

PATENT SPECIFICATION (11)

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(54) EVAPORATOR ASSEMBLY FOR AIR CONDITIONING APPARATUS

(71) We, BORG-WARNER CORPORATION, a Corporation organized and existing under the laws of the State of Delaware, United States of America of 200 South Michigan Avenue, Chicago, Illinois 60604, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to apparatus comprising a finned evaporator coil shaped to be mounted in a duct for air conditioning apparatus.

According to the invention there is provided apparatus for use in an air conditioning system and comprising an evaporator coil assembly location within a duct through which air to be conditioned is circulated through the coil assembly, in an upward direction, in use of the apparatus, the evaporator coil assembly including a plurality of parallel tube sections extending across the intended direction of air flow; a plurality of fins each lying in a plane parallel to the intended direction of air flow through the duct and being in heat exchange contact with the tube sections, means for collecting condensate dripping off an upstream edge of each of the fins the upstream edge of each of the fins being provided with V-shaped tapered teeth with the apex of each tooth being arranged to drip condensate into the condensate collecting means, and the downstream edge of each said fin having a saw-tooth like configuration with the flanks of the teeth inclined to the intended direction of air flow, the condensate-collecting means comprising a plurality of spaced parallel troughs so arranged as, in use of the apparatus, to underlie the V-shaped tapered teeth with each trough extending parallel with the tube sections to underlie teeth of different ones of the fins to collect condensate gravitating from the fins.

The invention will be further described,

by way of example, with reference to the accompanying drawings, wherein:

Figure 1 is a perspective view of an air conditioning compartment having an evaporator coil assembly embodying the present invention;

Figure 2 is a sectional view taken along line 2—2 of Figure 1 showing the fin and coil structure, and the edge configuration of the fins; and

Figure 3 is a sectional view taken along line 3—3 of Figure 2.

Referring now to the drawings, a duct or plenum compartment 10, which may form a portion of a warm air heating and air conditioning system, has side walls 11 and 12 and end walls 13 and 14. A finned evaporator coil structure 15, in the form of a bank of coil sections extending across parallel spaced metal fins 17 is horizontally positioned in the plenum and extends substantially the entire length and width of the compartment. A blower (not shown) is positioned upstream or downstream of the coil and adapted to draw (or force) air through the coil in upward fashion as shown by the arrows in Figure 3. The coil is supported on the plenum side walls 11 and 12 by a plurality of spaced brackets 16, connected to the sheet metal plate-like fins 17 of the coil assembly, and by bolts 18 extending through the walls 11 and 12 and into threaded openings in brackets 16.

The evaporator structure 15 comprises a tube bent back and forth upon itself to provide a coil 19 acting as a refrigerant expansion chamber and absorbing heat from the air to thus provide cooling thereof. Associated with the coil are the fins 17 mounted on the coil convolutions at right angles to the axes of the parallel coil portions and through which the coil passes. The evaporator structure 15 is mounted in the compartment 10 in the path of the air streams flowing vertically, as indicated by the arrows in Figure 3, to expose a maximum area to the air entering the lower open end of the compartment, flowing through

the evaporator structure, and discharging from the upper open end of the compartment.

As shown in Figure 2, each fin 17 has a saw toothlike bottom upstream providing a series of V-shaped portions 21 having both sides tapered angularly toward a point 22 at the lowermost extremity of the fin. This shape of the fins ensures that moisture, formed by condensation of the surfaces of each fin, will be in the form of a thin continuous film of condensate on the fin and will flow, by gravity, to the lowermost discharge point 22 of the fin.

A condensate collector assembly 23 is disposed in the plenum 10, and relative to the evaporator structure 15, to cooperate with the coil structure 15 in a manner to ensure that moisture, condensed on and flowing downwardly of the fins, is collected while providing minimum resistance and restriction to air flowing through the compartment and into the coil structure. More particularly, the collector assembly 23 comprises a plurality of U-shaped troughs 24 respectively disposed directly beneath the lowermost points of the fins, namely, tips 22 of the V-shaped portions 21 of the fins. The troughs 24 may be formed of thin metal or light-weight plastics material and of such width as to be aligned with and underlie only the tips 22 so that maximum air flow through the collector assembly 23 is ensured. The troughs are connected together by two spaced thin rods 26 extending through the side walls of the troughs and having their ends seated in pockets 27 in the side walls 11 and 12 of the compartment. Each trough 24 is angularly inclined to the end walls 13 and 14 of the plenum (Figure 3) so that condensate moisture in the troughs will flow downwardly from wall 13 to 14 and, at its lower closed end near the wall 14, will enter spouts 28 and flow into a collector trough 29 inclined angularly from the side wall 11 to the side wall 12 of the plenum. In Figure 2, the collector trough 29 is shown to be held in position by bolts 30 and 31 extending through the walls 11 and 12 and threaded into the trough ends to support the trough beneath the spouts 28 of the troughs 24.

As best shown in Figure 2, the feature to which the present invention is directed is the shape of the downstream upper edge of each fin 17. This upper edge is formed with upwardly extending V-shaped teeth 50 similar to the downwardly extending V-shaped elements 21. Each of the teeth 50 terminates in a sharp apex 52 which extends well above the level of the top row of heat exchange tubing 19a.

The purpose of the V-shaped elements 50 is to prevent the accumulation of liquid condensate at or adjacent the upper row of heat exchange tubes 19. For a coil assem-

ably having straight top edges to the fins, this phenomenon occurs at an air velocity which produces a pressure drop in the air flow through the coil assembly of about 0.22" H₂O. With the use of upwardly extending V-shaped teeth of the present invention, the accumulation of water will not begin until the air flow is sufficient to produce a pressure drop in excess of about 0.35" H₂O in the air flow through the coil assembly.

In apparatus with straight top edges to the fins, during use thereof water condensate droplets build up on the sides of the tubes and may eventually bridge across between adjacent tubes. The air flow forces the water upward to the top edges of the fins where it tends to collect and "sheet" across the entire assembly. As the water begins to sheet, the air pressure drop through the assembly becomes greater tending to bring up more water and increasing the forces holding the water up. If the fin edge is perpendicular to air flow, there is no edge for it to follow to get out of that condition because the edge has an affinity for the water. In the present invention at least some substantial portion of the extent of each upper fin edge is inclined to the direction of air flow through the duct. The substantial portion is provided by a plurality of sloping edges at the top of the fins having a saw tooth design. The water will still drive to that edge; but because the edge is at an angle, preferably about 60°, it cannot sheet and hold there because the air slides by it at an angle. Eventually the water will form a large enough droplet at the tip of a tooth for it to fall down between adjacent fins counter to the air flow so that it may drain to the collecting troughs below the fins.

WHAT WE CLAIM IS:—

1. Apparatus for use in an air conditioning system and comprising an evaporator coil assembly for location within a duct through which air to be conditioned is circulated through the coil assembly, in an upward direction, in use of the apparatus, the evaporator coil assembly including a plurality of parallel tube sections extending across the intended direction of air flow; a plurality of fins each lying in a plane parallel to the intended direction of air flow through the duct and being in heat exchange contact with the tube sections, means for collecting condensate dripping off an upstream edge of each of the fins the upstream edge of each of the fins being provided with V-shaped tapered teeth with the apex of each tooth being arranged to drip condensate into the condensate collecting means, and the downstream edge of each said fin having a saw-tooth like configuration with the flanks of the teeth inclined to the intended direction

the evaporator structure, and discharging from the upper open end of the compartment.

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As best shown in Figure 2, the feature to which the present invention is directed is the shape of the downstream upper edge of each fin 17. This upper edge is formed with upwardly extending V-shaped teeth 50 similar to the downwardly extending V-shaped elements 21. Each of the teeth 50 terminates in a sharp apex 52 which extends well above the level of the top row of heat exchange tubing 19a.

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of air flow, the condensate-collecting means comprising a plurality of spaced parallel troughs so arranged as, in use of the apparatus, to underlie the V-shaped tapered teeth with each trough extending parallel with the tube sections to underlie teeth of different ones of the fins to collect condensate gravitating from the fins.

8. Apparatus as claimed in claim 1, including the duct with the coil assembly being mounted in such duct with the parallel tube sections extending thereacross.

3. Apparatus comprising an evaporator coil assembly mounted in a duct constructed and arranged substantially as hereinbefore described with reference to and as shown by the accompanying drawings. 15

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