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OUTSIDE DEFROSTER FOR HEAT PUMPS

Filed June 10, 1959

2 Sheets-Sheet 1

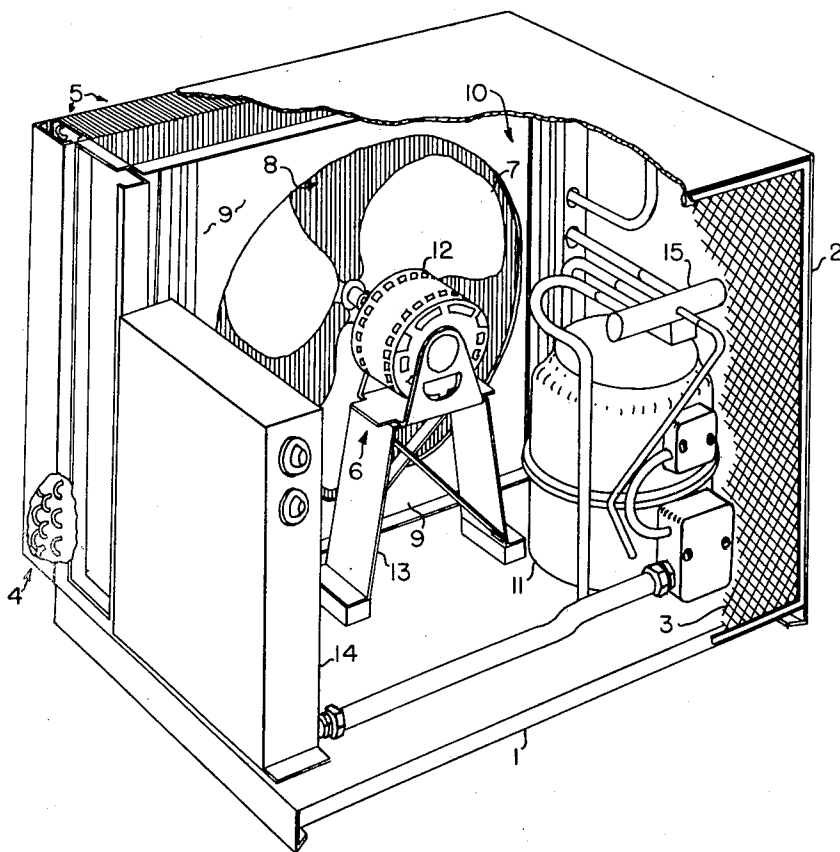


Fig. I

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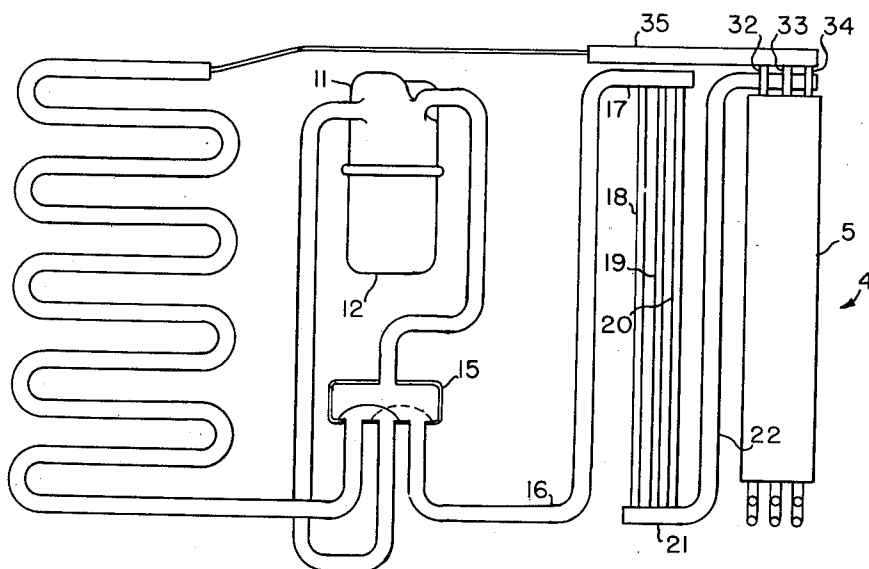


Fig. II

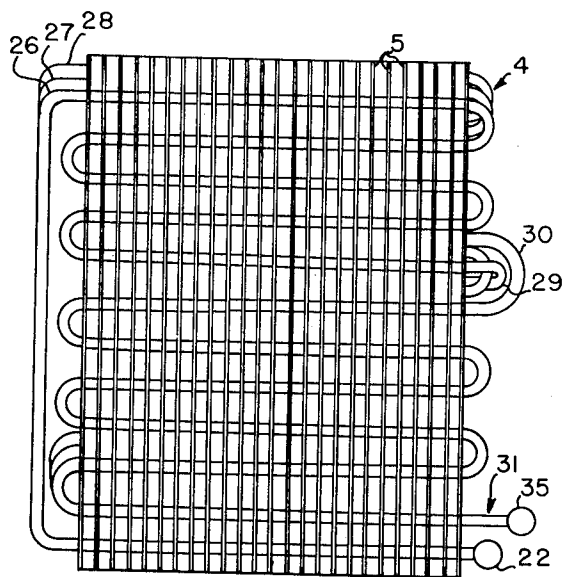


Fig. III

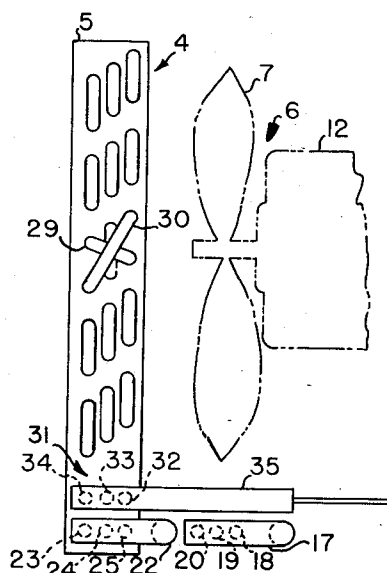


Fig. IV

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OUTSIDE DEFROSTER FOR HEAT PUMPS

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10 Claims. (Cl. 62-278)

This invention relates to heat pumps of the type which are capable of taking heat from the interior of a building and dissipating the heat outside during warm weather, and which can be adjusted to be capable of taking heat from the outside atmosphere and supplying the heat to air in the interior which the pump is required to heat during cold weather. A heat pump of this type comprises: a compressor which compresses a refrigerant in the gaseous phase (thereby raising the temperature of the refrigerant); a coil located in the interior of a building; a coil located in the outside atmosphere; a capillary tube or other restricted passage connecting the coils to each other; and piping incorporating a reversing valve which can be set to connect the discharge side of the compressor either to the inside coil or the outside coil and simultaneously to connect the suction side of the compressor to the other coil.

When the outside coil is absorbing heat from the surrounding nearby outside atmosphere the temperature of the coil is lower than that of the outside atmosphere and as heat flows from the surrounding nearby outside atmosphere to the coil, and to the refrigerant within the coil, the temperature of the portion of the outside atmosphere from which heat is being abstracted, falls, thus causing its relative humidity and dew point to rise until moisture condenses upon the outside coil and adjacent metallic parts. If the temperature is above the freezing point of water the condensate is in the form of water. If the temperature is below the freezing point of water the condensate takes the form of frost.

In order to utilize the heat exchange function of the coil as fully as practicable, outside atmospheric air is blown or drawn over the coil by means of a fan which is liable to fling droplets by centrifugal action against surrounding housing walls and other nearby parts from whence, or down which the moisture may creep to accumulate beneath the fan, fan blades, or other place which would tend to interfere with the proper operation of the heat pump where it may freeze during cold weather into a mass of ice. Thawing and refreezing are liable to form masses of ice also around the lower parts of the coil.

Defrosting of the outside coil and its surroundings is accomplished in heat pumps of the type to which this invention relates by periodically or occasionally reversing the direction of flow of refrigerant through the coil for relatively brief intervals. This is done by connecting the discharge side of the compressor to the outside coil and simultaneously connecting the suction side of the compressor to the inside coil so that the compressor discharges hot refrigerant into the outside coil.

It is an object of this invention to so arrange piping that connects the compressor to the outside coil that hot refrigerant enroute from the compressor to the outside coil traverses portions of the piping that are in intimate juxtaposition with places where ice is most liable to accumulate.

Another object is to arrange such piping so that such hot gaseous refrigerant enters and traverse the outside coil at the end where accumulations of frost and ice occur most rapidly.

It is a further object of the invention to so arrange the piping of an outside heat pump coil that during defrosting hot gas, after traversing the round of the coil where frost and ice are liable to accumulate most rapidly,

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is conducted next to a remote portion of the coil and thence progressively round by round to the final round which lies closely adjacent to the round of the coil first traversed by the hot gas.

Other objects and advantages will become apparent upon perusal of the following description as illustrated by the accompanying drawings in which:

FIG. I is a view in perspective of an outside section of a heating pump incorporating the instant invention, parts being broken away to expose to view important elements of the heat pump;

FIG. II is a top diagrammatic view showing a distinctive arrangement of piping by which the instant invention is implemented;

FIG. III is a diagrammatic elevational view taken from the right side of FIG. II; and

FIG. IV is an elevational view taken from the right side of FIG. III, FIG. IV showing the location of a fan which forms part of the heat pump incorporating the instant invention.

These drawings and the description that follows illustrate and describe a preferred embodiment of the instant invention but they are not to be regarded as embodying limitations on its scope.

The mechanism of the outside section of the heat pump is supported upon a base 1 and is enclosed within a housing 2 the top and sides of which may be made of sheet metal while the front wall is preferably a grid 3 of expanded metal through which the atmosphere can circulate freely.

The outside coil 4 with its vertical fins 5 constitutes the rear wall through which the atmosphere is drawn by a fan 6, the blades 7 of which rotate in a round opening 8 that is cut into a partition or shroud 9 which divides the housing 2 into a rear plenum chamber in front of the vertical fins 5 and a casing 10 that surrounds a compressor 11 as well as a fan motor 12 and a stand 13 on which the fan motor is supported. The casing 10 may also contain a panel 14 to support items of electrical equipment which are not per se features of this invention and, which therefore are not shown in the drawings or described in detail herein, as well as valve operating switches and a reversing valve 15.

When the fan 6 is operating it draws air through the opening 8 from the plenum chamber into the casing 10 from whence it escapes through the grid 3. The air withdrawn from the plenum chamber is continuously replaced by air from the atmosphere which flows over the outside coil 4 and the fins 5, the purpose of the circulation of the atmosphere through the coil and the fins being to augment the coil's heat exchange function so that it will extract more heat from the atmosphere than it would if the atmosphere surrounding the coil and the fins were stationary. During defrosting, however, heat exchange between the coil and the atmosphere is not desired. Therefore, during defrosting the fan 6 is stopped. While heat is being extracted from the atmosphere the coil 4 is kept cold so that heat will flow to it from the atmosphere. During defrosting, however, heat exchange between the atmosphere and the coil is temporarily of no importance.

The valve 15 is adjusted to direct hot refrigerant in gaseous phase into the coil 4 through a pipe 16 which leads from the valve 15 to a dividing header 17 from which three tubes 18, 19 and 20 extend over the base 1 in the plenum chamber beneath the fan blades 7 and contact the very hottest gaseous refrigerant through any block of ice that may have been built up there. After crossing the base 1 beneath the fan blades 7 the tubes 18, 19 and 20 deliver the still hot gas into a collecting header 21 from which it is led through a channel 22 to initial triple coil rounds 23, 24 and 25 which are posi-

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tioned directly across the bottom of the coil 4, and from whence the gas goes through vertical extensions to top rounds 26, 27 and 28 which are positioned directly across the top of the coil 4. Successive rounds of the coil 4 carry the gaseous refrigerant downwardly toward the initial bottom rounds, by which the gaseous refrigerant entered the coil, into the terminal rounds 32, 33 and 34, said rounds terminating in a header 35 by which the gaseous refrigerant leaves the coil arrangement. The terminal rounds 32, 33 and 34 lie just above the initial rounds by which the hot gaseous refrigerant entered the coil arrangement.

About midway between the top and bottom of the coils the order fore and aft of the rounds may be reversed by crossing the front and rear bends 29 and 30 of the rounds over each other in the manner illustrated in FIGS. III and IV.

Thus it will be seen that during the defrosting operation the hot compressed gaseous refrigerant from the compressor flows through the pipe 16 and header 17 and thence through three fan chamber defrost tubes 18, 19 and 20 beneath the fan blades 7. The heat from these three tubes is most effective during the defrosting operation for melting the heavy block or layer of ice that is liable to have accumulated beneath the fan blades. The hot compressed gaseous refrigerant next passes through the initial triple rounds 23, 24 and 25 across the bottom of the outside coil 4 where the ice or frost accumulation is usually the greatest and then it goes upwardly to the top rounds 26, 27 and 28. Then as the refrigerant gradually cools it goes downwardly round by round, the coolest round designated generally at 31 immediately overlying the hottest rounds 23, 24 and 25.

A significant feature of this arrangement is that during the defrosting operation the incoming hot gaseous refrigerant after going through the round at the extreme lower end of the coil immediately goes through the round at the extreme upper end of the coil. One defect of the prior art which this arrangement cures is that prior art coils tended to become quite hot at one end and to remain relatively cold at the other end and that defrosting was liable to be quite incomplete at the relatively cold end so that permanent icing was liable to occur there. With the arrangement illustrated and described it has been found that defrosting is almost equally effective at both ends of the coil and is quite uniformly effective throughout the intermediate portion of the coils.

Further, one side of the coil arrangement 4 is directly exposed to the atmosphere and wind which makes it relatively colder than the inner side facing the fan chamber. This tends to cool the refrigerant in an outside coil of the coil arrangement 4 more quickly than an inner coil. Thus, as illustrated in FIGS. III and IV, the order of the front and rear or inner and outer coils 29, 30 may be reversed. This cooperates with the previously described hot gas distribution arrangement to evenly distribute the defrosting heat from the hot gas defroster over the entire coil arrangement 4.

Therefore, the above-described coil 4 arrangement in cooperation with the fan or other chamber defrosting tubes 18, 19 and 20 form a complete defrosting system for a heat pump.

The words "top," "bottom," "upwardly" and "downwardly" aptly designate positions of elements and directions of flow with the coil oriented as shown in the drawings. In some cases the coil may, of course, be otherwise oriented. In such cases other apt words, e.g. "right," "left," etc., would be used to designate positions and directions. The instant invention encompasses all orientations of the coil, and such modifications as fall within the spirit and scope of the teachings of this invention.

Having described the invention, I claim:

1. In a heat pump having an outside coil and an outside fan for disposing outside atmospheric air in heat exchanging relationship with said coil, the combination in said heat pump of defrosting means for removing

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frost and ice which have accumulated upon said coil and below said fan and said coil, said defrosting means comprising means for conducting hot gaseous refrigerant into intimate juxtaposition with a major part of the area below said fan and into intimate juxtaposition with a major part of the area below said coil and through the lowermost round of said coil and thence through the uppermost round of said coil and progressively downwardly round by round to and through a terminal round which lies closely adjacent to the lowermost round.

2. In a heat pump having an outside coil, each round of said coil consisting of a plurality of lengths of tubing arranged in parallel, and an outside fan for disposing outside atmospheric air in heat exchanging relationship with said coil, the combination in said heat pump of defrosting means for removing frost and ice which have accumulated upon said coil and below said fan and said coil, said defrosting means comprising means for conducting hot gaseous refrigerant into intimate juxtaposition with a major part of the area below said fan and into intimate juxtaposition with a major part of the area below said coil and through the lowermost round of said coil and thence through the uppermost round of said coil and progressively downwardly round by round to and through a terminal round which lies closely adjacent to the lowermost round, bends of two lengths of tubing in an intermediate round being crossed so that tubing that is located foremost above where such bends cross is located rearmost below where such bends cross.

3. In a heat pump having an outside coil, the combination in said heat pump of defrosting means for removing frost and ice which have accumulated upon and below said coil, said defrosting means comprising means for conducting hot gaseous refrigerant into intimate juxtaposition with a major part of the area below said coil and through the lowermost round of said coil and thence through the uppermost round of said coil and progressively downwardly round by round to and through a terminal round which lies closely adjacent to the lowermost round.

4. In a heat pump having an outside coil, each round of said coil consisting of a plurality of lengths of tubing arranged in parallel, the combination in said heat pump of defrosting means for removing frost and ice which have accumulated upon and below said coil, said defrosting means comprising means for conducting hot gaseous refrigerant into intimate juxtaposition with a major part of the area below said coil and through the lowermost round of said coil and thence through the uppermost round of said coil and progressively downwardly round by round to and through a terminal round which lies closely adjacent to the lowermost round, bends of two lengths of tubing in an intermediate round being crossed so that tubing that is located foremost above where such bends cross are located rearmost below where such bends cross.

5. In a heat pump having an outside coil, the combination in said heat pump of defrosting means for removing frost and ice which have accumulated upon and below said coil, said defrosting means comprising means for conducting hot gaseous refrigerant through the lowermost round of said coil and thence through the uppermost round of said coil and progressively downwardly round by round to and through a terminal round which lies closely adjacent to the lowermost round.

6. In a heat pump having an outside coil each round of said coil consisting of a plurality of lengths of tubing arranged in parallel, the combination in said heat pump of defrosting means for removing frost and ice which have accumulated upon and below said coil, said defrosting means comprising means for conducting hot gaseous refrigerant through the lowermost round of said coil and thence through the uppermost round of said coil and progressively downwardly round by round to and through a terminal round which lies closely adjacent

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to the lowermost round, bends of two lengths of tubing in an intermediate round being crossed so that tubing that is located foremost above where such bends cross are located rearmost below where such bends cross.

7. In a heat pump having an outside coil and an outside fan for disposing outside air in heat exchange relationship with said coil, defrosting means for removing frost and ice which have accumulated upon said coil and below said fan, said defrosting means including first conduit means for conducting hot gaseous refrigerant into intimate juxtaposition with a major part of the area directly below said fan and second conduit means for conducting hot gaseous refrigerant into heat exchange relationship with said coil.

8. In a heat pump having an outside coil and an outside fan for disposing outside air in heat exchange relationship with said coil, a housing surrounding said coil and fan, defrosting means for removing frost and ice which have accumulated upon said coil and below said fan, said defrosting means including first conduit means for conducting hot gaseous refrigerant into intimate juxtaposition with a major part of the area directly below said fan within said housing and second conduit means conducting hot gaseous refrigerant into heat exchange relationship with said coil.

9. A refrigeration coil to be defrosted by a source of heated refrigerant, comprising; a plurality of rows of lengths of tubing; means for connecting one end of the first lengths of tubing of each row to a heated refrigerant source; means for connecting the other end of said first lengths of tubing to one end of the last lengths of tubing in said rows; means for connecting the other end of the

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last length of tubing in each row and successive intermediate lengths of tubing in the same row in a series flow connection until a predetermined intermediate length of tubing in a first and second row, respectively, is reached; and means for connecting the outlets of said predetermined intermediate lengths of tubing of a first row and a second row to a next successive length of tubing in said second row and first row, respectively.

10. A refrigeration coil for use as an outside coil in a heat pump system adapted to be defrosted by a source of heated refrigerant, comprising; a plurality of vertical rows of lengths of tubing; means for connecting one end of the lowermost lengths of tubing of each row to a source of heated refrigerant; means for connecting the other end of said lowermost lengths of tubing to one end of the uppermost lengths of tubing; means for connecting the other end of the uppermost length of tubing in each row and successive intermediate length of tubing in the same row in a series flow connection until a predetermined intermediate length of tubing in a front and back row, respectively, is reached; and means for connecting said predetermined intermediate lengths of tubing of said front row and said back row to a successive length of tubing in said back row and front row, respectively.

References Cited in the file of this patent

UNITED STATES PATENTS

30	2,694,904	Lange	Nov. 23, 1954
	2,801,523	Hansen	Aug. 6, 1959
	2,955,439	Pinter	Oct. 11, 1960