A semi-frozen product dispenser (10 or 200) is provided for at least partially freezing and dispensing a product. The product dispenser may include at least one freezing barrel (20-1) defining a freezing chamber (C1) configured to receive the product. A refrigeration system (60 or 260) is provided for at least partially freezing product in the freezing chamber (C1). A fluid heating system (80 or 280) is also provided to remove heat from the refrigeration system (60 or 260) and use it in an auxiliary system, such as a water pre-heating system. The fluid heating system (80 or 280) may include a fluid heat exchanger (102) disposed in a high pressure refrigerant line (67 or 267), a fluid tank (82 or 282), and a fluid pump (96). Fluid may be continuously circulated through the fluid heat exchanger (102 or 302) when the refrigeration system is operated, thereby to continuously provide refrigerant cooling and fluid warming.
SEMI-FROZEN PRODUCT DISPENSER

CROSS-REFERENCE TO RELATED APPLICATION


BACKGROUND

[0002] 1. Technical Field

[0003] The present disclosure generally relates to refrigeration systems and, more particularly, to apparatus for freezing and dispensing semi-frozen products.

[0004] 2. Description of the Related Art

[0005] Semi-frozen product dispensers employ refrigeration systems to freeze the product dispersed thereby. By way of background, a refrigeration system uses a refrigeration cycle which is employed in refrigerators, heat pumps and air conditioners. The refrigeration system becomes a heat pump when it is used to produce a heat flow into or out of a building. When it causes a heat flow out of the building it is then also called an air conditioner. As shown in the background diagram of FIG. 1, a refrigeration system includes a condenser 2, a throttling or expansion valve 4, an evaporator 6 and a compressor 5. The refrigerant flows in either a gaseous or liquid state (sometimes a mixture of the two) by way of lines or piping, the direction of the flow being as indicated by the arrows 8. In the refrigeration cycle, schematically illustrated in FIG. 2 the saturated liquid refrigerant passes through a throttling or expansion valve 4 and the liquid expands into a gas with some entrained liquid as shown at “b”. The gas, with a mixture of liquid, passes through the evaporator 6 which, in the case of a refrigerator, allows heat to be removed from food stuffs and the like and transferred to the gas, liquid mixture. The amount of heat or energy removed from the food stuff is represented by the line bd. As the gas, liquid mixture picks up heat it expands and the volume increases. The gas is then compressed by the compressor 5 as illustrated in line de in FIGS. 1 and 2, and then passed through a condenser 2 which gives off heat as the volume of the gas decreases and the pressure remains substantially constant. The energy of compression is represented by the line de projected onto the enthalpy axis. In the refrigeration cycle, as the gas is compressed from d to e, the gas increases in pressure with a decrease in volume. Refrigeration systems and heat pumps may be rated based on the coefficient of performance (COP). The COP is defined as the ratio of desired output divided by the required input. The COP is a measure of how well a refrigeration system or heat pump is operating. If the desired output is cooling, then:

\[
\text{COP}_{\text{cooling}} = \frac{\text{enthalpy change at evaporator}}{\text{enthalpy change at the compressor}}
\]

[0006] For the following equations, h represents enthalpy and the letter following h represents the refrigerant state on FIG. 2.

\[
\text{COP}_{\text{cooling}} = \frac{\text{h}-\text{hd}}{\text{b}-\text{hd}}
\]

[0007] If the desired output is heating, then:

\[
\text{COP}_{\text{heating}} = \frac{\text{enthalpy change at condenser}}{\text{enthalpy change at compressor}}
\]

\[
\text{COP}_{\text{heating}} = \frac{\text{b}-\text{ha}}{\text{h}-\text{hd}}
\]

[0008] If the desired output is both cooling and heating, then:

\[
\text{COP}_{\text{cooling and heating}} = \frac{\text{(hd-hb+he-ha)}(\text{b}-\text{hd})}{\text{(b}-\text{ha})(\text{h}-\text{hd})}
\]

[0009] It can be seen that the highest COP may be obtained from the COP of cooling and heating equation.

[0010] Semi-frozen product dispensers may dispense various types of food stuffs, such as soft-service ice cream, yogurt, custard and other semi-frozen food products, as well as semi-frozen drinks, sometimes referred to as slushes. The dispensers typically include a freezing cylinder through which the product is dispensed. The freezing cylinder, also referred to as a barrel, defines a longitudinally elongated freezing chamber. Typically, unfrozen liquid product mix is added to the freezing chamber at the aft end of the freezing cylinder and selectively dispensed at the forward end of the freezing cylinder through a manually operated dispensing valve. A rotating beater, typically formed by two or more helical blades driven by a drive motor at a desired rotational speed, scrapes semi-frozen mixture from the inner wall of the freezing cylinder and moves the product forwardly through the freezing chamber defined within the freezing cylinder as the product transitions from a liquid state to a semi-frozen state. The product within the freezing chamber changes from a liquid state to a semi-frozen state as heat is transferred from the product to a refrigerant flowing through an evaporator disposed about the freezing cylinder. The evaporator is operatively associated with and part of a conventional refrigeration system that also includes a compression device and a refrigerant condenser arranged in a conventional refrigerant cycle in a closed refrigeration circuit.Dispensing apparatus of this type may have a single freezing cylinder for dispensing a single flavor of product or a plurality of freezing cylinders, each housing a selected flavor of product, for dispensing each of the selected flavors and even a mix of flavors. U.S. Pat. No. 5,205,129, for example, discloses a semi-frozen food dispensing apparatus having a pair of freezing chambers.

[0011] As noted previously, heat is removed from the product within the freezing cylinder and carried away by a refrigerant circulating through an evaporator disposed about the freezing cylinder. In dispensing apparatus having more than one freezing cylinder, an evaporator is typically configured either as a tube wound around and in contact with the outside wall of the freezing cylinder or as an annular chamber formed between the outside wall of the freezing cylinder and the inside wall of an outer cylinder disposed coaxially about the freezing cylinder.

[0012] Refrigerant exits the condenser primarily as vapor. The vapor is drawn through a compressor, which elevates both the temperature and pressure of the refrigerant vapor. An air heat exchanger, in combination with an air mover, is typically provided to cool the refrigerant vapor. This conventional arrangement, however, discharges heated air into the surrounding environment, thereby increases the load on any interior space HVAC system. Depending on the temperature of the vapor refrigerant, operation of the air heat exchanger may be excessive, thereby reducing the energy efficiency of the dispenser. Still further, the heated air is typically treated as a waste by-product that is simply discharged into the interior space.

SUMMARY OF THE DISCLOSURE

[0013] In accordance with one aspect of the disclosure, a semi-frozen product dispenser is provided for at least par-
entially freezing and dispensing a product. The dispenser may include at least one freezing barrel defining a freezing chamber configured to receive the product, an evaporator operably coupled to the freezing barrel and including a refrigerant inlet and a refrigerant outlet, and a compressor having a suction inlet in fluid communication with the evaporator outlet through a low pressure refrigerant line and a discharge outlet. A high pressure refrigerant line may extend between the compressor discharge outlet and the evaporator refrigerant inlet, and an air heat exchanger may be operatively coupled to a portion of the high pressure refrigerant line. A fluid tank may be sized to hold a predetermined volume of fluid, and a fluid heat exchanger fluidly communicates with the high pressure refrigerant line to receive heated refrigerant and is configured to transfer heat from the heated refrigerant to the volume of fluid in the fluid tank.

[0014] In accordance with another aspect of the disclosure, a semi-frozen product dispenser is disposed in an interior space for at least partially freezing and dispensing a product. The dispenser may include at least one freezing barrel defining a freezing chamber configured to receive the product. A refrigeration system may be provided that includes an evaporator operably coupled to the freezing barrel, a refrigerant inlet, and a refrigerant outlet. The refrigeration system may further include a compressor having a suction inlet in fluid communication with the evaporator outlet through a low pressure refrigerant line and a discharge outlet, a high pressure refrigerant line extending between the compressor discharge outlet and the evaporator refrigerant inlet, and an air heat exchanger operatively coupled to a portion of the high pressure refrigerant line. The dispenser may further include a water heating system having a fluid tank sized to hold a predetermined volume of fluid, and a fluid heat exchanger fluidly communicating with the high pressure refrigerant line to receive heated refrigerant and configured to transfer heat from the heated refrigerant to the volume of fluid in the fluid tank.

[0015] In accordance with yet another aspect of the disclosure, a semi-frozen product dispenser is disposed in an interior space for at least partially freezing and dispensing a product. The dispenser may include an enclosure defining a housing space, and at least one freezing barrel disposed within the housing space and defining a freezing chamber configured to receive the product. An evaporator is disposed within the housing space, operably coupled to the freezing barrel, and includes a refrigerant inlet and a refrigerant outlet. A compressor is disposed within the housing space and has a suction inlet in fluid communication with the evaporator outlet through a low pressure refrigerant line and a discharge outlet. A high pressure refrigerant line is disposed within the housing space and extends between the compressor discharge outlet and the evaporator refrigerant inlet, and an air heat exchanger is disposed within the housing space and operatively coupled to a portion of the high pressure refrigerant line, the air heat exchanger discharging heated air into the interior space. A fluid heat exchanger is disposed in the high pressure refrigerant line and defines a refrigerant path and a fluid path, the fluid heat exchanger being configured to transfer heat from refrigerant in the refrigerant path to fluid in the fluid path. The dispenser may further include a fluid tank sized to hold a predetermined volume of fluid, the tank including a tank inlet fluidly communicating with the fluid heat exchanger fluid path and a tank outlet, and a fluid pump having a pump inlet in fluid communication with the tank outlet and a pump outlet in fluid communication with the fluid heat exchanger fluid path.

[0016] These are other aspects and features of the disclosure will become more apparent upon reading the following detailed description when taken in conjunction with the accompanied drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] FIG. 1 is a schematic drawing of a typical, idealized, closed cycle refrigeration system;
[0018] FIG. 2 is a pressure enthalpy diagram which indicates, for background purposes, the pressure enthalpy relationship of a refrigerant in the refrigeration system shown in FIG. 1;
[0019] FIG. 3 is a schematic diagram illustrating an exemplary embodiment of a semi-frozen product dispenser;
[0020] FIG. 4 is a schematic diagram of the semi-frozen product dispenser having an auxiliary fluid cycle constructed according to the present disclosure; and
[0021] FIG. 5 is a schematic diagram of an alternative embodiment of a semi-frozen product dispenser having an auxiliary fluid cycle constructed according to the present disclosure.

[0022] While the present disclosure is susceptible of various modifications and alternative constructions, certain illustrative embodiments thereof will be shown and described below in detail. It should be understood, however, that there is no intention to be limited to the specific embodiments disclosed, but on the contrary, the intention is to cover all modifications, alternative constructions, and equivalents falling within the spirit and scope of the present disclosure.

DETAILED DESCRIPTION OF THE DRAWINGS

[0023] Referring now to the drawings, and with particular reference to FIGS. 3 and 4, a semi-frozen product dispenser constructed in accordance with the teachings of the disclosure is generally referred to by reference numeral 10. The dispenser 10 is capable of freezing and dispensing semi-frozen food products, such as by way of example, but not limited to, soft serve ice cream, ice milk, yogurt, custard, shakes, and carbonated and/or non-carbonated ice slush drinks. While the following detailed description and drawings are made in reference to a semi-frozen product dispenser, it is to be understood that the teachings of the disclosure can be used in other types of refrigeration systems, including, but not limited to, cooled beverage dispensers, refrigerators, and the like.

[0024] In the illustrated embodiment, the dispenser 10 is disposed inside an interior space 12 and includes two freezing chambers C1 and C2 for dispensing food products of different flavors or types. The freezing chambers C1 and C2 are defined within the axially elongated cylindrical barrels 20-1 and 20-2, respectively. Although shown as a dual barrel dispenser, it is to be understood that the apparatus 10 may have only a single barrel for dispensing a single product or may have three or more barrels for dispensing a plurality of flavors or types of products. Each of the barrels 20-1, 20-2 includes an inner cylinder 30, an outer cylinder 40 circumscribing the inner cylinder 30, and an evaporator 50 formed between the inner cylinder and the outer cylinder 40. Refrigerant is supplied from a refrigeration system 60 to the evaporators 50 of the respective barrels 20-1, 20-2 for refrigerating product residing inside the respective freezing chambers C1 and C2.
A beater 22 is coaxially disposed and mounted for rotation within each of the chambers C1 and C2. Each beater 22 is driven by a drive motor 23 to rotate about the axis of its respective barrel 20-1, 20-2. In the embodiment of FIG. 3, a single drive motor (when energized) drives each of the beaters 22 in rotation about the axis of its respective barrel 20-1, 20-2. It should be understood, however, that each beater 22 may be driven by a dedicated motor. Respective product supplies 24 are operatively associated with the barrels 20-1, 20-2 for supply product to be frozen to the respective chamber C1 and C2 with which the product supply is associated. The apparatus 10 is also equipped with a dispensing valve system 11 that is selectively operable to dispense the semi-frozen product from the barrels 20-1, 20-2.

The refrigeration system 60 includes a single refrigerant vapor compressor 62 driven by a compressor motor 65 operatively associated with the compressor 62, and a condenser 64 connected with the evaporators 50 in a refrigerant circuit. The compressor 62 is connected in refrigerant flow communication by high pressure outlet line 61 connected to the refrigerant inlet of the condenser 64, and the refrigeration outlet of the condenser 64 is connected through a high pressure refrigerant supply line 63 to refrigerant flow control valves 66. Each refrigerant flow control valve 66 is operatively associated with a respective one of the evaporators 50 by a refrigerant line 67. A respective refrigerant outlet of each evaporator 50 is connected through a low pressure refrigerant return line 69 and an accumulator 68 to the suction side of the compressor 62 through line 27. The refrigerant flow control valves 66 may comprise, for example, on/off solenoid valves of the type which can be rapidly cycled between open and closed positions. The valves 66 may be pulse width modulated solenoid valves, electronic motor operated valves, automatic expansion valves, or similar restriction devices.

Different products have different thermal heat transfer rates and different freezing points. Therefore, operation of the refrigeration system 60 will vary depending upon the products being supplied to the freezing chambers C1 and C2. A control system 70 may control operation of the refrigeration system 60 by controlling operation of the compressor drive motor 65, the beater motor 23, and the flow control valves 66. The control system 70 includes a programmable controller 72 having a central processing unit with associated memory and temperature sensors for sensing the temperature of the product within the chambers C1 and C2. For a more thorough discussion of the design and operation of an exemplary control system 70, reference is made to U.S. Pat. No. 5,205,129, the disclosure of which is hereby incorporated by reference.

In the depicted embodiment, each barrel 20 is equipped with a selectively operable dispensing valve 11 disposed at the forward end of the barrel 20 for receiving product form the freezing chamber. The dispensing valve system, however, may include a third dispensing valve selectively operable to dispense a mix of the two flavors or types of products present in the mixing chambers C1 and C2. The dispensing valve system may also comprise a single selectively operable valve that is selectively positionable in a first position to dispense product from chamber C1 only, a second position to dispense product from chamber C2 only, and a third position to dispense a mix of the products from both chambers C1 and C2.

Briefly, in operation, product to be frozen is supplied to each of the chambers C1 and C2 from the respective product supply 24 associated therewith from a supply tube 27 opening into the chamber at the aft end of each barrel 20-1, 20-2. The product supplies 24 are arranged to feed as required a liquid consumable product mix and generally, but not always, an edible gas, such as for example air, nitrogen, carbon dioxide, or mixtures thereof, in proportions to provide a semi-frozen food product having the desired consistency. The liquid consumable product mix may be refrigerated by suitable apparatus (not shown) to pre-cool the product mix to a pre-selected temperature above the freezing temperature of the product mix prior to delivery to the chambers C1 and C2. Each beater 22 rotates within its respective chamber C1, C2 to churn the product mix resident within the chamber and also move the product mix to the forward end of the chamber for delivery to the dispensing valve 11. The blades of the beaters 22 may also be designed to pass along the inner surface of the inner cylinder 30 as the beater rotates, thereby to scrape product from the inner surface of the inner cylinder 30. As the product mix churns within the chambers C1 and C2, it is chilled to the freezing point temperature to produce a semi-frozen product ready on-demand for dispensing. If gas is added to the product mix, the gas is thoroughly and uniformly dispersed throughout the product mix as the beaters rotate.

A simplified schematic of the refrigeration system 60 coupled to one freezing chamber C1 is shown in FIG. 4. The evaporator 50 is shown disposed around the freezing chamber C1. The low pressure line 69 connects the suction inlet of the compressor 62 to the outlet of the evaporator 50. The high pressure line 67 connects the compressor outlet to the inlet of the evaporator 50. The condenser 64, which is shown as an air heat exchanger, is disposed in the high pressure line 67. An optional suction heat exchanger 74 is shown having a first line 76 in fluid communication with the high pressure line 67 and a second line 78 in fluid communication with the low pressure line 69. The first and second lines 76, 78 may be configured so that heat is transferred from the first line 76 to the second line 78, thereby to cool the refrigerant traveling through the high pressure line 67.

A fluid heating system 80 for heating a fluid, such as water, is also illustrated in FIG. 4. The fluid heating system 80 may be provided for pre-heating water for use in an auxiliary system used at the facility. For example, pre-heated water may be provided to a water heater which may then be used as needed on site. Alternatively, the pre-heated water may be used directly in other auxiliary systems, such as coffee makers, washing machines, or other equipment.

As best shown in FIG. 4, the fluid heating system 80 may include a fluid tank 82 for holding a reservoir of fluid. The water tank may include a cold water inlet 84 fluidly communicating with a water source 86 provided to the facility, a cold water outlet 88, a warm water inlet 90, and an warm water outlet 92 fluidly communicating with the auxiliary system, such as a water heater 94. The tank 82 may be formed of any material suitable for handling fluid, such as water, at a temperature of approximately 32-140 degrees F. (0-60 degrees C.). While the tank 82 may be sized to handle substantially any volume, it is expected that a tank volume of approximately 15-40 gallons (57-151 liters) should be sufficiently for most applications.

The fluid heating system 80 may also include a pump 96 for circulating fluid through the system. In the illustrated embodiment, the pump 96 has an inlet 98 fluidly communicating with the tank cold water outlet 88 and an outlet 100. While any known pump suitable for circulating
fluid may be used, the pump 96 may be configured and/or rated for use in a potable water system.

[0034] The fluid heating system 80 may further include a fluid heat exchanger 102 for transferring heat from the refrigeration system 60 to fluid in the heating system 80. In the illustrated embodiment, the fluid heat exchanger 102 includes a fluid path 101 having a fluid inlet 104 in fluid communication with the pump outlet 100 and a fluid outlet 106 in fluid communication with the tank warm water inlet 90. The fluid heat exchanger 102 may further include a refrigerant path 107 having a refrigerant inlet 110 and a refrigerant outlet 108, both of which may fluidly communicate with the high pressure line 67 of the refrigeration system 60. The fluid heat exchanger 102 may be configured to transfer heat from refrigerant in the refrigerant path 107 to fluid in the fluid path 101, thereby to preheat the water while simultaneously cooling the refrigerant. In certain applications, the fluid heat exchanger 102 may be configured and/or sized to heat water flowing therethrough by at least approximately 10 degrees. The preheated water then flows from the fluid heat exchanger 102 to the tank 82.

[0035] While the pump 96 is shown in FIG. 4 as located upstream of the fluid heat exchanger 102, it may be located in other positions. For example, the pump 102 may be positioned downstream of the fluid heat exchanger 102, as illustrated by pump 96a shown in phantom lines in FIG. 4.

[0036] An optional temperature sensor 112 may be provided with the tank 82 to provide temperature feedback regarding the fluid in the tank 82. In certain embodiments, the temperature sensor 112 and pump 96 may be operatively coupled to the controller 72 (FIG. 3). The controller 72 may be programmed to operate the pump 96 based on the temperature feedback from the sensor 112 and its relation to a predetermined set point. Alternatively, the controller 72 may be programmed to operate the pump 96 whenever the compressor 62 is operated, thereby to cool the refrigerant whenever the refrigeration system 60 is operated.

[0037] The location of the fluid heat exchanger 102 may enhance operation of both the refrigeration system 60 and the heating system 80, and may be selected based on a user's desired objectives. With the fluid heat exchanger 102 positioned upstream of the air heat exchanger 64, as illustrated in FIG. 4, the water may be heated to a higher temperature while cooling of the refrigerant may be limited by the capacity of the downstream air heat exchanger 64. The pre-cooling of refrigerant may lead to energy savings in the refrigeration system 60 because the air heat exchanger 64 may operate less frequently or at lower speeds. Reduced operation of the air heat exchanger 64 will also reduce the amount of heat discharged into the interior space, thereby reducing the heating load on any HVAC system provided for that interior space. Alternatively, if the fluid heat exchanger is positioned downstream of the air heat exchanger 64 (as shown by heat exchanger 102a drawn in phantom lines in FIG. 3), the refrigerant may be cooled to a lower temperature while less heat may be available for transfer to the water in the fluid heating system 80.

[0038] The fluid heating system 80 may be integrally housed with the refrigeration system 60, such as for new equipment, or it may be provided in modular form for retrofit applications. As schematically shown in FIG. 4, the compressor 62, evaporator 50, air heat exchanger 64, freezing barrel C1, and other refrigeration system components are disposed in an enclosure 120. The fluid heat exchanger 102, fluid tank 82, fluid pump 96, and other heating system components are shown as disposed an enclosure 122. In certain embodiments, the enclosures 120, 122 are integrally provided. In other embodiments, such as retrofit applications, the enclosure 120 may be pre-existing at the facility, in which case the enclosure 122 enclosing the heating system components is provided as an auxiliary enclosure, and the appropriate fittings for connecting the heating system 80 to the refrigeration system 60 may be provided.

[0039] An alternative semi-frozen product dispenser 200 is illustrated in FIG. 5. The dispenser 200 is nearly identical to the dispenser 10 described above, except for a fluid heat exchanger 302 being disposed in a fluid tank 282, as described more fully below. Accordingly, similar reference numerals have been used to identify the various components of the dispenser 200, including a compressor 262, an evaporator 250, an air heat exchanger 264, an optional suction heat exchanger 274, and a freezing barrel C1.

[0040] As briefly noted above, the fluid heat exchanger 302 is disposed within the fluid tank 282, thereby to directly transfer heat from the heated refrigerant to the fluid in the tank 282. The fluid heat exchanger 302 may include a refrigerant line forming a heat exchange section 330 in fluid communication with the high pressure refrigerant line 267. The heat exchange section 330 is disposed in heat transfer relationship with the fluid in the tank 282, such as by being submersed in the fluid. The tank 282 may include a cold water inlet 284 fluidly communicating with a cold water source 286 and a warm water outlet 292 fluidly communicating with an auxiliary system, such as a water heater 294. This alternative embodiment does not require a pump to circulate fluid from the fluid heat exchanger 302 to the tank 282, and therefore it has been omitted. The heat exchange section 330 may be oriented to create a countercflow arrangement in which hot refrigerant enters a top of the tank 282 though inlet 290 while cooled and at least partially condensed refrigerant exits a bottom of the tank 282 through outlet 288. The dispenser 200 may operate in a manner similar to dispenser 10 described above.

[0041] It is to be understood that while the foregoing description has been given with reference to a semi-frozen product dispenser, the teachings of this disclosure can be used in conjunction with other types of refrigeration systems known to those of ordinary skill in the art to remove heat from the high pressure side of the refrigeration system and add heat to a water tank provided on the premises associated with the refrigeration system, thereby to improve the energy efficiency of the refrigeration system as well as the energy requirements of the surrounding environment.

INDUSTRIAL APPLICABILITY

[0042] Based on the foregoing, it can be seen that the present disclosure sets forth a dispenser for flowable products, such as but not limited to, milksheakes. The teachings of this disclosure can be employed to use waste heat from a refrigeration system in an auxiliary process to heat a fluid such as water. Such an arrangement may decrease operation of an air heat exchanger, thereby lowering the energy cost for operating the dispenser. Additionally, reduced air heat exchanger operation will reduce the amount of heat discharged into the interior space in which the dispenser is disposed, thereby lowering the heat load on the HVAC system provided with the interior space. Still further, energy costs
associated with the auxiliary system, such as a water heater, are reduced due to the pre-heating of the water.

[0043] While only certain embodiments have been set forth, alternatives and modifications will be apparent from the above description to those skilled in the art. These and other alternatives are considered equivalents and within the spirit and scope of this disclosure and the appended claims.

What is claimed is:

1. A semi-frozen product dispenser (10 or 200) for at least partially freezing and dispensing a product, comprising:
   - at least one freezing barrel (20-1) defining a freezing chamber (C1) configured to receive the product;
   - an evaporator (50 or 250) operably coupled to the freezing barrel (20-1) and including a refrigerant inlet and a refrigerant outlet;
   - a compressor (62 or 262) having a suction inlet in fluid communication with the evaporator outlet through a low pressure refrigerant line (69 or 269) and a discharge outlet;
   - a high pressure refrigerant line (67 or 267) extending between the compressor discharge outlet and the evaporator refrigerant inlet;
   - an air heat exchanger (64 or 264) operatively coupled to a portion of the high pressure refrigerant line (67 or 267); a fluid tank (82 or 282) sized to hold a predetermined volume of fluid; and
   - a fluid heat exchanger (102 or 302) fluidly communicating with the high pressure refrigerant line (67 or 267) to receive heated refrigerant and configured to transfer heat from the heated refrigerant to the volume of fluid in the fluid tank (82 or 282).

2. The semi-frozen product dispenser (10) of claim 1, in which the fluid heat exchanger (102) defines a refrigerant path and a fluid path and is configured to transfer heat from the refrigerant in the refrigerant path to fluid in the fluid path, and the fluid tank (82) includes a cold water inlet (84), a cold water outlet (88), a warm water inlet (90) fluidly communicating with the fluid heat exchanger fluid path, and a warm water outlet (92).

3. The semi-frozen product dispenser (10) of claim 2, further comprising a fluid pump (96) having a pump inlet (98) in fluid communication with the cold water outlet (88) and a pump outlet (100) in fluid communication with the fluid heat exchanger fluid path.

4. The semi-frozen product dispenser (10) of claim 3, further comprising a temperature sensor (112) disposed in sensing relationship to an interior of the tank (82) and operably coupled to the pump (96).

5. The semi-frozen product dispenser (10) of claim 3, further comprising a controller (72) operably coupled to the compressor (62) and the fluid pump (98), the controller (72) being programmed to operate the fluid pump (98) whenever the compressor (62) is operated.

6. The semi-frozen product dispenser (200) of claim 1, in which the fluid heat exchanger (302) is disposed in the fluid tank (282) thereby to directly transfer heat from the refrigerant to the fluid in the fluid tank (282).

7. The semi-frozen product dispenser (10 or 200) of claim 1, in which the fluid heat exchanger (102 or 302) is disposed upstream of the air heat exchanger (64 or 264).

8. The semi-frozen product dispenser (10 or 200) of claim 1, in which the dispenser (10 or 200) is disposed in an interior space (12), and in which the air heat exchanger (64 or 264) discharges heated air into the interior space (12).

9. The semi-frozen product dispenser (10 or 200) of claim 1, further comprising a suction heat exchanger (74 or 274) having a first line (76 or 276) in fluid communication with the high pressure refrigerant line (67 or 267) and a second line (78 or 278) in fluid communication with the low pressure refrigerant line (69 or 269), wherein the first and second lines (76, 78, 276, 278) are disposed in heat transfer relationship with each other thereby to transfer heat from the high pressure refrigerant line (67 or 267) to the low pressure refrigerant line (69 or 269).

10. A semi-frozen product dispenser (10 or 200) disposed in an interior space (12) for at least partially freezing and dispensing a product, comprising:
   - at least one freezing barrel (20-1) defining a freezing chamber (C1) configured to receive the product;
   - a refrigeration system (60 or 260) including:
     - an evaporator (50 or 250) operably coupled to the freezing barrel (20-1) and including a refrigerant inlet and a refrigerant outlet;
     - a compressor (62 or 262) having a suction inlet in fluid communication with the evaporator outlet through a low pressure refrigerant line (69 or 269) and a discharge outlet;
     - a high pressure refrigerant line (67 or 267) extending between the compressor discharge outlet and the evaporator refrigerant inlet;
   - an air heat exchanger (64 or 264) operatively coupled to a portion of the high pressure refrigerant line (67 or 267); a fluid tank (82 or 282) sized to hold a predetermined volume of fluid; and
   - a fluid heat exchanger (102 or 302) fluidly communicating with the high pressure refrigerant line (67 or 267) to receive heated refrigerant and configured to transfer heat from the heated refrigerant to the volume of fluid in the fluid tank (82 or 282).

11. The semi-frozen product dispenser (10) of claim 10, in which the fluid heat exchanger (102) defines a refrigerant path and a fluid path and is configured to transfer heat from the refrigerant in the refrigerant path to fluid in the fluid path, and the fluid tank (82) includes a cold water inlet (84), a cold water outlet (88), a warm water inlet (90) fluidly communicating with the fluid heat exchanger fluid path, and a warm water outlet (92).

12. The semi-frozen product dispenser (10) of claim 11, further comprising a fluid pump (96) having a pump inlet (98) in fluid communication with the cold water outlet (88) and a pump outlet (100) in fluid communication with the fluid heat exchanger fluid path.

13. The semi-frozen product dispenser (10) of claim 12, further comprising a temperature sensor (112) disposed in sensing relationship to an interior of the tank (82) and operably coupled to the pump (96).

14. The semi-frozen product dispenser (10) of claim 12, further comprising a controller (72) operably coupled to the compressor (62) and the fluid pump (98), the controller (72) being programmed to operate the fluid pump (98) whenever the compressor (62) is operated.

15. The semi-frozen product dispenser (200) of claim 10, in which the fluid heat exchanger (302) is disposed in the fluid tank (282) thereby to directly transfer heat from the refrigerant to the fluid in the fluid tank (282).
16. The semi-frozen product dispenser (10 or 200) of claim 10, in which the fluid heat exchanger (102 or 302) is disposed upstream of the air heat exchanger (64 or 264).

17. The semi-frozen product dispenser (10 or 200) of claim 10, further comprising a suction heat exchanger (74 or 274) having a first line (76 or 276) in fluid communication with the high pressure refrigerant line (67 or 267) and a second line (78 or 278) in fluid communication with the low pressure refrigerant line (69 or 269), wherein the first and second lines (76, 78 or 276, 278) are disposed in heat transfer relationship with each other thereby to transfer heat from the high pressure refrigerant line (67 or 267) to the low pressure refrigerant line (69 or 269).

18. A semi-frozen product dispenser (10) disposed in an interior space (12) for at least partially freezing and dispensing a product, comprising:
   - an enclosure (120) defining a housing space;
   - at least one freezing barrel (20-1) disposed within the housing space and defining a freezing chamber (C1) configured to receive the product;
   - an evaporator (50) disposed within the housing space, operably coupled to the freezing barrel (20-1), and including a refrigerant inlet and a refrigerant outlet;
   - a compressor (62) disposed within the housing space, the compressor (62) having a suction inlet in fluid communication with the evaporator outlet through a low pressure refrigerant line (69) and a discharge outlet;
   - a high pressure refrigerant line (67) disposed within the housing space and extending between the compressor discharge outlet and the evaporator refrigerant inlet;
   - an air heat exchanger (64) disposed within the housing space and operatively coupled to a portion of the high pressure refrigerant line (67), the air heat exchanger (64) discharging heated air into the interior space (12);
   - a fluid heat exchanger (102) disposed in the high pressure refrigerant line (67) and defining a refrigerant path and a fluid path, the fluid heat exchanger (102) being configured to transfer heat from refrigerant in the refrigerant path to fluid in the fluid path;
   - a fluid tank (82) sized to hold a predetermined volume of water, the tank (82) including a cold water inlet (84), a cold water outlet (88), a warm water inlet (90) fluidly communicating with the fluid heat exchanger fluid path and a warm water outlet (92); and
   - a fluid pump (96) having a pump inlet (98) in fluid communication with the cold water outlet (88) and a pump outlet (100) in fluid communication with the fluid heat exchanger fluid path.

19. The semi-frozen product dispenser (10) of claim 19, in which the fluid heat exchanger (102), fluid tank (82), and fluid pump (96) are also disposed within the housing space.

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