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METHOD AND APPARATUS FOR REMOVING HEAT FROM A REFRIGERANT

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2 Sheets-Sheet 1

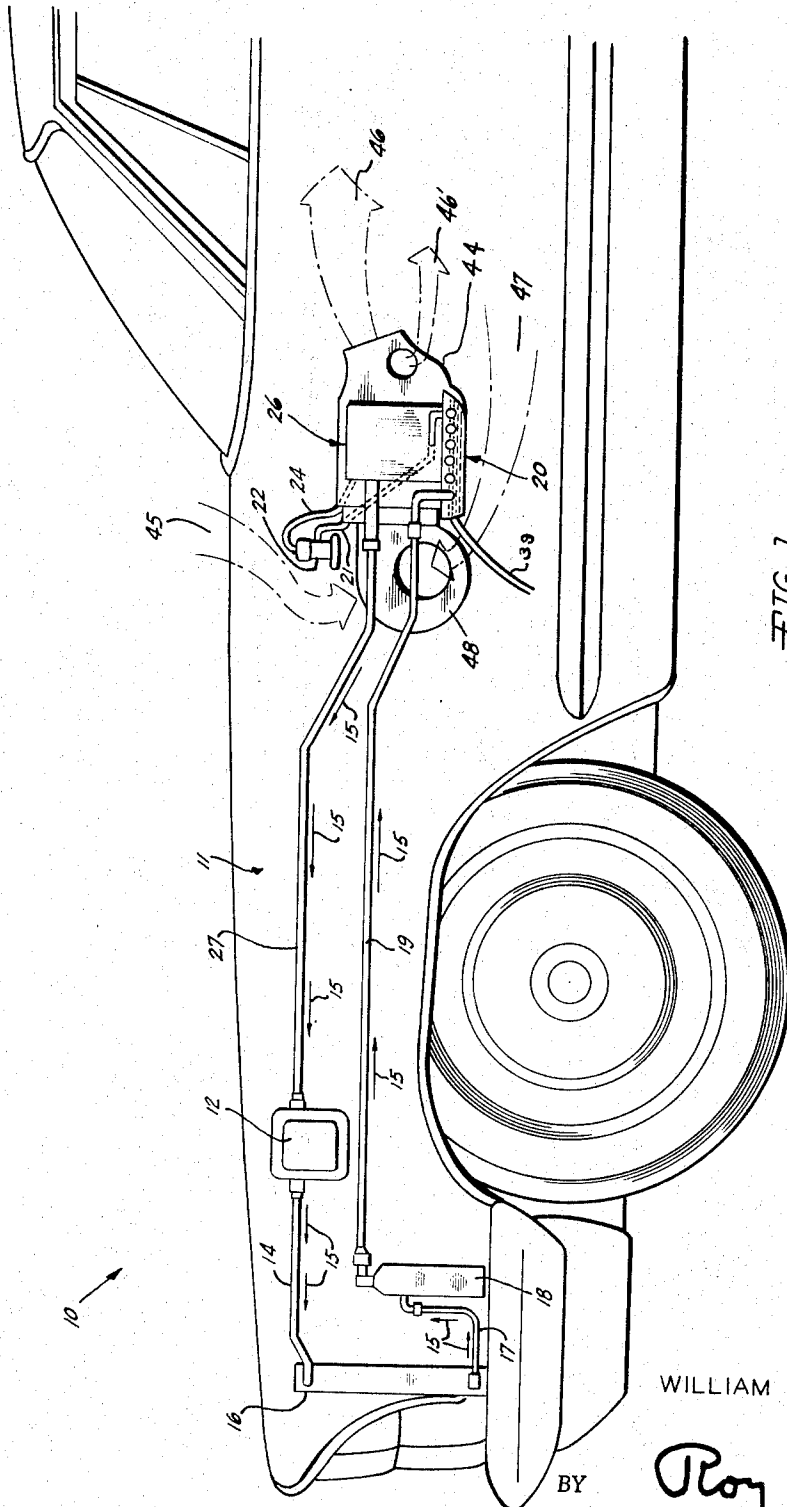


FIG. 1

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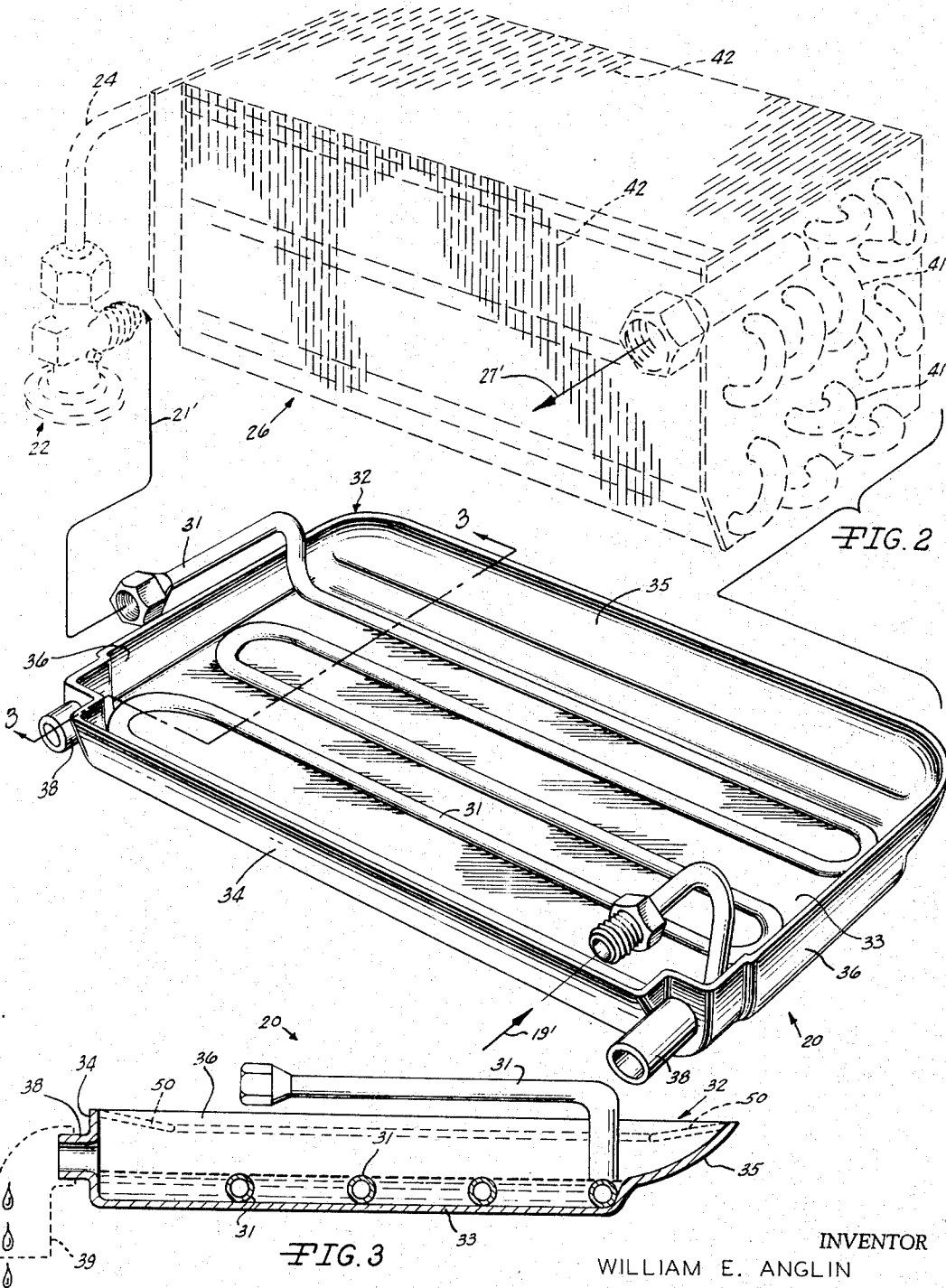
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METHOD AND APPARATUS FOR REMOVING HEAT FROM A REFRIGERANT

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4 Claims. (Cl. 62-244)

This invention relates broadly to a refrigeration or air conditioning system including the method of increasing its capacity, and more specifically to a refrigerated or air conditioning system having a heat exchanger device adjacent the evaporator unit and in contact with the refrigerant circulating line before it enters the evaporator.

The application and use of various devices to condition and/or cool air has been steadily increasing. Various applications and uses not previously part of the art until recently have developed sizeable sales markets. Because many of these new areas still have even larger sales volume potentials and new applications and uses are being discovered all the time, the refrigeration and air conditioning industry has been attempting to increase the efficiency of the various units while at the same time reducing the size as well as the initial and operational costs of the units. Some applications attempting to meet this develop a "flash gas" problem. Other units develop the problem of the evaporator fins frosting or icing up during their cooling operation. Still others develop problems when operating either in high humidity areas or in arid climates.

One of the major concerns in the refrigeration and air conditioning field is to reduce the heat present in the refrigerant as much as possible so that it can absorb more heat when it passes through its evaporator unit. This problem in many applications can be easily overcome because there is no critical limitation on the equipment used to do this as to size, weight, and even sometimes as to cost. In many other applications, however, due to the place of application, cost requirements, et cetera, expensive and elaborate pieces of equipment cannot be added to the system to help remove heat from the refrigerant.

Automobile air conditioning systems, for example, have been increasing rapidly in number over the last few years and these systems have many of the problems listed above. The automobile regardless of its location of sale is operated under various road and climatic conditions. It was a recognition of the above noted problems and the lack of a wholly satisfactory commercial solution to same which led to the conception and development of the present invention.

Accordingly, among the objects of the present invention is the provision of a new and novel heat exchanger unit for use adjacent the evaporator unit of a refrigeration or air conditioning system.

A further object is to provide a new and novel heat exchanger which pre-cools the refrigerant of a refrigeration or air conditioning system before it enters the evaporator unit.

Another object of the present invention is to provide a new and novel heat exchanger system in a refrigeration or air conditioning system which will reduce or substantially eliminate the opportunity of having a "flash gas" effect.

A still further object of the present invention is to provide a new and novel heat exchanger which helps control or eliminate the frosting or ice caking occurring on the evaporator fins.

A still further object is to provide a new and novel heat exchanger having a refrigerant line running serpentine through the drip pan positioned adjacent and

below an evaporator which will have a beneficial effect upon the entire refrigeration or air conditioning system in high humidity areas as well as arid areas.

A still further object is to provide a new method of pre-cooling a refrigerant in a refrigeration circulating cycle before the refrigerant enters the evaporator unit.

A still further object is to provide a new and novel heat exchanger which can be easily adapted to refrigeration or air conditioning systems presently in use.

Also, an object of the present invention includes the provision of a heat exchanger capable of accomplishing the above objectives with a minimum of material cost and fabricating expense, and at the same time being composed of simple and ruggedly formed structural members which are very reliable in application.

Still further objects and advantages of the invention will appear as the description proceeds.

To the accomplishment of the foregoing and related ends, the invention, then, consists of a new and novel heat exchanger unit adapted to be partially covered by water as hereinafter described and particularly pointed out in the claims, the annexed drawings and the following description setting forth in detail certain means for carrying out the invention, such disclosed means illustrating, however, but one of the various ways in which the principle of the invention may be used.

In the annexed drawings:

FIGURE 1 is an illustrative side elevational view of the front portion of an automobile chassis and body assembly illustrating a simple application of the present invention.

FIGURE 2 is an expanded front perspective view showing the heat exchanger unit and the condenser unit of FIGURE 1.

FIGURE 3 is a cross sectional side view of the heat exchanger unit as taken along line 3-3 of FIGURE 2 and viewed in the direction of the arrows.

The construction disclosed is a preferred form of the invention and will be specifically described, but attention is invited to the possibility of making variations within the obvious spirit and scope of the invention as illustrated and described.

In FIGURE 1 we have an automobile chassis and body assembly generally referred to as 10 which illustrates the relative position of an automobile air conditioning system generally referred to as 11. The basic elements of this air conditioning unit are disclosed and will be briefly described below.

A circular compressor 12 compresses a refrigerant, an example of which would be a refrigerant such as freon, discharging it into a high pressure vapor line 14 in the direction of the arrows 15. The high pressure vapor line carries the refrigerant into a condenser member 16 where the refrigerant is condensed into a high pressure liquid and discharged into a high pressure liquid line 17 in the direction of the arrows 15. The high pressure liquid line 17 carries the refrigerant to a receiver 18 where the refrigerant is stored, and various functions could be performed on it such as removing water, et cetera, and then passes it into high pressure line 19 in the direction of the arrows 15. The high pressure line 19 delivers the refrigerant into the heat exchanger 20, the full function of which will be explained in detail below. After passing through the heat exchanger 20, the refrigerant passes through conditioned refrigerant line 21 to a pressure release unit 22. The pressure release unit 22 could be of various forms such as an expansion valve, a capillary unit, or other flow control device. After passing through the pressure release unit 22, the refrigerant is released as a low pressure liquid and passes through the low pressure refrigerant line 24 into an evaporator unit 26. The refrigerant becomes a low pressure vapor in the evapora-

tor unit 26 and takes heat from the air which is passing through and adjacent to it. The refrigerant in the low pressure vapor state then passes from evaporator unit 26 through a low pressure vapor line 27, in the direction of the arrows 15, back to the intake side of the circulator compressor 12 where the cycle as just explained will be repeated.

Referring generally to FIGURES 2 and 3, we will discuss the operational functions which occur in the heat exchanger 20 and the evaporator unit 26. The refrigerant enters the heat exchanger 20 through high pressure line 19 represented by an arrow 19' in FIGURE 2. The refrigerant enters a heat exchanger line 31 which passes serpentine through a heat exchanger pan 32 of the heat exchanger 20. The heat exchanger pan 32 has a bottom portion 33, a front portion 34, a rear portion 35, and side portions 36. Front portion 34 has two drain openings 38, one positioned adjacent each side portion 36. Drain openings 38 hold the water in heat exchanger pan 32 at a predetermined level and permit any excess water to be discharged through a drain line 39, shown in phantom, to the ground outside the automobile chassis and body assembly. The refrigerant passes through the heat exchanger line 31 and is discharged through conditioned refrigerant line 21, which is represented by arrow 21', to the pressure release unit 22. The refrigerant then passes through the low pressure refrigerant line 24 to the evaporator unit 26. The refrigerant passes through the evaporator unit 26 by way of refrigerated tubes 41, which is a practice well known in the art, and back to the circulator compressor 12 by line 27 represented by an arrow 27'. The refrigerated tubes 41 have fin members 42 mounted to them which help pass the heat from the entering air to the refrigerant which is moving through the refrigerated tubes 41.

Referring to FIGURE 1, the outside air will pass into an evaporator housing 44 through an outside air inlet 45. The air passes through and around the evaporator unit giving up heat to the refrigerant through the fin members 42 and the refrigerated tubes 41. The conditioned air will be discharged to the inside of the automobile chassis and body assembly 10 through conditioned air outlets 46 and 46'. If the outside air is not to be used, there is an inside air return 47. A blower unit 48 will draw the air to be conditioned either in through outside air inlet 45 or inside air return 47. The specific construction of this ductwork and the damper controls in an automobile air conditioning unit are well known in the art and will not be covered in detail.

The air passing through the evaporator housing 44 and across the evaporator unit 26 will have moisture which will be removed when the heat is removed. This removed moisture will drip into the heat exchanger pan 32 and cover the heat exchanger line 31. The drain openings 38 maintain the level of the water in the heat exchanger pan 32 at a proper level to just cover the heat exchanger line 31 in a preferred embodiment. As the evaporation of the water in the heat exchanger pan 32 takes place, it will remove heat from the refrigerant passing through the heat exchanger line 31, permitting it to take more heat from the air which passes through the evaporator housing 44. When excessive moisture is collected in the heat exchanger pan 32 it will pass out through the drain openings 38 as water and will carry with it heat removed from the refrigerant in line 31. These actions will increase the refrigerating effect of each unit of refrigerant in the system. It also permits the refrigerant to pass into the evaporator unit 26 in a more consistent condition thus giving a more stable control at any given setting of the automobile air conditioning system's controls. As the water evaporates it helps prevent or eliminate any frosting or icing of the water vapor on the fin members 42 which is being removed from the passing air in the evaporator housing 44. In both humid and arid climatic conditions

it helps provide a stability effect of the water vapor present in the air as it passes into conditioned air outlets 46 and 46'.

Referring generally to FIGURE 3, in phantom is shown a retaining plate 50 which extends at an inclined angle, in a preferred embodiment, along the top periphery of the heat exchanger pan 32 toward the bottom portion 33 of the heat exchanger pan 32. In some applications the retaining plate 50 may be desirable to prevent the water held in the heat exchanger pan 32 from running over its edge if the unit is in a vehicle which would be passing over rough or irregular terrain. The retaining plate 50 could be of various configurations; however, in the present illustration, all moisture which contacts its upper surface will drain into the heat exchanger pan 32 when the vehicle is passing on level terrain.

The present invention pre-cools the refrigerant before expansion of the refrigerant or before it enters the evaporator. It has been illustrated in connection with an automobile air conditioning unit. Other applications would be appropriate for use with this unit; however, the most beneficial use is experienced in applications at 35 degrees Fahrenheit and above. In arid regions household refrigerators would use the water collected in the heat exchanger pan to raise the humidity on the inside of the refrigerator. This will help reduce the rate of dehydration of fresh fruits and vegetables and other food products. In very arid climates water could be added to the heat exchanger pan in other ways such as manually, by an automatic timer, et cetera.

The present invention discloses a method where the refrigerant of a refrigeration or air conditioning system has heat removed from it by collecting the condensed moisture from the cooled air and passing it over the refrigerant lines before the refrigerant reaches the pressure release unit.

From the foregoing, it will be seen that a novel construction and method have been disclosed for simple and economical obtaining of the desired ends. However, attention is again invited to the possibility of making various changes within the spirit and scope of the invention as shown and described.

Other modes of applying the principle of my invention may be employed instead of the one explained, change being made as regards the means and the method herein disclosed, provided those stated by any of the following claims or their equivalents be employed.

I therefore particularly point out and distinctly claim as my invention:

1. An air conditioning system comprising in combination:
 - (a) a first means to raise the pressure of a gaseous refrigerant to a substantially increased pressure, with an increase in the heat energy thereof;
 - (b) a means for delivering said compressed refrigerant to a first heat exchanger, wherein said refrigerant is substantially cooled and condensed;
 - (c) means for delivering said cooled and condensed refrigerant to a receiver;
 - (d) a compartment having air therein to be cooled by said refrigerant, said compartment having positioned therein an evaporator means, a receptacle for water which is positioned adjacent to and immediately below said evaporator means, said receptacle being formed to retain a significant amount of water, and a second heat exchange means which is positioned in said water;
 - (e) means for delivering refrigerant from said receiver to said second heat exchange means in said receptacle;
 - (f) means for conducting refrigerant from said second heat exchange means to an expansion means;
 - (g) means for delivering said refrigerant from said expansion means to said evaporating means; and
 - (h) means for returning refrigerant from said evapo-

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rator means to said first means for raising the pressure of said refrigerant;

said second heat exchange means in combination as defined increasing the volumetric efficiency of said system by utilizing the maximum amount of heat absorbency potential of the water in said receptacle, and at the same time returning moisture to the cooled air in said compartment.

2. A system as set forth in claim 1, wherein: said second heat exchange means in said receptacle is a serpentine tube positioned adjacent the bottom of said receptacle.

3. A system as set forth in claim 1, wherein: said receptacle has an inwardly projecting water-retaining flange around its upper marginal edge.

4. A system as set forth in claim 1, wherein:
(a) said system is installed in a vehicle having an engine compartment and an internal combustion engine therein;

(b) said first means and said first heat exchange means are positioned in said engine compartment; and

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(c) said means for delivering refrigerant from said receiver to said second heat exchange means passes through said engine compartment adjacent said internal combustion engine.

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