United States Patent

Welch

[15] **3,703,815**

[45] **Nov. 28, 1972**

[54] **DOUBLE FIN COOLING COIL WITH CONDENSATE DIRECTOR**

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[73] Assignee: **The Trane Company**, La Crosse, Wis.

[22] Filed: **Sept. 27, 1971**

[21] Appl. No.: **183,880**

[52] **U.S. Cl.**.....**62/290**, 62/272

[51] **Int. Cl.**.....**F25d 21/14**

[58] **Field of Search**.....62/272, 285, 290

[56] **References Cited**

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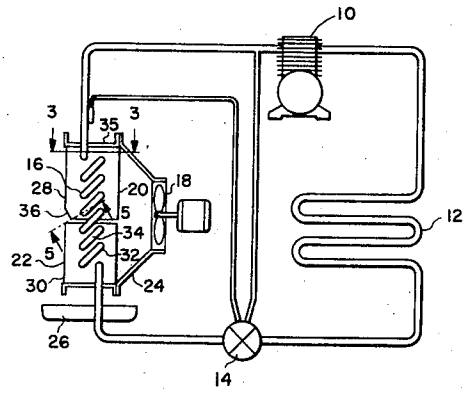
Primary Examiner—William J. Wye

Attorney—Arthur O. Andersen et al.

[57] **ABSTRACT**

A compression cycle refrigeration system for cooling air is shown wherein the evaporator heat exchanger coil has two sets of fins, one set of fins being arranged above the other. The lower downstream corners of the fins of the upper set are folded over on the next adjacent fin to thereby form a series of condensate directors to cause condensate running down the downstream margins of the upper fins to transfer and adhere to the lower fins with reduced entrainment of condensate in the air passing over the heat exchange coil.

9 Claims, 5 Drawing Figures



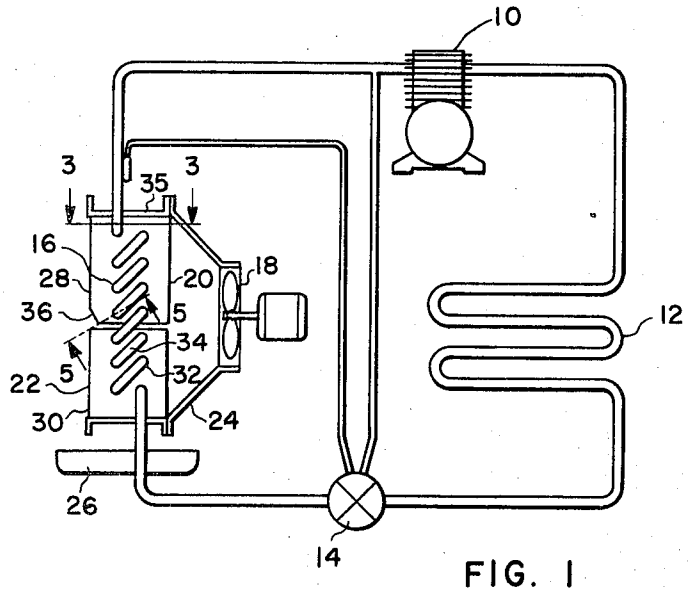


FIG. 1

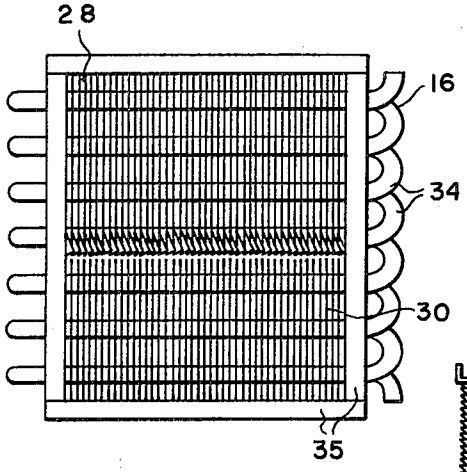


FIG. 2

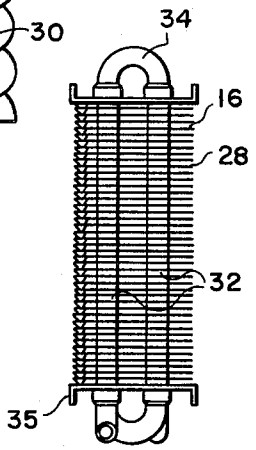


FIG. 3

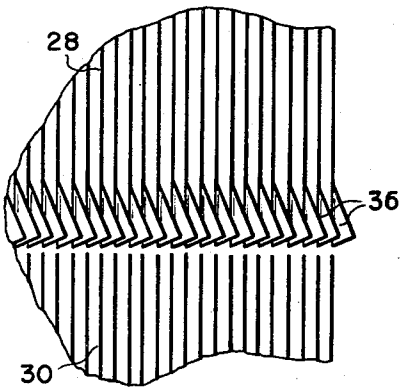


FIG. 4

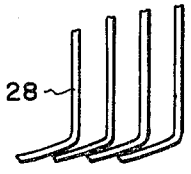


FIG. 5

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DOUBLE FIN COOLING COIL WITH CONDENSATE DIRECTOR

BACKGROUND OF THE INVENTION

Refrigeration systems employed for air conditioning usually employ a fin-and-tube heat exchanger for cooling the air. Refrigerant if conducted through the tubes to thereby cool the fins. In cooling the air below the dew point temperature, condensate normally forms on and adheres to the fins and runs down along the faces of the fins to a collection area. Where the heat exchanger employs two sets of fins, one above the other, a larger amount of condensate becomes entrained in the air stream passing over the heat exchanger. This phenomenon is present even if the upper set is in contact with the lower set of fins. I attribute this phenomenon to the loss of the adhesive bond between the condensate and fin surface as the condensate leaves the surfaces of the upper fins and attempts to adhere to the surfaces of the lower fins. At this junction air passing over the heat exchange coil may propel the condensate downstream causing a portion thereof to leave the fin surfaces and become entrained in the air stream.

SUMMARY OF THE INVENTION

The instant invention relates to apparatus for the transfer of condensate from the upper to the lower set of fins of a heat exchanger having upper and lower sets of fins. This is accomplished by folding the lower downstream corners of each of the fins of the upper set over onto the next adjacent fin. The folded portion functions as a condensate director. The condensate passing downwardly in the lower downstream portion of the upper set of fins is directed upstream whereby the condensate leaves the upper set of fins somewhat upstream of the downstream face of the upper set of fins. From this upstream position the condensate may transfer and adhere to the upper portions of the lower fins without passing beyond the downstream face of the set of lower fins and becoming entrained in the air stream. The fin folds also may tend to concentrate the condensate sufficiently to substantially block air movement at the area of transfer.

More specifically this invention involves heat exchange apparatus comprising: a first series of substantially parallel horizontally spaced vertically extending heat exchange plate first fins adapted to be disposed in an air stream and having generally coextensive generally vertically extending downstream edges; a second series of substantially parallel horizontally spaced vertically extending heat exchange plate second fins adapted to be disposed in the air stream and having coextensive generally vertically extending downstream edges; said second series of second fins being disposed immediately below said first series of first fins; a plurality of tubes extending through and in heat exchange relationship with said first and second fins and adapted to conduct a cooling fluid to cool said first and second fins to a temperature below the dew point of the air stream whereby condensate is formed on the fins and caused to pass downwardly along the downstream margins of said first and second fins adjacent the downstream edges thereof; and means associated with the lower portions of said first fins adjacent the downstream edges thereof for directing condensate in

an upstream direction whereby said condensate upon leaving said first fins transfers to said second fins with reduced entrainment of condensate in the air stream.

These and other aspects of this invention will become more apparent as this specification proceeds to describe the invention with reference to the drawings in which:

FIG. 1 is a schematic of a refrigeration system incorporating my invention; and

FIG. 2 is a side elevation of the downstream face of the evaporator heat exchanger coil shown in FIG. 1;

FIG. 3 is a horizontal section of the evaporator heat exchanger coil of FIG. 1 taken at line 3—3 of FIG. 1;

FIG. 4 is an enlarged detail of the heat exchanger coil shown in FIG. 2; and

FIG. 5 is an enlarged section of a detail of the heat exchanger coil taken at line 5—5 of FIG. 1.

DETAIL DESCRIPTION

Referring to the drawings, a refrigeration circuit is shown having a refrigerant compressor **10**, a refrigerant condenser **12** connected to the discharge of compressor **10**, a refrigerant expansion valve **14** connected to the outlet of condenser **12**, and a refrigerant evaporator **16** connected to receive liquid refrigerant from valve **14** and to discharge vaporized refrigerant to the inlet of compressor **10**. A fan **18** is arranged to pass moisture containing air through evaporator **16** from the upstream face **20** to the downstream face **22**. A shroud **24** may be provided to direct the air from fan **18** to evaporator **16**. A condensate drain pan **26** is provided to collect condensate drained from evaporator **16**.

Evaporator **16** has a first series of generally planar metallic upper fins **28** of rectangular configuration disposed in spaced face-to-face relationship and a second series of generally planar metallic lower fins **30** of rectangular configuration disposed in spaced face-to-face relationship. The second fins are immediately below the first fins and may be contiguous with some of the first fins. Evaporator **16** also includes a plurality of tubes **32** traversing through the fins **28** and **30** in heat exchange relationship therewith for conducting refrigerant from valve **14**. Tubes **32** are connected in series by U-bend elements **34** as required to complete the refrigerant circuit. The fins **28** and **30** and tubes **32** of evaporator **16** are supported in a rectangularly shaped frame **35** formed of channel members.

It will be seen that the lower downstream corner portion **36** of each of fins **28** has been folded over a similar fold on the next adjacent fin. Substantially all of the upper fins are thus folded. The crease between the fold portion and the main portion of the fin extends upwardly and downstream and makes an angle between 135° and 170° with the downstream edge of the fin. This angle is preferably about 155° and the fold portion has a height of about seven-eighths inch and a horizontal depth of about three-eighths inch. The fold portion is almost normal to the main portion of the fin as will be seen from FIG. 5.

The fold portions are preferably made by passing an appropriate bending tool along the lower downstream corner of the upper series of fins after they have been assembled with the tubes **32**. However, it is contemplated that such folds may be made in the individual fins prior to assembly with tubes **32**. It is also contem-

plated that the desired dimensions herein given will vary somewhat with expected air velocity and fin spacing.

During operation of the refrigeration system, refrigerant is passed serially through compressor **10**, condenser **12**, expansion valve **14**, and evaporator **16** while moisture laden air is passed by fan **18** through evaporator **16**. Condensate forms upon fins **28** and **30** of the evaporator. The movement of air over the fins tends to push the condensate to the downstream margins while gravity tends to cause the condensate to move downwardly. The condensate passing downwardly along the downstream margins of fins **28** is directly forwardly as it passes downwardly along fold portions **36**. From this forward position condensate leaves the upper fins **28** to transfer to the lower fins **30** whereupon such condensate may continue its downward progress into drain pan **26**.

Folds **36** thus function as condensate bridging means to allow the free passage of condensate from the upper series of fins to the lower series of fins with reduced condensate entrainment in the air stream.

Although I have described in detail the preferred embodiment of my invention, I contemplate that many changes may be made without departing from the scope or spirit of my invention, and I desire to be limited only by the claims.

I claim:

1. Heat exchange apparatus comprising: a first series of substantially parallel horizontally spaced vertically extending heat exchange plate first fins adapted to be disposed in an air stream and having generally coextensive generally vertically extending downstream edges; a second series of substantially parallel horizontally spaced vertically extending heat exchange plate second fins adapted to be disposed in the air stream and having generally coextensive generally vertically extending downstream edges; said second series of second fins being disposed immediately below said first series of first fins; a plurality of tubes extending through and in heat exchange

relationship with said first and second fins and adapted to conduct a cooling fluid to cool said first and second fins to a temperature below the dew point of the air stream whereby condensate is formed on the fins and caused to pass downwardly along the downstream margins of said first and second fins adjacent the downstream edges thereof; and means associated with the lower portions of said first fins adjacent the downstream edges thereof for directing condensate in an upstream direction whereby said condensate upon leaving said first fins transfers to said second fins with reduced entrainment of condensate in the air stream.

2. The apparatus as defined by claim **1** wherein said means includes a fold at the lower downstream corner of each fin of said first series of fins.

3. The apparatus as defined by claim **2** wherein said fold makes an obtuse angle with the main portion of said fin.

4. The apparatus as defined by claim **2** wherein the crease between said fold and the main portion of said fin extends upwardly and downstream.

5. The apparatus as defined by claim **4** wherein said crease makes an angle between 135° and 170° with the downstream edge of said fin.

6. The apparatus as defined by claim **5** wherein said angle is about 155°.

7. The apparatus as defined by claim **2** wherein each fold overlies the fold of an adjacent fin.

8. The apparatus as defined by claim **7** wherein said folds are contiguous.

9. The apparatus as defined by claim **2** wherein said first and second fins are rectangular plates having a generally vertically extending major axes.

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