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HEAT EXCHANGE APPARATUS

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FIG. 1

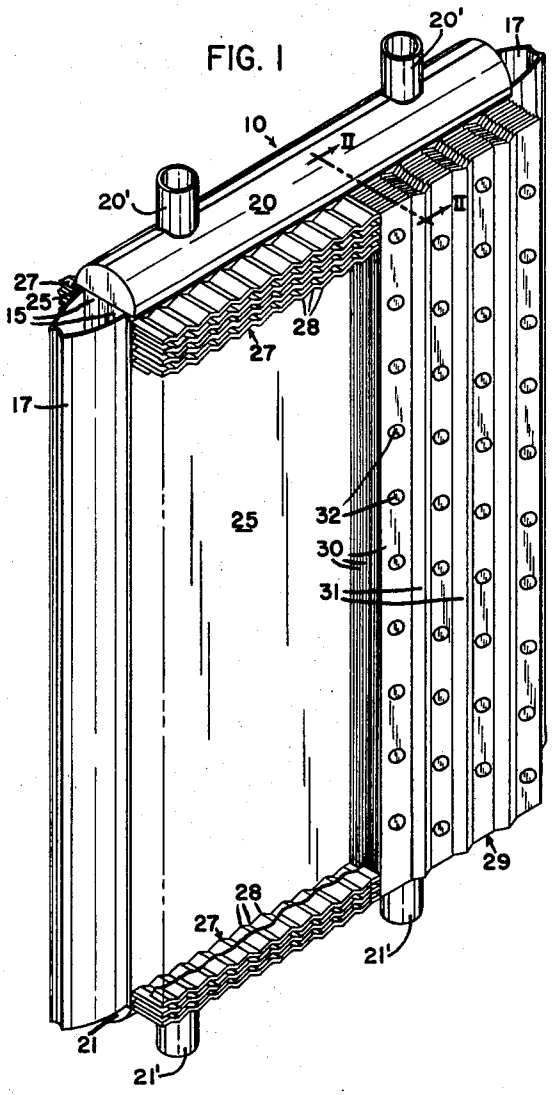
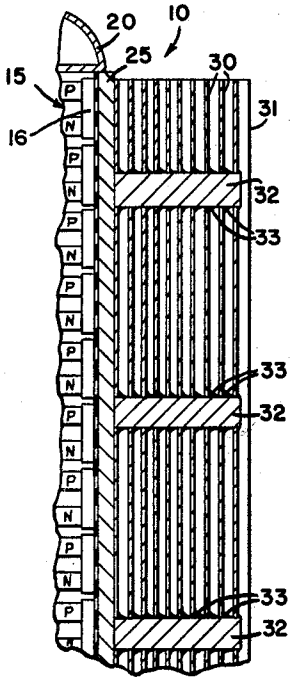


FIG. 2



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HEAT EXCHANGE APPARATUS

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This invention relates to heat transfer surfaces, more particularly to means for improving the efficiency of heat exchange via a heat transfer surface by extending the effective area of the surface, and simultaneously implementing condensate drainage from the surface. The improved heat transfer surface is of particular use in situations where condensation is likely to take place on the heat transfer surface.

A variety of situations exist in which a heat transfer surface is utilized under circumstances where condensation occurs upon the surface. As is apparent, this condensation on the heat transfer surface interferes with heat transfer efficiency in that the condensate acts to insulate the surface. Thus in an air conditioning installation, under circumstances of relatively high humidity in the area in heat exchange relationship with the heat absorbing elements of the air conditioner, condensation will occur on the heat exchange surface of the heat absorbing elements with a resultant decrease in heat transfer efficiency.

Conventional modes of increasing the effectiveness of a heat transfer surface as utilized in air conditioning installations include the applications of fins to the heat transfer surface so as to increase the effective area thereof. Where these fins extend in a horizontal plane, the moisture condensed out of the air accumulates on the horizontally extending fins decreasing the effectiveness of heat exchange between the fins and the air moving thereover, and similarly reducing the cross-sectional area of the air flow path between the fins. There are a number of installations where horizontally extending fins are required due to the geometry of the heat exchanger structure. Thus, where the fins are provided on a vertical plate member such as is utilized in thermoelectric panels, with air flow paths moving horizontally the fins must extend horizontally, and problems of condensate accumulation arise.

It is with the above problems and desiderata in mind that the present means have been evolved, means including both method and apparatus providing for an extension of effective heat transfer surface on a heat exchanger by the use of fins so as to obtain desired heat exchange efficiency, efficient air flow with respect to the heat exchange surface, and drainage of condensate from the fin surface.

It is accordingly an object of this invention to provide an improved fin arrangement for extending the effective heat transfer area of a heat exchange surface.

Another important object of the invention is to provide a fin arrangement producing desired heat transfer effects from a heat exchange surface and permitting ready drainage of any accumulating condensate.

It is also an object of this invention to eliminate the problems arising from condensate accumulation on the fins of a heat transfer surface.

It is a further important object of this invention to provide a novel fin structure implementing drainage of condensate from a heat exchange surface in conjunction with which said fin structure is employed.

A further object of the invention is to provide a drainage implementing fin structure which may readily be combined with a conventional fin structure to obtain desired heat exchange efficiency and condensate drainage.

It is an additional object of this invention to provide an improved heat transfer surface particularly suitable for use with thermoelectric structures employed to cool an air stream by the use of the Peltier effect.

These and other objects of the invention which will become hereafter apparent are attained by provision of a novel fin structure arrangement in which a plurality of spaced conducting rods are extended from the primary heat exchange surface. These rod members are of a heat conducting material such as copper or the like, and are provided with fins arranged about the periphery of the rod so that the heat of the heat exchange surface is conducted via the rods and the surface extending fins of the rods to the medium in which the rods and fins are arranged. This novel fin structure which comprises a combination of a rod and a fin permit orientation of the fin in a vertical plane so that condensate accumulations on either the rods or the fins may readily be drained. The conventional plate fin structure normally employed to extend the effective heat transfer surface of a heat exchanger member may be combined with the novel finned rod so that the desired heat exchange efficiency of the conventional plate fin may be utilized in combination with the drainage effects of the finned rod to obtain desired heat exchange effects, air moving effects, and condensate drainage.

An important feature of the invention resides in the novel finned rods which implement condensate drainage.

Another feature of the invention resides in the combination of these finned rods with the plate fins to obtain desired temperature drops over the area covered by the plate fins, and a continuance of temperature drops in the area covered by the finned rods along with condensate drainage at the area of the heat exchanger where condensation first begins to accumulate.

An additional feature of the invention resides in the fact that normal air movement over the plate fins will aid in directing any condensate forming on the plate fins towards the condensate draining finned rods.

The specific details of a preferred embodiment of the invention will be made most manifest and particularly pointed out in clear, concise and exact terms in conjunction with the accompanying drawings, wherein:

FIGURE 1 is a perspective view with parts broken away of a thermoelectric heat exchanger utilized to effect air cooling and employing the novel fin arrangement of the instant invention; and

FIGURE 2 is a fragmentary cross-sectional view along lines II—II of FIGURE 1.

Referring now more particularly to the drawings, like numerals in the various figures will be taken to designate like parts.

As best seen in FIGURE 1, a heat exchanger **10** is shown, which in this instance happens to be a thermoelectric air cooler, but as will be apparent to those skilled in the art, the principles of this invention may readily be embodied in conjunction with a variety of other types of heat exchange equipment.

In the air cooling heat exchanger **10** of FIGURE 1 a thermoelectric panel **15** forms the core of the heat exchanger. Panel **15** forms no part of this invention and is of the type conventionally formed of thermoelectric couples fabricated from P-type and N-type semi-conductor materials joined by a conductor strap **16**. A terminal cover and air deflecting vane **17** is arranged at opposite ends of the panel as viewed in FIGURE 1. Deflecting vane **17** acts to guide the air stream to the fins on opposite sides of the panel. An upper water header **20** and a lower water header **21** are provided at the top and bottom respectively of the heat exchanger so that cooling water may be directed through inlet pipes **20'** into heat exchange relationship with the heat dissipating junctions

of the thermoelectric panel **15** and be drained from header **21** through outlet pipes **21'**. A heat exchange plate member **25** forming a primary heat transfer surface is arranged in heat exchange relationship with the straps **16** forming heat absorbing cold junctions of thermoelectric panel. As seen in the drawing, the heat exchanger **10** here employed is symmetrical about a vertical plane, with the heat absorbing heat exchange plate members **25** being arranged one on each side of the structure, so that cooling may be effected from either side of the device.

The front side of the structure as viewed in FIGURE 1 will be described, but it will be understood that the description is applicable to the obverse side of the FIGURE 1 structure.

Arranged on the left-hand side of heat exchange surface **25** which will form the upstream portion of the heat exchanger are conventional plate fins **27**. Plate fins **27** are formed of a material of high heat conducting capacity such as aluminum, copper, or the like material. The plate fins in the illustration are fabricated of a sheet material formed with a plurality of crimps **28** which serve the twofold purpose of increasing the strength of the fin structure and permitting an increase in surface area of the material of the fin per unit of surface area of the heat exchange plate **25** over which said fins are arranged. These conventional plate fins are arranged over the upstream surface of heat exchange plate **25** (to the left in the drawing) and extend in a horizontal plane implementing the movement of air along the heat exchanger surface.

At the downstream end of the heat exchanger, the novel finned rods **29** are arranged. Finned rods **29** as best seen in FIGURE 2 comprises a plurality of spaced vertically extending crimped plate members **30** formed with stiffening ribs **31** as best seen in FIGURE 1. The plate members **30** of finned rods **29** are arranged in a plane parallel to that of heat exchanger plate **25** and perpendicular to that of plate fins **27**. The plate members **30** are formed of a material similar to that of plate fins **27** such as copper, aluminum, or the like. Extending through the plate members **30** at spaced intervals, and in heat exchange relationship with and secured to heat exchange plate **25** are projections in the form of pins or rods **32** of a high heat conductivity material such as copper or the like. Appropriate solder joints **33** are suitably utilized for joining the rods to the plate members **30** and for joining the bars to the heat exchange plate **25** as best seen in FIGURE 2.

The aforedescribed improved heat transfer surface may be employed in conjunction with a variety of different types of heat exchangers as will be apparent to those skilled in the art, and as heretofore noted. In the illustrated embodiment of the invention, the novel heat transfer surfaces are shown and described in conjunction with a thermoelectric air cooler in which the heat dissipating junctions of a thermoelectric panel **15** are arranged for water cooling.

The heat exchanger **10** as shown in FIGURE 1, and above described, is formed with two thermoelectric panels arranged so that their heat absorbing junctions face outwardly. The heat dissipating junctions of thermoelectric panels **15** are arranged for water cooling by the space between opposed plates **25** serving as a water jacket sandwiched between the two thermoelectric panels.

In use, the novel heat exchanger **10** is arranged so that the air to be cooled passes over the surface of the heat exchanger in a direction from left to right as viewed in FIGURE 1. Air flow is established over the surface in any conventional fashion, due to natural air currents, or artificially by means of fans or the like.

The heat exchanger is set into operation by appropriately energizing the heat pumping components of the panel, in this case by directing current flow through the thermoelectric elements, and the resulting heat pumping effects will reduce the temperature of heat exchange plates **25**. When heat exchange plates **25** reach a temperature below that of the air passing over the heat exchanger **10**, heat is absorbed from this air. As the air stream progresses over the surface of the heat exchanger **10** it is reduced in temperature so that the air at the upstream side of the heat exchanger (to the left in FIGURE 1) is at a higher temperature than the air at the downstream side (to the right in FIGURE 1).

Desired design conditions are such that the temperature of the air at the end of the run of plate fins **27** will approach the dew point temperature of the air. Under these optimum design conditions condensation will first begin to form when the air stream enters the section containing the finned rods **29**. Thus any condensate forming will be drained downwardly where it may either be collected or dissipated.

Since optimum design conditions do not always prevail, there is, of course, the possibility that under conditions of high humidity the dew point temperature will occur before the air stream reaches the novel condensate draining finned rods **29**. Under these circumstances, condensate will form on the surface of the plate fins **27**. However, the condensate will, in most instances, be blown along by the air stream until it reaches the novel finned rods **29**, whence it may be drained.

It is thus seen that a novel heat transfer surface has been provided in which the heat transfer efficiency of the plate fin may be utilized to obtain rapid and efficient cooling of an air stream, and the drainage benefits of a novel finned rod structure may be utilized for condensate dissipation once the air has attained desired temperature levels, and dehumidification with its resultant condensate accumulation results.

The above disclosure has been given by way of illustration and elucidation, and not by way of limitation, and it is desired to protect all embodiments of the herein disclosed inventive concept within the scope of the appended claims.

I claim:

1. An air cooler comprising: a thermoelectric panel; heat dissipating junctions on said panel in heat exchange relationship with cooling water; a heat exchange plate member in heat transfer relationship between the air to be cooled and the heat absorbing junctions of said panel; plate fins on said panel contacting the air to be cooled as it first commences flow over the heat exchange plate member, said plate fins extending in the direction of flow of the air; rods extending from said plate member downstream of said plate fins; and fins on said rod extending in a direction other than the horizontal, whereby condensate will be drained.

2. Means for effecting heat transfer between a heat exchanger and a gaseous medium flowing over the heat exchanger from an upstream point to a downstream point, said means comprising: primary heat conducting surface means on said heat exchanger; upstream fin means on said primary surface means in heat exchange relationship with said primary surface means and the gaseous medium as the gaseous medium first commences flow over the heat exchanger, said upstream fin means extending in a plan parallel to the direction of flow of the gaseous medium; and downstream fin means in heat exchange relationship with said primary heat conducting surface means and the gaseous medium, said downstream fin means extending in a plane other than the horizontal whereby condensate will be drained.

3. Means for effecting heat transfer as in claim 2 in which projecting means extend from said primary heat conducting surface means through said downstream fin means in heat exchange relationship with said surface means and said fin means.

4. Means for effecting heat transfer as in claim 2 in which said fin means are formed with reinforcing rib means.

5. A heat transfer surface for effecting heat exchange between a relatively cold coolant and a flowing relatively

warmer gaseous medium with the flow of heat from the gaseous medium produced by said heat exchange resulting in condensate formation on the heat transfer surface, said surface comprising: a primary heat conducting surface in heat exchange relationship with the relatively cold coolant; fins formed on said primary surface and extending in a plane parallel to the direction of flow of the gaseous medium; and fins in heat exchange relationship with said primary conducting surface and said flowing gaseous medium at a point downstream of said first named fins, said last-named downstream fins extending in a plane other than the horizontal whereby condensate will be drained.

6. A heat transfer surface as in claim 5 in which heat conducting rods are extended from said primary surface to said downstream fins.

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