Jan. 15, 1963 L. A. STAEBLER 3,073,126

REFRIGERATION APPARATUS

Filed Jan. 25, 1961

FIG. 1.

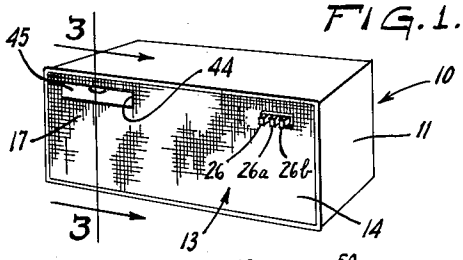
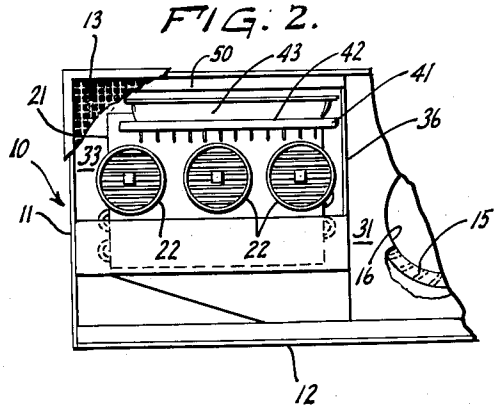


FIG. 2.



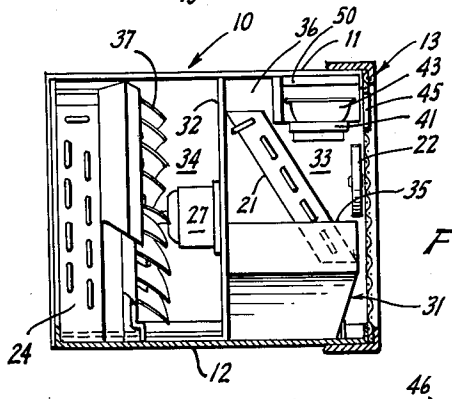


FIG. 3.

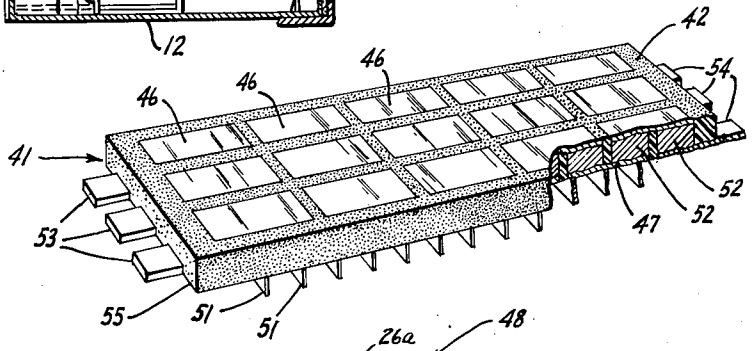


FIG. 4.

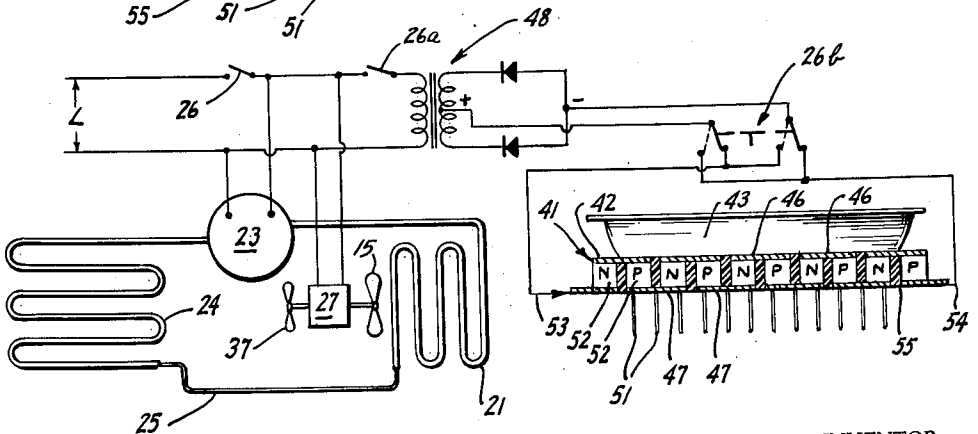


FIG. 5.

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REFRIGERATION APPARATUS

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This invention relates to refrigeration apparatus, and more particularly to a novel combination of cooling means, each different in principle from the other but so cooperatively disposed in a single refrigerating apparatus as to achieve a desired relatively wide range of temperatures.

Considering refrigerated compartment and room cooler means, by way of example, it will be appreciated that when such means are combined difficulties arise due to the characteristically wide variance in temperature requirements of the two means. Room cooler or air conditioner evaporators utilizing for example, the liquid-vapor principle normally operate in an above-freezing temperature range of 40° F. to 45° F., whereas an evaporator of a similarly cooled refrigerated compartment normally operates in a below-freezing temperature range of −10° F. to +10° F. Multiple evaporator arrangements have been proposed which provide these temperatures in a single device, but it has been found that simultaneous operation of the high and low temperature evaporators requires the compressor to operate at the lower suction pressure with consequent reduction in compressor pumping capacity, which seriously reduces air conditioning capacity. In other words, in providing simultaneously high and low temperature cooling in conventional liquid-vapor refrigerating means, the compressor capacity tends to a lower value because of the low temperature and pressure operation imposed on the system by the lower temperature evaporator.

It is therefore a broad objective of the invention to provide simple and effective combined refrigerated compartment and room cooling means overcoming the above described difficulties.

It is a particular objective of the invention to provide thermal coupling of thermoelectric heat exchanger means with liquid-vapor heat exchanger means and enhancement of the efficiency of operation of the thermoelectric heat exchanger means without appreciably detracting from the operating efficiency of the liquid-vapor heat exchanger.

It is another objective of the invention to provide thermoelectric heat exchanger means for freezing ice in novel cooperative heat exchange arrangement with fluid cooled by a separate cooling means.

It is a specific objective of the invention to provide thermoelectric heat exchanger means for freezing ice, in novel cooperative arrangement with a room-cooler or air conditioner.

In the achievement of the foregoing as well as other objects and advantages, the invention contemplates, in a preferred embodiment thereof, provision of thermoelectric cooling means having cold junctions disposed and adapted to support a receptacle for containing water to be frozen and hot junctions disposed in heat exchange relation with the cooling means of a room-cooler.

The manner in which the foregoing and other objects and advantages may best be achieved will best be understood from a consideration of the following description taken in light of the accompanying drawing, in which:

FIGURE 1 is a perspective showing of air conditioning apparatus embodying the invention;

FIGURE 2 is an enlarged elevational showing, with parts broken away, of apparatus seen in FIGURE 1;

FIGURE 3 is an enlarged sectional view, in elevation, and looking in the direction of arrows 3—3 as applied to FIGURE 1;

FIGURE 4 is a perspective view, partly in section and with parts broken away, of the thermoelectric cooler seen also in FIGURES 2 and 3; and

FIGURE 5 is a somewhat diagrammatic showing of a heat exchange system incorporating the principles of the present invention.

Referring with more particularity to the drawing, there is seen in FIGURES 1, 2, and 3 an air conditioner 10 of the window mounted type and including a cabinet or housing 11, preferably but not necessarily rectangular in configuration, having a base portion 12 and a conventional decorative panel 13, the latter comprising inlet and outlet passage means for the air moving apparatus to be hereinafter more fully described. The inlet includes grill portion 14 disposed in air flow communication with inlet opening 16 of the indoor blower portion 15 of the air moving means. The aforesaid outlet air passage includes the grille portion 17 disposed in air flow communication with an evaporator coil 21. A plurality of independently rotatable louvers 22 are disposed between evaporator coil 21 and the grille portion 17 and are adapted to provide selectivity of the direction of discharge air flow. Evaporator coil 21 is preferably of the finned type and is part of the conventional vapor-compression refrigerating system, disposed within housing 11 and shown diagrammatically in FIGURE 5. This system includes a motor compressor 23, condenser coil 24, restrictor 25, and associated conduits through which the refrigerant motor compressor, condenser coil, restrictor, and evaporator coil are connected in series flow circuit. Compressor 23 is selectively energized through line L having in series therewith control switch means 26.

Referring further to the air moving means, a blower or fan motor 27 is connected across line L and rotatably supports blower or fan 15 adapted to cause circulation of air in heat exchange relation with evaporator coil 21. Blower 15 is housed within suitable scroll structure 31 disposed adjacent a partition 32 which divides cabinet 11 into an evaporator coil chamber 33 and a condenser coil chamber 34. The mouth portion 35 of scroll structure 31 extends through partition 36 to direct air against one face of evaporator coil 21, for flow therethrough and outwardly through rotatably mounted louvers 22 and grille portion 17.

Condenser coil chamber 34 also has disposed therein motor compressor 23 and fan motor 27. A propeller type fan 37 is rotatably supported within chamber 34 by motor 27 to provide for drawing outside air into the chamber over condenser coil 24, and discharging this air outwardly from chamber 34 over motor compressor 23.

In particular accordance with the invention, and as best seen in FIGURES 2 and 3, thermolectric means 41 may take the form of a panel disposed in the upper portion of evaporator coil chamber 33. Thermoelectric panel means 41 has an upwardly presented surface portion 42

disposed and adapted to support a receptacle, for example an ice tray 43 which may be either a conventional plastic type or of aluminum having an anodized surface, thereby to ensure against electrically short circuiting the cold junctions. Short circuiting is however unlikely, since thermoelectric panel means of this type characteristically operate under low voltage, high current conditions. Under such conditions even a conductive metal tray presents a very high impedence to short circuiting current flow. Surface portion 42 of the thermoelectric panel means is disposed cooperatively with box-like thermally insulative wall means 50 to form a compartment accessible, for insertion and removal of ice tray 43, through an opening 44 over which a hingedly mounted door 45 is disposed.

As best seen in FIGURE 4, thermoelectric panel means 41 comprises thermocouples made up of thermoelectric elements 52 electrically and thermally insulated one from the other by suitable means 55 within which elements 52 are embedded. Elements 52 are electrically interconnected by suitable electrically conductive straps 46 and 47 (see also FIGURE 5) partially embedded in insulation means 55, straps 46 having surface portions cooperatively disposed with means 55 to form surface portion 42.

Thermoelectric elements 52 may be of any suitable known type for example they may comprise semiconductive materials having dissimilar thermoelectric properties and arranged as adjacent blocks. While but three rows of blocks or elements 52 have been indicated, it is to be understood that any desired number of such rows may be disposed side by side in the plane of panel means 41. Each block like element 52 further is designated in FIGURE 5 by either the letter P or the letter N to indicate its thermoelectric property. The terms P and N have found wide usage in the semiconductor art, the term P designating a material having an abundance of "holes" and the term N designating a material having an abundance of electrons. Semiconductive components such as bismuth telluride have been found suitable for use as the respective P and N type materials.

Copper has been found suitable for use as straps 46 and 47. The lower conductive straps 47 are provided with heat exchange fins 51 that extend downwardly into the stream of cool air which flows from the vicinity of evaporator coil 21 and into the space being air conditioned.

Suitable power supply means 48 for thermoelectric panel means 41 is connected to line L, through switches 26, 26*a* and 26*b*, and is adapted to supply the desired direct current flow through each of the thermocouple junctions to the terminal means 53 and 54 provided in panel means 41. To freeze ice, switch 26*b* is moved to the full line position to cause current to flow as shown by the arrow at terminal means 53, the construction and arrangement of the panel means being such that, in the aforesaid switch position, the straps 46 disposed in its upper surface comprise the cold junctions of the panel and the lower, finned straps 47 comprise the hot junctions thereof. In the broken line position, switch 26*b* effects reversal of current flow whereby the upper straps 46 become hot junctions and lower straps 47 become cold junctions for a purpose mentioned below.

In the operation of the apparatus hereinabove described, closing of switch 26 energizes the compressor and fan motors, whereby the refrigerating and air moving systems function to cool the enclosure or room to be treated. Also with the closing of switches 26 and 26*a*, and with switch 26*b* in its full line position, thermoelectric panel means 41 is energized, whereby upper straps 46 comprise the cold junctions and become cold and lower straps 47 comprise the hot junctions and become warm. Heat generated at the hot junctions flows into fins 51 and is dissipated therefrom into the stream of cold air being circulated past the evaporator of the air conditioner.

In the described arrangement, heat exchange is provided between the heat rejecting fins 51 of the thermoelectric panel means 41 and the heat absorbing element or surface means—evaporator coil 21—of the air conditioning refrigerating unit. By this heat-exchange coupling, between vapor-compression and thermoelectric systems, the efficiency of the thermoelectric panel in performance of its ice freezing function is greatly enhanced, without unduly decreasing the cooling capacity of the air conditioner. Upon completion of freezing of the ice, any ice bond between the ice tray 43 and cold junctions 46 is eliminated by momentarily moving switch 26*b* to its broken line position. As explained above, this brings about a reversal of current and causes junctions 46 to become sufficiently warm to melt the ice bond.

It will now be appreciated that bringing into heat exchange relation portions of refrigerating systems operating on dissimilar principles has the advantage of making it possible to maintain, in a single machine, temperatures lying within a wide range. In the particular embodiment described the novel combination of this invention makes it possible to freeze ice in an air conditioner without significantly detracting from the air cooling and dehumidifying effectiveness of the latter.

More specifically, it has been shown that by the above-described unusual "cascading" the higher temperature heat absorbing element of a vapor-compression refrigerating machine with the heat rejecting element of a thermoelectric heat exchanger having a lower temperature heat absorbing element, only a relatively small portion of the air conditioning capacity is consumed in overcoming the losses of the thermoelectric system.

I claim:

1. A combination refrigerator and space cooler, comprising: cabinet means; a refrigerant evaporator compartment in said cabinet means and in air flow communication with a space to be cooled; a refrigerant evaporator disposed in said evaporator compartment; means for moving air through said evaporator compartment sequentially over said evaporator and into said space to be cooled; thermocouple panel means disposed within said cabinet means and disposed cooperatively with the latter to form a storage compartment, said panel means having cold junctions to one side thereof adapted to refrigerate said storage compartment and hot junctions to the other side thereof disposed for high heat exchange relation with air being caused to flow between said evaporator and said space being cooled; and means including said cabinet means defining an access opening to said storage compartment.

2. A combination room air conditioner and refrigerator, comprising: means defining a cabinet; means defining an air cooling surface in said cabinet; means for moving air to be cooled sequentially over said cooling surface and into a room; insulated compartment means within said cabinet; and thermocouple means comprising cold junctions disposed and adapted to cool said compartment means and hot junctions disposed for high heat exchange with air after it is caused to flow over said cooling surface and prior to entry thereof into such room.

3. A combination in accordance with claim 2, and further characterized in that said hot and cold thermocouple junctions are disposed in panel like configuration, said cold junctions comprising article support means and being presented to the inside of said compartment means, and said hot junctions being presented toward said air as it is caused to flow.

4. A combination in accordance with claim 2 and further characterized in that said air cooling surface is adapted to be maintained at above freezing temperatures and said cold junctions are adapted to be maintained at below freezing temperatures.

5. In a room air conditioner of the type having a refrigerating compartment disposed in air flow communication with a space to be conditioned, a refrigerant evaporator disposed for heat exchange with said compartment, and means for moving air from said room being conditioned

sequentially through said compartment, in heat exchange relation with said evaporator, and outwardly from said compartment into said room, auxiliary cooling means comprising: thermocouple panel means disposed within said compartment and including hot junctions disposed for high heat exchange with the stream of cooled air moving toward said room, and cold junctions disposed to the other side of said panel means and adapted to cool the region adjacent thereto within said compartment.

6. In a room air conditioner of the type having a refrigerating compartment disposed in air flow communication with a space to be conditioned, a refrigerant evaporator disposed for heat exchange with said compartment, and means for moving air from said room being conditioned sequentially through said compartment, in heat exchange relation with said evaporator, and outwardly from said compartment into said room, auxiliary cooling means comprising: thermocouple panel means including hot junctions disposed for high heat exchange with the stream of cooled air moving toward said room, and cold junctions disposed to the other side of said panel means and adapted to cool the region adjacent thereto.

References Cited in the file of this patent

UNITED STATES PATENTS

484,182	Dewey	Oct. 11, 1892
2,826,048	Wheeler	Mar. 11, 1958
2,886,618	Goldsmid	May 12, 1959
2,964,912	Roeder	Dec. 20, 1960
2,978,875	Lackey	Apr. 11, 1961