Feb. 28, 1967 E. F. HOLYFIELD 3,306,071

COOLING COIL WITH CONDENSATE DIRECTOR

Filed Aug. 26, 1965 3 Sheets-Sheet 1

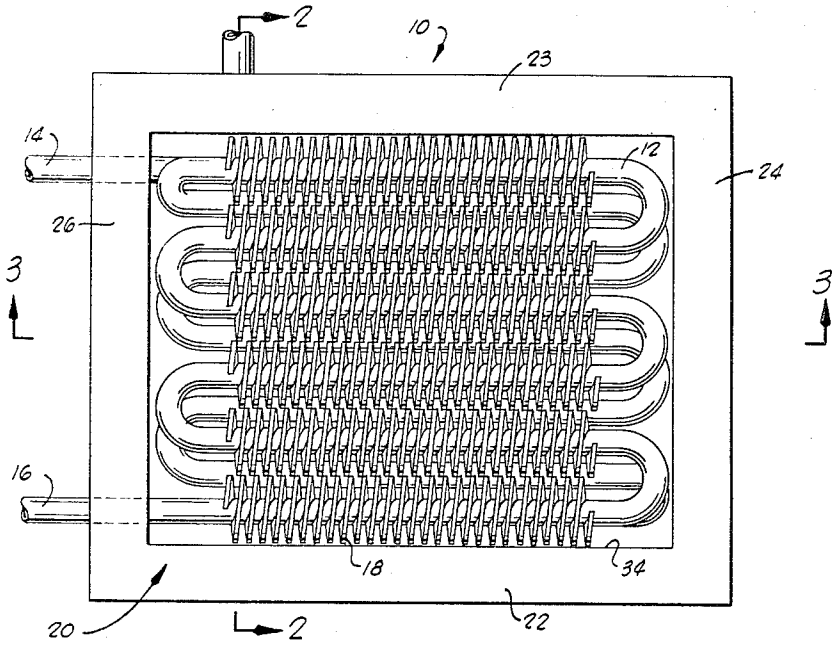


Fig. 1

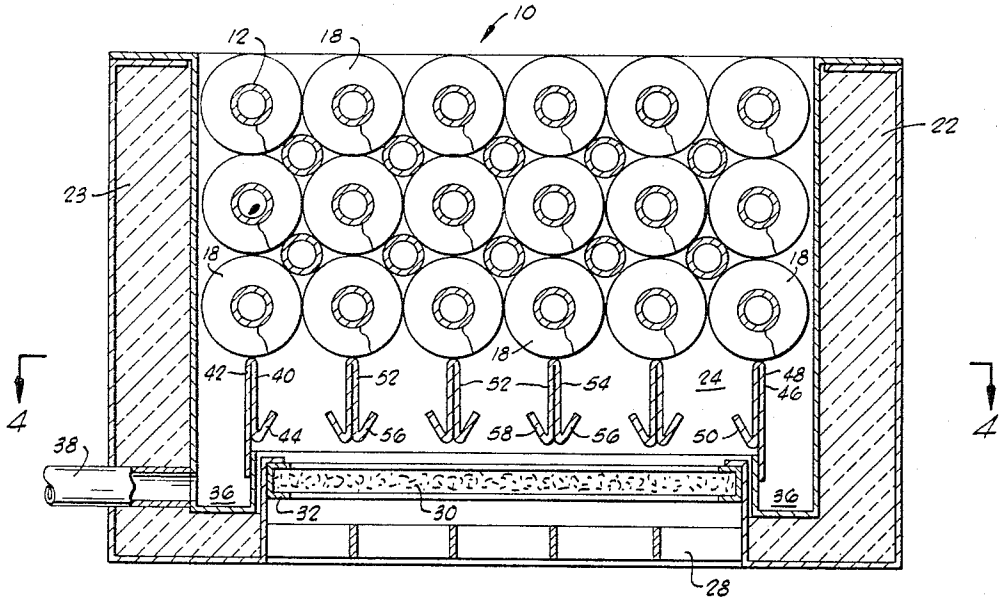


Fig. 2

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COOLING COIL WITH CONDENSATE DIRECTOR

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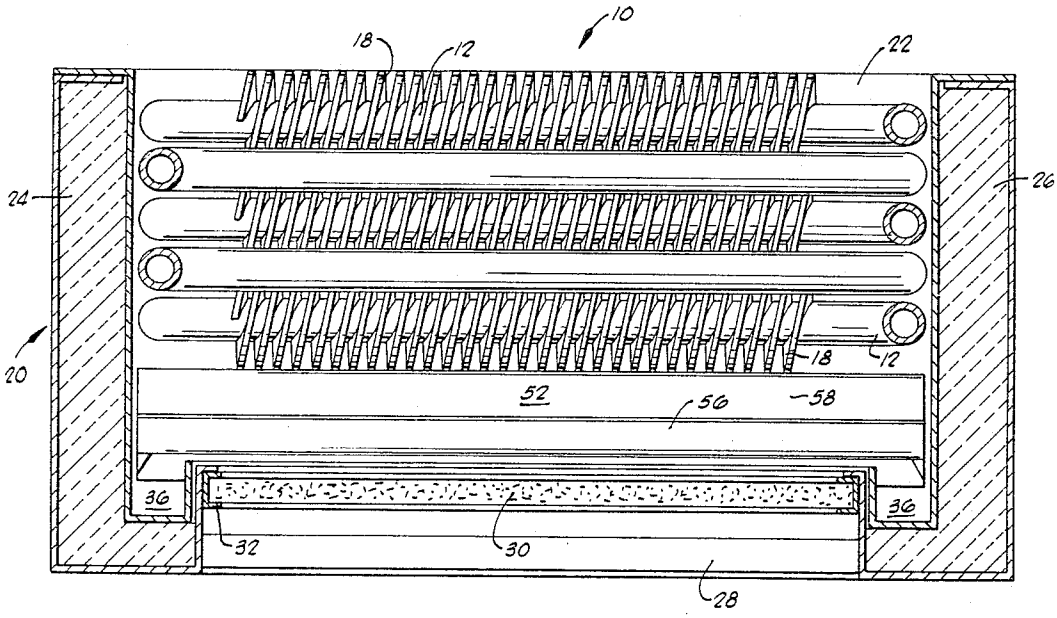


FIG. 3

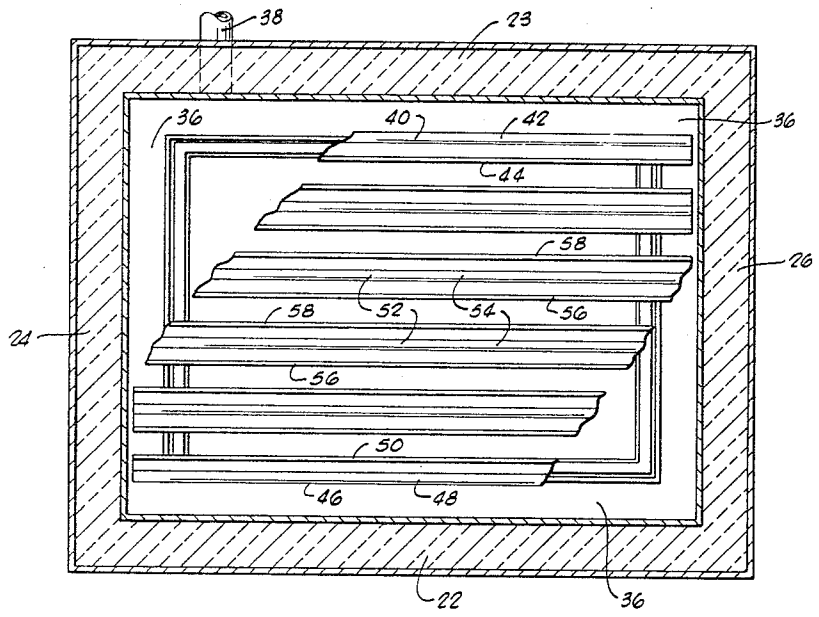


FIG. 4

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COOLING COIL WITH CONDENSATE DIRECTOR

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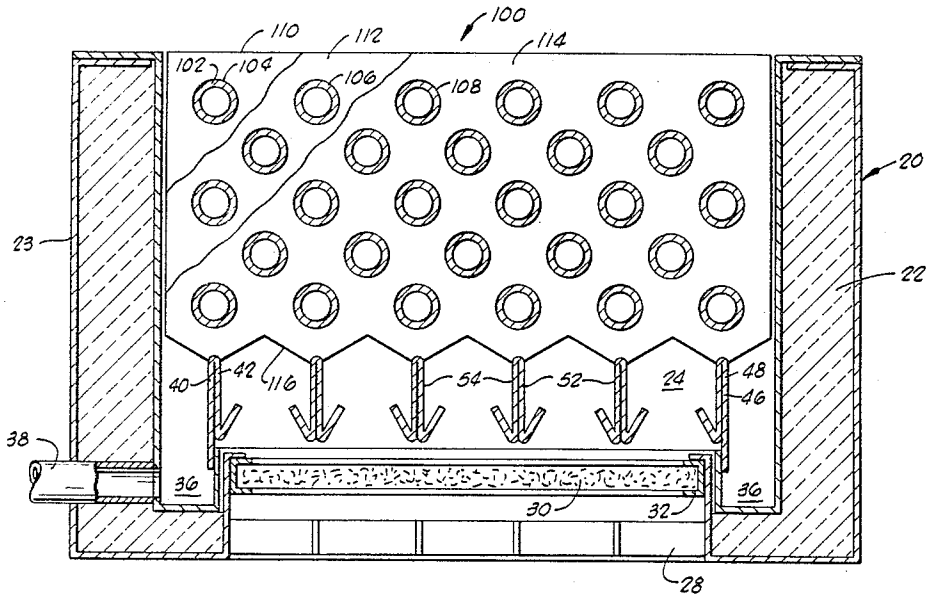


FIG. 5

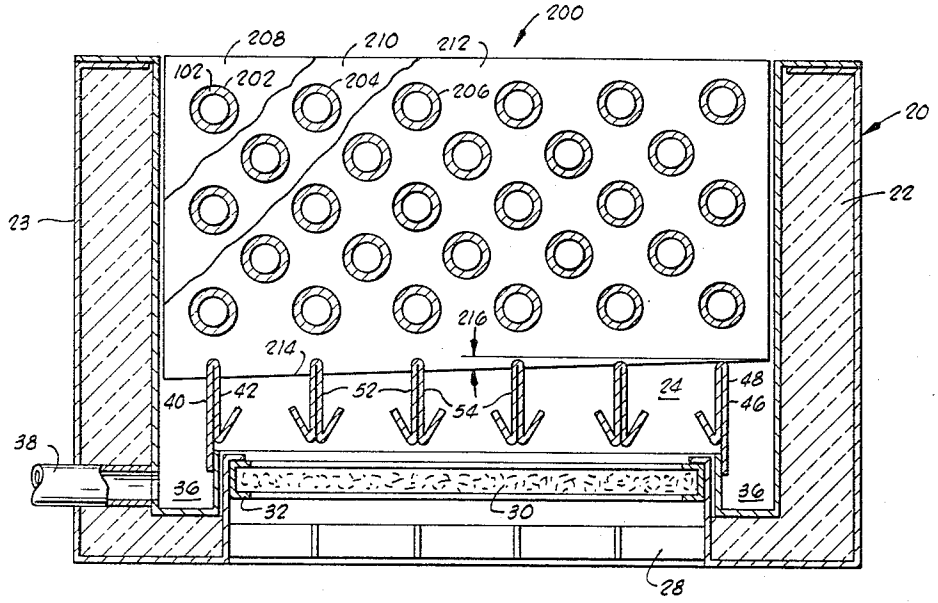


FIG. 6

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3,306,071

COOLING COIL WITH CONDENSATE DIRECTOR

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6 Claims. (Cl. 62—290)

This invention relates generally to improved cooling coils for use in connection with air conditioning systems. More particularly, but not by way of limitation, this invention relates to an improved cooling coil for an air conditioning system incorporating means therein for removing the condensate from the cooling coil.

In the construction of air conditioning systems, a great deal of difficulty has been encountered in the construction of the cooling coil. Primarily, the difficulty with the cooling coils has resulted from the formation of condensate thereon as the air, which is to be cooled, passes over the relatively cold cooling coil. The drop in temperature in the air deposits a conisderable amount of moisture in the form of condensate on the cooling coil. Naturally, the amount of condensate formed on the coil will vary depending upon the temperature of the coil and the relative humidity of the air.

In recent years, the development in air conditioning systems for homes and offices or the like has tended toward a combined heating and cooling unit. In these units the cooling coil of the air conditioning system is generally mounted on top of the furnace, that is, above the fan and burners used when the unit is used for heating. In some of these units, generally referred to as "updraft" systems, the air is moved by the fan upwardly through the cooling coil into a system of ducts generally mounted in the ceiling of the space to be cooled. In these "updraft" units, the problem of removing the condensate from the cooling coils has not been too difficult. However, a great deal of care must be exercised in mounting the cooling coil so that no portion of the coil touches the framework of the air conditioning unit because of the inherent characteristic of the condensate to collect at the lower points on the coil and to drip therefrom. The usual practice is to provide a drip pan below the lowest point on the cooling coil to receive the condensate as it drips therefrom.

The problem of condensate removal is magnified when the air conditioning unit is of the "down draft" type, that is, where the air enters the unit from the top and flows downwardly therethrough into a system of ducts having outlets located in the floor or in the baseboard of the house or office. Most of the means provided for removing the condensate from cooling coils in "down draft" units have not proved satisfactory.

In most of the air conditioning units, the condensate problem is so acute that the cooling coils are positioned at a relatively steep angle relative to the horizontal so that the condensate will collect at the lower end of the coil which is disposed above the condensate or drip pan. To position the cooling coils at the angle required to alleviate the condensate problems results in an overall height of the cooling coil that may be prohibitive in the instance of relatively limited vertical space.

Therefore, this invention provides an improved cooling coil construction including: a conduit for carrying a refrigerant and having substantially vertically disposed radiating means thereon; an elongated duct member having an upstanding portion in engagement with the lower portion of the radiating means and having a trough portion on the lower end of the upstanding portion for collecting the condensate; and, means for receiving the condensate from the trough portion.

One object of this invention is to provide an improved cooling coil for air conditioning systems that includes an

effective means for removing the condensate formed thereon.

Another object of the invention is to provide an improved cooling coil construction for air conditioning systems that requires a minimum of vertical space for installation of the cooling coil.

A further object of the invention is to provide an improved cooling coil for air conditioning systems that can be easily and economically constructed.

Still another object of the invention is to provide an improved cooling coil including condensate removing means that requires little or no maintenance during the service life of the cooling coil.

A further object of the invention is to provide improved means for removing condensate from a cooling coil used in an air conditioning system.

The foregoing and additional objects and advantages of the invention will become more apparent as the following detailed description is read in conjunction with the accompanying drawings wherein like reference characters denote like parts in all views and wherein:

FIG. 1 is a top plan view of a cooling coil constructed in accordance with the invention;

FIG. 2 is an enlarged, vertical cross-sectional view of the cooling coil of FIG. 1, taken substantially along the line 2—2 of FIG. 1;

FIG. 3 is an enlarged vertical cross-sectional view of the cooling coil of FIG. 1, taken substantially along the line 3—3 of FIG. 1;

FIG. 4 is a horizontal cross-sectional view of reduced size illustrating the condensate removing means utilized in the cooling coil of FIG. 1 and taken substantially along the line 4—4 of FIG. 2;

FIG. 5 is a vertical cross-sectional view similar to FIG. 2, but illustrating another embodiment of cooling coil also constructed in accordance with the invention; and,

FIG. 6 is a vertical cross-sectional view similar to FIG. 5, but illustrating still another embodiment of cooling coil also constructed in accordance with the invention.

Embodiment of FIG. 1

FIGS. 1 through 4 illustrate in detail the structure of a cooling coil generally designated by the reference character **10** and constructed in accordance with the invention. As illustrated in FIG. 1, the cooling coil **10** includes an anfractuous conduit **12** having an inlet **14** and an outlet **16** that will be connected with the compressor (not shown) of the air conditioning system. The conduit **12** may be constructed from a continuous length of tubing or from a plurality of sections forming a continuous length and provided with a plurality of reverse bends whereby elongated portions of the conduit **12** lie in vertically and horizontally spaced parallel rows as may be seen most clearly in FIGS. 2 and 1, respectively.

Each of the elongated portions of the conduit **12**, in alternating vertical rows (see FIG. 2), are provided with a helically wound radiating fin **18**. As may be most clearly seen in FIG. 3, the fins **18** are arranged generally in a vertical position. To promote the heat transfer from the elongated portions of the conduit **12** that are not provided with the fins **18**, those portions are arranged in engagement with the fins **18** on the alternating rows of conduit **12** having the attached fins **18**.

The cooling coil **10** is provided with a housing **20** that is compatible with the air conditioning system in which the coil **10** is to be installed. As illustrated, the housing **20** includes vertically disposed insulated walls **22**, **23**, **24** and **26** enclosing the evaporator **10**. The structure of the insulated walls **22**, **23**, **24** and **26** are more clearly shown in FIGS. 2, 3 and 4. The housing **20** is provided

with an opening 28 extending through the lower portion or bottom thereof to provide for air flow across the cooling coil 10.

An air filter 30 is removably mounted in the opening 28 in a bracket 32 attached to the housing 20. The air filter 30 is of conventional construction and may be satisfactorily fabricated from spun glass or the like.

As can be appreciated from viewing FIGS. 2, 3 and 4, the lower, inside portions of the walls 22, 23, 24 and 26 are bent in a U-shape to form a continuous conduit 36 having an open upper side. A drain conduit 38 has one end connected in fluid communication with the conduit 36 and the other end arranged to drain the condensate collected in the conduit 36 to a suitable drain (not shown).

An elongated duct member 40 extends across the opening 28 in the housing 20 (see FIG. 4) in parallel spaced relation with the elongated portions of the conduit 12 (see FIG. 3). The duct member 40 includes an upstanding portion 42 having its upper end attached to the fins 18 of the lowermost row formed by the conduit 12. As may be seen clearly in FIG. 2, the upstanding portion 42 extends downwardly into the conduit 36.

A trough portion 44 on the duct member 40 is constructed by forming a reverse bend in the upstanding portion 42 of the duct member 40 so that condensate dripping from the fins 18 will run down the upstanding portion 42 and be trapped in the trough portion 44. The condensate is then delivered by the trough portion 44 into the conduit 36 adjacent the insulated walls 24 and 26 as shown in FIG. 4.

An identical though oppositely disposed duct member 46 extends across the opening 28 in the housing 20 and has an upstanding portion 48 thereon. The upper end of the upstanding portion 48 is connected with the fins 18 of one of the lowermost rows of conduit 12. The duct member 46 also includes a trough portion 50 that is formed by a reverse bend in the upstanding portion 48 of the duct member 46.

A plurality of elongated duct members 52 also extend across the opening 28 in the housing 20. Each duct member 52 includes an upstanding portion 54 having its upper end connected with the fins 18 on one of the lowermost rows of conduit 12. Each of the duct members 52 also includes a trough portion 56 that is formed by a reverse bend in the upstanding portion 54 of the duct member 52. However, it will be noted in FIG. 2 that the duct members 52 each includes an additional trough portion 58 that is also formed by a reverse bend in the duct members 52. The trough portion 58 is located on the opposite side of the upstanding portion 54 with respect to the trough portion 56. Each of the duct members 40, 46 and 52 are sufficiently long to extend completely across the opening 28 in the housing 20 so that condensate collected therein is drained into the conduit 36 as clearly shown in FIG. 4.

In the operation of the cooling coil 10, it will be evident that the cold refrigerant passing through the conduit 12 results in the condensation of moisture from the air onto the conduit 12 and onto the attached fins 18. As the condensate collects on the conduit 12 and fins 18, it gravitates toward the lowermost vertical row of the conduit 12. (While the term "gravitates" is used herein to describe the movement of the condensate toward the duct members, it will be understood by those skilled in the art that other forces, not completely understood act on the condensate resulting in the collection of the condensate at the point of engagement between the duct members and the fins or, for that matter, at the point of engagement between any two members. It is believed that the phenomenon may be somewhat similar to capillary flow.) Upon reaching this point, the condensate accumulates on the lower portion of the fins 18 attached to the lowermost vertical row of the conduit 12 and from there the condensate runs onto the upstanding portions 42, 48 and 54 of the duct members 40, 52 and 46, respectively.

As the condensate runs down the upstanding portion of the various duct members, it is collected in the trough portions 44, 50, 56 and 58 and delivered thereby into the open top side of the conduit 36. From the conduit 36 the condensate flows through the attached drain conduit 38 to the drain (not shown).

As will be evident from viewing FIGS. 2 and 4, a relatively large open area is provided between the trough portions of the duct members 40, 52 and 46 so that their resistance to air flow through the cooling coil 10 will not be greater than the resistance offered by the conduit 12 and attached fins 18. Also, the upturned trough portions 44, 50, 56 and 58 of the duct members provide a means of positively trapping the condensate so that even though the air flow may be in a downwardly direction through the cooling coil 10, the condensate is effectively collected thereby. Thus, a cooling coil constructed in accordance with the invention may be used with either "updraft" or "down draft" air conditioning systems.

One other important feature of a cooling coil constructed in accordance with the invention is the relatively small vertical space that it occupies. As will be evident from viewing FIGS. 2 and 3, the conduit 12 can be disposed in a horizontal position without the necessity of canting or setting the conduit 12 and fins 18 at an angle to alleviate the condensate problem. Therefore, a cooling coil constructed in accordance with the invention can be easily positioned on top of most heating units within the usual space available above such units. Furthermore, the reduced space occupied by a cooling coil constructed in accordance with the invention permits the installation thereof in a space-type air conditioner or in a window air conditioning unit while permitting the reduction in the overall size of the unit which enhances its appearance and, of course, reduces the space required by the air conditioner.

Embodiment of FIG. 5

FIG. 5 illustrates another embodiment of cooling coil generally designated by the reference character 100 and also constructed in accordance with the invention. As will be evident from viewing FIG. 5, the cooling coil 100 is also installed in the housing 20.

The housing 20 is constructed identically to the housing 20 previously described in connection with FIGS. 1 through 4. As mentioned in the description of those figures, the housing 20 includes vertically disposed insulated walls 22, 23, 24 and 26. Also, the housing 20 includes an opening 28 in the lower portion thereof. The filter 30 is mounted in the bracket 32 and extends across the opening 28 below the cooling coil 100. Also, the lower interior portions of the walls 22, 23, 24 and 26 are formed in a U-shape providing the open sided conduit 36 as described in connection with the embodiment of FIG. 1.

The cooling coil 100 includes an anfractuous conduit 102 provided with a plurality of elongated portions disposed in generally vertically and horizontally spaced rows as described in connection with the anfractuous conduit 12 of the embodiment of FIG. 1. In constructing the conduit 102, the usual procedure is to first form the elongated straight portions. The straight portions are then inserted through apertures 104, 106 and 108 extending through a plurality of radiating fins 110, 112 and 114, respectively. The adjacent ends of the straight portions of the conduit 102 are joined by reverse bends or elbows (not shown) to form a continuous conduit 102 as described in connection with the conduit 12. The conduit 102 is also provided with an inlet and outlet (not shown).

While only three radiating fins 110, 112 and 114 have been illustrated, it will be understood that a large number of fins are provided in the actual construction of the cooling coil 100. Each of the fins 110, 112 and 114 are plate-like members disposed in a generally vertical plane and in spaced parallel relation relative to each other. The fins 110, 112 and 114 are of identical construction and each includes a serrated lower edge 116.

The cooling coil 100 also includes elongated duct members 40, 46 and 52 constructed as described in connection with the embodiment of FIG. 1. However, and as may be clearly seen in FIG. 5, the upstanding portions 42, 48 and 54 of the duct members 40, 46 and 52, respectively, are each connected with a respective one of the lowermost portions of the serrated edges 116.

In operation, cold refrigerant is passed through the conduit 102 resulting in the condensation of moisture from the air onto the circuit 102 and the attached fins 110, 112 and 114. As the condensate collects on the conduit 102 and the fins 110, 112 and 114, it gravitates along the fins 110, 112 and 114 to the lowermost portions on the serrated edges 116.

As previously mentioned, the duct members 40, 46 and 52 have their respective upstanding portions 42, 48 and 54 attached to the lowermost portions on the serrated edges 116 of the fins 110, 112 and 114 so that the condensate flows downwardly along the upstanding portions into the respective trough portions of the duct members. From the trough portions of the duct members, the condensate flows into the open upper side of the conduit 36 and then into the drain conduit 38.

It is believed evident from the foregoing detailed description of the cooling coil 100 that the cooling coil 100 offers the advantages previously pointed out with respect to the embodiment of FIG. 1. For example, it is not necessary to tilt or cant the conduit 102 or the fins 110, 112 or 114 to promote the gravitation of the condensate into a drip pan. Thus, the cooling coil 100 may be constructed in a relatively small vertical space as compared to the usual construction for cooling coils. Also, the cooling coil 100 may be used with either updraft or downdraft air conditioning systems as described in connection with the embodiment of FIG. 1 due to the arrangement of the duct members 40, 46 and 52 relative to the conduit 102 and the fins 110, 112 and 114.

Embodiment of FIG. 6

FIG. 6 illustrates another embodiment of cooling coil generally designated by the reference character 200 and also constructed in accordance with the invention. As will be evident from viewing FIG. 6, the cooling coil 200 is constructed in a very similar manner to the cooling coil 100 as previously described in connection with FIG. 5.

As shown in FIG. 6, the cooling coil 200 includes the housing 20 having vertically disposed, insulated walls 22, 23, 24 and 25. The housing 20 also includes the opening 28 extending through the bottom thereof. The filter 30 extends across the opening 28 and is removably mounted in the bracket 32.

The anfractuous conduit 102, constructed as described in connection with FIG. 5, extends through a plurality of apertures 202, 204 and 206 in a plurality of plate-like, radiating fins 208, 210 and 212, respectively. The plate-like fins 208, 210 and 212 are each disposed in a vertical plane in parallel, spaced relation relative to each other. While only three fins are illustrated, it should be understood that a large number of the fins are provided in the actual construction of the cooling coil 200. Each of the fins 208, 210 and 212 includes a lower edge 214 that is disposed at an angle 216 relative to the horizontal as illustrated in FIG. 6.

The cooling coil 200 also includes a plurality of elongated duct members 40, 46 and 52 constructed as described in detail in connection with the embodiments of FIGS. 1 and 5. However, the upstanding portions 42, 48 and 54 of the duct members are attached to the lower edge 214 of the fins 208, 210 and 212.

In operation, the cold refrigerant is passed through the conduit 102, reducing the temperature of the conduit 102 and the attached fins 208, 210 and 212. The cooling of the conduit 102 and attached fins results in the condensation of moisture as air passes through the cooling coil 200. The condensate collects on the conduit 102

and the fins 208, 210 and 212, gravitating to the lower edge 214 of each of the fins. When the condensate reaches the lower edge 214, it continues to run toward the lowest point on the edge 214. As the condensate flows along the edge 214, it encounters the upstanding portions 42, 48 and 54 of the duct members 40, 46 and 52, respectively.

The condensate then gravitates down the upstanding portions 42, 48 and 54 into the respective trough portions of the duct members. Upon reaching the trough portions of the duct members, the condensate flows into the open top side of the conduit 36. The condensate flows from the conduit 36 into the drain conduit 38.

As will be readily apparent to those skilled in the art, it is not necessary to form the angle 216 on the lower edge 214 of the fins 208, 210 and 212. Instead, the fins may be constructed from a rectangular plate and one end of the plate lowered very slightly so that the angle 216 is, in effect, produced. Again, it should be pointed out that the cooling coil 200 is satisfactory for use with either updraft or downdraft air conditioning systems due to the structure of the condensate collecting duct members 40, 46 and 52 and their arrangement in relation to the fins 208, 210 and 212. Also, it can be readily perceived in FIG. 6 that the overall height of a cooling coil constructed as illustrated therein is relatively small. Thus, the cooling coil 200 may, like the cooling coils 10 and 100, be used on top of existing furnaces where the available space above the furnace is relatively limited.

It should be understood that the embodiments described hereinbefore are presented by way of example only and that many changes and modifications can be made thereto without departing from the spirit of the invention or from the scope of the annexed claims.

What I claim is:

1. A cooling coil for an air conditioning system comprising:

a housing having vertically disposed insulated walls defining a flow passageway, said walls having the lower interior ends arranged to form a continuous, open-topped conduit encompassing said flow passageway;

an anfractuous conduit located in said flow passageway relatively above said open-topped conduit, said anfractuous conduit having an inlet and outlet, a plurality of vertically and horizontally spaced elongated portions disposed in a substantially horizontal position, and a plurality of reverse bend portions connecting said elongated portions;

radiating means connected with and helically wound on the elongated portions of alternating rows of said anfractuous conduit and disposed in a generally vertical position;

a plurality of elongated duct members having an upstanding portion engaging the lower portion of said radiating means on the lowermost row of said anfractuous conduit and having a trough portion on the lower end of said upstanding portion, said duct members having the ends thereof disposed above the open top of said open-topped conduit whereby condensate collected in said trough portion gravitates into said open-topped conduit; and,

a drain conduit having one end in communication with said open-topped conduit for permitting condensate to drain from said open-topped conduit.

2. A cooling coil for air conditioning systems comprising:

an anfractuous conduit for carrying a refrigerant, said anfractuous conduit including a series of substantially parallel linear portions;

a radiating fin helically wound around said anfractuous conduit and having an inner peripheral edge engaging said anfractuous conduit and an outer peripheral edge spaced from said anfractuous conduit;

an elongated condensate receiving duct member having a vertically extending portion engaging the outer

peripheral edge of said radiating fin at the lowermost portion thereof at several aligned points spaced along said fin in its direction of helical projection, said duct member extending parallel to a linear portion of said anfractuous conduit, and said elongated duct member having a trough portion on the lower end of said vertically extending portion.

3. Means for removing condensate from the exterior surface of substantially vertically disposed radiating fins connected with a cooling coil in an air conditioning system, said means comprising:

at least one elongated duct member having:

an elongated upstanding portion disposed in a vertical plane extending at a right angle relative to said fins and engaging the lower edges of said fins;

an elonagted trough portion on the lower end of said upstanding portion for receiving condensation moving downwardly along said upstanding portion; and

means for receiving condensate from said trough portion.

4. The condensate removing means of claim 3 wherein said means for receiving the condensate from said trough portion includes:

a conduit encompassing an air passageway in the air conditioning system, said system having an open top disposed relatively below the trough portion of said duct member; and

a drain conduit connected in fluid communication with said conduit for removing condensate from said conduit.

5. A cooling coil for use in air conditioners comprising:

an anfractuous refrigerant conduit having a plurality of substantially parallel, horizontally extending sections;

radiating vertical fins on said conduit and horizontally spaced along the parallel, horizontally extending sections thereof from each other;

horizontally spaced, elongated condensation ducts disposed below and in vertical alignment with each of a plurality of said horizontally extending conduit sections with each condensation duct extending parallel to said parallel horizontally extending conduit sections, said ducts each including an elongated, upstanding, vertically extending portion contacting a

plurality of said vertically extending fins at the lower edge thereof and extending at right angles to each of said fins, and each of said ducts further including a V-shaped, upwardly opening trough secured at its apex to the lower edge of said upstanding, vertically extending portion with the legs of said V-shaped trough diverging from each other on opposite sides of said upstanding portion to deflect air away from said upstanding portion.

6. A cooling coil for an air conditioning system comprising:

a housing having vertically disposed insulated walls defining a flow passageway, said walls having the lower interior ends arranged to form an open-topped conduit encompassing at least a portion of said flow passageway;

an anfractuous conduit located in said flow passageway and spaced above said open-topped conduit, said anfractuous conduit having an inlet and outlet and including a plurality of vertically and horizontally spaced elongated parallel portions disposed in a substantially horizontal position and further having a plurality of reverse bent portions connecting said elongated portions;

radiating fins in contact with the elongated portions of said anfractuous conduit and extending substantially normal thereto in a substantially vertical plane;

a plurality of elongated duct members having an upstanding portion engaging the lowermost portion of said radiating fins and having a trough portion on the lower end of said upstanding portion, said duct members having the ends thereof disposed above the open top of said open-topped conduit whereby condensate collected in said trough portion gravitates into said open-topped conduit; and,

drain means connected to said open-topped conduit for permitting condensate to drain therefrom.

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