United States Patent [19]

Ares

[11] **3,923,098**

[45] **Dec. 2, 1975**

[54] **FORCED AIR HEAT EXCHANGE UNIT WITH IMPROVED CONDENSATE REMOVAL CONSTRUCTION**

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[52] **U.S. Cl.** **165/111;** 62/285; 62/288

[51] **Int. Cl.²** **F25D 21/14**

[58] **Field of Search** 165/111; 62/272, 285, 288, 62/290, 291

[56] **References Cited**

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2,983,115	5/1961	Caswell	62/285
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3,703,815	11/1972	Welch	62/290

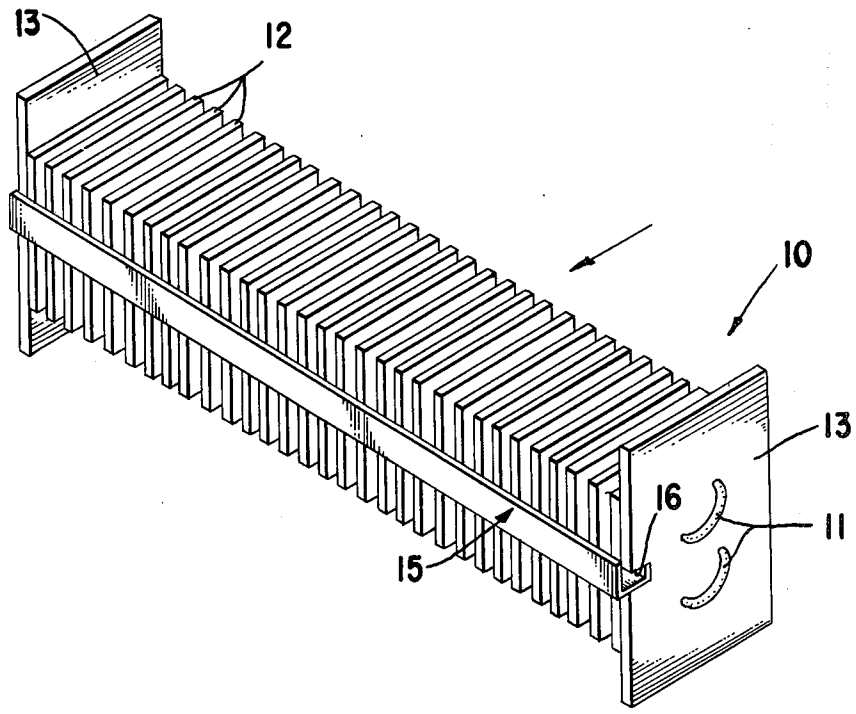
Primary Examiner—Albert W. Davis, Jr.

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[57] **ABSTRACT**

A forced air heat exchange unit comprising at least one horizontally-extending coil of thermally conductive tubing carrying thermally conductive fins thereon and supported between end plates, at least one condensate channel connected across and supported within cut-out portions formed in all of said fins and end plates adjacent the end stream edges thereof to direct condensate from the fins to the area of at least one of said end plates and thereby reduce entrainment of fly-off condensate in the conditioned air.

2 Claims, 6 Drawing Figures



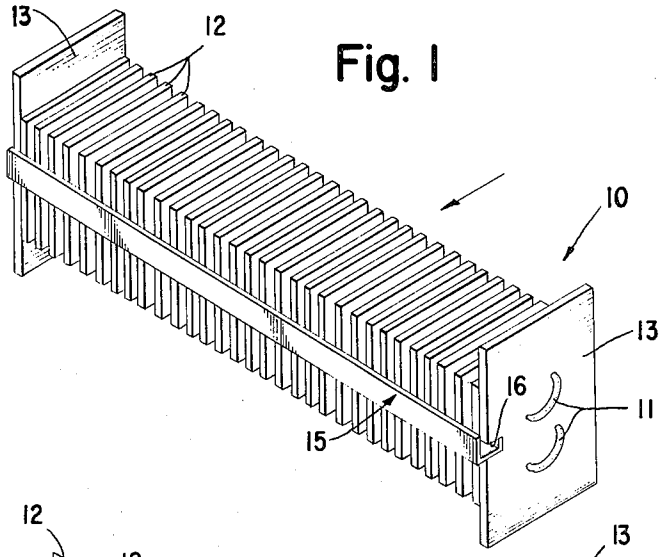


Fig. 1

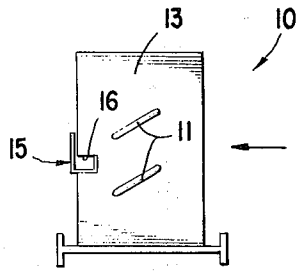


Fig. 2

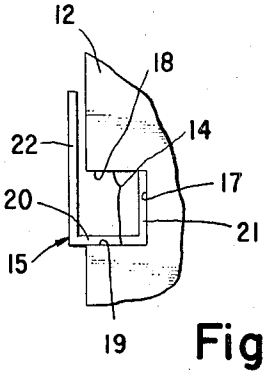


Fig. 3

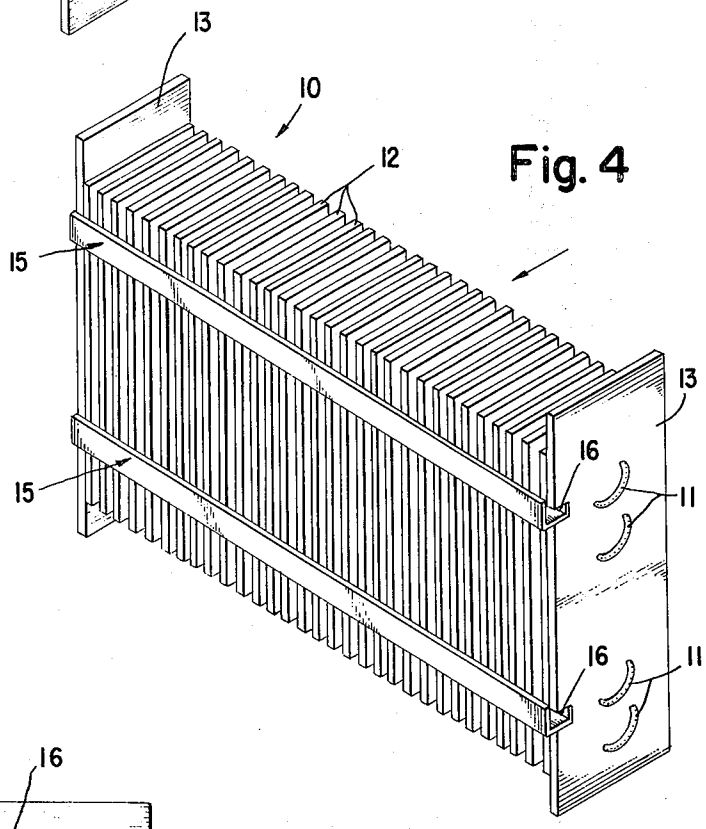


Fig. 4

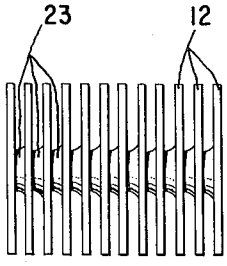


Fig. 5

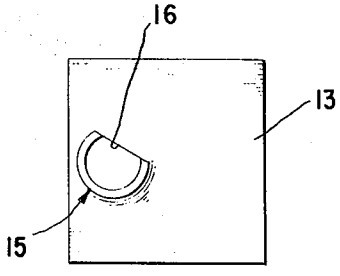


Fig. 6

FORCED AIR HEAT EXCHANGE UNIT WITH IMPROVED CONDENSATE REMOVAL CONSTRUCTION

BACKGROUND OF THE INVENTION

The present invention relates to heat exchangers of the type in which a stream of air is cooled by being forced horizontally across the finned surfaces of a cooling coil or at an angle of up to approximately 45°of the horizontal. The heat exchange unit is preferably of the dehumidifying or wetted surface type. Condensate droplets are known to accumulate upon the fins and are forced by the airstream towards the downstream edge thereof where, upon attaining sufficient size, such droplets are blow off the fins and are entrained for a distance in the airstream. This is an undesirable phenomenon because of several factors, not least of which is that it increases the moisture content of the conditioned air and also re-introduces latent heat into the airstream thereby adversely affecting the overall thermodynamic efficiency of the heat exchange unit. The problem appears to be aggravated when the heat exchange unit utilizes superposed coils, the condensate formed on the upper coil invariably being blown off into the conditioned air.

Attempts have been made heretofore to minimize entrainment of condensate in the treated air, one such expedient being deformation of a corner portion of each fin of an upper coil so as to direct the condensate away from the downstream edges of such fins and effect a transfer of the condensate to the lower fins with reduced entrainment of the condensate in the airstream. For a more detailed description of this alternative reference is made to U.S. Pat. No. **3,703,815** granted Nov. **28, 1972.** It has also been known previously to provide a condensate trough or channel to carry away condensate which forms on the fins of a heat exchanger as may be seen from U.S. Pat. Nos. **2,667,041** granted Jan. **26, 1954; 2,876,631** granted Mar. **10, 1959** and **2,983,115** granted May **9, 1961.** However, none of such patents were concerned with the specific problem of condensate fly-off nor do such patents provide a structural arrangement which is as simple and economical as that of the present invention. Such patents employ full face fins with the coils of their heat exchanger construction.

SUMMARY OF THE INVENTION

It is one object of the present invention to provide a heat exchange unit of the forced air substantially horizontal flow type which substantially reduces the entrainment of fly-off condensate in the conditioned air.

It is another object of the present invention to provide a heat exchange unit of the forced air horizontal-flow type which substantially eliminates the entrainment of fly-off condensate in the conditioned air and is particularly efficacious where two or more coils are superposed to form such unit.

Yet another object of the invention is to provide a heat exchange unit of the forced air type mounted at an angle up to 45°of horizontal where drip-back of the condensate is substantially eliminated.

Other objects and advantages will be readily gleaned from the following description of the invention.

According to the present invention there is provided in a forced air heat exchange unit comprising at least one horizontally extending coil of thermally-conductive tubing supported between end plates and carrying thermally-conductive fins thereon, the improvement comprising at least one condensate channel connected across and supported within cut-out portions formed in all of said fins and end plates adjacent the downstream edges thereof, whereby condensate formed on said fins is conducted via said channels to the area of at least one of said end plates for collection and disposal.

BRIEF DESCRIPTION OF THE DRAWINGS

In order that the invention may be more fully comprehensive it will now be described, with reference to the accompanying drawings in which:

FIG. **1** is a perspective view of a heat exchange unit embodying the present invention;

FIG. **2** is an end view of the heat exchange unit of FIG. **1**;

FIG. **3** is an enlarged view of a condensate channel nested within a notch of a fin in accordance with a preferred embodiment of the invention;

FIG. **4** is a view similar to FIG. **1** showing a heat exchanger in which two condensate channels are positioned in superposed relation;

FIG. **5** is a front elevational view of a portion of a heat exchange unit according to a second embodiment of the invention; and

FIG. **6** is an end view of the heat exchange unit of FIG. **5.**

DETAILED DESCRIPTION OF THE INVENTION

Referring to the drawings, there is shown a heat exchange unit **10** which includes a coil of thermally conductive tubing having parallel legs connected by U-shaped bends **11.** The tubing is adapted to circulate a cooling medium therewithin and to carry a plurality of plate-like fins **12** formed of a thermally conductive material. The coil is supported between a pair of end plates **13.** A blower (not shown), is provided to direct a stream of the air to be conditioned across the surfaces of the fins in the direction indicated by the arrows in FIGS. **1, 2** and **4.** As may be more clearly seen from FIGS. **2** and **3,** the fins may be provided with at least one notch **14** in the downstream edges thereof in order to accommodate one or more condensate channels **15** to be hereinafter described. It will, of course, be appreciated that several such channels may be utilized with each such heat exchanger. The exact number and location of the channels to be employed will be determined by the design requirements for the unit, e.g. extent of dehumidification and cooling to be effected. However, according to the preferred embodiment of the invention a notch is formed in the downstream edge of each of the fins at approximately the same elevation to receive each of such channels which are to be employed.

In addition to the provision of notches in each of the fins, the end plates **13** are similarly provided with notches **16** for reception of the condensate channel. Preferably the notches of both the fins and end plates are formed such that the base **17** of the notch and the upper and lower sidewalls **18, 19** thereof are similarly dimensioned.

As may be seen most clearly from FIG. **3,** the condensate channel may be formed to present a U-shaped configuration in cross-section in which the legs have unequal lengths. The base **20** of the channel and the shorter leg **21** are nested within the notches of the fins and end plates whereas the channel leg **22** having the

greater dimension extends upwardly outside of the notches either on or in close proximity to the downstream edges of the fins. One alternate form of construction, not illustrated, involves positioning leg **22** in close engagement with the edges of the fins such as by being secured thereto by means of a suitable adhesive.

The notches on the fins and end plates may be so located elevationally across the face of the heat exchanger that a slight pitch is desirably provided for the condensate channel in order to expedite drainage of the condensate to one of the end plates. Since the ends of the channel are open, however, it will be appreciated that while a pitch will accelerate drainage of the condensate it is not essential. A condensate pan (not shown) may be positioned below the heat exchanger to receive condensate which has been conducted away from the fins to the area of the end plates. This pan may also serve to collect such condensate as may avoid entrapment in the channel **15** and drip down from the fins. Alternatively, the notches may be so arranged as to provide for drainage from the mid-point of the coil to each of the end plates. In such event there would be a center mounted end plate not incorporating channel notch provisions. Also, each channel could present the appearance of a slightly inverted V. Desirably, the channel is constructed as a unitary member although it is within the scope of the invention to construct the channel in more than one piece and to either assemble the sections in end-to-end relationship within the notches or to unite the section prior to positioning on the fins and end plates as may be preferred where drainage to both end plates from the mid-point of the heat exchanger is desired. One or both of the terminal ends of the condensate channel may extend a substantial distance beyond the end plate.

As shown in FIG. **4** of the drawings, dehumidifying coils of substantial height and/or such coils operating at high volumetric airflow rates may require a number of channels positioned across the air-leaving face of such coils.

It will be understood also, that instead of a square or rectangular notch and corresponding channel it is within the ambit of the invention to utilize a notch and channel having a different configuration, e.g. that of a half-moon. In this respect attention is drawn to FIGS. **5** and **6** where another embodiment of the invention is illustrated. In this form the condensate channel is made up by a series of collars **23** which are extruded on the fins. The collars are so dimensioned that when the fins are in position on the coil of tubing they interconnect so as to form a continuous channel across all of the fins to at least one of the end plates. As shown the channel is located closely adjacent the downstream edges of the fins and end plates. It will, of course, be understood that the collars may be formed at the edge itself as depicted in FIGS. **1–4.**

As will be appreciated, drainage of the condensate is preferably conducted to a point beyond the exterior surface of the end plate in order to avoid entrainment of any of the collected condensate in the airstream which usually flows between the interior surfaces of the end plates and across the surfaces of the fins.

It will also be understood that overall heat exchanger performance is improved by removal of the condensate droplets from the coil surfaces as soon as each droplet attains sufficient size. This permits a minimizing of the wetted surface effect of the fin surface and allows for a somewhat reduced surface temperature, thereby enhancing cooling coil performance when operating at dehumidification conditions.

It will still further be recognized that the construction of the present invention enables the realization of an uneven across-the-face surface temperature when desired such as in face control circuited coils controlled by two or more in-tube fluid control devices.

Numerous alterations of the structure herein disclosed will suggest themselves to those skilled in the art. However, it is to be understood that the present disclosure relates to a preferred embodiment of the invention which is for purposes of illustration only and not to be construed as a limitation of the invention. All such modifications which do not depart from the spirit of the invention are intended to be included within the scope of the appended claims.

Having thus set forth the nature of the invention, what is claimed herein is:

1. In a forced air heat exchange unit having at least one horizontally extending coil of thermally-conductive tubing supported between end plates and carrying thermally-conductive fins thereon, the improvement comprising at least one condensate channel connected across and supported within notches formed in all of said fins and end plates adjacent the downstream edges thereof, whereby condensate formed on said fins is conducted via such channel to the area of at least one of said end plates for collection and disposal, said channel and notches being dimensioned such that one leg and substantially all of the base of said channel nests within said notches with the base of the notches being substantially coextensive in height with said one leg of the channel, the other leg of said channel being of greater dimension than said one leg and extending upwardly outside of said notches in close proximity to the downstream edges of said fins.

2. In a forced air heat exchange unit comprising at least one horizontally extending coil of thermally-conductive tubing supported between end plates and carrying thermally conductive fins thereon, the improvement comprising at least one condensate channel connected across and supported within cut-out portions formed in all of said fins and end plates adjacent the downstream edges thereof, whereby condensate formed on said fins is conducted via such channel to the area of at least one of said end plates for collection and disposal, said condensate channel comprising individual extruded collars formed on said fins with a cross-sectional configuration of a half-moon, said collars being so dimensioned that when the fins are in position on the coil tubes said collars engage to form a continuous channel across said unit.

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