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REFRIGERANT SUBCOOLING UNIT

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2 Sheets-Sheet 1

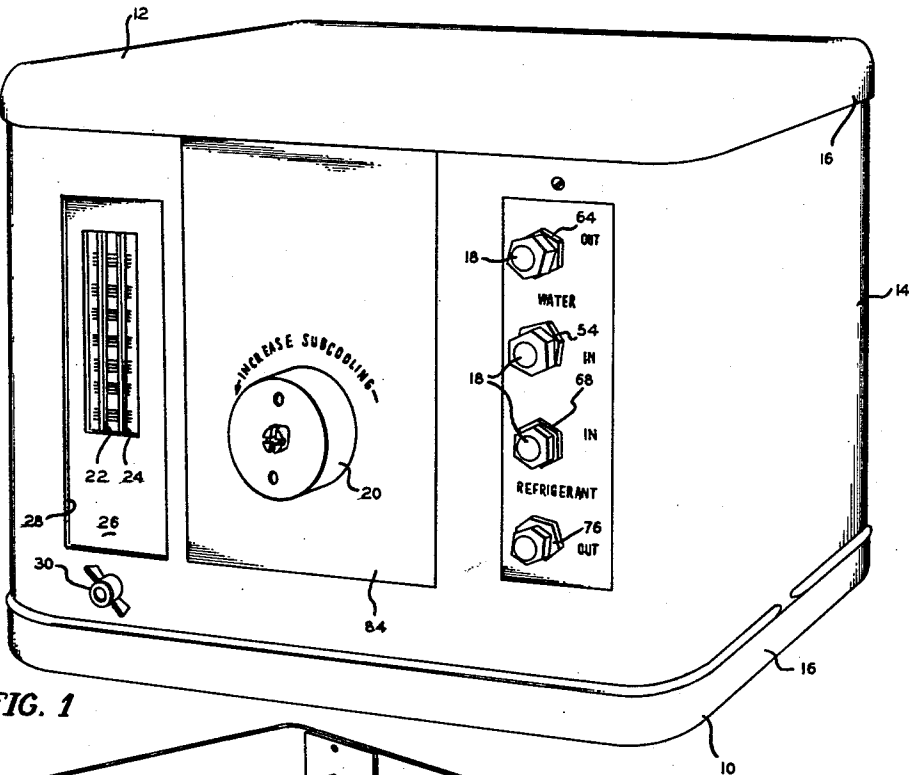


FIG. 1

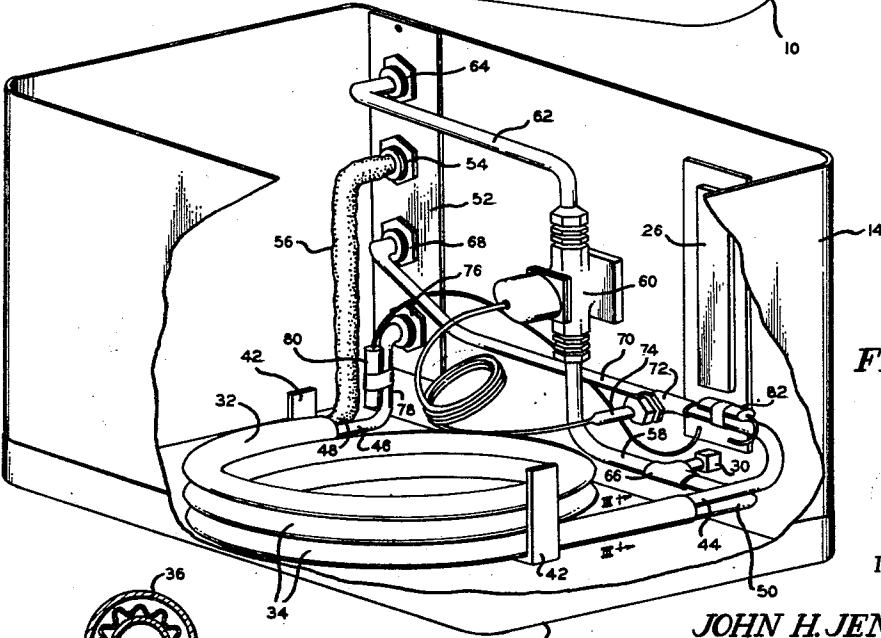


FIG. 2

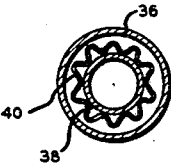


FIG. 3

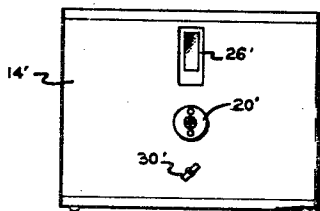
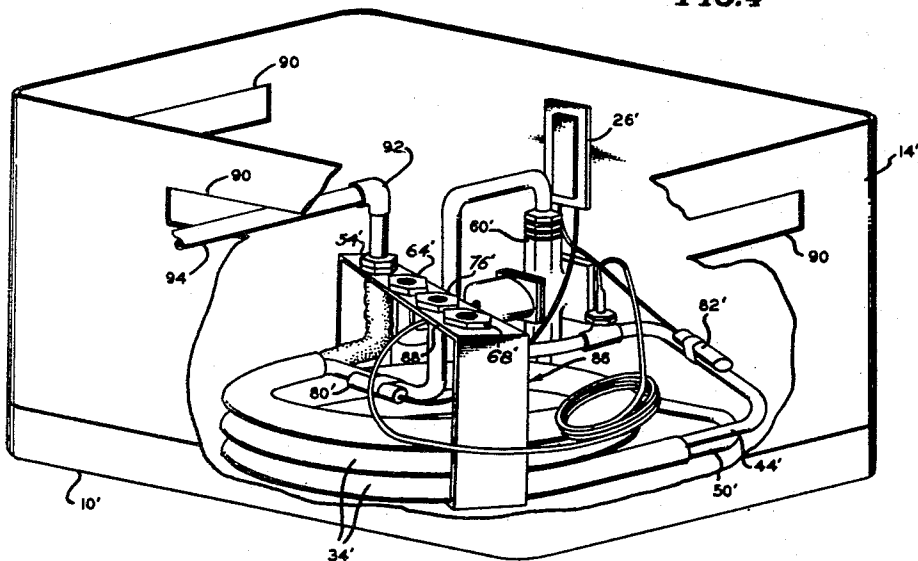
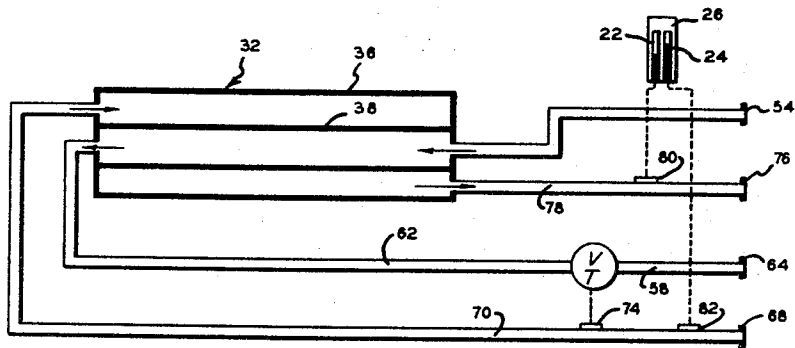
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2 Sheets-Sheet 2



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REFRIGERANT SUBCOOLING UNIT

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3 Claims. (Cl. 165—39)

The invention pertains to a refrigerant subcooling unit, and particularly relates to preassembled refrigerant subcooling apparatus which may be manufactured, marketed, and installed as a unit auxiliary to the refrigeration system employing the refrigerant.

It is known that the subcooling of a liquid refrigerant below the temperature at which it was condensed will increase the refrigerating capacity of the compressor system due to less flash gas being produced at the expansion valve by the colder refrigerant and the increased capacity of the refrigerant for absorbing heat. The subcooling of the liquid refrigerant is an effective means for increasing the refrigerating capacity of a given refrigeration unit, such as a refrigerator, air conditioner, or low temperature freezer. It has been found that for every 2° F. of subcooling of conventional halogenated refrigerants that takes place, the capacity of the refrigerating system will be increased by approximately one percent.

It is an object of the invention to provide a refrigerant subcooling unit which is preassembled and may be readily manufactured, marketed, and installed in an existing refrigeration system. The unit, in accord with the invention, is attractive in appearance and is so constructed as to be incorporated in the refrigeration system with a minimum of effort and skill.

A further object of the invention is to provide a preassembled refrigerant subcooling unit wherein cooling water is employed for subcooling the liquid refrigerant, and temperature sensing means is provided for determining the amount of subcooling accomplished, and the resultant addition to refrigeration capacity produced by the subcooling unit.

Yet another object of the invention is to provide a preassembled refrigerant subcooling unit wherein automatic control means is employed to render the subcooling unit active and inactive in accordance with the need for subcooling.

Yet another object of the invention is to provide a preassembled refrigerant subcooling unit which may be readily assembled and manufactured, and is capable of a very long service life with a minimum of maintenance.

These and other objects of the invention arising from the relationship and details of components thereof will be apparent from the following description and accompanying drawings wherein:

FIG. 1 is a perspective front view of a preassembled refrigerant subcooling unit in accord with the invention,

FIG. 2 is a perspective rear view, with the housing partially in section, showing the relationship of the internal components of the housing.

FIG. 3 is an elevational, sectional, detail view of the heat exchanger member employed in conjunction with the invention taken along section III—III of FIG. 2,

FIG. 4 is a diagrammatic sketch of the refrigerant and cooling medium systems and also illustrating the temperature indicating means,

FIG. 5 is a rear perspective, partly sectioned, view of the internal components within another embodiment of a subcooling unit housing, and

FIG. 6 is a front, elevational, view of the subcooling unit of FIG. 5.

Referring to FIGS. 1 through 4, the arrangement of components of one embodiment will be apparent. The subcooling unit in accord with the invention includes a housing which consists of bottom and top plates 10 and

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12, respectively, which enclose the bottom and top of a rectangular shroud 14. The top and bottom plates enclose the open ends of the shroud 14, and are provided with vertically extending peripheral flange portions 16 which overlap the edges of the shroud whereby a unitary box-like appearance is produced.

Referring to FIG. 1, the front face of the shroud 14 is provided with a plurality of conventional threaded fittings extending therethrough for connection with the water and refrigerant conduits. The fittings are shown with caps 18 closing the bores, such caps being employed when shipping the units. The front of the housing also includes a water regulator valve control knob 20 for adjusting the operation limits of a water regulator valve, as will be later apparent. A pair of thermometers 22 and 24 are mounted upon a plate 26 which is affixed to the shroud 14 on the inside thereof wherein the thermometers will be visible through an opening 28 defined in the shroud. A cooling water drain valve 30 projects through the lower region of the shroud, permitting draining of the unit, if the unit is employed in a location susceptible to freezing.

A heat exchanger member is located within the unit housing and is mounted upon the bottom plate 10. In the described embodiments, the heat exchanger unit consists of a coaxial double tube device 32 which is formed in a plurality of coils 34. The heat exchanger unit may be of any conventional, commercially available type, for example, such as that produced by the Edwards Engineering Corporation of Pompton Plains, New Jersey. This particular type of heat exchanger member includes a metal outer tube 36 encompassing an inner metal tube 38 which has a corrugated fin member 40 soldered to the exterior thereof. The corrugated fin member is of about 1/8" width and is spirally, axially, disposed along the tube 38. The refrigerant flows between the annular space defined by the tubes 36 and 38, and the cooling water flows through the tube 38. The fins 40 will very efficiently transmit heat from the refrigerant to the cooling water and lower the temperature of the refrigerant.

The heat exchanger coil is provided with several bracket members 42 which may be affixed thereto, and these brackets are connected to the bottom plate 10 by sheet metal screws or the like. The heat exchanger member 32 is provided with a refrigerant inlet portion 44 and a refrigerant outlet portion 46. The heat exchanger 32 is also provided with a cooling medium inlet portion 48 and a cooling medium outlet portion 50. As will be observed, the cooling medium inlet portion is located adjacent the refrigerant outlet portion such that the flow of cooling medium through the heat exchanger will be counter to the flow of refrigerant therethrough.

The refrigerant and cooling medium fittings projecting through the front face of the shroud 14 are mounted, preferably, on a common plate 52, which is attached to the back of the shroud front face by sheet metal screws. Holes defined in the shroud permit the threaded portion of the fittings to extend therethrough for exterior accessibility.

Referring to FIGS. 1, 2, and 4, the plumbing associated with the inlet and outlet portions of the heat exchanger will be appreciated. The cooling water inlet fitting 54 is in communication with the heat exchanger cooling medium inlet portion 48. Preferably, the plumbing throughout the unit consists of copper tubing employing soldered connections, and the tubing interconnecting the water inlet fitting and heat exchanger inlet portion is encased in an insulating jacket 56 to prevent the formation of water vapor condensate on the exposed cold water piping. The heat exchanger cooling water outlet portion 50 communicates with a conduit

58 which is connected to the water regulator valve 60, and the conduit 62 interconnects valve 60 with the water outlet fitting 64. A T 66 is located within the conduit 58 in communication with the drain fitting 30.

The refrigerant inlet fitting 63 employs a conduit 70 for establishing communication with the heat exchanger inlet portion 44. The conduit 70 is provided with a T 72 and appropriate fitting for receiving the refrigerant pressure tap fitting 74 of the pressure responsive water regulator valve 60. Thus, the pressure of the entering refrigerant is accurately sensed by the regulator valve control means. The refrigerant outlet fitting 76 is in communication with the heat exchanger outlet portion 46 by means of a short conduit 78. The water regulator valve 60 is described in this embodiment as being operated by the pressure within the refrigerant system and is, thus, termed a pressure responsive valve. As the pressure within the refrigerant system will be closely related to the refrigerant temperature, the valve 60 will sense the requirement for subcooling. A regulator valve, such as Type 56 manufactured by the Marsh Instrument Company of Skokie, Illinois, is suitable. It will be understood that valve 60 may be a temperature controlled valve, if desired, wherein the fitting 74 would include a refrigerant temperature sensing bulb, and that the substitution of a temperature sensing water regulator valve for a pressure sensing regulator valve is within the scope of one skilled in the art. In most commercial embodiments of the invention, a pressure sensing regulator valve will be employed because of its lower cost.

The valve 60 regulates the flow of water through the subcooling unit, and by locating the valve 60 on the outlet side of the heat exchanger, the temperature of the water passing therethrough will not be of a degree which will normally produce water vapor condensation on the valve or associated tubing. The valve 60 is, preferably, of the variable type wherein the control knob 20 may be rotated to adjust the pressure or temperature at which the valve opens and closes, depending on the type of valve 60 employed. Thus, the flow of water through the heat exchanger may be very accurately controlled, and the amount of subcooling accurately regulated. The use of the water regulator valve 60 insures a most efficient use of cooling water in that subcooling will only take place at those ambient temperatures which require increased refrigerating capacity, and when the ambient temperatures are sufficient to produce the desired refrigerant cooling with the normal condenser, the subcooling unit will be inoperative and no flow of water through the heat exchanger 32 will take place.

It is desirable for the operator or owner of the refrigerating system to be able to determine the amount of subcooling desired, and for this purpose the thermometers 22 and 24 are employed. Thermometer 22 is provided with a temperature sensing bulb 80 which is affixed to the refrigerant outlet conduit 78, and the temperature sensing bulb 82 of thermometer 24 is affixed to the refrigerant inlet conduit 70. Thus, thermometer 24 will indicate the temperature of the refrigerant as received from the regular condenser, and thermometer 22 will indicate the temperature of the refrigerant leaving the subcooling unit. By dividing the difference of the refrigerant inlet and outlet temperatures by two, the operator may directly determine approximately the percentage of increased refrigeration capacity obtained by the use of the subcooling unit.

Installation of the subcooling unit in an existing refrigerating system is very simple in that it is only necessary for the installer to connect appropriate conduits to the appropriate fittings projecting through shroud 14. A conduit is affixed to the outlet of the regular refrigeration condenser and affixed to fitting 68. Another conduit connects fitting 76 to the refrigeration circuit at the point normally supplied by the outlet of the con-

ventional condenser. A cooling water line is connected to fitting 54 and a drain line is connected to fitting 64. With large size subcooling units, the increased volume of the refrigerating system produced by the subcooling unit may necessitate the addition of a small amount of refrigerant to the system. By maintaining the caps 18 in place during transporting, the system is sealed against the entrance of foreign matter.

The construction of the housing, as described, simplifies the assembly of the subcooling unit in that the piping may be assembled before the shroud 14 is placed on the bottom plate 10. Thus, access to the plumbing is available from every direction. A hole is provided in the shroud for receiving the knob 20 and decalcomania 84 may be affixed to the shroud indicating the direction of knob rotation to increase or decrease the amount of subcooling desired, and indicia may also be added to the shroud to indicate the purpose of each fitting. As the inlet and outlet fittings are affixed to the plate 52, a hole need only be drilled in the shroud for receiving each fitting and the drain valve 30. After the assembly of the internal components of the unit, the shroud may be placed on the bottom plate and the fittings and valve knob inserted into the proper holes. The valve 60 is now affixed to the inside of the housing shroud. Placing of the top plate 12 in position completes the assembly.

An embodiment of the invention is shown in FIGS. 5 and 6 wherein the principles are identical to those described with regard to the embodiment of FIGS. 1 through 4, and merely the location of the components differs. Like components to those described above are indicated by primes. The relocation of the inlet and outlet fittings permits relocation of the thermometers and valve control knob on the housing, as shown in FIG. 6. The embodiment of FIGS. 5 and 6 is more adaptable with the larger size subcooling units than with the smaller size units to which the embodiment of FIG. 1 is primarily directed.

In the embodiment of FIGS. 5 and 6, a U-shaped bracket member 86 is affixed to the bottom plate 10' and vertically arises therefrom whereby the bracket base portion 88 will be in spaced relation to the heat exchanger coils 34'. The base portion 88 is, preferably, diagonally related to the rectangular configuration of the shroud 14' for a purpose which will be described later.

Four holes are provided in the bracket base portion 88 whereby the inlet and outlet fittings 54', 64', 68', and 76' may be affixed thereto. The underside of these fittings is in communication with the appropriate conduits, as explained in conjunction with the embodiment of FIG. 1. The shroud 14' is provided with a slot 90 in the sides and back portion. If desired, the slot 90 may consist of a knockout portion whereby only one knockout portion is removed from the shroud. The purpose of the slot 90 is to permit the water and refrigerant conduits to enter the housing from the most advantageous direction for connection with the appropriate fitting.

The fittings will normally have elbows 92 associated therewith, one of which is shown in FIG. 5, whereby the conduit 94 providing the cooling water may be attached thereto. The conduit 94 extends through the slot 90, and in like manner it will be appreciated that the three remaining conduits attached to the appropriate subcooling unit fitting will also extend through a slot 90. A slot 90 is provided in three sides of the shroud permitting the piping to extend through the side of the unit housing most appropriate to the particular installation. By relating the bracket 86 diagonally with respect to the bottom plate 10' and shroud configuration, it is possible to employ parallel piping on a common horizontal plane through any one of the slots 90 without interference whereby the piping will be parallel and pro-

duce an orderly appearance and greatly simplify the installation.

With the larger size subcooling units it may be desired to discourage unauthorized adjustment of valve 69' by means of knob 20' and, thus, the knob 20' may be removed and only a hole provided in the shroud 14' for permitting entry of a screwdriver, or similar tool, into the housing for adjusting the valve 60.

By producing a preassembled subcooling unit of the disclosed nature, refrigerant subcooling is herein available in a more concise and readily installable form than heretofore, which may be readily installed in existing refrigeration systems.

By employing the illustrated control members, an accurate regulation for most efficient use of the cooling water is achieved and by enclosing the unit in an attractive housing, employment of the subcooling unit with existing refrigerating units becomes practical.

It is understood that various modifications to the described embodiments may be apparent to those skilled in the art without departing from the spirit and scope of the invention, and it is intended that the invention be defined only by the following claims.

I claim:

1. A preassembled refrigerant subcooling unit adapted to be universally installable into existing refrigeration circuits and systems comprising, in combination, a housing, a refrigerant conduit within said housing having inlet and outlet portions and defining a refrigerant flow path, a cooling medium conduit within said housing having inlet and outlet portions defining a flow path in heat exchanging relation to the refrigerant flow path, cooling medium flow control valve means within said cooling medium conduit, and standard connection fittings communicating with said conduits inlet and outlet portions exteriorly accessible of said housing.

2. A preassembled refrigerant subcooling unit adapted to be universally installable into existing refrigeration circuits and systems comprising, in combination, a housing, a refrigerant conduit within said housing having an inlet portion and an outlet portion, a cooling medium conduit within said housing having an inlet portion and an outlet portion and in heat exchanging relation to said refrigerant conduit, an adjustable valve having a variable operating range operatively interposed in said cooling

medium conduit controlling cooling fluid flow there-through, refrigerant characteristic sensing means operatively associated with and controlling operation of said valve associated with said refrigerant conduit sensing the refrigerant characteristics within the refrigerant conduit, and control means accessible from the exterior of said housing operatively associated with said valve adjusting the operating range of said valve.

3. A preassembled refrigerant subcooling unit adapted to be universally installable into existing refrigeration circuits and systems comprising, in combination, a housing, a refrigerant conduit within said housing having an inlet portion and an outlet portion, a cooling medium conduit within said housing having an inlet portion and an outlet portion and in heat exchanging relation to said refrigerant conduit, a variable range control valve within said housing operatively interposed in said cooling medium conduit controlling cooling fluid flow there-through, valve control means adapted to vary the operating range of said valve connected to said valve and exteriorly accessible of said housing, refrigerant characteristic sensing means within said housing in communication with said refrigerant conduit and operatively connected with and controlling operation of said valve, a pair of thermometers mounted on said housing each having a temperature sensing bulb, one of said bulbs being attached to the inlet portion of said refrigerant conduit and the other bulb being attached to the outlet portion of said refrigerant conduit, and connection fittings mounted upon said conduits inlet and outlet portions and related to said housing as to be exteriorly accessible thereof.

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