further includes a humidistat for sensing ambient humidity and in which said refrigeration system is coupled to and controlled by said humidistat whereby said refrigeration system operates only when the ambient humidity rises above a predetermined level.

3. The cooling system of claim 2 in which said refrigeration subsystem further includes a compressor and condenser.

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