May 11, 1948. A. F. HOESEL 2,441,270

REFRIGERATING SYSTEM AND HEAT EXCHANGER THEREFOR

Filed Sept. 16, 1944 2 Sheets-Sheet 1

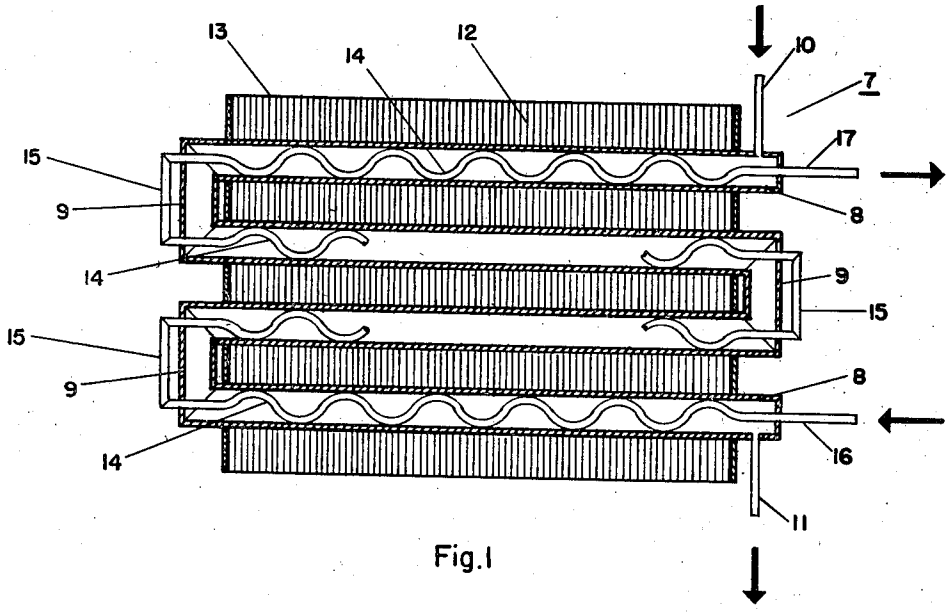


Fig.1

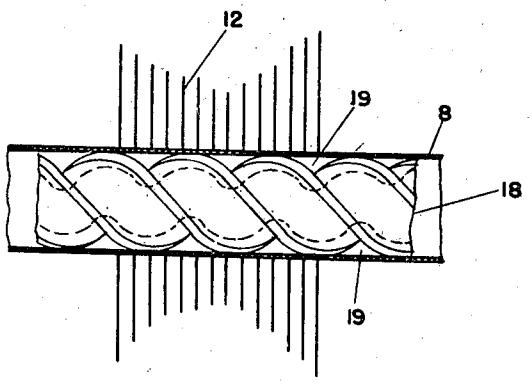


Fig.2

INVENTOR

Anthony F. Hoesel

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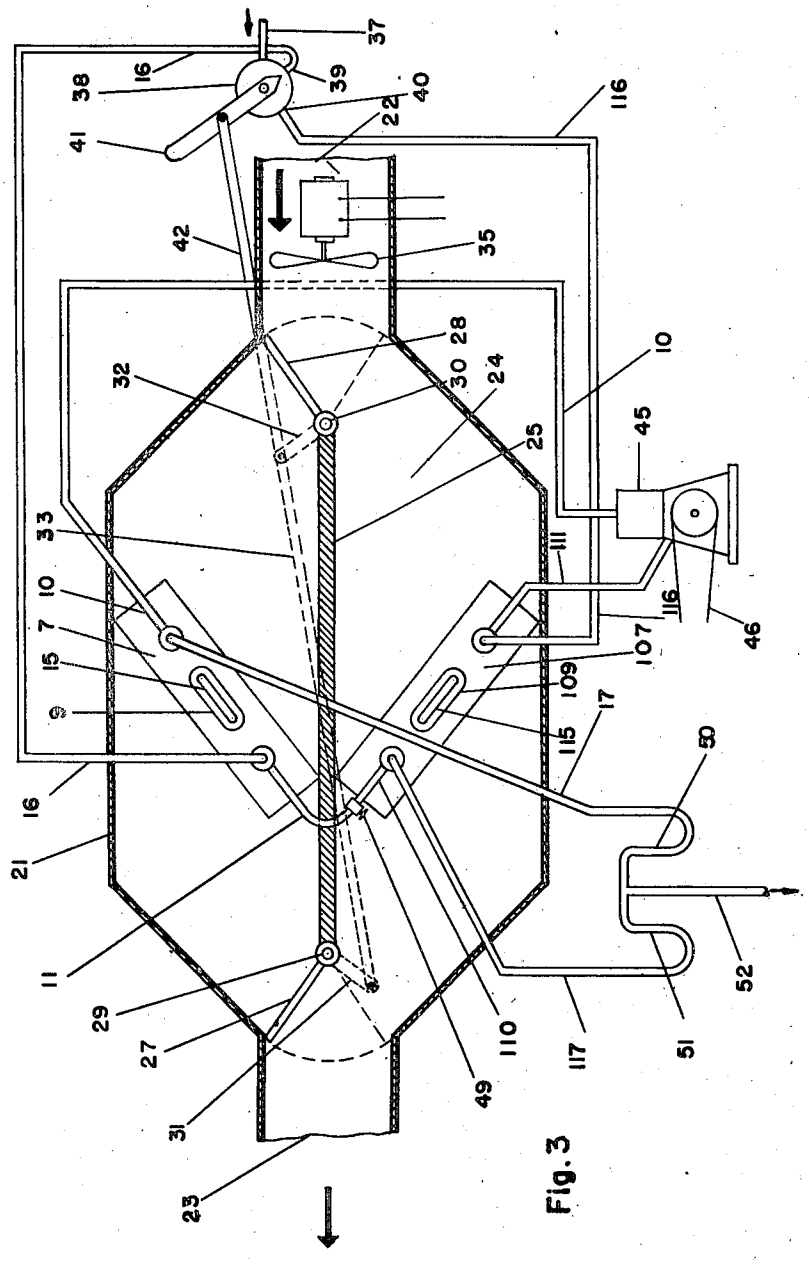


Fig. 3

INVENTOR

Anthony F. Hoesel

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REFRIGERATING SYSTEM AND HEAT EXCHANGER THEREFOR

Anthony F. Hoesel, Chicago, Ill., assignor to Peerless of America, Inc., Marion, Ind.

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8 Claims. (Cl. 62—129)

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The present invention is concerned with the operation of an expander-compressor-condenser series circuit refrigeration system, which can be operated as an air cooling and dehumidifying system during the summer months and which can also be operated to supply heat during the winter months.

In the systems now in use which can be operated for cooling and de-humidifying and to supply heat the installations involve a complexity of control valves, which must be shifted every time a reverse operation is called for, therefore the installation becomes both complex and expensive, and especially so if the operation is under automatic control.

An object, of the present invention, is to provide a refrigerating system which is both simple and inexpensive.

Another object, of the present invention, is to provide heat exchangers, for such refrigerating systems, which have high efficiencies for a given cubical displacement.

Further object, of the present invention, will be disclosed in the following specification and claims.

In the drawings:

Fig. 1 is a cross sectional elevation of a heat exchanger embodying the invention.

Fig. 2 shows an alternate form of the water conduits 14 of Fig. 1.

Fig. 3 is a diagrammatic view, of a refrigerating system embodying the invention, showing the simple cycle shifting means.

In Fig. 1, the heat exchanger 7 comprises a plurality of nested tubes 8 joined by end connectors 9, as shown, to provide a series conduit circuit between the refrigerant fluid inlet 10 and the refrigerant fluid outlet 11. Mounted, in intimate thermal contact, upon, and coextensive with the refrigerant tubes 8, are a plurality of spaced apart fin plates 12 surrounded, at top, bottom and the two ends, as shown, by a casing 13 through which an air circulation may be forced.

Inside, the refrigerant tubes 8, I place spirally formed water conduits 14 joined by end connectors 15, as shown, to provide a series conduit circuit between the water inlet 16 and the water outlet 17. It will be noted that the two circuits are of the counterflow type.

A definite advantage accrues from the spiral forming, of the water conduit 14, since the flow velocity of the refrigerant fluid, through the refrigerant tubes 8, tends to sweep the entire surface

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areas of both tubes 8 and 14, and thereby keep the heat transfer efficiency at a maximum.

In Figure 2, I show the refrigerant tube 8 containing a water conduit 18 the outside diameter of which is a close fit to the internal diameter of the refrigerant tube 8. To provide a refrigerant fluid spiral flow path, I form thread like grooves 19 into the outer wall of the water conduit 18. The internal water passage, through the water conduit 18, also partakes of the exterior contour thereby imparting a spiral flow to the water passing therethrough and further increasing the efficiency of the system.

In Fig. 3 I have two heat exchangers similar to the heat exchanger 7 of Fig. 1. One of these is the refrigerant fluid condenser and all details are membered similar to that of Fig. 1. The other of these has 100 added to the numerals designating similar parts and this is the refrigerant fluid expander.

The casing 21 has an air inlet 22 and an air outlet 23 both of which are connected to the usual duct system for hot air heating or air cooling. In general, this is a series air circulation system.

The casing 21 has an enlarged chamber 24, which is partially subdivided by a partition 25. In the upper subdivision I place the refrigerant fluid condenser 7 and in the lower subdivision I place the expander 107. To complete the subdivision I have dampers 27 and 28 fulcrumed on the pins 29 and 30 respectively. The rocker levers 31 and 32, connected by the link 33, serve to simultaneously move both the dampers 27 and 28 to close off the air circulation, by means of the fan 35, through either the upper subdivision or the lower subdivision of the chamber 24.

A water inlet conduit 37 connects to a three way valve 38 having outlets 39 and 40, leading to the conduits 16 and 116 respectively, either of which may be opened by positioning the hand lever 41 connected to a link 42 which in turn connects to the rocker lever 32 as shown.

Movement, of the hand lever 41, is also accompanied by movement of the dampers 27 and 28 and it is contemplated that such movements be of sufficient magnitude to completely throttle all air movement through either the upper or lower subdivision of the chamber 24.

The outlet 111, of the expander 107, connects to the suction side of a refrigerant compressor 45 driven by means of the belt 46 connected to some suitable source of power not shown.

The discharge, of the compressor 45, is led, by means of the conduit 10, to the condenser 7 wherein the abstraction of heat condenses the

refrigerant fluid to its liquid phase. The conduit outlet 11 serves to carry the refrigerant liquid to an expansion valve 49 from whence the expanded fluid is discharged to the inlet 110 of the expander 107 wherein the fluid absorbs heat and thereby changed to its vapor phase prior to entering the compressor 45. This is the refrigerant circuit and it is well to note that there are no valve or other control means to vary the series circuit refrigerant circulation, which is not the case with most other reverse cycle systems.

Both of the water outlets 17 and 117 connect to traps 50 and 51 respectively which spill, through the conduit 52, to a sewer or otherwise.

Having described the elements of the system, I shall now describe its operation.

In the position shown, the air circulation is through the lower subdivision, of the chamber 24, and over the exterior surfaces of the expander 107 which is refrigerated by the circulation of refrigerant fluid therethrough and the air, leaving the outlet 23, is cooled and dehumidified.

The outlet 39, of the three way valve 38, is open to pass water to the conduit 16 and thence to the condenser 7 wherein it absorbs heat from the compressed refrigerant fluid and condenses the same to its liquid phase. The heated condensing water passes to the conduit 52.

The system is now operating as a normal air cooling-dehumidifying system such as would be desired for summer comfort. At the approach of winter and for the call for heating instead of cooling, I would then move the hand lever 41 to its opposite extreme and make no other adjustments.

The air circulation, now, is through the upper subdivision, of the chamber 24, and over the exterior surfaces of the condenser 7, and the discharge 40, of the three way valve 38, is open to pass water to the conduit 116 leading to the expander 107 wherein the water rejects heat, to the circulated refrigerant fluid, prior to its discharge to the conduit 52.

It is presumed that the entering water temperature is approximately 50° F. minimum and the leaving water temperature approximately 40° F. maximum.

Since there is no water circulation through the condenser 7, all of the condensing heat must be rejected to the circulated air passing thereover and consequently hot air passes through the outlet 23.

It is contemplated that, at certain times, the maximum cooling capacity or the maximum heating capacity would be too great, and it might also be undesirable, under certain conditions, to operate the system with on cycles and off cycles. In that case, it is possible to so position the hand lever 41 so that the dampers 27 and 28 would not completely close off the air circulation over the condenser 7 or the expander 107. With such a condition we could have a major circulation of hot air plus a minor circulation of cooled air or vice versa.

From the foregoing it will be obvious that I have provided a very simple refrigerating system which can be alternatively operated as an air cooling and de-humidifying system and for providing heat. Anyone, versed in the art, could incorporate present commercially available controls such as thermostats, solenoids, etc., to make the system completely automatic, but, since that is no part of the present invention I have, for purposes of simplicity, omitted them.

While the drawings show and the specifications

explain a particular embodiment of the invention, it is understood that numerous modifications may be employed without departing from the spirit and scope of the invention, which is to be limited only to the following claims.

I claim:

1. A refrigerating system comprising: a condenser heat exchanger; an expander heat exchanger; each exchanger including, a refrigerant fluid circulation conduit and a heat transfer fluid conduit within the refrigerant conduit, both conduits being sealed against intermingling of fluids; means for circulating refrigerant, in series, through both of said heat exchangers; means for circulating air selectively over the exterior surfaces of either of said exchangers; and means for passing a fluid, other than the refrigerant fluid, through the heat transfer conduit of the heat exchanger over which air is not forced.

2. A refrigerating system comprising: a condenser heat exchanger; an expander heat exchanger; each exchanger including, a refrigerant fluid circulation conduit; extended heat transfer surface upon the outer surface of the refrigerant conduit, and a heat transfer fluid conduit within the refrigerant conduit, both conduits being sealed against intermingling of fluids; means for circulating refrigerant, in series, through both of said heat exchangers; means for circulating air selectively over the exterior surfaces of either of said exchangers; and means for passing a fluid, other than the refrigerant fluid, through the heat transfer fluid of the heat exchanger over which air is not forced.

3. A refrigerating system comprising: a condenser heat exchanger; an expander heat exchanger; each exchanger including, a refrigerant fluid circulation conduit and a heat transfer fluid conduit within the refrigerant conduit having means for directing the refrigerant in a spiral path adjacent the wall of the refrigerant conduit; both conduits being sealed against intermingling of fluids; means for circulating refrigerant, in series, through both of said heat exchangers; means for circulating air selectively over the exterior surfaces of either of said exchangers; and means for passing a fluid, other than the refrigerant fluid, through the heat transfer conduit of the heat exchanger over which air is not forced.

4. A refrigerating system comprising: a condenser heat exchanger; an expander heat exchanger; each exchanger including a refrigerant fluid circulation conduit and a heat transfer fluid conduit within the refrigerant conduit, both conduits being sealed against intermingling of fluids; means for circulating refrigerant, in series, through both of said heat exchangers; means forming a compartment around the exchangers and partition-means between the heat exchangers; means for forcing air through said compartment; valve-means for selectively controlling circulation of air over the exterior surfaces of either of said exchangers; and means for passing a fluid, other than the refrigerant fluid, through the heat transfer conduit of the exchanger over which air is not forced.

5. A refrigerating system comprising: a condenser heat exchanger; an expander heat exchanger; each exchanger including a refrigerant fluid circulation conduit and a heat transfer fluid conduit within the refrigerant conduit, both conduits being sealed against intermingling of fluids; a refrigerant compressor for circulating refrigerant, in series, through both of said heat ex-

changers; means forming a compartment around the exchangers and partition-means between the heat exchangers; means for forcing air through said compartment; damper-means for selectively controlling circulation of air over the exterior surfaces of either of said exchangers; and valve-means for passing a fluid, other than the refrigerant fluid, through the heat transfer fluid conduit of the heat exchanger over which air is not forced.

6. A refrigerating system comprising: a condenser heat exchanger; an expander heat exchanger; each exchanger including a refrigerant fluid circulation conduit and a heat transfer fluid conduit within the refrigerant conduit, both conduits being sealed against intermingling of fluids; a compressor for circulating refrigerant, in series, through both of said heat exchangers; means forming a compartment around the exchangers and partition-means between the heat exchangers; means for forcing air through said compartment; damper-means for selectively controlling circulation of air over the exterior surfaces of either of said exchangers; and valve-means for selectively passing a fluid, other than the refrigerant fluid, through the heat transfer fluid conduit of the heat exchanger over which air is not forced.

7. A refrigerating system comprising: a condenser heat exchanger; an expander heat exchanger; each exchanger including a refrigerant fluid circulation conduit and a heat transfer fluid conduit within the refrigerant conduit, both conduits being sealed against intermingling of fluids; a compressor for circulating refrigerant, in series, through both of said heat exchangers; means forming a compartment around the exchangers and partition-means between the heat exchangers; means for forcing air through said compartment; damper-means for selectively controlling circulation of air over the exterior surfaces of either of said exchangers; and three-way valve-means for selectively passing a fluid, other than the refrigerant fluid, through the heat transfer fluid conduit of the heat exchanger over which air is not forced.

8. A refrigerating system comprising: a condenser heat exchanger; an expander heat exchanger; each exchanger including a refrigerant fluid circulation conduit and a heat transfer fluid conduit within the refrigerant conduit, both conduits being sealed against intermingling of fluids; a compressor for circulating refrigerant, in series, through both of said heat exchangers; means forming a compartment around the exchangers with partition-means between the heat exchangers; means for forcing air through said compartment; damper-means for selectively controlling circulation of air over the exterior surfaces of either of said exchangers; and valve-means for selectively passing water through the heat transfer conduit of the exchanger over which air is not forced, said valve-means and damper-means being interconnected, for circulating air over one exchanger and circulating water through the heat transfer conduit of the other exchanger.

ANTHONY F. HOESEL.

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