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CONDENSING PRESSURE CONTROLS FOR REFRIGERATION SYSTEM

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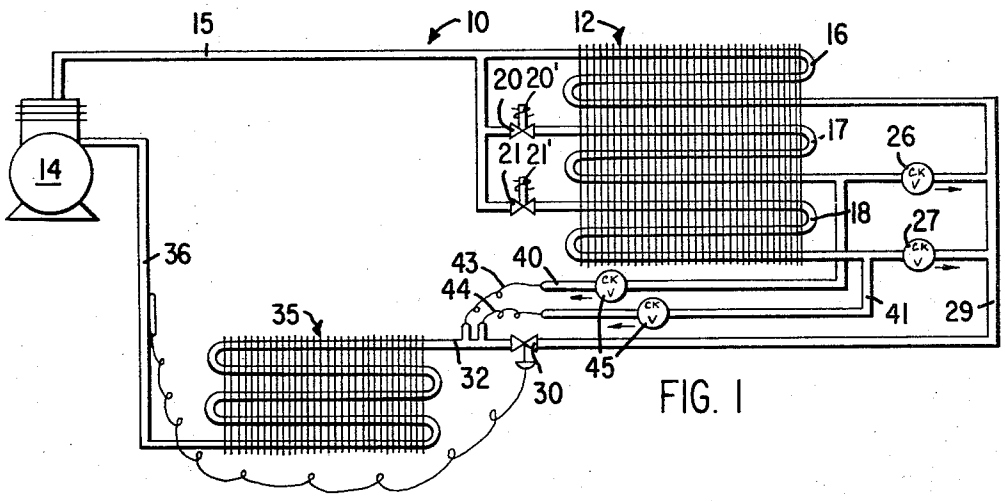


FIG. 1

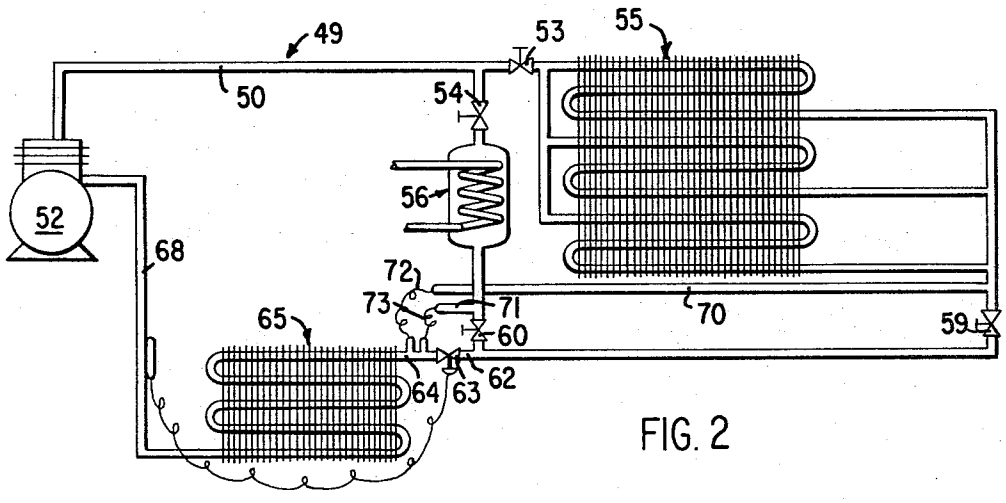


FIG. 2

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CONDENSING PRESSURE CONTROLS FOR REFRIGERATION SYSTEM

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This invention relates to a refrigeration system and, more particularly, to an arrangement for controlling condensing pressures in a refrigeration system.

To sustain capacity of a refrigeration system, it is essential that an adequate pressure differential be held across the system expansion device. Where the system is of the type having an air-cooled condenser, the pressure differential across the expension device is largely dependent upon outdoor temperature conditions. When outdoor temperatures are low, pressures within the condenser fall while the condensing rate increases, and the pressure differential across the expansion device drops.

To offset the increased condensing rate, such as occurs in air cooled condensers at low outdoor temperatures, portions of the condenser may be isolated from the system. However, refrigerant as well as oil may be trapped in the separated or isolated portions of the condenser which can reduce system efficiency and cause over-heating of the compressor.

It is a principal object of the present invention to provide a new and improved refrigeration system.

It is a further object of the present invention to provide an arragement for controlling head pressure in a refrigeration system by isolating portions of the system condenser without concurrent trapping of refrigerant and lubricant.

It is a further object of the present invention to provide an improved head pressure control for refrigeration systems incorporating means to return to the system refrigerant and lubricant in those parts of the condenser separated from the system.

It is an object of the present invention to provide a refrigeration system employing alternately usable condensers incorporating means to insure return of refrigerant and lubricant trapped in the off condenser to the system.

This invention relates to a refrigeration system comprising in combination, a compressor with suction and discharge sides; refrigerant expansion means; and evaporator series-connected between the expansion means and the suction side of the compressor; condenser means arranged between the discharge side of the compressor and the refrigerant expansion means, the condenser means including at least two coil sections circuited to provide parallel refrigerant flow paths; first valve means between at least one of the condenser coil sections and the discharge side of the compressor effective when actuated to interrupt flow of refrigerant from the compressor to the one coil section; a conduit for returning refrigerant and lubricant trapped in the one condenser coil section to the system, the conduit communicating with the system downstream of the refrigerant expansion means, and including a restricted portion to control the flow of returning refrigerant and lubricant from the one condenser coil section to the system; and second valve means for preventing flow of refrigerant from the other of the condenser coil sections into the one condenser coil section.

Other objects of the invention will be perceived from the ensuing description and drawings in which:

FIGURE 1 is a schematic view showing a refrigeration system with head pressure control incorporating the refrigerant and lubricant return arrangement of the present invention, and

FIGURE 2 is a schematic view of a modified refrigeration system having a plurality of alternating usable condeners incorporating the refrigerant and lubricant return means of the present invention.

Referring to FIGURE 1 of the drawings, refrigeration system 10 includes outdoor coil or condenser 12 series connected with the discharge side of a suitable refrigerant compression means 14 by line 15. In the exemplary arrangement of FIGURE 1, condenser 12 is comprised of coil sections 16, 17, 18 providing parallel paths to refrigerant flow. Coil sections 17, 18 are connected to refrigerant line 15 through control valves 20, 21, which may be conveniently operated by solenoids 20', 21' respectively. While condenser 12 is illustrated as comprising three separate and individual coil sections, 16, 17, 18, it is understood that the number of coil sections may be varied to suit individual applications.

Check valves 26, 27 series connect coil sections 17, 18 respectively with refrigerant line 29 and a suitable refrigerant expansion device such as thermal valve 30. Check valves 26, 27 permit flow of refrigerant from condenser coil sections 17, 18 to valve 30 while preventing opposite flow of refrigerant from coil section 16 and line 29 into coil sections 17, 18 as will be more apparent hereinafter.

While the refrigerant expansion device is illustrated as comprising a thermal expansion valve 30, other suitable expansion devices such as a capillary tube may be contemplated.

Refrigerant line 32 connects expansion valve 30 with indoor coil or evaporator 35. Refrigerant line 36 connects the outlet side of evaporator 35 to the suction side of compressor 14 to complete the refrigeration system 10.

Refrigerant bypass or drain lines 40, 41 connect the outlet side of condenser coil sections 17, 18 upstream of check valves 26, 27 with refrigerant line 32 downstream of expansion valve 30. Drain lines 40, 41 each include a restricted part such as capillary section 43, 44 respectively. Capillary sections 43, 44 permit the controlled egress of liquid refrigerant and lubricant from condenser sections 17, 18 to the system.

With control valves 20, 21, relatively hot, high pressure refrigerant from compressor 14 passes via line 15 into coil sections 16, 17, 18 of condenser 12 where the refrigerant is condensed. Liquid refrigerant from coil sections 16, 17, 18 flows through line 29 to expansion valve 30. Relatively low pressure liquid refrigerant from expansion valve 30 passes through line 32 to evaporator coil 35 wherein the liquid refrigerant is vaporized. Vaporized refrigerant from evaporator 35 returns through line 36 to the suction side of compressor 14. A relatively small amount of liquid refrigerant in condenser coil sections 17, 18 may flow through drain lines 40, 41 and capillary sections 43, 44 thereof into line 32 and the system bypassing expansion valve 30.

On an increase in system condensing rate, as for example, when outdoor ambient temperatures become low, solenoid 21' may be energized from a suitable power source (not shown) to close control valve 21 and interrupt the flow of refrigerant to condenser coil section 18. It is understood that condenser coil sections 16, 17 continue to function in the usual manner. With closure of valve 21, pressure in condenser coil section 18 soon approximates the pressure downstream of expansion valve 30, that is, system low side pressure. As pressure in coil section 18 decreases, coil section 18 in effect functions as an evaporator, and refrigerant and lubricant trapped therewithin by closure of valve 21 returns through line 41 and capillary section 44 to the system. Check valve 27 effectively prevents flow of refrigerant from condenser sections 16, 17 into condenser section 18. Refrigerant which leaks past valve 27 into condenser sec-

tion 18 returns through line 41 and capillary 44 into line 32.

It is understood that a further reduction in condenser capacity may be effected by energizing solenoid 20' to close control valve 20 and interrupt flow of refrigerant into condenser section 17. Check valve 26 prevents ingress of refrigerant from section 16 into condenser section 17 while line 40 permits refrigerant and lubricant trapped in condenser section 17 to return to the system.

Check valves 45 in drain lines 40, 41 obviate reverse flow of refrigerant from evaporator 35 to condenser section 17 and/or 18 when control valves 20 and/or 21 are closed.

Referring to FIGURE 2 of the drawings, there is shown a refrigeration system 49 arranged to permit selective use of either air-cooled condenser 55 or liquid-cooled condenser 56. Referring thereto, refrigerant line 50 connects the discharge side of a suitable refrigerant compression means 52 through control valves 53, 54 with condensers 55, 56 respectively. Valves 59, 60 connect condensers 55, 56 respectively with refrigerant line 62 and a suitable refrigerant expansion device such as thermal valve 63. Line 64 connects expansion valve 63 with the system evaporator coil 65. Refrigerant line 68 connects evaporator coil 65 with the suction side of compression means 52 to complete the refrigeration system 49.

Drain lines 70, 71 each with a capillary type restrictor 72, 73 respectively, communicate the outlet side of condensers 55, 56 upstream of control valves 59, 60 with refrigerant line 64. While condensers 55, 56 are illustrated as being air and liquid cooled types of condensers respectively, it is appreciated that condensers 55, 56 both may be either air or liquid cooled.

When air-cooled condenser 55 is functioning, valves 54, 60 are closed isolating the liquid-cooled condenser 56 from the refrigeration system 49. Liquid refrigerant trapped in condenser 56 flows through line 71 and capillary 73 thereof into line 64 and the refrigeration system.

Where it is desired to use liquid-cooled condenser 56, valves 54, 60 are opened to permit the flow of refrigerant through condenser 56. If condenser 56 is to be utilized alone, valves 53, 59 are closed to interrupt ingress and egress of refrigerant to and from air-cooled condenser 55. Liquid refrigerant trapped in condenser 55 drains

through line 70 and capillary 72 thereof into the refrigeration system.

While I have described a preferred embodiment of my invention, it will be understood that my invention is not limited thereto since it may be otherwise embodied within the scope of the following claims.

I claim:

1. In a refrigeration system including a compressor with suction and discharge sides, refrigerant expansion means, and an evaporator series-connected between said expansion means and the suction side of said compressor, the combination of: condenser means arranged between the discharge side of said compressor and said refrigerant expansion means, said condenser means including at least two coil sections circuited to provide parallel refrigerant flow paths; first valve means between at least one of said condenser coil sections and the discharge side of said compressor effective when actuated to interrupt flow of refrigerant from said compressor to said one coil section; a conduit for returning refrigerant and lubricant trapped in said one condenser coil section to said system, said conduit communicating with said system downstream of said refrigerant expansion means, and including a restricted portion to control the flow of returning refrigerant and lubricant from said one condenser coil section to said system; and second valve means for preventing flow of refrigerant from the other of said condenser coil sections into said one condenser coil section.

2. A refrigeration system according to claim 1 including third valve means for preventing reverse flow of refrigerant from said system through said conduit into said one condenser coil section.

3. A refrigeration system according to claim 1 in which said conduit restricted portion comprises a capillary.

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