Nov. 7, 1950 G. E. HICKE 2,529,215

HEAT EXCHANGER

Filed Nov. 10, 1947 2 Sheets-Sheet 1

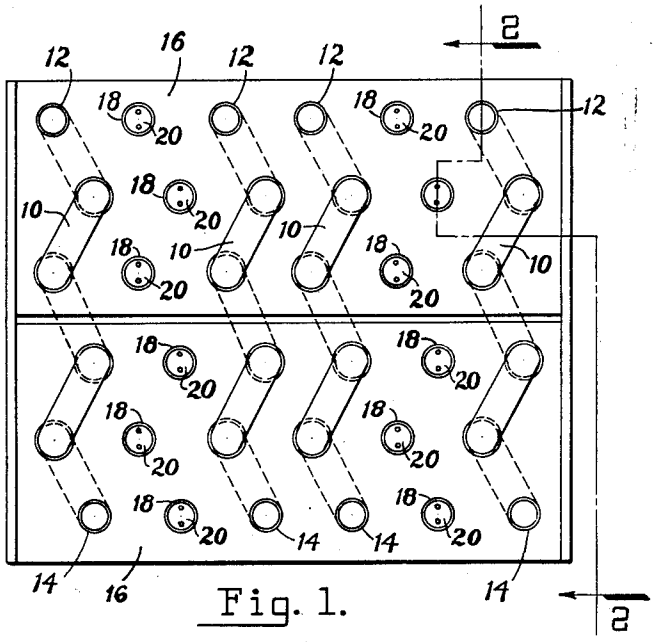


Fig. 1.

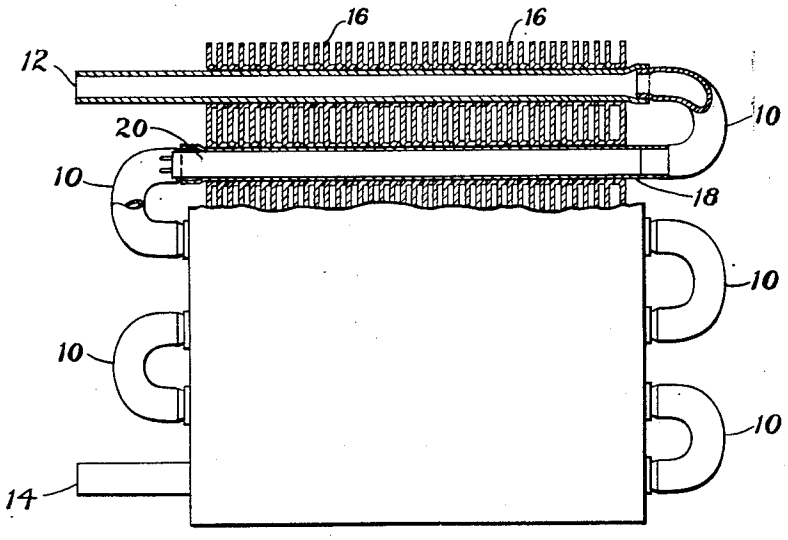


Fig. 2.

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Filed Nov. 10, 1947 2 Sheets-Sheet 2

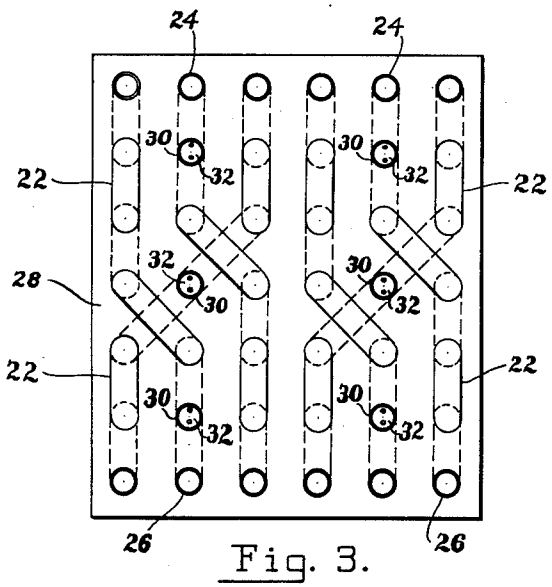


Fig. 3.

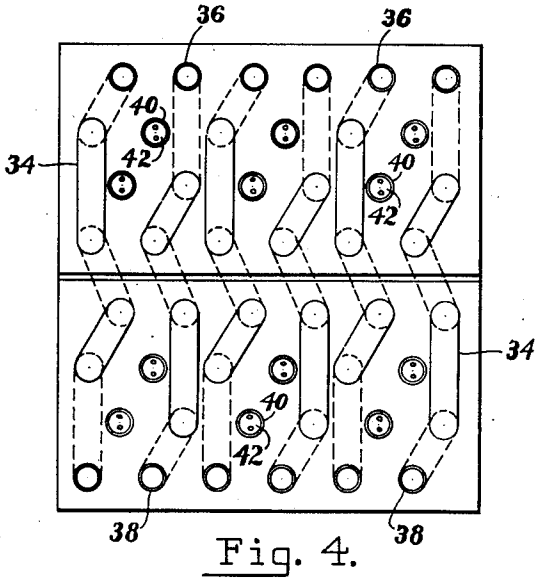


Fig. 4.

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HEAT EXCHANGER

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6 Claims. (Cl. 219—19)

1

This invention relates in general to air conditioning and in particular to a coil having refrigerating and heating elements therein. The heating elements may be used to heat the coil and thereby defrost it, or they may be used to heat the air passing through the coil with the flow of refrigerant shut off.

Various methods of defrosting have been used, but all of them have certain disadvantages. For instance one method sprays a strong brine over the frosted coil to dissolve the frost. This method is costly, because the brine is diluted by the amount of the frost, and it must be reclaimed or new brine must be used for each defrosting.

Another method sprays steam or hot water over the coil, but this method is impractical in many applications, because a supply of steam or hot water is not available. This method may damage the coil, because of the rapid change in temperature and the excessive pressure in the coil due to the high temperature.

Another method feeds hot gas from the discharge side of the compressor through the coil. Such a method is slow, because the refrigerant gas has a relatively low specific heat.

Still another method disclosed in Patent Number 2,266,373 issued December 16, 1941, uses an electrical heating element below each vertical row of tubes. Such an arrangement is slow, because the heating elements are so remote from portions of the coil that little or no heat would be conducted by the fins to the top of the coil. Convection of heat to the top of the coil would be extremely slow, because of the resistance offered by the narrow passages between the fins especially when the fins are covered with frost.

One object of the invention is to eliminate the difficulties outlined above, and to provide a refrigeration and heating coil of simple construction which will be fast and efficient in its operation.

Another object of the invention is to provide a refrigeration coil with heating elements for rapidly defrosting the coil.

Still another object of the invention is to provide a refrigerating coil with heating elements arranged throughout the coil so that the heat is distributed evenly and rapidly to all portions of the coil.

The foregoing and many other features of my invention are set forth in the following specification, where I describe the preferred embodiments of my invention. These are illustrated in the accompanying drawings wherein:

Fig. 1 is a front view of the coil of my invention;

Fig. 2 is a side view of the coil partly in section on the lines 2—2 of Fig. 1;

Fig. 3 is a front view of a modification of my

2

invention showing another arrangement of refrigerant and heating tubes;

Fig. 4 is a front view of another modification of my invention.

Referring to Figs. 1 and 2 of the drawings, numeral 10 is used to refer to the tube circuits which are connected to a pressure source of heat exchange medium such as a refrigerant of the Freon group at least a part of which is in the liquid state. The ends 12 of the tube circuits are connected to this source. The refrigerant evaporates as it proceeds through the serpentine circuit 10 and leaves the coil at the end 14 which may be connected to a suction source. There are a plurality of fins 16 which have the tubes of the tube circuits 10 extending through holes therein. The tubes 10 are in good heat exchange relation with the fins 16 as by having tight mechanical contact with the fins obtained by expanding the tube into the fin. The fins may be soldered or welded to the tubes if desired.

As the refrigerant evaporates during its proggress through its circuit, it takes heat from the fins which in turn take heat from the air passing through the coil. In low temperature work the coil accumulates a layer of frost or ice on the fins from freezing the moisture removed from the air passing through the coil. Since this frost impedes the flow of air the coil must be defrosted periodically.

In order to provide heat for defrosting, I have located at spaced points throughout the coil a plurality of heating tubes 18 which are in tight mechanical contact with the fins or soldered or welded thereto, each of said tubes containing an electric heating element 20 mounted therein. These heating elements 20 are connected to a suitable source of electrical potential so that they may be energized during the defrosting period. The heating elements have been so distributed in the coil that the entire fin area is equally provided with heat. The heat from the elements travels by conduction along the fins to rapidly melt the ice at its contact with the fin. In this way it is possible to shed the ice from the coil without entirely melting the ice.

Fig. 3 shows a modified form of my invention in which the ratio of the number of heating tubes to the number of refrigerant tubes has been reduced. The refrigerant tube circuits 22 are connected at their ends 24 to a source of refrigerant under pressure and at their ends 26 to a suction source. The tubes pass through holes in fins 28 in substantially the same manner as in the form of Figs. 1 and 2. The heating tubes 30 each contain an electric heating element 32.

Fig. 4 shows still another arrangement of refrigerant tubes and heating tubes. The refrigerant tube circuits 34 are connected at their ends

36 to a source of refrigerant under pressure and at their ends 38 to a suction source. The heating tubes 40 each contain an electric heating element 42. This arrangement of tube circuits by-passes two tubes in each circuit so that each tube circuit has the same number of tubes, and the by-passed tubes containing heating elements are positioned in the coil to give equal distribution of heat to the fin area of the coil. During operation of the coil a fan is used to cause a flow of air through the coil in a vertical direction. The fan may be located on the exit side to draw air through the coil or it may be on the entering side to blow the air through the coil.

When defrosting becomes necessary, the flow of refrigerant to the coil will be shut-off. This is necessary to prevent waste of heat in evaporating the liquid refrigerant in the tubes and to prevent excessive pressure in the event of failure of the defrosting control devices. The fans which blow the air through the coil are then stopped and heat is applied by sending an electric current through the heating elements until the temperature of the coil is above freezing. The flow of refrigerant is then started again, and the fans are started when the coil is down to the proper temperature.

When it is desired to use the heating elements to furnish heat to the conditioned space, the flow of refrigerant is shut off, and the fans continue to operate to cause a flow of air through the coil and into the conditioned space.

It should be understood that although Figs. 1 and 4 show two rows of fins, a single row of fins which extends over the entire area of the coil could be used. Two rows of fins have been shown merely because the smaller fin is easier to manufacture and assemble in the coil. It should also be understood that, although the drawings show the tubes in tight mechanical contact with a collar on the fin, the fins could be used with or without the collar, and the fins could be soldered or welded to the tube without departing from the spirit and scope of this invention.

While I have described the foregoing preferred embodiments 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. A heat exchanger for cooling air comprising a plurality of fins, tubes extending through the fins and substantially perpendicular thereto, said tubes being in intimate contact with the fins, some of said tubes being connected to form a plurality of tube circuits, each of said tube circuits being connected to a source of refrigerant having a temperature below 30° Fahrenheit, each of said tube circuits by-passing certain tubes, and electric heating elements in the by-passed tubes for defrosting said heat exchanger, said by-passed tubes being spaced throughout the fin area to transmit heat substantially uniformly and at the same rate to all portions of the fin.

2. A heat exchanger for cooling air comprising a plurality of fins, tubes extending through the fins substantially perpendicularly thereto, said tubes being in expanded contact with the fins, some of said tubes being connected to form a plurality of tube circuits, each of said tube circuits being connected to a source of refrigerant having a temperature below 32° Fahrenheit, each of said tube circuits by-passing an equal number of tubes, electric heating elements in the by-passed tubes for defrosting said heat exchanger, said by-passed tubes being spaced throughout the fin area to transmit heat substantially uniformly and at the same rate to all portions of the fin.

3. A heat exchanger for cooling air comprising a plurality of rows of fins, tubes substantially circular in cross-section extending substantially perpendicularly through the fins in the rows, some of said tubes being connected to form a plurality of tube circuits, each of said tube circuits being connected to a source of refrigerant having a temperature below 32° Fahrenheit, each of said tube circuits by-passing one or more tubes in each row of fins, electric heating elements in the by-passed tubes for defrosting said heat exchanger, the by-passed tubes in each row of fins being substantially uniformly spaced throughout the fin area so as to transmit heat substantially uniformly and at the same rate to all portions of the fins in that row.

4. A heat exchange coil for cooling air comprising a plurality of fins, tubes of substantially circular cross-section extending through the fins substantially perpendicular thereto, some of said tubes being adapted to be connected to a source of refrigerant having a temperature below 32° Fahrenheit, electric heating elements in others of said tubes which are spaced throughout the fin surface for raising the temperature of all portions of the coil for defrosting the same.

5. A heat exchange coil for cooling air comprising a plurality of fins, tubes extending through the fins substantially perpendicular thereto, said tubes being substantially circular in cross-section and in expanded contact with the fins, some of said tubes being adapted to be connected to a source of refrigerant having a temperature below 32° Fahrenheit, electric heating means in others of said tubes for defrosting said coil, the tubes containing electric heating elements being spaced throughout the fin area to transmit heat substantially uniformly to all portions of the fin.

6. A heat exchanger for cooling air comprising a plurality of primary tubes adapted to be connected to a source of refrigerant having a temperature below 32° Fahrenheit, a plurality of secondary tubes substantially circular in cross-section, electric heating elements in said secondary tubes, a plurality of continuous fins having flanged holes, the primary and secondary tubes extending through the flanged holes in the fins and being in expanded metal contact with the flanged holes of the fins, said secondary tubes being substantially uniformly spaced throughout the fin area to transmit heat substantially uniformly to all portions of the fins to raise the temperature of the exchanger above the freezing point of water to defrost the same.

GERALD E. HICKE.

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