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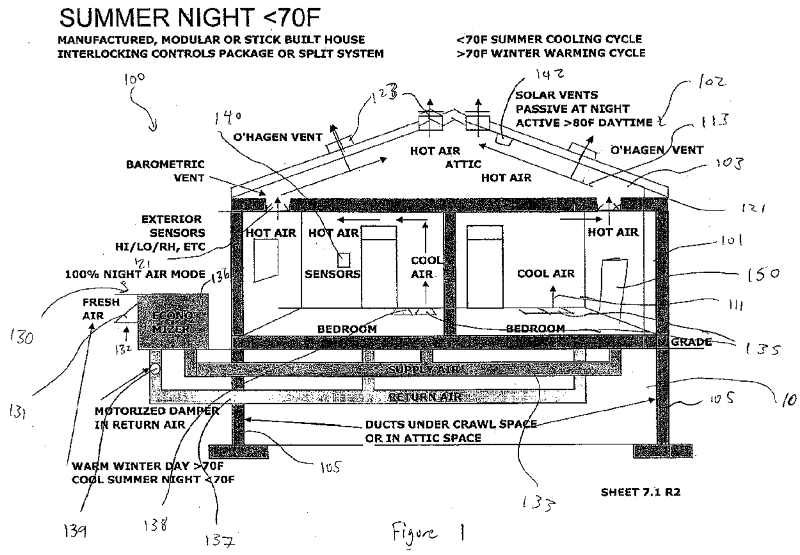


Figure 1

(57) **Abstract**: A multiplatform heating ventilation and air conditioning control system configured to maximize energy efficiency in maintaining desired conditions within an area through beneficial use of natural energy sources. In some embodiments, the multiplatform heating ventilation and air conditioning control system can include sensors and a control system. In some embodiments, the sensors can detect conditions inside and outside of the controlled area to determine the most efficient method of maintaining desired conditions.

WO 2012/047938 A2

MULTIPLATFORM HEATING VENTILATION AND AIR CONDITIONING CONTROL SYSTEM

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Patent Application No. 61/389,630, filed October 4, 2010, the entirety of which is incorporated by reference herein.

BACKGROUND

Field

[0002] Embodiments disclosed herein relate to heating, ventilation, humidity, and air conditioning ("HVAC") systems. More specifically, certain embodiments concern HVAC control systems that are configured, for example, to efficiently cool one or more structures, to heat one or more structures, and/or to provide hot water to one or more structures. Energy reduction methods and strategies are utilized to decrease overall energy usage and to achieve net zero energy usage when combined with alternative power production sources such as solar photovoltaic power, hydropower, micro-hydropower, geothermal, biomass, biodigester, or any other alternative power production source.

Description of Related Art

[0003] As world energy usage and energy demands continue to rise, the cost of energy has dramatically increased. Additionally, the world has seen an increase in energy volatility caused by wars, weather and climate related events and disasters, infrastructure breakdowns, natural disasters, and production changes and manipulation, for example. Thus, energy is more precious and valuable than ever.

[0004] Greater energy conservation can be achieved through increased efficient energy use, in conjunction with decreased energy consumption and/or reduced consumption from conventional energy sources. Energy conservation can result in increased financial capital, environmental quality, national security, personal security, and human comfort. Embodiments disclosed herein relate generally to systems, devices and methods that can provide improved energy usage, can minimize the loss of energy and can capture previously wasted or unused energy.

SUMMARY

[0005] The systems, devices, and methods disclosed herein each have several aspects, no single one of which is solely responsible for their desirable attributes. Without limiting the scope of the claims, some prominent features will now be discussed briefly. Numerous other embodiments are also contemplated, including embodiments that have fewer, additional, and/or different components, steps, features, objects, benefits, and advantages. The components, aspects, and steps may also be arranged and ordered differently. After considering this discussion, and particularly after reading the section entitled "Detailed Description of Certain Embodiments," one will understand how the features of the devices and methods disclosed herein can provide advantages over other known devices and methods.

[0006] Some embodiments relate to a method of controlling the temperature of a structure. The method of controlling the temperature of a structure can include, for example, one or more of sensing a temperature of ambient air outside the structure, determining whether the sensed temperature is below a first pre-determined value, above the first pre-determined value and below a second pre-determined value, or above the second pre-determined value, pressurizing the structure with ambient air if the sensed temperature is below the first pre-determined value, cooling ambient air with an evaporative cooling system if the sensed temperature is above the first pre-determined value and below the second pre-determined value, pressurizing the structure with the cooled ambient air if the sensed temperature is above the first pre-determined value and below the second pre-determined value, and using a heat pump to cool the structure if the sensed temperature is above the second pre-determined value.

[0007] In some embodiments of the method of controlling the temperature of a structure, the evaporative cooling system can be, for example, an indirect evaporative cooling system. In some embodiments of the method of controlling the temperature of a structure, the first pre-determined value can be, for example, between about 40 and 80 degrees Fahrenheit, or about 45, 50, 55, 60, 65, 75 or about 80 degrees Fahrenheit, or about 75 degrees Fahrenheit for example. The second pre-determined value can be, for example, about 75-110 degrees Fahrenheit, for example, or about 85 to 100 degrees Fahrenheit, or about 90 degrees Fahrenheit, for example. Some embodiments of the method of controlling the temperature of a structure can further include, for example, exhausting air from the structure. This air can have, for example, a temperature greater or less than the first pre-determined value.

[0008] Some embodiments relate to a method of controlling the temperature of a structure. This can include, for example, providing a solar hot air panel, heating ambient air with the solar hot air panel and directing the heated air into the structure, sensing a temperature of air within the structure at night, determining whether the sensed temperature is below a first pre-determined value, and using a heat pump to heat air within the structure if the sensed temperature is below the pre-determined value. The predetermined value can be any desired temperature above which the temperature is desired. For example, it can be below any value between about 0 and 80 degrees Fahrenheit, or about 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 75 or about 80 degrees Fahrenheit, or about 75 degrees Fahrenheit for example.

[0009] Some embodiments of the method of controlling the temperature of a structure can further include sensing a temperature of a space disposed over the structure during the day, determining whether the sensed temperature is above a second pre-determined value, and circulating ambient air through the structure if the sensed temperature is above the second pre-determined value. The predetermined value can be any desired value. For example, the predetermined value can be any predetermined value described herein, including without limitation a temperature above a value between 30 and 100 degrees Fahrenheit or any value therebetween, for example.

[0010] Some embodiments relate to a method of efficient cooling control of a building. This method can include, for example, circulating untreated ambient air within a building when ambient conditions are within a first pre-determined temperature range, such as, for example, between 10 and 150 degrees Fahrenheit, between 30 and 100 degrees Fahrenheit, between 40 and 90 degrees Fahrenheit, between 50 and 80 degrees Fahrenheit, between 60 and 70 degrees Fahrenheit, or in any other desired temperature range, treating ambient air, by, for example, indirect or direct evaporative cooling, to cool the ambient air to a desired temperature when ambient conditions are in a second pre-determined temperature range, such as, for example, between 10 and 150 degrees Fahrenheit, between 30 and 100 degrees Fahrenheit, between 40 and 90 degrees Fahrenheit, between 50 and 80 degrees Fahrenheit, between 60 and 70 degrees Fahrenheit, or in any other desired temperature range, circulating the treated ambient air within the building when ambient conditions are within the second pre-determined temperature range, exhausting air from the structure, managing temperature of an enclosed space of the building, such as, for example, an attic, to assist in cooling the building. In some embodiments, the temperature can be managed by, for example, venting warmed air from the space and circulating untreated ambient air to maintain temperatures within the space at or below ambient temperatures, and, circulating cooled building air throughout the building when ambient temperatures are within a third pre-determined temperature range, such as, for example, between 10 and 150 degrees Fahrenheit, between 30 and 100 degrees Fahrenheit, between 40 and 90 degrees Fahrenheit, between 50 and 80 degrees Fahrenheit, between 60 and 70 degrees Fahrenheit, or in any other desired temperature range. In some embodiments, the circulated cooled air can be cooled through indirect evaporative cooling.

[0011] Some embodiments relate to a method for efficient heating control of a building, including, for example, circulating untreated ambient air when ambient conditions are within a pre-determined temperature range, such as, for example, between 10 and 150 degrees Fahrenheit, between 30 and 100 degrees Fahrenheit, between 40 and 90 degrees Fahrenheit, between 50 and 80 degrees Fahrenheit, between 60 and 70 degrees Fahrenheit, or in any other desired temperature range, heating, by, for example, solar heating, ambient air to obtain a desired temperature when ambient temperatures are in a second pre-determined temperature range, such as, for example, between 10 and 150 degrees Fahrenheit, between 30 and 100 degrees Fahrenheit, between 40 and 90 degrees Fahrenheit, between 50 and 80 degrees Fahrenheit, between 60 and 70 degrees Fahrenheit, or in any other desired temperature range, managing attic temperature, by, for example, circulating warmed attic air into the building and cool building air into the attic to maintain a desired temperature, to assist in heating the building, and circulating heated building air throughout the building when ambient temperatures are within a third pre-determined temperature range, such as, for example, between 10 and 150 degrees Fahrenheit, between 30 and 100 degrees Fahrenheit, between 40 and 90 degrees Fahrenheit, between 50 and 80 degrees Fahrenheit, between 60 and 70 degrees Fahrenheit, or in any other desired temperature range.

[0012] Some embodiments relate to a method of maximizing building efficiency, including, circulating untreated ambient air when ambient conditions are within a pre-determined temperature range, cooling ambient air to obtain a desired temperature when ambient conditions are in a second pre-determined temperature range.

In some embodiments, the cooling of ambient air can include, for example cooling through indirect evaporative cooling. The method of maximizing building efficiency can further include managing attic temperature to assist in cooling the building. In some embodiments, the temperature is managed by venting warmed attic air and circulating untreated ambient air to maintain attic temperatures at or below ambient temperatures. The method of maximizing building efficiency can further include circulating cooled building air, including building air cooled through indirect evaporative cooling, throughout the building when ambient temperatures are within a third pre-determined temperature range, heating ambient air, including heating ambient air with solar heating, to obtain a desired temperature when ambient temperatures are in a second pre-determined temperature range, managing attic temperature by circulating warmed attic air into the building and cool building air into the attic to maintain a desired temperature to assist in heating the building, circulating heated building air throughout the building when ambient temperatures are within a third pre-determined temperature range, and, heating water with excess heat captured from building activities. In some embodiments, the heat can be, for example, captured through the use of heat pumps. In some embodiments, the hot water can be used to provide additional building climate control or to provide for heated water needs. In some embodiments, water generated through the heat capture activities can be utilized in connection with the building.

[0013] Some embodiments relate to a method of utilization of an environmental cycle by a climate control system to decrease energy required to maintain a desired condition within a defined volume. This can include, for example, sensing a parameter of the defined volume, comparing the sensed parameter of the defined volume to a desired parameter for the defined volume, sensing a parameter of the environment surrounding the defined volume, comparing the sensed parameter of the environment surrounding the defined volume to the sensed parameter of the defined volume and the desired parameter for the defined volume, and altering the parameter of the defined volume to match the desired parameter for the defined volume in part via heat or energy transfer to or from the environment.

[0014] In some embodiments, two or more electrical devices, including, for example, one or more compressors, can be managed to avoid simultaneous start and thus to reduce electrical demand penalties. In some embodiments, heat can be extracted, for example, from high heat sources with a heat pump, such as, for example, an air-to water heat pump. In some embodiments, the heat can be extracted from any part of a building or from equipment stored in the building, such as, for example, a kitchen, laundry, pool, from areas around compressors, or from electrical equipment or areas around electrical equipment. In some embodiments, moisture can be simultaneously extracted from high heat areas.

[0015] In some embodiments, a defined volume can include, for example, the internal volume of a structure, such as, for example, a residential structure, including a mobile home, or a non-residential structure. In some embodiments, the defined volume can include, for example, the internal volume of a tank, such as, for example, a water tank.

[0016] In some embodiments, the parameter of the defined volume can include, for example, a temperature or a relative humidity. In some embodiments, the parameter of the environment can include, for example, a temperature or a relative humidity.

[0017] In some embodiments, altering the parameter of the defined volume can include, for example, replacing a portion of the air of the defined volume with air from the environment, utilizing captured energy to heat the contents of the defined volume. This energy can be captured, for example, with a solar heating system such as, for example, a solar hot air panel or a solar hot water panel. In some embodiments, altering the parameter of the defined volume can include, for example, non-environmentally based cooling with, for example, evaporative cooling or a heat pump, or non-environmentally caused heating with, for example, a heat pump.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] The foregoing and other features of the present disclosure will become more fully apparent from the following description taken in conjunction with the accompanying drawings. Understanding that these drawings depict only several embodiments in accordance with the disclosure and are not to be considered limiting of its scope, the disclosure will be described with additional specificity and detail through use of the accompanying drawings.

[0019] Figure 1 schematically illustrates a cross-sectional view of one example of a non-limiting embodiment of a HVAC system that may be implemented with a multiplatform control system.

[0020] Figures 2A-2F are block diagrams schematically illustrating non-limiting examples of various applications for the HVAC system of Figure 1.

[0021] Figure 3A schematically illustrates a top plan view of one non-limiting examples of an embodiment of a HVAC system configured to provide winter heating.

[0022] Figure 3B schematically illustrates a top plan view of a non-limiting example of the HVAC system of Figure 3A configured to provide summer cooling.

[0023] Figure 4 schematically illustrates a non-limiting example of an attic ventilation system that can be incorporated with the HVAC systems disclosed herein.

[0024] Figures 5A-5C schematically illustrates a non-limiting example of an embodiment of an attic space ventilation system configured to operate in three different applications.

[0025] Figure 6 schematically illustrates a non-limiting example of a hydronic system used in connection with one embodiment of a multiplatform control system.

[0026] Figures 7A-7L are block diagrams schematically illustrating non-limiting examples of various applications of the hydronic system of Figure 6.

[0027] Figure 8A is a block diagram schematically illustrating a non-limiting example of an energy production system for use in connection with some embodiments of a multiplatform control system.

[0028] Figure 8B is a block diagram schematically illustrating a non-limiting example of an energy production system for use in connection with some embodiments of a multiplatform control system.

[0029] Figure 8C is a block diagram schematically illustrating a non-limiting example of a climate control system for use in connection with some embodiments of a multiplatform control system.

[0030] Figure 8D is a block diagram schematically illustrating a non-limiting example of a climate control system for use in connection with some embodiments of a multiplatform control system.

[0031] Figure 9 depicts one non-limiting example of an embodiment of a solar energy system that can be used in connection with some embodiments of a multiplatform control system.

[0032] Figures 10A-10C depict various non-limiting examples of embodiments of utility structures that can optionally be used in connection with some embodiments of a multiplatform control system.

[0033] Figure 11 depicts one non-limiting example of an embodiment of an electrical system that can be used in connection with some embodiments of a multiplatform control system.

[0034] Figure 12 depicts one non-limiting example of an embodiment of a pre-filtration unit that can be used in connection with some embodiments of a multiplatform control system.

[0035] Figure 13 depicts one non-limiting example of an embodiment of a bypass system that can be used in connection with some embodiments of a multiplatform control system.

[0036] Figure 14 depicts one non-limiting example of an embodiment of a radiator cooling system that can be used in connection with some embodiments of a multiplatform control system.

DETAILED DESCRIPTION OF CERTAIN EMBODIMENTS

[0037] In the following detailed description, reference is made to the accompanying drawings, which form a part hereof. In the drawings, similar symbols typically identify similar components, unless context dictates otherwise. The illustrative embodiments described in the detailed description and drawings are not meant to be limiting. Other embodiments may be utilized, and other changes may be made, without departing from the spirit or scope of the subject matter presented here. It will be readily understood that the aspects of the present disclosure, as generally described herein, and illustrated in the Figures, can be arranged, substituted, combined, and designed in a wide variety of different configurations, all of which are explicitly contemplated and make part of this disclosure.

[0038] Some embodiments disclosed herein relate to multiplatform systems, for example, HVAC control systems for residential structures, for example, houses, and/or for commercial structures, for example, restaurants. As used herein, "multiplatform" control systems refer to control systems that incorporate multiple systems for heating and/or cooling, for example, heat pumps, solar hot air modules, and/or evaporative cooling systems. In this way, multiplatform control systems may utilize the most efficient system or method available to heat or cool a given structure depending on climatic conditions (e.g., temperature and/or relative humidity). For example, a multiplatform control system may control a conventional heat pump and a solar hot air module to provide heat to a given structure. However, a person having ordinary skill in the art will understand that the embodiments disclosed herein can be implemented to control the heating and/or cooling of a structure as a stand alone system as well as in a multiplatform system. For example, the air circulation system discussed below with reference to Figure 1 can be implemented to supplement HVAC capabilities provided by a conventional heat pump and/or can be implemented as the primary HVAC system for any given structure.

[0039] The HVAC systems disclosed herein can include smart board and/or analog control components with one or more sensors that initiate the various methods of heating, cooling, and ventilation. The control components can be configured to minimize energy usage by a HVAC system by controlling the operation of different components of the HVAC system. In one embodiment, control components can limit the use of a heat pump during summer nights to reduce power consumption required for cooling. In one embodiment, control components can limit the use of a heat pump during winter days to reduce power consumption required for heating. Additionally, the control components may monitor the power use of various HVAC system components to assess, diagnose, optimize, and maintain these components. The control components may also monitor waste heat sources, for example, kitchen areas, and recycle waste heat to limit power consumption required for HVAC.

[0040] Several non-limiting examples of embodiments will now be described with reference to the accompanying figures, wherein like numerals refer to like elements throughout. The terminology used in the description presented herein is not intended to be interpreted in any limited or restrictive manner, simply because it is being utilized in conjunction with a detailed description of certain specific embodiments. Furthermore, embodiments can include several novel features, no single one of which is solely responsible for its desirable attributes or which is essential to practicing the technology herein described.

[0041] In some embodiments, the multiplatform HVAC control system can, for example, tie local environmental cycles to the structure associated with the multiplatform HVAC control system. The multiplatform HVAC control system can, in some embodiments, integrate the specific local environmental cycles into the associated structure to optimize heating, ventilation, air conditioning, and humidity control. In some embodiments integrated environmental factors can include, for example, diurnal swing, solar gain, solar radiation, solar reflectance, solar refractance, absorption, adsorption, or any other environmental factor. In some embodiments, the multiplatform HVAC control system uniquely combine technologies to harness these environmental factors, including, for example, a hot air panel, a cold air panel, an indirect and/or direct pre-cooler associated with one or several condensers, a solar attic ventilator, a solar fan, an economizer cycle, a ventilator, traumwalls, an attachable and/or detachable eaves, geothermal wells, which can be located, for example, in ground loops or under a floor, and/or any other technology.

[0042] In some embodiments, the multiplatform HVAC control system can be configured to advantageously use structural environmental conditions to minimize energy consumption. In some embodiments, the multiplatform HVAC control system can be configured to use, for example, waste heat, low and/or high humidity, or any other condition within the structure to minimize energy consumption. Advantageously, the use of a multiplatform HVAC control system can allow the capture and use of the, until now, largely ignored sources of available energy. This energy can be used for heating and for cooling and can decrease the high cost and energy consumption associated with the use of, for example, conventional heat pumps, natural gas, electric heating, or other heating and cooling systems.

[0043] In some embodiments, the multiplatform HVAC control system can sense a parameter of a controlled area such as, for example, a structure, a room, a container, or any other desired area. In some embodiments, this parameter can be, for example, a temperature, a relative humidity, or any other parameter.

[0044] In some embodiments, the multiplatform HVAC control system can compare the parameter of the controlled area with a desired parameter for the controlled area. This desired parameter can be a fixed value, or variable. In some embodiments, this parameter can be set with an input device, such as, for example, a thermostat. In some embodiments, this desired parameter could be any value between 0 to 200 degrees Fahrenheit, 30 to 100 degrees Fahrenheit, 50 to 80 degrees Fahrenheit, or in any other desired numbers. Similarly, in some embodiments, this desired parameter could be between 0 and 100 percent relative humidity, between 15 and 80 percent relative humidity, between 25 and 60 percent relative humidity, between 35 and 50 percent relative humidity, or any other desired relative humidity percent. The comparison of the sensed parameter of the controlled area with the desired parameter of the controlled parameter can determine if the sensed parameter is within a designated range of the desired parameter. This range can be, within 30 percent of the desired parameter, within 20 percent of the desired parameter, within 10 percent of the desired parameter, within 5 percent of the desired parameter, within 1 percent of the desired parameter, or within any other range relative to the desired parameter. In one embodiment, this range can be expressed as a temperature, such as, for example, a within 20 degrees Fahrenheit, within 10 degrees Fahrenheit, within 5 degrees Fahrenheit, within 1 degrees Fahrenheit, or within any other desired temperature. In some embodiments, this range can be a relative humidity, such as, for example, within 30 percent relative humidity, within 20 percent relative humidity, within 10 percent relative humidity, within 5 percent relative humidity, within 1 percent relative humidity, or within any other range of relative humidity. If the sensed parameter is within the specified range of the desired parameter, then, for example, the multiplatform HVAC control system of some embodiments may take no action and await a sensed parameter outside of the specified range of the desired parameter.

[0045] If the sensed parameter is outside of the specified range of the desired parameter, some embodiments of the multiplatform HVAC control system can sense a parameter of an area outside the controlled area, such as, for example, the environment in which the structure is located. This parameter can include, for example, the outdoor temperature, outdoor relative humidity, a solar parameter such as, for example, insolation, the heating or cooling ability of a geothermal system, or any other parameter. The sensed parameter of the area outside the controlled area is compared to the sensed parameter for the controlled area and the desired parameter for the controlled area. Based on the relative positioning of the sensed parameter of the area outside the controlled area to the sensed parameter of the controlled and the desired parameter of the controlled area, a method of changing the parameter of the controlled area is selected. Thus, based on the parameter of the area outside the controlled area, a method of heat and/or energy transfer is selected which can, for example, bring the sensed parameter into the desired range with the least amount of energy. This can include, for example, mixing air from outside the controlled area with air inside the controlled area, solar heating, evaporative cooling, use of a heat pump, or any other technique to transfer heat and/or energy.

[0046] Some embodiments relate to methods and materials for improving the heating and cooling efficiency of structures, for example, by utilizing an improved insulation methodology. Also, some embodiments relate to structures, including for example, manufactured structures and modular structures such as manufactured homes and modular homes. In some aspects the methods can provide improved insulation of the structures including by minimizing adverse moisture and/or by ensuring sufficient circulation to ensure fresh air, etc.

[0047] Traditional insulation techniques often involve the use of “cavity” insulation, or in other words, the insertion of insulation between wall studs and between rafters on ceilings. The cavity insulation methods can be inefficient due to significant loss of temperature, such as heat, through conduction via the studs and rafters. Furthermore, infiltration leads to significant loss of or change of temperature via gaps and other openings that occur in structures, particularly as structures age, settle, etc.

[0048] Thus, some embodiments relate to the surprising and unexpected methods, materials and structures for improving the heating and cooling insulation of homes, including in some aspects with no adverse effects due to excess moisture (e.g., mold) and/or to lack of circulated air. The methods can include wrapping or sealing a structure such as a modular or manufactured home on the exterior portion of the frame with an insulative material. In some aspects the insulative material is continuous in the sense that it covers the entire exterior region, except doors and windows, for example. The insulative material also can be included on the exterior of the foundation. In some aspects the insulative material can be a material at least in part made from Biaxially-oriented polyethylene terephthalate (BoPET; e.g., Mylar), for example a single or dual sided Mylar product. For example, the p2000 product sold by P2000 systems and Proactive Technology Inc. In some embodiments traditional cavity insulation can be used in addition to the wrap material, while in others no cavity insulation is required or used, if desired.

[0049] As one example, a structure can be illustrated by the following example of a modular home. It should be understood that the methods, material and structure can be applied to other structures besides modular homes, for example, manufactured homes, non-manufactured homes, mobile homes, etc. In the non-limiting example, the modular home is “wrapped” in P2000 insulation material by contacting or attaching the P2000 material to one or more of: the exterior side of the studs, the exterior of the joists, the exterior of the rafters, underside or exterior the floor studs and the exterior of the foundation. It should be understood that the material can be configured so as to not cover things such as windows, doors, vents, etc. The contacted or attached insulative material can then be covered with one or more additional exterior materials or coverings. For example, the walls can be covered with one or more of plywood, weather coating, concrete, stucco, paint, etc. The joist or rafter insulative material can be covered by one or more of plywood, tar, weather coating, paint, stone, shingles, etc. Similar exterior coatings or treatments can be applied to the floor and foundation insulative material, if desired. The methods further can include configuring the modular home for proper ventilation and airflow. An example of a minimum airflow is 70-200 cubic feet per minute (CFM), in some aspects 85-150 CFM or in some aspects about 100 CFM, for example, all for at least 8-15 hours per day, or in some aspects for at least 10-13 hours per day, or in some aspects for at least about 12 hours per day. In some embodiments, the insulative material can be contacted, attached, adhered to concrete structures such as foundations using any suitable technique. For example, the insulative material can be positioned prior to pouring the concrete foundation such that upon pouring it will contact and stick to the concrete. In some aspects the insulative material can be implemented with integrated concrete form technologies, for example.

[0050] Surprisingly and unexpectedly, the structures utilizing the above-described methods exhibit improved avoidance of loss due to conduction and/or infiltration.

[0051] Figure 1 schematically illustrates a cross-sectional view of one embodiment of a HVAC system 100 that may be implemented with a multiplatform control system. The HVAC system 100 includes an air circulation system 130 that is fluidly coupled with a structure 102. The structure 102 may be any structure, including, for example, a house, barn, garage, storage facility, industrial structure, commercial building, and/or place of worship. The structure 102 includes a main space 101, an attic space 103 disposed over the main portion, and an optional lower space 104 disposed below the main portion. The lower space 104 may include, for example, a cellar, basement, or crawl space. In some embodiments, the main space 101 is fluidly coupled to the attic space 103 by one or more vents or openings 121. As discussed in more detail below, vents 121 may be barometric vents configured to open or close depending on pressure conditions. For example, the vents 121 may be configured to open when the pressure of the main space 101 is above a certain pre-determined value and/or to close when the pressure of the main space 101 is below the pre-determined value.

[0052] Still referring to Figure 1, the attic space 103 may include one or more vents 123 configured to provide a fluid conduit from the attic space 103 to the environment outside of structure 102. In some embodiments, the attic vents 123 can be produced by O'Hagin's, Inc. of Rohnert Park, California. The attic vents 123 can be controlled independently from vents 121 disposed between the attic space 103 and the main space 101 such that attic vents 123 may be closed when the vents 121 are open and/or may be open when the vents 121 are closed. In this way, the attic space 103 can include at least four ventilation configurations. A first configuration can include the attic vents 123 in a closed configuration and the vents 121 in a closed configuration. A second configuration can include the attic vents 123 in an open configuration and the vents 121 in an open configuration. A third configuration can include the attic vents 123 in an open configuration and the vents 121 in a closed configuration. A fourth configuration can include the attic vents 123 in a closed configuration and the vents 121 in an open configuration. Further, in some embodiments, the vents 121 can be configured such that at least one vent 121 is in an open configuration and such that at least one other vent 121 is in a closed configuration. Similarly, attic vents 123 can be configured such that at least one attic vent 123 is in an open configuration and such that at least one other attic vent 123 is in a closed configuration. Thus, the attic space 103 may be controlled to optionally exchange air or fluid with the main space 101 and/or the ambient environment disposed outside of the structure 102.

[0053] With continued reference to Figure 1, the air circulation system 130 can include an air intake 132 configured to receive ambient air from outside the structure 102 and an air circulator disposed within a housing 136. The air circulator may be configured to direct air received through the intake 132 to the structure 102 by one or more supply vents, register duct, or conduits 133. In some embodiments, the air circulator comprises a centrifugal fan or squirrel-cage fan configured to direct air through a supply conduit 133 to the structure 102. Thus, the air circulation system 130 can be configured to pressurize the main space 101 of structure 102 by providing an air flow stream through supply conduit 133.

[0054] In some embodiments, supply conduit 133 provides an air flow stream to the main space 101 through one or more vents 135 disposed in the floor of the main space 101. In another embodiment, the air circulation system 130 may be disposed within the lower space 104 of the structure 102 and the air circulation system 130 is configured to provide an air flow stream to the main space 101 through one or more ducts 105 that are fluidly connected with the main space 101. As shown in Figure 1, the air circulation system can also include one or more return conduits 137 configured to receive air from the main space 101 through one or more vents 138 and direct the received air to the housing 136. A controllable damper or stopping mechanism 139 can be disposed within the return conduit 137 to open or close the return conduit 137. Thus, the air circulation system 130 can supply air to the structure 102 through the supply conduit 133 and/or can receive air from structure 102 through return conduit 137 depending on whether damper 139 is open or closed.

[0055] In some climatic conditions, it may be desirable to pre-cool ambient air that is received by the air circulation system 130 through the intake 132. Thus, a pre-cooling system 131 can optionally be disposed between the intake 132 and the housing 136. The pre-cooling system 131 can comprise various components configured to cool air that passes therethrough. In one embodiment, pre-cooling system 131 includes an evaporative cooling system that is configured to cool air that passes therethrough by transferring latent heat from the air to water. In some embodiments, pre-cooling system 131 can include direct, indirect, and/or direct/indirect evaporative cooling system to control the amount of water that may optionally be added to air that passes therethrough. For example, a direct evaporative cooling system may be configured to cool air that passes therethrough and may add moisture to the air. In another example, an indirect evaporative cooling system may be configured to cool air that passes therethrough without adding moisture to the air. In yet another example, an indirect/direct evaporative cooling system may be configured to cool air that passes therethrough by direct cooling, which may add moisture to the air, in a first step, and then indirectly cooling the air in a second step. Thus, the pre-cooling system 131 can be configured to treat the temperature and specific humidity of air that is received through the intake 132. In some embodiments, HVAC system 100 optionally includes one or more filtering elements (not shown) disposed between the air intake 132 and the air circulator. The filtering elements can be configured to filter air that passes therethrough to separate solid materials, for example, particulate matter, from air received through the intake 132.

[0056] Still referring to Figure 1, one or more solar hot air modules 150 can optionally be disposed within the structure 102 to transfer thermal energy received from electromagnetic radiation (e.g., sunlight) to air disposed within the structure 102. In one embodiment, a solar hot air module 150 is disposed within a wall of the main space 101 and configured to transfer thermal energy from sunlight incident thereon to air disposed within the main space 101. Examples of solar hot air modules are described in U.S. Provisional Application Number 61/382,798 which is hereby incorporated by reference in its entirety. Generally, solar hot air modules can include a solar module configured to receive thermal energy and a solar panel configured to transfer the received thermal energy to air that passes therethrough. The solar panel may include one or more fans to draw air into the panel and one or more vents to exhaust heated air from the panel. Thus, the one or more solar hot air modules 150 can be configured to heat air within the structure 102 during the day time.

[0057] The HVAC system schematically illustrated in Figure 1 may further include one or more sensors 140 disposed within the main space 101 and/or one or more sensors 142 disposed within the attic space 103. The sensors 140, 142 can be configured to sense an air temperature within the main space 101 or attic space 103 and/or relative humidity levels within the main space 101 or attic space 103. The sensors 140, 142 may provide the sensed characteristics (e.g., temperature and/or relative humidity) to control circuitry (not shown) configured to control the HVAC system 100. Based on the sensed characteristics, the control circuitry may adjust various components and/or systems of the HVAC system 100 to change climactic conditions within the structure 102. When the HVAC system 100 is part of a multiplatform system including a conventional heat pump (not shown) and/or other components, the control circuitry may control the various components of the multiplatform system to maximize the efficiency and/or minimize energy consumption of the multiplatform system.

[0058] With continued reference to Figure 1, in some implementations, HVAC system 100 may be configured to cool structure 102 when the temperature of air outside the structure 102 is below a predetermined value. For example, in one embodiment, HVAC system 100 may be configured to cool the structure 102 when the outside air temperature is below about 70 degrees Fahrenheit. In this embodiment, the air circulator disposed within housing 136 may be configured to draw outside air in through intake 132. The received air may be directed to the main space 103 through supply conduit 133 and vents 135. The air circulator may be configured to provide the air to the structure 102 at an air flow rate sufficient to pressurize the structure 102 relative to the surrounding environment. As a result, air within the main space 101 that is warmer than the air 111 provided through vents 135 may rise to the top of the main space 101 and be forced into the attic space 101 through vents 121. Similarly, air 113 in the attic space 101 that is warmer than the air received through vents 121 may be exhausted through the attic vents 123. Thus, the air circulator may continuously provide air into the structure 102 that is below the predetermined value to force warmer air out of the structure 102 in order to cool the structure 102.

[0059] In another embodiment, HVAC system 100 may be configured to cool the structure 102 when the outside temperature is above a first predetermined value but below a second predetermined value. For example, in one embodiment, HVAC system 100 may be configured to cool the structure 102 when the outside air temperature is above about 70 degrees Fahrenheit and below about 90 degrees Fahrenheit. In this embodiment, the air circulator disposed within housing 136 may be configured to draw outside air in through intake 132. The received air may be cooled by a pre-cooling system 131 before passing through housing 136 to supply conduit 133 such that the air is below a third predetermined value. As discussed above, the pre-cooling system 131 may optionally be configured to add moisture to air received through the intake 132 in extremely dry climates. The cooled air may then be directed to the main space 103 through vents 135. The air circulator may be configured to provide the air to the structure 102 at an air flow rate sufficient to pressurize the structure 102 relative to the surrounding environment. As a result, air within the main space 101 that is warmer than the air 111 provided through vents 135 may rise to the top of the main space 101 and be forced into the attic space 101 through vents 121. Similarly, air 113 in the attic space 101 that is warmer than the air received through vents 121 may be exhausted through the attic vents 123. Thus, the air circulator may continuously provide air into the structure 102 that is below the third predetermined value to force warmer air out of the structure 102 in order to cool the structure 102. In another embodiment, HVAC system 100 may be configured to cool the structure 102 without drawing in outside air, for example, when outside air is above a predetermined value. For example, air circulation system 130 may include a direct, indirect, and/or indirect/direct cooling system disposed within housing 136 and damper 139 may be opened to allow the air circulation system 130 to cycle air from the house through the cooling system in a closed loop.

[0060] In yet another embodiment, HVAC system 100 may be configured to heat the structure 102 when the outside is below a predetermined value. For example, hot air solar module 150 may be configured to transfer thermal energy from sunlight during the day to air within the main space 101. To maintain the temperature within the main space 101, vents 121 may be closed to prevent heated air from exhausting to the attic space 103. Additionally, attic vents 123 may be closed to prevent the exhaust of warm air from the attic space 101. In this way, the solar hot air module 150 may warm the main space 101 of structure 102 during the day. In some conditions, it may be desirable to circulate ambient air from outside the structure 102 via the air circulation system 130 to prevent the main space 101 from getting too warm. In one embodiment, the vents 121 may be closed, solar hot air module 150 may operate to warm the main space 101, damper 139 may be opened, and the air circulator may be configured to slowly circulate ambient air through main space 101 to keep the temperature within the main space above a first predetermined value and below a second predetermined value. In this configuration, the attic vents 123 may be closed to maintain a desired temperature within the attic space 103 to slow the loss of heat from the attic space 103 at night when the solar hot air module 150 is not operative.

[0061] In some configurations, it may be desirable to maintain a warm temperature within the main space 101 while allowing air from the attic space 103 to exhaust to the outside environment. Thus, vents 121 may be closed to prevent the exhausting of warm air from the main space 101 to the attic space 103 and the attic vents 123 may be open to allow warm air from the attic space to exhaust to the outside environment. In this configuration, the attic space 103 may act as a heat cycle to transfer thermal energy from the main space 101 to cooler air that enters the attic space 103 through attic vents 123. In some embodiments, warmth from the attic space 103 may infiltrate the main space 101 through the ceiling. In this way, thermal energy from the relatively warm attic space 101 air may transfer to the main space 101 by thermal transference similar to an inversion layer effect. In some embodiments, the higher temperature air may transfer by convection.

[0062] The embodiments discussed above relate to exemplary embodiments of HVAC systems 100 that may be configured to cool and/or heat structure 102. A person having ordinary skill in the art will understand that the features disclosed herein can be implemented in a multitude of different ways to affect the climactic conditions within a given structure (e.g., to heat, cool, and/or control the specific humidity of air within the structure). For example, the air circulation system 130 discussed above can be supplemented with a conventional heat pump to cool/heat structure 102 and/or can be configured to alternately operate with other HVAC components (e.g., a heat pump system). Further, a person having ordinary skill in the art will understand that the efficiency of the systems disclosed herein can be buttressed by the implementation of passive solar building designs configured to reduce the energy required to heat and/or cool a given structure.

[0063] Turning now to Figures 2A-2F, block diagrams schematically illustrating various example applications for the HVAC system of Figure 1 are provided. Figure 2A schematically illustrates a first example application for the HVAC system of Figure 1 for situations when the temperature for air outside the structure range between about 75 and about 90 degrees Fahrenheit at night with a relative humidity of less than about 30% (e.g., during summer month and/or summer transition month). In this application, a thermostat within the structure may call for the main space to be cooled to a temperature of between about 65 and about 70 degrees Fahrenheit as shown by block 201a. Control circuitry may receive this input information and call for information from one or more sensors as to whether air outside the structure has a temperature of between about 75 and about 90 degrees Fahrenheit as shown by block 203a. Additionally, the control circuitry may call for information from one or more sensors as to whether the relative humidity of air outside the structure is less than about 30% as indicated by block 209a. If either of these parameters is not met, the control circuitry may call for a heat pump to run in order to cool the structure as indicated by block 205a. On the other hand, if both of the parameters are met, the control circuitry may call for the air control system to pressurize the main space of the structure with air from outside the structure as shown by block 211a. Additionally, the air control system may pre-cool the outside air before directing it into the structure as indicated by block 213a. In some implementations, an attic space may include one or more fans to force air from the attic space to the surrounding environment. In these implementations, the control circuitry may call for the attic space fans to run when a temperature of the attic space is above about 80 degrees Fahrenheit as shown by block 215a. In some embodiments of HVAC systems and/or control systems may include a manual override function as shown by block 207a to override the automatic and/or programmed selections of the control circuitry.

[0064] Figure 2B schematically illustrates a second example application for the HVAC system of Figure 1 for daytime operation during the summer and/or a summer transition month. In this application, a thermostat within the structure may call for the main space to be cooled to a temperature of between about 65 and about 75 degrees

Fahrenheit as shown by block 201b. Control circuitry may receive this input information and call for information from one or more sensors as to whether air outside the structure has a temperature of less than about 75 degrees Fahrenheit as shown by block 203b. Additionally, the control circuitry may call for information from one or more sensors as to whether the relative humidity of air outside the structure is less than about 30% as indicated by block 209b. If the relative humidity is less than about 30%, the control circuitry may call for the air circulation system to pressurize the main space of the structure with air from outside the structure as indicated by block 213b. In some configurations, the air circulation system may include a pre-cooling system as discussed above to pre-cool the air received by the air circulation system. If the relative humidity is greater than about 30%, the control circuitry may optionally call for a heat pump to run in order to cool the structure to the desired temperature as indicated by block 205b. In some implementations, an attic space may include one or more fans to force air from the attic space to the surrounding environment. In these implementations, the control circuitry may call for the attic space fans to run when a temperature of the attic space is above about 80 degrees Fahrenheit as shown by block 215b. In some embodiments of HVAC systems and/or control systems may include a manual override function as shown by block 207b to override the automatic and/or programmed selections of the control circuitry.

[0065] Figure 2C schematically illustrates a third example application for the HVAC system of Figure 1 for nighttime operation during the summer in desert, coastal, and/or mountain climates where the nighttime temperatures are less than about 65 degrees Fahrenheit for 6 hours or more and the relative humidity is less than about 30%. In this application, a thermostat within the structure may call for the main space to be cooled to a temperature of about 60 degrees Fahrenheit as shown by block 201c. Control circuitry may receive this input information and call for information from one or more sensors as to whether air outside the structure has a temperature of less than about 70 degrees Fahrenheit as shown by block 203c. If the outside air temperature is less than about 65 degrees Fahrenheit, the control circuitry may call for the ventilation systems damper to open and the air circulation system to pressurize the main space of the structure with air from outside the structure as indicated by block 213c. If the thermostat within the structure indicates that the temperature within the structure is about 60 degrees Fahrenheit, the control circuitry may call for the air circulation system to run at a diminished capacity, for example, half speed, as shown by block 217c to maintain a main space temperature of about 60 degrees Fahrenheit without significant over cooling. Conversely, if the outside air temperature is greater than about 75 degrees Fahrenheit, the control circuitry may call for the heat pump to cool the main space to a temperature of about 60 degrees Fahrenheit as shown by block 205c. In such a situation, the outside air temperature would not be low enough to cool the main space to a temperature of about 60 degrees Fahrenheit. In some implementations, an attic space may include one or more fans to force air from the attic space to the surrounding environment. In these implementations, the control circuitry may call for the attic space fans to run when a temperature of the attic space is above a certain pre-determined value. However, when the outside air temperature is below about 65 degrees Fahrenheit and the thermostat calls for cooling of about 60 degrees, the attic space fans will be shut off by the control circuitry as indicated by block 215c. In some embodiments of HVAC systems and/or control systems may include a manual override function as shown by block 207c to override the automatic and/or programmed selections of the control circuitry.

[0066] Figure 2D schematically illustrates a fourth example application for the HVAC system of Figure 1 for operation in coastal or other climates with nighttime temperatures greater than about 75 degrees Fahrenheit and relative humidity greater than about 30%. In this application, a thermostat within the structure may call for the main space to be cooled to a temperature of between about 65 and about 70 degrees Fahrenheit as shown by block 201d. Control circuitry may receive this input information and call for information from one or more sensors as to whether air outside the structure has a temperature of greater than about 75 degrees Fahrenheit as shown by block 203d. If the outside air temperature is less than about 75 degrees Fahrenheit, the control circuitry may call for the air circulation system to pressurize the main space of the structure with air from outside the structure as indicated by block 213d. If the outside temperature is greater than about 75 degrees Fahrenheit, the control circuitry may call for a heat pump to cool the main space as shown by block 205d. To reduce the relative humidity within the main space, the air cooled by the heat pump may be dehumidified as shown by block 227d. Water that is separated from the cooled air may purified as shown by block 229d to be used as potable water and/or may be used for non-potable applications including greywater use, agricultural use, and/or toilet use, as indicated by reference numeral 231d. In some embodiments in which chilled water is desired, and as depicted in block 225d, an air-to-water heat pump can cool water. Waste heat from the heat pump may be harnessed to heat domestic water within the structure as indicated by block 223d and/or may be exhausted outside the structure. The attic space may include one or more fans that are controlled by the control circuitry to run during the daytime when an attic space temperature sensor indicates that the air temperature within the attic space is greater than about 80 degrees Fahrenheit.

[0067] Figure 2E schematically illustrates a fifth example application for the HVAC system of Figure 1 for operation in desert or other climates with relative humidity of less than about 30%. In this application, a thermostat within the structure may call for the main space to be cooled to a temperature of between about 70 and about 75 degrees Fahrenheit as shown by block 201e. Control circuitry may receive this input information and call for information from one or more sensors as to whether air outside the structure has a temperature of greater than about 90 degrees Fahrenheit as shown by block 203e. If the outside air temperature is less than about 90 degrees Fahrenheit, the control circuitry may call for the air circulation system to pressurize the main space of the structure with air from outside the structure as indicated by block 213e. If the outside temperature is greater than about 90 degrees Fahrenheit, the control circuitry may receive an input from one or more sensors regarding the relative humidity of the outside air as indicated by block 209e. If the relative humidity of the outside air is less than about 30%, the control circuitry may call for the heat pump fan to draw air through a pre-cooling system as indicated by block 250e to cool the received air. The fan may then distribute this cooled air throughout the main space without the use of the heat pump compressor as indicated by block 252e. A person having ordinary skill in the art will also appreciate that if the relative humidity of the outside air is greater than about 30%, the control circuitry may call for the heat pump to cool the main space with the use of the compressor (not shown). The attic space may include one or more fans that are controlled by the control circuitry to run during certain situations. As shown by block 215e, when the heat pump fan is operating the attic space fans may be non-operative. In some embodiments of HVAC systems and/or control systems may include a manual override function as shown by block 207e to override the automatic and/or programmed selections of the control circuitry.

[0068] Figure 2F schematically illustrates a sixth example application for the HVAC system of Figure 1 for operation during a winter day. In this application, a thermostat within the structure may call for the main space to be heating to a temperature of between about 70 and about 75 degrees Fahrenheit as shown by block 201f. Control circuitry may receive this input information and call for information from one or more sensors as to whether air outside the structure has a temperature of less than about 70 degrees Fahrenheit as shown by block 203f. If the outside temperature is less than about 70 degrees Fahrenheit, the control circuitry will not call for the air circulation system to pressurize the main space with outside air and the return conduit damper will be closed as shown by block 213f. Also, if the outside temperature is less than about 70 degrees Fahrenheit, the control circuitry will call for the solar hot air module to transfer thermal energy to the air within the main space as shown by block 269f. If the solar hot air module is unable to sufficiently heat the air within the main space, thermal energy may be transferred from hot water to air within the main space. For example, solar hot water (e.g., water heated by solar heating systems) may be provided as shown by block 261f and directed through a heating coil element to transfer thermal energy from the solar hot water to air within the main space as shown by block 263f. If solar hot water is not available but another hot water source is available, as shown by block 265f, this water may also be provided to the heating coil element to heat the main space. Lastly, a heat pump disposed in another portion of the structure and/or the main space may be configured to heat the main space as shown by block 267f. The attic space may include one or more fans that are controlled by the control circuitry to run during certain situations. As shown by block 215f, when the thermostat calls for heating, the attic space fans or vents may be non-operative to conserve thermal energy within the structure. In some embodiments of HVAC systems and/or control systems may include a manual override function as shown by block 207f to override the automatic and/or programmed selections of the control circuitry.

[0069] Turning now to Figure 3A, a top plan view of one embodiment of a HVAC system 300a is schematically illustrated. The system 300a includes a structure 302a that includes a main space 301a. The HVAC system 300a can be configured to heat and/or cool the main space 301a to a desired temperature. The main space 301a includes a thermostat 357a that may be part of a control system including control circuitry to control and/or regulate the various components of the HVAC system 300a. The system 300a further includes at least one warm air vent 335a, at least one barometric vent 323a, at least one upduct 321a, and optionally includes at least one heat source 338a. Warm air may be provided to the main space 301a by at least one fan 351a. The fan 351a may receive warm air from any suitable source, for example, a solar hot air module, a hydronic coil, and/or a heat pump. The warm air directed by the fan 351a may be received in the main space 301a through the warm air vents 335a. Similar to the HVAC system 100 of Figure 1, warm air that is received within the main space 301a may be maintained within the main space 301a by configuring the barometric vents 323a and the upducts 321a to remain closed during heating cycles. Additionally, colder air that sinks to the bottom of the main space 301a may be drawn from the main space 301a by one or more conduits to increase the heat of the main space. Further, HVAC system 300a may harness waste heat from the various heat sources 338a within the main space to further improve the heating efficiency of the system 300a. Heat sources 338a may include any heat source disposed within the main space 301a of a structure 302a, including, for example, televisions, computer hardware, electric appliances, gas appliances, and/or living beings (e.g., farm animals). Heat from the heat sources 338a may be directed to the main space 301a instead of to an overlying attic space to increase the temperature within the main space without requiring additional energy. As indicated in Figure 3A, system 300a may further include at least one exterior sensor to provide at least one outside air characteristic to the control circuitry.

[0070] Turning now to Figure 3B, HVAC system 300a of Figure 3A is schematically illustrated again. In contrast to Figure 3A, HVAC system 300a in Figure 3B is configured to provide cooling to the structure 302a. Instead of a source of warm air, fan 351a is configured to receive air that is cooler than the air within the main space 301a from a source of cool air. The source of cool air may comprise any suitable source, for example, a heat pump, an evaporative cooling system, and/or a system configured to circulate ambient air from outside the structure 302a within the main space 301a. When the source of cool air includes ambient air provided to the main space 301a at a flow rate sufficient to increase the pressure of the structure 302a relative to the outside environment, barometric vents 323a and upducts 321a are configured to be open to allow warmer air to exhaust to an overlying attic space. In this way, pressurizing the main space 301a may provide cooler air to the main space 301a and drive relatively warmer air out of the structure 302a through attic vents (not shown). Additionally, instead of harnessing waste heat from the heat sources 338a, waste heat may also be exhausted through the attic to maintain a desired temperature within the main space 302a.

[0071] Figure 4 schematically illustrates an attic space ventilation system 400 that can be incorporated with the various HVAC systems disclosed herein. System 400 includes a module 480 that is configured to draw in ambient air from outside an attic space 403 while exhausting air from within the attic space 403. In this way, the air temperature within the attic space 403 may be regulated by system 400. In one implementation, module 480 includes at least one fan configured to draw air into the attic space 403 at a certain flow rate and at least one vent configured to allow for the egress of air from the attic space 403 at the certain flow rate. The attic space ventilation system 400 may be useful during situations when it is desirable to cool an attic space. For example, attic space 403 may include air having a temperature above a certain value while the temperature of air outside the attic space 403 is below the certain value. The module 480 may draw in air that is relatively colder than air within the attic space 403, this air may sink toward the bottom most portion of the attic space 403, and the input of air from outside the attic space 403 may force warmer air out of the module 480 resulting in a cooling effect.

[0072] Figures 5A-5C schematically illustrate an embodiment of an attic space ventilation system 500 configured to operate in three different applications. Attic space ventilation system 500 includes a first set of input vents 501 disposed on a roof 504 of a structure 502. Attic space ventilation system 500 also includes output vents 503 disposed on roof 504. Input vents are configured to provide ingress to an attic space of structure 502 and output vents are configured to provide egress therefrom. Attic space ventilation system 500 may also include one or more fans (not shown) disposed underneath the input vents 501 and configured to draw air from outside the structure 502 through the input vents 501 and into the underlying attic space. In this configuration, the air drawn in through input vents 501 may force air within the attic space through the output vents 503 to the surrounding environment. As discussed in more detail below, the flow rate of air through the attic space may be selectively controlled by control circuitry depending on a desired attic space temperature. Further, input vents 501 and output vents 503 may be controlled to open, close, partially open, and/or partially close, to regulate the flow rate of air therethrough. The attic space may include one or more sensors, for example, RF sensors, configured to provide a signal to the control circuitry such that other components of an HVAC system may be regulated based on the provided signal.

[0073] Figure 5A illustrates attic space ventilation system 500 configured to operate in a winter day application. In this application, the system 500 may be controlled to cycle air through the attic space when the air temperature within the attic space is greater than about 80 degrees Fahrenheit. The attic space ventilation system 500 may also be controlled to not cycle air through the attic space when the air temperature within the attic space is less than about 80 degrees Fahrenheit in order to maintain a desired temperature within the structure 502. The attic space ventilation system 500 may be configured to not cycle air through the attic space by not operating the one or more fans and/or by closing off the input vents 501 and output vents 503.

[0074] Figure 5B illustrates attic space ventilation system 500 configured to operate in a summer night application. During a summer night, an HVAC system may cool the structure 502 by pressurizing the structure 502 with outside air that is cooler than air within the structure 502 as discussed above with reference to Figure 1. In such a configuration, it is desirable to exhaust air from a main space of the structure 502 to the attic space and exhaust air from the attic space through outlet vents 503 to the surrounding environment. Thus, in one implementation, it may be desirable to not draw air in through input vents 501 during a summer night so as to not interfere with a process of cooling structure 502. However, an overall control system that may include control circuitry may control the attic space ventilation system and any other system configured to cool the structure 502 to limit the overall energy required to cool the structure 502 to a desired temperature. Thus, in some implementations the attic space ventilation system 500 may be configured to cycle air through an attic space during a summer night.

[0075] Figure 5C illustrates attic space ventilation system 500 configured to operate in a summer day application. During a summer day, a sensor within the attic space may determine the temperature of air contained within the attic space. If the temperature of the air within the attic space is above about 80 degrees Fahrenheit, the attic space ventilation system 500 may be configured to cool the attic space by exhausting relatively warm air through outlet vents 503 while drawing in relatively cooler air from outside the structure 502 through input vents 501. Conversely, if the temperature within the attic space is below about 80 degrees Fahrenheit, the attic space ventilation system 500 may be controlled by control circuitry to not cycle air through the attic space.

[0076] As discussed above, some embodiments disclosed herein relate to multiplatform HVAC control systems for various structures, including for example, commercial structures. Certain structures, for example, restaurants (e.g., coffee shops), include abundant sources of air that includes significant amounts of thermal energy and/or water. As discussed in more detail below, the thermal energy may be harnessed to decrease the amount of energy required for HVAC and/or hot water heating in such structures. Additionally, the water may be harnessed to decrease the amount of water supplied by other sources (e.g., public utility companies). In some embodiments, a multiplatform HVAC control system may be configured to harness waste heat during winter months to provide heating capabilities to one or more spaces within a structure. In some embodiments, a multiplatform HVAC control system may be configured to harness waste heat during summer months to heat water for domestic use. In some embodiments, a multiplatform HVAC control system may be configured to draw water from one or more sources of waste heat to use the drawn water for various applications.

[0077] Figure 6 schematically illustrates a hydronic system used in connection with one embodiment of a multiplatform control system. A hydronic system can comprise a variety of components configured for, among other things, collection, generation, and distribution of heat within a structure as well as between the interior volume of a structure and the structure's surroundings. Components of a hydronic system can, for example, be further configured for temperature control and humidity control of air. As depicted in Figure 6, one exemplary embodiment of a hydronic system comprises a heat pump 610. A heat pump 610 can be an air-to-air heat pump, an air-to-liquid heat pump, or any other configuration of heat pump. A heat pump can be configured to transfer heat from a heat source to a heat sink. A heat pump can function by manipulating the pressure of a working liquid to control the temperature of the working liquid and to thereby facilitate transfer of heat from a heat source to a heat sink. A heat pump can comprise a compressor for increasing the pressure of the working fluid and an expansion valve for decreasing the pressure of a working fluid. A heat pump can further comprise an evaporator for absorbing heat from a heat source and a condenser for transferring heat to a heat sink.

[0078] In some embodiments, a heat pump 610 can be configured to pump heat from air surrounding the heat pump into another area or medium. A heat pump 610 can also be configured, for example, to remove moisture from the air. In some embodiments, a heat pump 610 can have evaporator coils located in thermal contact with air surrounding the heat pump and condenser coils located in thermal contact with a cooling liquid. In one embodiment of a heat pump 610, the cooling liquid can be water used for domestic and heating purposes.

[0079] A hydronic system can further comprise a plurality of tanks. These tanks can, for example, store water used to cool the condenser coils of the heat pump 610. In some embodiments, this water can be sufficiently heated to be used as domestic hot water or to be used in heating. Figure 6 depicts a first domestic tank 620, a second domestic tank 630, and a hydronic tank 640. As depicted in Figure 6, a first or second domestic tank 620, 630, or both tanks, can be connected with the some aspects of a heat pump 610. In one embodiment, liquid from the first and/or second domestic tank 620, 630 is thermally connected with the condenser coils of the heat pump 610. The first and/or second domestic tank 620, 630 can additionally be thermally connected with other components of a heat pump 610, such as, for example, the compressor, the expansion valve, or any other component that generates heat. This thermal connection can be used to simultaneously heat the liquid from the first and/or second domestic tank 620, 630 and to assist in cooling the components with which the first and/or second domestic tank 620, 630 are thermally connected. In some embodiments, the first and/or second domestic tank 620, 630 can be configured with electric backup heating elements 622, 632. The electric backup heating elements 622, 632 can maintain the desired water temperature when the heat pump 610 is not sufficiently heating the water. As depicted in Figure 6, the hydronic system can include a supply of cold water, for example, a 1 and ½ inch diameter pipe.

[0080] In some embodiments, one or more of the tanks can be configured for use as a heat exchanger, for example, the second domestic tank 630 can be configured for use as a heat exchanger. In some aspects of a tank configured for use as a heat exchanger, the tank can comprise a cold liquid inlet, a dip tube, a cold liquid outlet, and a warm liquid inlet. In some configurations, a tank can be configured with a cold liquid outlet. In some embodiments, the cold liquid outlet can be located towards the bottom of the tank. The cold liquid outlet can fluidly connect to an air-to-water heat pump. In some embodiments, the cold liquid outlet can fluidly connect to an air-to-water heat pump through at least one pump configured to pressurize the liquid. In some further embodiments in which a tank is configured for use as a heat exchanger, the heat pump can additionally fluidly connect with the warm water inlet of the tank. In some embodiments, this warm water inlet can be located towards the top of the tank.

[0081] A tank configured for use as a heat exchanger can further include a cold liquid inlet configured for allowing ingress of cold liquid into the tank. In some embodiments, the cold liquid inlet can be located towards the bottom of the tank. In alternative embodiments, the cold liquid inlet can be located towards the top of the tank and fluidly connected with the bottom of the tank by a dip tube. A person skilled in the art will recognize that the liquid inlets and outlets can be positioned in a variety of locations in the tank. A person of skill in the art will further recognize that fluid connection of cold liquid inlets to bottom regions of the tank and warm liquid inlets to upper regions of the tank can assist in tank liquid temperature stratification. A person of skill in the art will further recognize that location of the cold liquid outlet in bottom regions of the tank can assist in drawing cool liquid from the tank.

[0082] In tanks configured for use as a heat exchanger, liquid egresses the tank through the cold liquid outlet. The liquid, in some embodiments, passes through a heat exchanger, where the liquid can act as either a heat sink or heat source. Liquid can then, for example, return to the tank where the liquid can exchange heat with the surrounding environment.

[0083] Liquid in the first and/or second domestic tank 620, 630 can be heated to a desired temperature. In some embodiments of a first and/or second domestic tank 620, 630, liquid can be heated to a temperature between 50 and 500 degrees Fahrenheit, between 100 and 200 degrees Fahrenheit, or between 140 and 150 degrees Fahrenheit. A person skilled in the art will recognize that the temperature of the water depends on user needs.

[0084] In embodiments in which the heated liquid in the first and/or second domestic tank 620, 630 is water, the water from the first and/or second domestic tank 620, 630 can be used for domestic hot water purposes, including, for example, cooking, drinking, or cleaning.

[0085] A hydronic tank 640 can also store heated liquid. A hydronic tank 640 can be thermally connected with a heat pump 610 or with liquid that is thermally connected with a heat pump 610. In Figure 6, a heat exchanger 642 thermally connects liquid from the hydronic tank 640 with liquid from the first and/or second domestic tank 620, 630. Through this thermal connection, liquid from the first and/or second domestic tank 620, 630 transfers heat from the heat pump to the liquid of the hydronic tank 640.

[0086] A hydronic tank 640 can also be thermally connected, directly and/or indirectly, with one or more hydronic coils. In some embodiments, hydronic coils can be configured to transfer heat between the liquid from the hydronic tank 640 and another medium. As depicted in Figure 6, hydronic tank 640 is thermally connected with a first hydronic coil 646, a second hydronic coil 648, a third hydronic coil 650, a fourth hydronic coil 652, and a fifth hydronic coil 654. The different hydronic coils 646, 648, 650, 652, 654 can be configured to transfer heat to different areas. As depicted in Figure 6, the first hydronic coil 646 can be configured to transfer heat to a dining seating area of a restaurant, a fourth hydronic coil 652 can be configured to transfer heat to air vented from a heat pump, including heat pump 610, and a fifth hydronic coil 654 can be configured to transfer to a heat pump and/or to the dining room of a restaurant.

[0087] The different hydronic coils 646, 648, 650, 652, 654 can be uniquely or integrally thermally connected to a hydronic tank 640. In some embodiments, the hydronic tank 640 can be fluidly connected to the different hydronic coils 646, 648, 650, 652, 654. Figure 6 depicts one embodiment in which the hydronic coils 646, 648, 650, 652, 654 are thermally connected to the hydronic tank 640 by heat exchanger 642. As depicted in Figure 6, heat can be transferred from the liquid in the hydronic tank to liquid circulated through the hydronic coils 646, 648, 650, 652, 654 through a heat exchanger 642.

[0088] A hydronic tank 640 can additionally be directly or indirectly thermally connected with heat dump 644. As depicted in Figure 6, heat dump 644 can be thermally connected through heat exchanger 642 with hydronic tank 640. A heat dump 644 can be used to maintain an upper threshold of liquid temperature in hydronic tank 640. In some embodiments, a heat dump 644 can comprise a heat exchanger for transferring heat from a hydronic tank 640 to another medium. As depicted in Figure 6, one example of a heat dump can transfer heat between a hydronic tank 640 and air.

[0089] In addition to the specifically discussed features of a hydronic system, a hydronic system includes tubing connecting components of a hydronic system, valves, sensors, wires, electronic control equipment, as well as a variety of other known components. A hydronic system may be additionally used in connection with one or more additional heat pumps. In some embodiments, additional heat pumps may be configured to provide additional heating or cooling to air or liquid in connection with the hydronic system. In one embodiment, a hydronic system may be used in connection with an air-to-air heat pump located in a dining area and a second air-to-air heat pump located in proximity to heat pump 610. A person skilled in the art will recognize that a hydronic system is not limited to the specific embodiments discussed above, but includes a variety of components in a variety of combinations.

[0090] Figures 7A-7L are block diagrams schematically illustrating various applications of the hydronic system of Figure 6. Figure 7A schematically illustrates a first example application for the hydronic system of Figure 6 for situations when the temperature for air outside the structure is less than about 35 degrees Fahrenheit (e.g., during winter month). In this application a thermostat within the structure may call for the structure interior, or portions thereof, to maintain a temperature between approximately 70 to 75 degrees Fahrenheit as shown by block 702a. If this temperature has been achieved, control circuitry may call for the system to idle as depicted in block 700a. Control circuitry may receive this input information and call for information from one or more sensors as to whether the temperature of air outside the structure is less than approximately 65 degrees Fahrenheit as shown by block 704a. The control circuitry may then call for information from one or more sensors as to whether the relative humidity of air outside the structure is less than about 30% as indicated by block 710a. If either or both of these parameters are not met, the control circuitry may call for a heat pump to run in order to heat the structure as indicated by block 706a. For example, if the outside air temperature is greater than approximately 65 degrees Fahrenheit and the relative humidity is less than approximately 30%, then an air circulation system opens and uses a supply fan to circulate external air into the structure as shown in block 706a. External air can then, in some embodiments, be raised to the desired temperature range through the use of an air-to-air heat pump or by hot air solar heating as depicted in block 708a.

[0091] On the other hand, if both of the parameters are met, the control circuitry may call for aspects of a heat pump, such as an air-to-air heat pump with a hydronic coil supply to run. If both parameters are met, control circuitry may call for information from one or more sensors as to whether the liquid temperature in a hot liquid tank is greater than approximately 130 degrees Fahrenheit as depicted in block 714a. If the sensors indicate that the temperature of the tank is greater than approximately 130 degrees Fahrenheit, as depicted in block 712a, the control circuitry, in some embodiments, may call for the fan of an air-to-air heat pump to run, and for the compressor of the heat pump to be off.

[0092] Figure 7B schematically illustrates a second example application for the hydronic system of Figure 6 for applications in a kitchen in situations when the temperature for air outside the structure is less than about 35 degrees Fahrenheit (e.g., during winter month). In this application a thermostat within the structure may call for the structure interior, or portions thereof, to maintain a set heat of approximately 65 degrees Fahrenheit as shown by block 702b. If this temperature has been achieved, control circuitry may call for the system to idle as depicted in block 700b. Control circuitry may receive this input information and call for information from one or more sensors as to whether the temperature of air outside the structure is less than approximately 65 degrees Fahrenheit as shown by block 704b. The control circuitry may then call for information from one or more sensors as to whether the relative humidity of air outside the structure is less than about 30% as indicated by block 710b. If either or both of these parameters are not met, the control circuitry may call for a heat pump to run in order to heat the structure as indicated by block 706b. For example, if the outside air temperature is greater than approximately 65 degrees Fahrenheit and the relative humidity is less than approximately 30%, then an air circulation system opens and uses a supply fan to circulate external air into the structure as shown in block 706b. External air can then, in some embodiments, be raised to the desired temperature range through the use of, for example, hot air solar heating as depicted in block 708b.

[0093] On the other hand, if both of the parameters are met, the control circuitry may call for aspects of a heat pump, such as an air-to-air heat pump with a hydronic coil supply to run. If both parameters are met, control circuitry may call for information from one or more sensors as to whether the liquid temperature in a hot liquid tank is greater than approximately 110 to 130 degrees Fahrenheit as depicted in block 714b. If the sensors indicate that the temperature of the tank is greater than approximately 110 to 130 degrees Fahrenheit, as depicted in block 712b, the control circuitry, in some embodiments, may call for the fan of an air-to-air heat pump to run, and for the compressor of the heat pump to be off.

[0094] Figure 7C schematically illustrates a third example application for the hydronic system of Figure 6 for applications in a kitchen in situations for cloudy and/or rainy weather (e.g., during winter month). In this application, heat can be recovered from the kitchen area by the air-to-water heat pump and distributed as directed. In this application a thermostat within the structure may call for the structure interior, or portions thereof, to maintain a set heat of approximately 65 degrees Fahrenheit as shown by block 702c. If this temperature has been achieved, control circuitry may call for the system to idle as depicted in block 700c. If on the other hand, this temperature has not been achieved, the Control circuitry may receive this input information and call for cooling by the air-to-water heat pump as shown in block 720C.

[0095] Running the air-to-water heat pump extract moisture from the air, which moisture can be recovered as shown in block 722c. In some embodiments, control circuitry can manage use or purification and use of water recovered from the air by the air-to-water heat pump. As shown in block 724c, water recovered from the dehumidification function can be purified, and as shown in block 726c, this recovered water can be used in domestic applications, like, for example, use in toilets.

[0096] In applications in which the air-to-water heat pump is running, control circuitry can further direct heating of water within at least one domestic hot water tank and/or at least one hydronic heat tank. As depicted in Figure 7C, control circuitry may call for information from one or more sensors as to the temperature of the at least one domestic hot water tank. When the temperature is below a preset value, heat can be added to the domestic hot water tank. Conversely, when the temperature is above some preset value, heat is not added to the domestic hot water tank. As depicted in block 728c when the sensor indicates that the temperature of the domestic hot water tank is above approximately 135 degrees Fahrenheit, heat is not added to the water of the domestic hot water tank. In addition to determining the temperature of the domestic hot water tank, control circuitry can call for information from one or more sensors as to the temperature of at least one hydronic hot water tank. When the temperature is below a preset value, heat can be added to the hydronic hot water tank. Conversely, when the temperature is above some preset value, heat is not added to the hydronic hot water tank. As depicted in block 730c when the sensor indicates that the temperature of the domestic hot water tank is below approximately 110 degrees Fahrenheit, heat is added to the water of the hydronic hot water tank. Conversely, when the temperature is above approximately 130 degrees Fahrenheit, heat is not added to the hydronic hot water tank. In addition to adding heat to at least one domestic tank or at least one hydronic tank, some embodiments can be configured with features to cool these tanks if the temperatures exceed a threshold. As depicted in block 744C, excess heat within either the at least one domestic tank or at least one hydronic can be dissipated with a heat dump.

[0097] Water from the hydronic tank can be used for distributing heat throughout the structure. In some embodiments, control circuitry may call for hot water from the hydronic tank to heat a hydronic coil in thermal communication with air exiting the air-to-water heat pump and to thereby reheat that exit-air as depicted in block 732c. The amount of reheating of exit air can be controlled by a thermostat and related control circuitry, and can, as depicted in block 734c, be maintained at approximately 70 degrees Fahrenheit. The control circuitry can additionally call for heating of additional spaces of a structure. As depicted in block 736c, control circuitry may call for information from one or more sensors relating to the temperature of the dining room. As further indicated in 736c, when temperatures are outside of some range, in this case between approximately 70 and 75 degrees Fahrenheit, hot water from a hydronic tank can be supplied to hydronic coils in an air-to-air heat pump as depicted in block 738c. Control circuitry can direct the fan of the air-to-air heat pump to run and to thereby circulate room air around the heated hydronic coils and heat the room. Similarly, if a temperature within a second temperature zone is below a set point value, as indicated as approximately 65 degrees Fahrenheit in block 740c, hot water from the hydronic tank can be supplied to hydronic coils in other air-to-air heat pump or alternative heat transfer devices.

[0098] Figure 7D schematically illustrates a fourth example application for the hydronic system of Figure 6 for applications in a kitchen in situations with outside temperatures above approximately 80 degrees Fahrenheit, relative humidity below approximately 30%, and clear skies (e.g., during summer transitional month). In this application, heat can be recovered by the air-to-water heat pump from the kitchen and solar energy can be collected from outdoors. In this application a thermostat within the structure may call for the structure interior, or portions thereof, to maintain a set heat of approximately 65 degrees Fahrenheit as shown by block 702d. If this temperature has been achieved, control circuitry may call for the system to idle as depicted in block 700d. If on the other hand, this temperature has not been achieved, the Control circuitry may receive this input information relating to outside temperature and conditions, and if the outside temperature and conditions exceed some predetermined threshold, which as depicted in 704d can be approximately 80 degrees Fahrenheit, call for cooling by the air-to-water heat pump as shown in block 720d.

[0099] Running the air-to-water heat pump extract moisture from the air, which moisture can be recovered as shown in block 722d. In some embodiments, control circuitry can manage use or purification and use of water recovered from the air by the air-to-water heat pump. As shown in block 724d, water recovered from the dehumidification function can be purified, and as shown in block 726d, this recovered water can be used in domestic applications, like, for example, use in toilets.

[0100] In applications in which the air-to-water heat pump is running, control circuitry can further direct heating of water within at least one domestic hot water tank and/or at least one hydronic heat tank. As depicted in Figure 7D, control circuitry may call for information from one or more sensors as to the temperature of the at least one domestic hot water tank. When the temperature is below a preset value, heat can be added to the domestic hot water tank. Conversely, when the temperature is above some preset value, heat is not added to the domestic hot water tank. As depicted in block 728d when the sensor indicates that the temperature of the domestic hot water tank is above approximately 135 degrees Fahrenheit, heat is not added to the water of the domestic hot water tank. In some configurations, heat to the domestic hot water tank can be provided from external solar sources as depicted in block 750d. In some embodiments, the external solar sources may provide sufficient energy to attain and maintain adequate temperatures in the at least one domestic hot water tank and/or the at least one hydronic water tank. Alternatively, the air-to-water heat pump can wholly or partially supplement solar energy in maintaining the liquid temperature in these tanks.

[0101] In addition to determining the temperature of the domestic hot water tank, control circuitry can call for information from one or more sensors as to the temperature of the at least one hydronic hot water tank. When the temperature is below a preset value, heat can be added to the hydronic hot water tank. Conversely, when the temperature is above some preset value, heat is not added to the hydronic hot water tank. As depicted in block 730d when the sensor indicates that the temperature of the domestic hot water tank is below approximately 110 degrees Fahrenheit, heat is added to the water of the hydronic hot water tank. Conversely, when the temperature is above approximately 130 degrees Fahrenheit, heat is not added to the hydronic hot water tank.

[0102] Water from the hydronic tank can be used for distributing heat throughout the structure. In some embodiments, control circuitry may call for hot water from the hydronic tank to heat a hydronic coil in thermal communication with air exiting the air-to-water heat pump and to thereby reheat that exit-air as depicted in block 732d. The amount of reheating of exit air can be controlled by a thermostat and related control circuitry, and can, as depicted in block 734d, be maintained at approximately 70 degrees Fahrenheit. The control circuitry can additionally call for heating of additional spaces of a structure. As depicted in block 736d, control circuitry may call for information from one or more sensors relating to the temperature of the dining room. As further indicated in 736d, when temperatures are outside of some range, in this case between approximately 65 and 75 degrees Fahrenheit, hot water from a hydronic tank can be supplied to hydronic coils in an air-to-air heat pump as depicted in block 738d. Control circuitry can direct the fan of the air-to-air heat pump to run and to thereby circulate room air around the heated hydronic coils and heat the room. Similarly, if a temperature within a second temperature zone is below a set point value, hot water from the hydronic tank can be supplied to hydronic coils in other air-to-air heat pump or alternative heat transfer devices. Additionally, if temperatures are above a predetermined threshold in another area of the structure, for example, above approximately 78 degrees Fahrenheit as depicted in block 740d, control circuitry can call for cooling and an air-to-air heat pump thermally connected to the air of that warm area can run as depicted in block 742d.

[0103] Figure 7E schematically illustrates a fifth example application for the hydronic system of Figure 6 for applications in a kitchen in situations with outside temperatures above approximately 80 degrees Fahrenheit, relative humidity above approximately 30%, and clear skies (e.g., during summer transitional month). In this application, heat can be recovered by the air-to-water heat pump from the kitchen and solar energy can be collected from outdoors. In this application a thermostat within the structure may call for the structure interior, or portions thereof, to maintain a set heat of approximately 65 degrees Fahrenheit as shown by block 702e. If this temperature has been achieved, control circuitry may call for the system to idle as depicted in block 700e. If on the other hand, this temperature has not been achieved, the control circuitry may receive this input information relating to outside temperature and conditions, and if the outside temperature and conditions exceed some predetermined threshold, which as depicted in 704e can be approximately 80 degrees Fahrenheit, call for cooling by the air-to-water heat pump as shown in block 720e. Similarly, if this temperature has been achieved, but the relative humidity within the building is above 30%, as depicted in block 703e, the control circuitry can call for dehumidification by the air-to water heat pump as shown in block 720e.

[0104] Running the air-to-water heat pump extracts moisture from the air, which moisture can be recovered as shown in block 722e. In some embodiments, control circuitry can manage use or purification and use of water recovered from the air by the air-to-water heat pump. As shown in block 724e, water recovered from the dehumidification function can be purified, and as shown in block 726e, this recovered water can be used in domestic applications, like, for example, use in toilets.

[0105] In applications in which the air-to-water heat pump is running, control circuitry can further direct heating of water within at least one domestic hot water tank and/or at least one hydronic heat tank. As depicted in Figure 7E, control circuitry may call for information from one or more sensors as to the temperature of the at least one domestic hot water tank. When the temperature is below a preset value, heat can be added to the domestic hot water tank. Conversely, when the temperature is above some preset value, heat is not added to the domestic hot water tank. As depicted in block 728e when the sensor indicates that the temperature of the domestic hot water tank is above approximately 135 degrees Fahrenheit, heat is not added to the water of the domestic hot water tank. In some configurations, heat to the domestic hot water tank can be provided from external solar sources as depicted in block 750e. In some embodiments, the external solar sources may provide sufficient energy to attain and maintain adequate temperatures in the at least one domestic hot water tank and/or the at least one hydronic water tank. Alternatively, the air-to-water heat pump can wholly or partially supplement solar energy in maintaining the liquid temperature in these tanks.

[0106] In addition to determining the temperature of the domestic hot water tank, control circuitry can call for information from one or more sensors as to the temperature of at least one hydronic hot water tank. When the temperature is below a preset value, heat can be added to the hydronic hot water tank. Conversely, when the temperature is above some preset value, heat is not added to the hydronic hot water tank. As depicted in block 730e when the sensor indicates that the temperature of the domestic hot water tank is below approximately 110 degrees Fahrenheit, heat is added to the water of the hydronic hot water tank. Conversely, when the temperature is above approximately 130 degrees Fahrenheit, heat is not added to the hydronic hot water tank. In addition to adding heat to the at least one domestic tank or at least one hydronic tank, some embodiments can be configured with features to cool these tanks if the temperatures exceed a threshold. As depicted in block 744e, excess heat within either the at least one domestic tank or at least one hydronic can be dissipated with a heat dump.

[0107] Water from the hydronic tank can be used for distributing heat throughout the structure. In some embodiments, control circuitry may call for hot water from the hydronic tank to heat a hydronic coil in thermal communication with air exiting the air-to-water heat pump and to thereby reheat that exit-air. Alternatively, if reheating is not desired, hot water from a hot water tank is not used to heat a hydronic coil in thermal communication with air exiting the air-to water heat pump. The reheating of exit air can be controlled by a thermostat and related control circuitry, and can, as depicted in block 734e, be maintained at approximately 70 degrees Fahrenheit. As depicted in block 732e, if when temperatures are above a threshold, reheating is turned off and cooling is turned on.

[0108] The control circuitry can additionally call for heating or cooling of additional spaces of a structure. As depicted in block 736e, control circuitry may call for information from one or more sensors relating to the temperature of the dining room. As further indicated in 736e, when temperatures are above some range, in this case between approximately 65 and 75 degrees Fahrenheit, the control circuitry can stop flow of hot water to hydronic coils in an air-to-air heat pump and direct the running of the air-to-air heat pump to cool the area as depicted in block 738e. Similarly, if a temperature within a second temperature zone is above a set point value, for example above approximately 78 degrees Fahrenheit as depicted in block 740e, hot water from the hydronic tank can be cut-off from hydronic coils of an air-to-air heat pump and control circuitry can call for cooling and for the running of an air-to-air heat pump thermally connected to the air of that warm area as depicted in block 742e.

[0109] Figure 7F schematically illustrates a sixth example application for the hydronic system of Figure 6 for applications in situations with outside temperatures above approximately 65 degrees Fahrenheit and with relative humidity below approximately 30% (e.g., during summer transitional month). In this application, heat can be recovered by the air-to-water heat pump from the kitchen and solar energy can be collected. In this application a thermostat within the structure may call for the structure interior, or portions thereof, to maintain a set heat of approximately 65 to 70 degrees Fahrenheit as shown by block 702f. In some configurations, the control circuitry can additionally receive information relating to the relative humidity inside the structure. As depicted in block

703f, the information relating to relative humidity can also result in the control circuitry calling for dehumidification or cooling. Thus, in some embodiments, for example, cooling begins when the internal temperature of the structure, or some portions thereof, exceeds a threshold, or when the internal relative humidity of the structure, or some portions thereof, exceeds a threshold. If the desired internal conditions have been achieved, control circuitry may call for the system to idle as depicted in block 700f. If on the other hand, the desired internal conditions have not been achieved, the control circuitry may receive input information relating to outside temperature and conditions and based on this information related to outside temperatures, cool through a variety of means. If the outside temperature is between approximately 65 and 90 degrees Fahrenheit, as depicted in 704f, the control circuitry can call for cooling. In some embodiments, control circuitry can manage an air-to-air heat pump in response to information received relating to inside an outside temperatures and conditions. In one embodiment, and as depicted in block 752f, the control circuitry can request the economizer damper on an air-to-air heat pump to open, for the supply fan to run, for the damper to solar hot air to close, and for the economizer damper to outside air to close. The control circuitry can further call for, as depicted in block 754f, the indirect or direct pre-cooler used in connection with the air-to-air heat pump to start, the supply fan to start, the compressor on the air-to-air heat pump to stop, and for the opening of the damper for indirect or direct cooling in the economizer. In other embodiments, the control circuitry can call for any combination of the above mentioned conditions as well as combinations of the opposite condition (e.g. opened and closed).

[0110] Additionally, the control circuitry may receive input information relating to outside conditions such as the relative humidity. As depicted in block 705f, when the relative humidity is greater than approximately 30%, call for cooling by the air-to-water heat pump as shown in block 720f.

[0111] Running the air-to-water heat pump extracts moisture from the air, which moisture can be recovered. In some embodiments, control circuitry can manage use or purification and use of water recovered from the air by the air-to-water heat pump. Water recovered from the dehumidification function can be purified, and this recovered water can be used in domestic applications, like, for example, use in toilets.

[0112] In applications in which the air-to-water heat pump is running, control circuitry can further direct heating of water within at least one domestic hot water tank and/or at least one hydronic heat tank. As depicted in Figure 7F, control circuitry may call for information from one or more sensors as to the temperature of the at least one domestic hot water tank. When the temperature is below a preset value, heat can be added to the domestic hot water tank. Conversely, when the temperature is above some preset value, heat is not added to the domestic hot water tank. As depicted in block 728f when the sensor indicates that the temperature of the domestic hot water tank is above approximately 135 degrees Fahrenheit, heat is not added to the water of the domestic hot water tank.

[0113] In addition to determining the temperature of the domestic hot water tank, control circuitry can call for information from one or more sensors as to the temperature of the at least one hydronic hot water tank. When the temperature is below a preset value, heat can be added to the hydronic hot water tank. Conversely, when the temperature is above some preset value, heat is not added to the hydronic hot water tank. As depicted in block 730f when the sensor indicates that the temperature of the domestic hot water tank is below approximately 110 degrees Fahrenheit, heat is added to the water of the hydronic hot water tank. Conversely, when the temperature is above approximately 130 degrees Fahrenheit, heat is not added to the hydronic hot water tank. In addition to adding heat to the at least one domestic tank or at least one hydronic tank, some embodiments can be configured with features to cool these tanks if the temperatures exceed a threshold. As depicted in block 744f, excess heat within either the at least one domestic tank or at least one hydronic can be dissipated with a heat dump.

[0114] Water from the hydronic tank can be used for distributing heat throughout the structure. In some embodiments, control circuitry may call for hot water from the hydronic tank to heat a hydronic coil in thermal communication with air exiting the air-to-water heat pump and to thereby reheat that exit-air. Alternatively, if reheating is not desired, hot water from a hot water tank is not used to heat a hydronic coil in thermal communication with air exiting the air-to water heat pump. In other embodiments, hydronic coils can be configured for duct heating. Control circuitry can call for flow of hot water to heat areas as desired. In some embodiments, water is circulated through hydronic coils for heating, in other embodiments in which heating is not desired, and as depicted in blocks 756f and 758f, water is not circulated through hydronic coils and no heating occurs.

[0115] In some embodiments, control circuitry can call for information relating to temperatures within specific areas of the structure. When these temperatures exceed some threshold, for example, approximately 78 degrees Fahrenheit as depicted in block 742f, an air-to-air heat pump can locally cool air. On the other hand, if local temperatures are below some threshold, the control circuitry can call for the air-to-air heat pump to idle as depicted in block 700f.

[0116] Additionally, some embodiments can include solar heating features. In some configurations, a solar heating feature can include a sensor to monitor and/or control the temperature of the solar heating feature. Thus, in some embodiments, when a solar heating temperature exceeds a threshold temperature, the solar heating feature can be cooled, for example, by running a fan. As depicted in block 760f, a fan can be used to maintain the temperature of a solar heating feature, the fan running when the temperature exceeds some threshold temperature.

[0117] Figure 7G schematically illustrates a seventh example application for the hydronic system of Figure 6 for applications in situations with outside temperatures above approximately 65 degrees Fahrenheit and with relative humidity below approximately 30% (e.g., during summer transitional month). In this application, heat can be recovered by the air-to-water heat pump from the kitchen and solar energy can be collected. In this application a thermostat within the structure may call for the structure interior, or portions thereof, to maintain a set heat of approximately 65 to 70 degrees Fahrenheit as shown by block 702g. In some embodiments, this may be a central thermostat, or a thermostat unique to a specific area within the structure. In some configurations, the control circuitry can additionally receive information relating to the relative humidity inside the structure. As depicted in block 703g, the information relating to relative humidity can also result in the control circuitry calling for dehumidification or cooling. Thus, in some embodiments, for example, cooling begins when the internal temperature of the structure, or some portions thereof, exceeds a threshold, or when the internal relative humidity of the structure, or some portions thereof, exceeds a threshold. If the desired internal conditions have been achieved, control circuitry may call for the system to idle as depicted in block 700g. If on the other hand, the desired internal conditions have not been achieved, the control circuitry may receive input information relating to outside temperature and conditions, and based on this information related to outside temperatures and conditions, cool through a variety of means. If the outside temperature is between approximately 65 and 90 degrees Fahrenheit, as depicted in 704g, the control circuitry can call for cooling. In some embodiments, control circuitry can manage an air-to-air heat pump in response to information received relating to inside an outside temperatures and conditions. In one embodiment, and as depicted in block 752g, the control circuitry can request the economizer damper on an air-to-air heat pump to open, for the supply fan to run, for the damper to hot air to close, and for the economizer damper to outside air to close. The control circuitry can further call for, as depicted in block 754g, the indirect or direct pre-cooler used in connection with the air-to-air heat pump to start, the supply fan to start, the compressor on the air-to-air heat pump to stop, and for the opening of the damper for indirect or direct cooling in the economizer. In other embodiments, the control circuitry can call for any combination of the above mentioned conditions as well as combinations of the opposite condition (e.g. opened and closed).

[0118] Additionally, the control circuitry may receive input information relating to outside conditions such as the relative humidity. As depicted in block 705g, when the relative humidity is greater than approximately 30%, call for cooling by the air-to-water heat pump as shown in block 720g.

[0119] Running the air-to-water heat pump extracts moisture from the air, which moisture can be recovered. In some embodiments, control circuitry can manage use or purification and use of water recovered from the air by the air-to-water heat pump. Water recovered from the dehumidification function can be purified, and this recovered water can be used in domestic applications, like, for example, use in toilets.

[0120] In applications in which the air-to-water heat pump is running, control circuitry can further direct heating of water within at least one domestic hot water tank and/or at least one hydronic heat tank. As depicted in Figure 7G, control circuitry may call for information from one or more sensors as to the temperature of the at least one domestic hot water tank. When the temperature is below a preset value, heat can be added to the domestic hot water tank. Conversely, when the temperature is above some preset value, heat is not added to the domestic hot water tank. As depicted in block 728g when the sensor indicates that the temperature of the domestic hot water tank is above approximately 135 degrees Fahrenheit, heat is not added to the water of the domestic hot water tank.

[0121] In addition to determining the temperature of the domestic hot water tank, control circuitry can call for information from one or more sensors as to the temperature of the at least one hydronic hot water tank. When the temperature is below a preset value, heat can be added to the hydronic hot water tank. Conversely, when the temperature is above some preset value, heat is not added to the hydronic hot water tank. As depicted in block 730g when the sensor indicates that the temperature of the domestic hot water tank is below approximately 110 degrees Fahrenheit, heat is added to the water of the hydronic hot water tank. Conversely, when the temperature is above approximately 130 degrees Fahrenheit, heat is not added to the hydronic hot water tank. In addition to adding heat to the at least one domestic tank or at least one hydronic tank, some embodiments can be configured with features to cool these tanks if the temperatures exceed a threshold. As depicted in block 744g, excess heat within either the at least one domestic tank or at least one hydronic can be dissipated with a heat dump.

[0122] Water from the hydronic tank can be used for distributing heat throughout the structure. In some embodiments, control circuitry may call for hot water from the hydronic tank to heat a hydronic coil in thermal communication with air exiting the air-to-water heat pump and to thereby reheat that exit-air. Alternatively, if reheating is not desired, hot water from a hot water tank is not used to heat a hydronic coil in thermal communication with air exiting the air-to water heat pump. In other embodiments, hydronic coils can be configured for duct heating. Control circuitry can call for flow of hot water to heat areas as desired. In some embodiments, water is circulated through hydronic coils for heating, in other embodiments in which heating is not desired, and as depicted in blocks 756g and 758g, water is not circulated through hydronic coils and no heating occurs.

[0123] In some embodiments, control circuitry can call for information relating to temperatures within specific areas of the structure. When these temperatures exceed some threshold, for example, approximately 78 degrees Fahrenheit as depicted in block 742g, an air-to-air heat pump can locally cool air. On the other hand, if local temperatures are below some threshold, the control circuitry can call for the air-to-air heat pump to idle as depicted in block 700g.

[0124] Additionally, some embodiments can include solar heating features. In some configurations, a solar heating feature can include a sensor to monitor and/or control the temperature of the solar heating feature. Thus, in some embodiments, when a solar heating temperature exceeds a threshold temperature, the solar heating feature can be cooled, for example, by running a fan. As depicted in block 760g, a fan can be used to maintain the temperature of a solar heating feature, the fan running when the temperature exceeds some threshold temperature.

[0125] Figure 7H schematically illustrates a eighth example application for the hydronic system of Figure 6 for applications in situations with outside temperatures between approximately 65 and 90 degrees Fahrenheit (e.g., during summer transitional month). In this application, heat can be recovered by the air-to-water heat pump from the kitchen. In this application a thermostat within the structure may call for the structure interior, or portions thereof, to maintain a set heat of approximately 65 to 70 degrees Fahrenheit as shown by block 702h. In some embodiments, this may be a central thermostat, or a thermostat unique to a specific area within the structure. In some configurations, the control circuitry can additionally receive information relating to the relative humidity inside the structure. As depicted in block 703h, the information relating to relative humidity can also result in the control circuitry calling for dehumidification or cooling. Thus, in some embodiments, for example, cooling begins when the internal temperature of the structure, or some portions thereof, exceeds a threshold, or when the internal relative humidity of the structure, or some portions thereof, exceeds a threshold. If the desired internal conditions have been achieved, control circuitry may call for the system to idle as depicted in block 700h. If on the other hand, the desired internal conditions have not been achieved, the control circuitry may receive input information relating to outside temperature and conditions, and based on this information related to outside temperatures and conditions, cool through a variety of means. If the outside temperature is between approximately 65 and 90 degrees Fahrenheit, as depicted in 704h, the control circuitry can call for cooling. In some embodiments, control circuitry can manage an air-to-air heat pump in response to information received relating to inside an outside temperatures and conditions. In one embodiment, and as depicted in block 752h, the control circuitry can request the economizer damper on an air-to-air heat pump to open, for the supply fan to run, and for the damper to solar hot air to close. The control circuitry can further call for, as depicted in block 754h, the indirect or direct pre-cooler used in connection with the air-to-air heat pump to start, the supply fan to start, the compressor on the air-to-air heat pump to stop, and for the opening of the damper for indirect or direct cooling in the economizer. In other embodiments, the control circuitry can call for any combination of the above mentioned conditions as well as combinations of the opposite condition (e.g. opened and closed).

[0126] Additionally, the control circuitry may receive input information relating to outside conditions such as the relative humidity. As depicted in block 705h, when the relative humidity is greater than approximately 30%, call for cooling by the air-to-water heat pump as shown in block 720h.

[0127] Running the air-to-water heat pump extracts moisture from the air, which moisture can be recovered. In some embodiments, control circuitry can manage use or purification and use of water recovered from the air by the air-to-water heat pump. Water recovered from the dehumidification function can be purified, and this recovered water can be used in domestic applications, like, for example, use in toilets.

[0128] In applications in which the air-to-water heat pump is running, control circuitry can further direct heating of water within at least one domestic hot water tank and/or at least one hydronic heat tank. As depicted in Figure 7H, control circuitry may call for information from one or more sensors as to the temperature of the at least one domestic hot water tank. When the temperatures are below a preset value, heat can be added to the domestic hot water tank. Conversely, when the temperature is above some preset value, heat is not added to the domestic hot water tank. As depicted in block 728h when the sensor indicates that the temperature of the domestic hot water tank is below approximately 135 degrees Fahrenheit, heat is added to the water of the domestic hot water tank.

[0129] In addition to determining the temperature of the domestic hot water tank, control circuitry can call for information from one or more sensors as to the temperature of the at least one hydronic hot water tank. When the temperature is below a preset value, heat can be added to the hydronic hot water tank. Conversely, when the temperature is above some preset value, heat is not added to the hydronic hot water tank. As depicted in block 730h when the sensor indicates that the temperature of the domestic hot water tank is below approximately 110 degrees Fahrenheit, heat is added to the water of the hydronic hot water tank. Conversely, and as further depicted in block 730h, when the temperature is above approximately 130 degrees Fahrenheit, heat is not added to the hydronic hot water tank. In addition to adding heat to the at least one domestic tank or at least one hydronic tank, some embodiments can be configured with features to cool these tanks if the temperatures exceed a threshold. As depicted in block 744h, excess heat within the at least one domestic tank and/or the at least one hydronic can be dissipated with a heat dump.

[0130] Water from the hydronic tank can be used for distributing heat throughout the structure. In some embodiments, control circuitry may call for hot water from the hydronic tank to heat a hydronic coil in thermal communication with air exiting the air-to-water heat pump and to thereby reheat that exit-air. Alternatively, if reheating is not desired, hot water from a hot water tank is not used to heat a hydronic coil in thermal communication with air exiting the air-to water heat pump. In other embodiments, hydronic coils can be configured for duct heating. Control circuitry can call for flow of hot water to heat areas as desired. In some embodiments, water is circulated through hydronic coils for heating, in other embodiments in which heating is not desired, and as depicted in blocks 756h and 758h, water is not circulated through hydronic coils and no heating occurs.

[0131] In some embodiments, control circuitry can call for information relating to temperatures within specific areas of the structure. When these temperatures exceed some threshold, for example, approximately 78 degrees Fahrenheit an air-to-air heat pump can locally cool air. On the other hand, if local temperatures are below some threshold, for example, approximately 78 degrees Fahrenheit, as depicted in block 742h, the control circuitry can call for the air-to-air heat pump to idle as depicted in block 700h.

[0132] Additionally, some embodiments can include solar heating features. In some configurations, a solar heating feature can include a sensor to monitor and/or control the temperature of the solar heating feature. Thus, in some embodiments, when a solar heating temperature exceeds a threshold temperature, the solar heating feature can be cooled, for example, by running a fan. As depicted in block 760h, a fan can be used to maintain the temperature of a solar heating feature, the fan running when the temperature exceeds some threshold temperature.

[0133] Figure 7I schematically illustrates a ninth example application for the hydronic system of Figure 6 for applications in situations with outside temperatures between approximately 50 and 65 degrees Fahrenheit and relative humidity below approximately 30% (e.g., during summer transitional month in combination with a coastal or monsoon climate). In this application, the system can alternatively heat, cool, and dehumidify the structure as required to maintain comfortable temperatures and conditions In this application a thermostat within the structure may call for the structure interior, or portions thereof, to maintain a set temperature of approximately 70 to 75 degrees Fahrenheit as shown by block 702i. In some embodiments, this may be a central thermostat, or a thermostat unique to a specific area within the structure. In some configurations, the control circuitry can additionally receive information relating to the temperature and relative humidity at another location inside the structure. As depicted in block 703i, the information relating to conditions in this area can also result in the control circuitry calling for dehumidification, cooling, or heating. Thus, in some embodiments, for example, heating begins when the internal temperature of the structure or some portions thereof, drops below a threshold temperature. If the desired internal conditions have been achieved, control circuitry may call for the system to idle as depicted in block 700i. If on the other hand, the desired internal conditions have not been achieved, the control circuitry may receive input information relating to outside temperature and conditions, and based on this information related to outside temperatures and conditions, cool through a variety of means. If the outside temperature is between approximately 65 and 90 degrees Fahrenheit, as depicted in 704i, the control circuitry can call for heating. In some embodiments, control circuitry can manage an air-to-air heat pump in response to information received relating to inside an outside temperatures and conditions. In one embodiment, and as depicted in block 752i, the control circuitry can request the economizer damper on an air-to-air heat pump to open, for the supply fan to run, and for the damper to solar hot air to open. The control circuitry can further call for, as depicted in block 754i, the indirect or direct pre-cooler used in connection with the air-to-air heat pump to stop, the supply fan to start, the compressor on the air-to-air heat pump to stop, and for the closing of the damper for indirect or direct cooling in the economizer. This combination results in the circulation of warmed air. In other embodiments, the control circuitry can call for any combination of the above mentioned conditions as well as combinations of the opposite condition (e.g. opened and closed).

[0134] Additionally, the control circuitry may receive input information relating to outside conditions such as the relative humidity. As depicted in block 705i, when the relative humidity is greater than approximately 30%, call for cooling and dehumidification by the air-to-water heat pump as shown in block 720i.

[0135] Running the air-to-water heat pump extracts moisture from the air, which moisture can be recovered. In some embodiments, control circuitry can manage use or purification and use of water recovered from the air by the air-to-water heat pump.

Water recovered from the dehumidification function can be purified, and this recovered water can be used in domestic applications, like, for example, use in toilets.

[0136] In applications in which the air-to-water heat pump is running, control circuitry can further direct heating of water within at least one domestic hot water tank and/or at least one hydronic heat tank. As depicted in Figure 7I, control circuitry may call for information from one or more sensors as to the temperature of the at least one domestic hot water tank. When the temperatures are below a preset value, heat can be added to the domestic hot water tank. Conversely, when the temperature is above some preset value, heat is not added to the domestic hot water tank. As depicted in block 728i when the sensor indicates that the temperature of the domestic hot water tank is below approximately 135 degrees Fahrenheit, heat is added to the water of the domestic hot water tank.

[0137] In addition to determining the temperature of the domestic hot water tank, control circuitry can call for information from one or more sensors as to the temperature of the at least one hydronic hot water tank. When the temperature is below a preset value, heat can be added to the hydronic hot water tank. Conversely, when the temperature is above some preset value, heat is not added to the hydronic hot water tank. As depicted in block 730i when the sensor indicates that the temperature of the domestic hot water tank is below approximately 110 degrees Fahrenheit, heat is added to the water of the hydronic hot water tank. Conversely, and as further depicted in block 730i, when the temperature is above approximately 130 degrees Fahrenheit, heat is not added to the hydronic hot water tank as depicted in block 731i. In addition to adding heat to the at least one domestic tank or at least one hydronic tank, some embodiments can be configured with features to cool these tanks if the temperatures exceed a threshold. As depicted in block 744i, excess heat within either the at least one domestic tank or at least one hydronic tank can be dissipated with a heat dump.

[0138] Water from the hydronic tank can be used for distributing heat throughout the structure. In some embodiments, control circuitry may call for hot water from the hydronic tank to heat a hydronic coil in thermal communication with air exiting the air-to-water heat pump and to thereby reheat that exit-air. Alternatively, if reheating is not desired, hot water from a hot water tank is not used to heat a hydronic coil in thermal communication with air exiting the air-to water heat pump. In other embodiments, hydronic coils can be configured for duct heating. Control circuitry can call for flow of hot water to heat areas as desired. In some embodiments, and as depicted in blocks 756i and 758i, water is circulated through hydronic coils for heating, in other embodiments in which heating is not desired, water is not circulated through hydronic coils and no heating occurs.

[0139] In some embodiments, control circuitry can call for information relating to temperatures within specific areas of the structure. When these temperatures exceed some threshold, for example, approximately 78 degrees Fahrenheit an air-to-air heat pump can locally cool air. On the other hand, if local temperatures are below some threshold, for example, approximately 78 degrees Fahrenheit, as depicted in block 742i, the control circuitry can call for the air-to-air heat pump to idle as depicted in block 700i.

[0140] Additionally, some embodiments can include solar heating features. In some configurations, a solar heating feature can include a sensor to monitor and/or control the temperature of the solar heating feature. Thus, in some embodiments, when a solar heating temperature exceeds a threshold temperature, the solar heating feature can be cooled, for example, by running a fan. As depicted in block 760i, a fan can be used to maintain the temperature of a solar heating feature, the fan running when the temperature exceeds, for example, approximately 130 degrees Fahrenheit.

[0141] Figure 7J schematically illustrates a tenth example application for the hydronic system of Figure 6 for applications in situations with outside temperatures between approximately 60 and 65 degrees Fahrenheit (e.g., during summer transitional month). In this application, the system can alternatively heat, cool, and dehumidify the structure as required to maintain comfortable temperatures and conditions In this application a thermostat within the structure may call for the structure interior, or portions thereof, to maintain a set temperature of approximately 70 to 75 degrees Fahrenheit as shown by block 702j. In some embodiments, this may be a central thermostat, or a thermostat unique to a specific area within the structure. In some configurations, the control circuitry can additionally receive information relating to the temperature and relative humidity at another location inside the structure. As depicted in block 703j, the information relating to conditions in this area can also result in the control circuitry calling for dehumidification, cooling, or heating. Thus, in some embodiments, for example, heating begins when the internal temperature of the structure or some portions thereof, drops below a threshold temperature. If the desired internal conditions have been achieved, control circuitry may call for the system to idle as depicted in block 700j. If on the other hand, the desired internal conditions have not been achieved, the control circuitry may receive input information relating to outside temperature and conditions, and based on this information related to outside temperatures and conditions, cool through a variety of means. If the outside temperature is between approximately 65 and 90 degrees Fahrenheit, as depicted in 704j, the control circuitry can call for heating. In some embodiments, control circuitry can manage an air-to-air heat pump in response to information received relating to inside an outside temperatures and conditions. In one embodiment, and as depicted in block 752j, the control circuitry can request the economizer damper on an air-to-air heat pump to open, for the supply fan to run, and for the damper to solar hot air to open. The control circuitry can further call for, as depicted in block 754j, the indirect or direct pre-cooler used in connection with the air-to-air heat pump to stop, the supply fan to start, the compressor on the air-to-air heat pump to stop, and for the closing of the damper for indirect or direct cooling in the economizer. This combination results in the circulation of warmed air. In other embodiments, the control circuitry can call for any combination of the above mentioned conditions as well as combinations of the opposite condition (e.g. opened and closed).

[0142] Additionally, the control circuitry may receive input information relating to outside conditions such as the relative humidity. As depicted in block 705j, when the relative humidity is greater than approximately 30%, call for cooling and dehumidification by the air-to-water heat pump as shown in block 720j.

[0143] Running the air-to-water heat pump extracts moisture from the air, which moisture can be recovered. In some embodiments, control circuitry can manage use or purification and use of water recovered from the air by the air-to-water heat pump. Water recovered from the dehumidification function can be purified, and this recovered water can be used in domestic applications, like, for example, use in toilets.

[0144] In applications in which the air-to-water heat pump is running, control circuitry can further direct heating of water within at least one domestic hot water tank and/or at least one hydronic heat tank. As depicted in Figure 7J, control circuitry may call for information from one or more sensors as to the temperature of the at least one domestic hot water tank. When the temperatures are below a preset value, heat can be added to the domestic hot water tank. Conversely, when the temperature is above some preset value, heat is not added to the domestic hot water tank. As depicted in block 728j when the sensor indicates that the temperature of the domestic hot water tank is below approximately 135 degrees Fahrenheit, heat is added to the water of the domestic hot water tank.

[0145] In addition to determining the temperature of the domestic hot water tank, control circuitry can call for information from one or more sensors as to the temperature of the at least one hydronic hot water tank. When the temperature is below a preset value, heat can be added to the hydronic hot water tank. Conversely, when the temperature is above some preset value, heat is not added to the hydronic hot water tank. As depicted in block 730j when the sensor indicates that the temperature of the domestic hot water tank is below approximately 110 degrees Fahrenheit, heat is added to the water of the hydronic hot water tank. Conversely, and as further depicted in block 730j, when the temperature is above approximately 130 degrees Fahrenheit, heat is not added to the hydronic hot water tank. In addition to adding heat to the at least one domestic tank or at least one hydronic tank, some embodiments can be configured with features to cool these tanks if the temperatures exceed a threshold. As depicted in block 744j, excess heat within either the at least one domestic tank or at least one hydronic can be dissipated with a heat dump.

[0146] Water from the hydronic tank can be used for distributing heat throughout the structure. In some embodiments, control circuitry may call for hot water from the hydronic tank to heat a hydronic coil in thermal communication with air exiting the air-to-water heat pump and to thereby reheat that exit-air. Alternatively, if reheating is not desired, hot water from a hot water tank is not used to heat a hydronic coil in thermal communication with air exiting the air-to water heat pump. In other embodiments, hydronic coils can be configured for duct heating. Control circuitry can call for flow of hot water to heat areas as desired. In some embodiments, and as depicted in blocks 756j, water is circulated through hydronic coils for heating, in other embodiments in which heating is not desired, and as depicted in block 758j, water is not circulated through hydronic coils and no heating occurs.

[0147] In some embodiments, control circuitry can call for information relating to temperatures within specific areas of the structure. When these temperatures exceed some threshold, for example, approximately 78 degrees Fahrenheit an air-to-air heat pump can locally cool air. On the other hand, if local temperatures are below some threshold, for example, approximately 78 degrees Fahrenheit, as depicted in block 742j, the control circuitry can call for the air-to-air heat pump to idle as depicted in block 700j.

[0148] Additionally, some embodiments can include solar heating features. In some configurations, a solar heating feature can include a sensor to monitor and/or control the temperature of the solar heating feature. Thus, in some embodiments, when a solar heating temperature exceeds a threshold temperature, the solar heating feature can be cooled, for example, by running a fan. As depicted in block 760j, a fan can be used to maintain the temperature of a solar heating feature, the fan running when the temperature exceeds, for example, approximately 130 degrees Fahrenheit.

[0149] Figure 7K schematically illustrates a eleventh example application for the hydronic system of Figure 6 for applications in situations with outside temperatures above approximately 65 degrees Fahrenheit (e.g., during summer transitional month with coastal or monsoon climatic impact). In this application, the system can alternatively heat, cool, and dehumidify the structure as required to maintain comfortable temperatures and conditions In this application a thermostat within the structure may call for the structure interior, or portions thereof, to maintain a set temperature of approximately 70 to 75 degrees Fahrenheit as shown by block 702k. In some embodiments, this may be a central thermostat, or a thermostat unique to a specific area within the structure. In some configurations, the control circuitry can additionally receive information relating to the temperature and relative humidity at another location inside the structure. As depicted in block 703k, the information relating to conditions in this area can also result in the control circuitry calling for dehumidification, cooling, or heating. Thus, in some embodiments, for example, heating begins when the internal temperature of the structure or some portions thereof, drops below a threshold temperature. If the desired internal conditions have been achieved, control circuitry may call for the system to idle as depicted in block 700k. If on the other hand, the desired internal conditions have not been achieved, the control circuitry may receive input information relating to outside temperature and conditions, and based on this information related to outside temperatures and conditions, cool through a variety of means. If the outside temperature is below approximately 80 degrees Fahrenheit, as depicted in 704k, the control circuitry can call for cooling. In some embodiments, control circuitry can manage an air-to-air heat pump in response to information received relating to inside an outside temperatures and conditions. In one embodiment, and as depicted in block 752k, the control circuitry can request the economizer damper on an air-to-air heat pump to close, for the supply fan to run, and for the damper to solar hot air to close. The control circuitry can further call for, as depicted in block 754k, the indirect or direct pre-cooler used in connection with the air-to-air heat pump to stop, the supply fan to start, the compressor on the air-to-air heat pump to stop, and for the closing of the damper for indirect or direct cooling in the economizer. This combination results in the circulation of cool air. In other embodiments, the control circuitry can call for any combination of the above mentioned conditions.

[0150] Additionally, the control circuitry may receive input information relating to outside conditions such as the relative humidity. As depicted in block 705k, when the relative humidity is greater than approximately 30%, call for cooling and dehumidification by the air-to-water heat pump as shown in block 720k.

[0151] Running the air-to-water heat pump extracts moisture from the air, which moisture can be recovered. In some embodiments, control circuitry can manage use or purification and use of water recovered from the air by the air-to-water heat pump. Water recovered from the dehumidification function can be purified, and this recovered water can be used in domestic applications, like, for example, use in toilets.

[0152] In applications in which the air-to-water heat pump is running, control circuitry can further direct heating of water within at least one domestic hot water tank and/or at least one hydronic heat tank. As depicted in Figure 7K, control circuitry may call for information from one or more sensors as to the temperature of the at least one domestic hot water tank. When the temperatures are below a preset value, heat can be added to the domestic hot water tank. Conversely, when the temperature is above some preset value, heat is not added to the domestic hot water tank. As depicted in block 728k when the sensor indicates that the temperature of the domestic hot water tank is above approximately 135 degrees Fahrenheit, heat is not added to the water of the domestic hot water tank.

[0153] In addition to determining the temperature of the domestic hot water tank, control circuitry can call for information from one or more sensors as to the temperature of the at least one hydronic hot water tank. When the temperature is below a preset value, heat can be added to the hydronic hot water tank. Conversely, when the temperature is above some preset value, heat is not added to the hydronic hot water tank. As depicted in block 730k when the sensor indicates that the temperature of the domestic hot water tank is below approximately 110 degrees Fahrenheit, heat is added to the water of the hydronic hot water tank. Conversely, and as further depicted in block 730k, when the temperature is above approximately 130 degrees Fahrenheit, heat is not added to the hydronic hot water tank. In addition to adding heat to the at least one domestic tank or at least one hydronic tank, some embodiments can be configured with features to cool these tanks if the temperatures exceed a threshold. As depicted in block 744k, excess heat within either the at least one domestic tank or at least one hydronic can be dissipated with a heat dump.

[0154] Water from the hydronic tank can be used for distributing heat throughout the structure. In some embodiments, control circuitry may call for hot water from the hydronic tank to heat a hydronic coil in thermal communication with air exiting the air-to-water heat pump and to thereby reheat that exit-air. Alternatively, if reheating is not desired, hot water from a hot water tank is not used to heat a hydronic coil in thermal communication with air exiting the air-to water heat pump. In other embodiments, hydronic coils can be configured for duct heating. Control circuitry can call for flow of hot water to heat areas as desired. In some embodiments, and as depicted in blocks 756k, water is circulated through hydronic coils for heating, in other embodiments in which heating is not desired, and as depicted in block 758k, water is not circulated through hydronic coils and no heating occurs.

[0155] In some embodiments, control circuitry can call for information relating to temperatures within specific areas of the structure. When these temperatures exceed some threshold, for example, approximately 78 degrees Fahrenheit an air-to-air heat pump can locally cool air. On the other hand, if local temperatures are below some threshold, for example, approximately 78 degrees Fahrenheit, as depicted in block 742k, the control circuitry can call for the air-to-air heat pump to idle as depicted in block 700k.

[0156] Additionally, some embodiments can include solar heating features. In some configurations, a solar heating feature can include a sensor to monitor and/or control the temperature of the solar heating feature. Thus, in some embodiments, when a solar heating temperature exceeds a threshold temperature, the solar heating feature can be cooled, for example, by running a fan. As depicted in block 760k, a fan can be used to maintain the temperature of a solar heating feature, the fan running when the temperature exceeds, for example, approximately 130 degrees Fahrenheit.

[0157] Figure 7L schematically illustrates a eleventh example application for the hydronic system of Figure 6 for applications in situations with outside temperatures above approximately 65 degrees Fahrenheit (e.g., during summer transitional month specifically configured for maintaining temperature during a high load period). In this application, the system can alternatively heat, cool, and dehumidify the structure as required to maintain comfortable temperatures and conditions In this application a thermostat within the structure may call for the structure interior, or portions thereof, to maintain a set temperature of approximately 70 to 75 degrees Fahrenheit as shown by block 702l. In some embodiments, this may be a central thermostat, or a thermostat unique to a specific area within the structure. In some configurations, the control circuitry can additionally receive information relating to the temperature and relative humidity at another location inside the structure. As depicted in block 703l, the information relating to conditions in this area can also result in the control circuitry calling for dehumidification, cooling, or heating. Thus, in some embodiments, for example, heating begins when the internal temperature of the structure or some portions thereof, drops below a threshold temperature. If the desired internal conditions have been achieved, control circuitry may call for the system to idle as depicted in block 700l. If on the other hand, the desired internal conditions have not been achieved, the control circuitry may receive input information relating to outside temperature and conditions, and based on this information related to outside temperatures and conditions, cool through a variety of means. If the outside temperature is above approximately 75 degrees Fahrenheit, as depicted in 704l, the control circuitry can call for cooling. In some embodiments, control circuitry can manage an air-to-air heat pump in response to information received relating to inside an outside temperatures and conditions. In one embodiment, and as depicted in block 752l, the control circuitry can request the economizer damper on an air-to-air heat pump to close, for the supply fan to stop, and for the damper to solar hot air to close. The control circuitry can further call for, as depicted in block 754l, the indirect or direct pre-cooler used in connection with the air-to-air heat pump to stop, the supply fan to start, the compressor on the air-to-air heat pump to start, and for the closing of the damper for indirect or direct cooling in the economizer. This combination results in the circulation of cool air. In other embodiments, the control circuitry can call for any combination of the above mentioned conditions as well as combinations of the opposite condition (e.g. opened and closed).

[0158] Additionally, the control circuitry may receive input information relating to outside conditions such as the relative humidity. As depicted in block 705l, when the relative humidity is greater than approximately 30%, call for cooling and dehumidification by the air-to-water heat pump as shown in block 720l.

[0159] Running the air-to-water heat pump extracts moisture from the air, which moisture can be recovered. In some embodiments, control circuitry can manage use or purification and use of water recovered from the air by the air-to-water heat pump. Water recovered from the dehumidification function can be purified, and this recovered water can be used in domestic applications, like, for example, use in toilets.

[0160] In applications in which the air-to-water heat pump is running, control circuitry can further direct heating of water within at least one domestic hot water tank and/or at least one hydronic heat tank. As depicted in Figure 7L, control circuitry may call for information from one or more sensors as to the temperature of the at least one domestic hot water tank. When the temperatures are below a preset value, heat can be added to the domestic hot water tank. Conversely, when the temperature is above some preset value, heat is not added to the domestic hot water tank. As depicted in block 728l when the sensor indicates that the temperature of the domestic hot water tank is above approximately 135 degrees Fahrenheit, heat is not added to the water of the domestic hot water tank.

[0161] In addition to determining the temperature of the domestic hot water tank, control circuitry can call for information from one or more sensors as to the temperature of the at least one hydronic hot water tank. When the temperature is below a preset value, heat can be added to the hydronic hot water tank. Conversely, when the temperature is above some preset value, heat is not added to the hydronic hot water tank. As depicted in block 730l when the sensor indicates that the temperature of the domestic hot water tank is below approximately 110 degrees Fahrenheit, heat is added to the water of the hydronic hot water tank. Conversely, and as further depicted in block 730l, when the temperature is above approximately 130 degrees Fahrenheit, heat is not added to the hydronic hot water tank. In addition to adding heat to the at least one domestic tank or at least one hydronic tank, some embodiments can be configured with features to cool these tanks if the temperatures exceed a threshold. As depicted in block 744l, excess heat within either the at least one domestic tank or at least one hydronic can be dissipated with a heat dump.

[0162] Some embodiments can, for example, include redundant systems, for example, as depicted in block 762l, in case of a failure of the air-to-water heat pump, and alarm can sound, and notification can be sent to monitoring or repair personnel. This alarm can be triggered by a variety of malfunctions in the air to water heat pump. An alarm can be similarly signaled in case of a failure of another component of the system, including, a temperature reading in one of the hot water tanks exceeding, for example, approximately 150 degrees Fahrenheit. One example of a redundant system can be heating strips in the water tanks, the heating strips maintaining a desired water temperature in case of failure or inadequate output by another system component. A person skilled in the art will recognize that a variety of other redundant components can be integrated into the system to increase safety and reliability.

[0163] Water from the hydronic tank can be used for distributing heat throughout the structure. In some embodiments, control circuitry may call for hot water from the hydronic tank to heat a hydronic coil in thermal communication with air exiting the air-to-water heat pump and to thereby reheat that exit-air. Alternatively, if reheating is not desired, hot water from a hot water tank is not used to heat a hydronic coil in thermal communication with air exiting the air-to water heat pump. In other embodiments, hydronic coils can be configured for duct heating. Control circuitry can call for flow of hot water to heat areas as desired. In some embodiments, and as depicted in blocks 756l, water is circulated through hydronic coils for heating, in other embodiments in which heating is not desired, and as depicted in block 758l, water is not circulated through hydronic coils and no heating occurs.

[0164] In some embodiments, control circuitry can call for information relating to temperatures within specific areas of the structure. When these temperatures exceed some threshold, for example, approximately 78 degrees Fahrenheit an air-to-air heat pump can locally cool air. On the other hand, if local temperatures are below some threshold, for example, approximately 78 degrees Fahrenheit, as depicted in block 742l, the control circuitry can call for the air-to-air heat pump to idle as depicted in block 700l.

[0165] Additionally, some embodiments can include solar heating features. In some configurations, a solar heating feature can include a sensor to monitor and/or control the temperature of the solar heating feature. Thus, in some embodiments, when a solar heating temperature exceeds a threshold temperature, the solar heating feature can be cooled, for example, by running a fan. As depicted in block 760l, a fan can be used to maintain the temperature of a solar heating feature, the fan running when the temperature exceeds, for example, approximately 130 degrees Fahrenheit.

[0166] Figures 7A-7L illustrate example applications of how the hydronic system of Figure 6 can harness waste heat to efficiently heat one or more structures, to efficiently cool one or more structures, and/or or to provide hot water to one or more structures. A person having ordinary skill in the art will appreciate that the hydronic system of Figure 6, Figures 7A-7L, or other suitable hydronic systems described herein, in whole or in part (e.g., components or subcomponents of the systems), may be utilized to harness waste heat in a variety of applications, for example, shopping malls, swimming pools, laundromats, restaurants, canneries, industrial applications including factories, and car washes. Thus, a hydronic systems and components thereof can be utilized in conjunction with any process area that may have available waste heat, whether indoors or outdoors, to harness the waste heat to efficiently heat one or more structures, to efficiently cool one or more structures, and/or or to provide hot water to one or more structures. Waste heat can be provided from a source of hot air and/or can be transferred from a source of hot liquid, for example, from a pressure line or pipe containing a hot liquid. Additionally, in some embodiments, a hydronic system or component thereof may incorporate water jackets and/or heat exchangers to transfer the waste heat source to the system.

[0167] Figure 8A is a block diagram schematically illustrating an energy production system 840 for use in connection with some embodiments of a multiplatform control system. The energy production system 840 includes a source of energy for example, a solar tracker, wind turbine, geothermal system, or hydroelectric system, that is configured to provide electric power to various components including a battery pack, a hydronic space heater 815, a direct current fan 817, a direct current pump 805, and/or a direct current electric coil 811. The energy production system 840 may at least partially power a water heating system 820 and/or a HVAC control system 822. Water heating system 820 may include a source of domestic water, for example, a fill truck 801 or plumbing connection that is configured to provide water to a domestic water tank 803. In some embodiments, a direct current pump 805 may be disposed between the domestic water tank 803 and a hot water tank 807 to pump water from the domestic water tank 803 to the hot water tank 807. The hot water tank 807 may be fluidly coupled to a solar hot water system including one or more solar thermal panels 809 to heat water contained therein. In some embodiments, a direct current element 811 may be configured to receive electric power from the energy production system 840 and transfer thermal energy to water contained within the hot water tank 807.

[0168] Still referring to Figure 8A, the HVAC system 822 may include a hydronic heater 815 configured to receive hot water from the hot water tank 807 and to transfer thermal energy received from the hot water to air that passes thereover. The heated air may be used to heat one or more spaces in a given structure. Additionally, the HVAC system 822 may include a heat exchanger 813 configured to receive waste heat from the battery pack and to direct the waste heat to one or more spaces in a given structure to heat the structure. The HVAC system 822 may also include an optional air circulation system 817 including a direct current fan powered at least in part by the energy production system and/or the battery pack. The air circulation system 817 may be configured to pressurize one or more spaces within a given structure with ambient air to cool the one or more spaces in certain applications. Thus, the energy production system 840 may be configured to provide electric power to one or more structures and/or to power HVAC and/or water heating systems that are coupled to the one or more structures.

[0169] Figure 8B is a block diagram schematically illustrating one embodiment of an energy production system 840 for use in connection with some embodiments of a multiplatform control system. The energy production system 840 includes a source of energy for example, a solar tracker, wind turbine, geothermal system, or hydroelectric system, that is configured to provide electric power to various components including a battery pack, a hydronic space heater 815, a direct current fan 817, a direct current pump 805, and/or a direct current electric coil 811. The hydronic space heater 815 can, in some embodiments include a direct current fan 817 for use in a silent aire night cycle. The energy production system may include a source of domestic water, for example, a high level filler truck 801 configured to provide water to a domestic water tank 803. In some embodiments, the domestic tank can be, for example, a 525 gallon domestic tank with a low level float. In some embodiments, a direct current pump 805 may be disposed between the domestic water tank 803 and a hot water tank 807 to pump water from the domestic water tank 803 to the hot water tank 807. The hot water tank 807, can, for example, comprise a 100 gallon hot water tank, and may be fluidly coupled to a solar hot water system including one or more solar thermal panels 809 to heat water contained therein.

[0170] Still referring to Figure 8B, the system 840 may include a hydronic heater 815 configured to receive hot water from the hot water tank 807 and to transfer thermal energy received from the hot water to air that passes thereover. The heated air may be used to heat one or more spaces in a given structure. Additionally, the system 840 may include a heat exchanger 813 configured to receive waste heat from the battery pack and to direct the waste heat to one or more spaces in a given structure to heat the structure.

[0171] Figure 8C is a block diagram schematically illustrating a climate control system 850 for use in connection with some embodiments of a multiplatform control system. Climate control system 850 includes a source of energy 851. Source of energy 851 can include various systems or subsystems including, for example, a solar tracker, wind turbine, geothermal system, hydraulic system, and/or hydronic system and may be configured to provide electric power to various components of climate control system 850. A high voltage charge controller 853 may receive electric power from the source of energy 851 and may provide the electric power to a direct current exo current protection module 853 and an inverter 857. The inverter 857 may provide electric power to a stand-by generator 865, a battery pack 867, a power protection panel 869, and/or to a power panel 871 for one or more structures. When the source of energy 851 produces an excess amount of electric power, electric power may be provided through a shunt 859 to an auxiliary battery pack 863 and/or to a hot water tank 873. Hot water tank 873 may receive potable water from a storage tank 875 and the water may be pumped therefrom by a pump 877. Hot water tank 873 may also be heated in part by one or more solar panels 861 and water may be drawn from the hot water tank 873 for various uses, including for example, use in a lavatory or bathroom 879. Hot water from hot water tank 873 may also be directed to a heater 881 to provide heat to one or more structures.

[0172] Thus, the climate control system 850 may be configured to provide electric power to one or more structures and/or to power HVAC and/or water heating systems that are coupled to the one or more structures.

[0173] Figure 8D is a block diagram schematically illustrating a climate control system 850 for use in connection with some embodiments of a multiplatform control system. Climate control system 850 includes a source of energy 851. Source of energy 851 can include various systems or subsystems including, for example, a solar photovoltaic module including, with a single or dual axis passive or active tracker with an early wake-up, a wind generator, a geothermal system, and/or a microhydro system and may be configured to provide electric power to various components of climate control system 850. A high voltage charge controller 853 may receive electric power from the source of energy 851 and may provide the electric power to a direct current exo current protection module 855 and an inverter 857. The inverter 857 may provide electric power to a stand-by generator 865, a battery pack 867, comprising, for example, 8 batteries, 16 batteries, or any desired number of batteries based on the system size, a power protection panel 869, and/or to a power panel 871 for one or more structures. As depicted in Figure 8D, the power panel 871 can power to a house, to a house subpanel, to a shed, and/or connect to any electrical equipment. When the source of energy 851 produces an excess amount of electric power, electric power may be provided through a shunt 859 to an auxiliary battery pack 863 and/or to a hot water tank 873. Hot water tank 873 may receive potable water from a storage tank 875 and the water may be pumped therefrom by a pump 877. Hot water tank 873 may also be heated in part by one or more solar panels 861 and water may be drawn from the hot water tank 873 for various uses, including for example, use in a lavatory or bathroom 879. Hot water from hot water tank 873 may also be directed to a heater 881 to provide heat to one or more structures.

[0174] Referring to Figure 9, a solar energy system 900 generates electricity for operating electric systems relating to the multiplatform control system. As depicted in Figure 9, the solar energy system may include, for example, at least one solar panel 902 and a base 904. The solar system 900 may include, for example, a variety of types of electricity generating panels 902. In preferred embodiments the solar energy system may include a plurality of solar panels 902. Different embodiments of a solar energy system 900 can comprise different numbers of solar panels 902, the number of solar panels configured to match the desired level of solar electricity generation. A person skilled in the art will recognize that the amount of solar power generation capacity required depends on a variety of factors such as component power consumption and processing rate requirements and that the present disclosure does not limit a multiplatform control system or single platform control system to any specific number of solar panels.

[0175] Referring again to Figure 9, preferred embodiments of a base 904 can include a mobile tracker base. A mobile tracker base can increase solar panel efficiency, by up to approximately forty to fifty percent, by tracking movement of the sun throughout the day and thus constantly directing the solar panels at the sun. Some embodiments of a tracker base include active tracker bases, chronological tracker bases, and passive tracker bases. Preferred embodiments of a mobile tracker base comprise a passive tracker base.

The base 904 can include a trailer mount to mount the solar energy system to a movable trailer. In some embodiments, the base includes one or more concrete ballasts.

[0176] One embodiment of a passive tracker base comprises two chambers, gas filling the chambers, connections between the chambers, and reflectors for directing sunlight onto the chambers. In this embodiment, sun light is differentially reflected onto the chambers by the reflectors depending on the angle defined between the base and the sun. As the sun moves, and this relative angle changes, one of the chambers receives more sunlight, and thus achieves a higher temperature. This temperature difference between the chambers drives gas from one chamber to the other, resulting in a weight differential between the chambers. This weight differential results in the movement of the tracker base. Some aspects can include "shadow plates" that differentially shade or block light from one or more of the chambers. The light that can be differentially shaded from the chambers by the shadow plates depending upon the angle defined between the base and the sun.

[0177] Preferred embodiments of passive trackers additionally may include a controlled heating device position on the chambers. The heating device control may be configured so that the heating device creates a temperature differential in the chambers before sun rise, the temperature differential resulting in the pre-orientation of the tracker base towards the position of the sunrise. The heater can receive energy for heating from a variety of sources including from batteries, from a power grid, or from any other energy source. In preferred embodiments, the heating device may include a forty watt silicon heater. In further preferred embodiments, the heating device control includes an astronomical timer comprising data regarding the time of sunrise for each day of the year. In preferred embodiments, the heating device begins heating of one chamber approximately one-half to one hour before sun rise. Advantageously, use of a controlled silicon heater can increase efficiency of solar energy capture by up to ten percent over comparable passive tracker bases lacking such a controlled heater.

[0178] The tracker base further may include, for example, a support structure 906 and a stand structure 908. The support structure may include a mast 910, and axel, rails, and truss tubes. The mast 910, a feature of both the support structure and the stand structure, connects the support structure to the stand structure. The axel, rails, and truss tubes together connect the solar panels 902 to the mast 910.

[0179] Figures 10A-10C depict various embodiments of utility structures that can optionally be used in connection with some embodiments of a multiplatform control system, for example, any of the embodiments disclosed herein. Additional details relating to the utility structures are disclosed in U.S. Provisional Application Number 61/382,798 which is hereby incorporated by reference in its entirety.

[0180] Referring to Figure 11, some embodiments of an electrical system 1000 can be configured with a ground point 1002. The ground point 1002 may be improved by creating depression 1004 around the ground point 1002, the depression 1004 configured to catch and store liquid from the drain line 1006. In some embodiments, the depression can include a liner 1008. The liner 1008 can, in some embodiments, be made of plastic, concrete, metal, wood, or other material. In some embodiments with a lined depression 1004, the liner 1008 can include an orifice 1010 through which a grounding rod 1012 may be passed, the orifice 1010 also allowing water to pass from the depression 1004 into the ground around the grounding rod 1012. In further embodiments, the drain lines 1006 can be configured to provide approximately one gallon per hour to the depression 1004 to maintain adequate moisture and conductivity at the ground point 1002.

[0181] Referring to Figure 12, some embodiments of a multiplatform control system can include a raw water delivery system 1200. A raw water delivery system 1200 may include, for example, a tube or pipe that is referred to as a "straw" 1202, which straw 1202 can be made of a variety of materials including, for example, metal, plastic, composites, or ceramics and in a variety of sizes. The diameter can be any suitable diameter that will be sufficient for the filtration requirements and needs.

[0182] Figure 12 depicts an embodiment in which the straw 1202 comprises an elongated tube having an inlet end 1204, into which fluid enters the water delivery device 1200. The straw 1202 further includes an outlet end 1206. The outlet end 1206 further comprises an opening through which a water/fluid line 1208 passes which water/fluid line 1208 carries water to the filtration unit. One or both of the inlet and outlet ends 1204, 1206 can be covered by a cap 1210. The straw 1202 further may include openings 1212 allowing the passage of water from outside the straw 1202 to inside the straw 1202.

[0183] Figure 12 also depicts a cross section view of the embodiment of a raw water delivery system 1200. As depicted, bolt 1214 can pass through the straw 1202 in proximity to the inlet end 1204. In some embodiments, one or more cables can be affixed to the ends of the bolt 1214. Advantageously, these cables can enable fixing the position of the straw in a body of water.

[0184] As also shown in Figure 12, a gravel pack 1216 is inserted into the straw 1202. The gravel pack 1216 can comprise an elongate tube. The gravel pack 1216 may be sized to slidably fit within the straw 1202, and to rest on top of the bolt 1214. A submersible pump 1218, sized to fit within the gravel pack 1216, is inserted into the gravel pack 1216. In some embodiments of a raw water delivery system 1200, a cable can be affixed to one end of the pump enabling the removal of the pump from the straw without removing the straw from the water.

[0185] Additional embodiments of raw water delivery system 1200 further can include one or more bodies extending through the outlet end of the straw and into the straw. In some embodiments this body may include a water/fluid line 1208. This body can further include an electric cable for providing power and control to the water pump 1218. As depicted in Figure 12, the electric cable is integral with the water line. In a further embodiment, this body can also comprise one or more tubes. This can include an air tube 1220 having a perforated end 1222 or a vacuum tube (not shown) extending to the inlet end of the straw. Advantageously, inclusion of a perforated air tube 1220 may enable users of the straw 1202 to clean the gravel pack 1216 and the straw 1202 by blowing compressed air out of the tube 1220 and through the gravel pack 1216 and openings. This removes accumulations from the gravel pack 1216 and straw 1202 and enables more efficient filtration by decreasing the frequency of necessary filter shutdown for straw 1202 and gravel pack 1216 cleaning and by decreasing the flow resistance caused by a dirty gravel pack 1216. The inclusion of a vacuum tube similarly increases the efficiency of filtration by decreasing the frequency of straw 1202 cleaning by allowing the user to such particulate accumulations out of the straw 1202 without removing the straw 1202 from the water.

[0186] Some embodiments of a multiplatform control system can include a bypass system 1300 as depicted in Figure 13. A bypass system 1300 may include, for example, a solenoid valve 1302 connected to the multiplatform control system, a check valve 1304, and a bypass line 1306 connecting raw water line 1308 to the drain line 1310

[0187] Some embodiments of a pump bypass system 1300 may additionally include a solenoid valve 1312 connected to the raw water line 1308 and the bypass line 1306.

[0188] In some aspects, the multiplatform control system can initiate a backwash. Once the backwash is to begin, the multiplatform control system signals the begin of the backwash, which signal opens the solenoid valve 1302, allowing raw water to flow from the raw water line 1308 through the bypass line 1306, and out the drain line 1310. Additionally, the check valve 1304 which is located downstream of the bypass line 1306 on the raw water line 1308, can prevent further flow of raw water other systems of the multiplatform control system.

[0189] Figure 14 depicts one embodiment of a radiator 1400, which can include channels 1402 for process liquid to pass through and features to encourage heat transfer with the process fluid. The channels 1402 can further include inlet and outlet channels (not shown) to allow fluid to flow into and out of the channels 1402 in the radiator 1400. In some embodiments, the radiator system can include fins and a fan 1404. In some preferred embodiments, the fan 1404 can comprise a direct current (DC) fan. The fan 1404 can be configured to assist in passing air over electronic components of the multiplatform control system, thus facilitating the transfer of heat between the components and the air. The fan 1404 can be further configured to assist in passing air over the radiator channels 1402, thus facilitating the transfer of heat between the air and the radiator channels 1402. The fan 1404 can be configured to enter air into the radiator 1400 through an air inlet 1406, and after having passed the air over the channels 1402, exit the air from the radiator 1400 through an air outlet 1408. Advantageously, inclusion of a radiator 1400 in a multiplatform control system can assist in maintaining the ideal temperature of the components of the multiplatform control system, and thus can increase the efficiency of those components.

[0190] Additionally, some embodiments of a multiplatform control system can incorporate the capture, manipulation, and redistribution of heat energy throughout the system and/or can incorporate cooling heat energy. Surprisingly, this capture and use of seemingly insignificant amounts of energy has resulted in significant improvement in system efficiency as well as in component efficiency. Thus, the system is able to function at fixed capacity using less energy or to increase capacity while using the same amount of energy. This efficiency is the result of capturing energy from sources that have previously not been recognized as useful energy sources, and transferring this energy to aspects of a system in which the energy can be beneficially used. Also surprisingly, the combination of energy from these diverse sources results in a synergistic improvement in efficiency above what would be expected based on the individual amounts of energy captured from each source. A person skilled in the art will recognize that the synergistic benefit of collecting energy from a plurality of small energy sources, and applying that energy to another aspect of a system can be applied in a wide variety of situations and is not limited to application in connection with a reverse osmosis system or any subsystem thereof.

Example 1

Commercial, Industrial, Manufacturing, Institutional, Agricultural Multi-Platform Energy Optimization and Control System

[0191] Some embodiments relate to conditioned enclosures such as commercial, industrial, manufacturing and agricultural enclosure structures, which can include, for example, one or more of interlocking and interacting controls. The controls can be configured, for example, to optimize space conditioning and energy usage reduction methods. In some aspects, the controls and methods can achieve decreased energy usage, for example, net zero, or lowest, power/energy use with or without power grids or alternative power sources such as solar photovoltaic, geothermal, micro hydro, wind, biomass, biogas, hydrogen fuel cell, compressed air, etc.

[0192] The control systems can include, for example, one or more non-limiting elements or features such as smart board or analog controls with multiple sensors that initiate alternative methods of heating, cooling, and ventilating for minimum energy use; attic ventilation only in cooling and ventilation months; controls that in some aspects do not allow a compressor to run during night ventilation/cooling mode; use of low energy usage systems such as evaporative cooling/night/day ventilation to off set compressor operation; heat pump that can be used as last resort, not primary source of heating and cooling; dehumidification/condensate recovery for grey water or water purification, for Ag or toilets or purification on site; combined use of passive and active monitored elements to achieve improved or optimum energy and systems performance; prevention of simultaneous compressor use to lower demand cost; utilization of waste heat/cold from, for example, interior spaces and exterior spaces, garages, laundries, kitchens, indoor pools, production, animal containment areas, for production of hot air, hot water, air conditioning, dehumidification and water recovery; interlocking of self powered and grid powered ac/dc devices to achieve improved or maximum energy efficiency and function; adjustable fan speed on supply, exhaust air in response to temperature drop/rise vs. time- temperature differential system optimizing energy trimming; monitoring of power use of systems to assess, diagnose, optimize and maintain systems; monitoring of run time of systems to assess, diagnose, optimize and maintain; setting of alarm parameters to notify out of normal optimized performance; monitoring/recovering, optimize waste heat from multiple sources and recycle energy into system to optimize system.

[0193] Some aspects relate to new, surprising and unexpected methods of two or more of: automatically monitoring, controlling, heating, cooling, and ventilating systems independently of grid power. The methods can include for example, indoor and outdoor sensors selected for or configured for the least energy intensive means to achieve indoor comfort for an inhabited space.

Example 2

Residential Multi Platform Energy Optimization and Control System

[0194] Also, some embodiments relate to residential enclosures, for example, habitable enclosures with interlocking and/or interacting controls for optimizing space conditioning and energy usage. Some embodiments relate to energy reduction methods to achieve decreased power usage, for example, net zero, or lowest, power use with or without alternative power sources such as solar pv, hydrogen fuel cell, geo thermal, micro hydro, wind, biomass, bio gas, etc.

[0195] The enclosures, systems and related methods can include one or more of the following elements and features: smart board or analog controls with multiple sensors that initiate alternative methods of heating, cooling, and ventilating for minimum energy usage; Attic venting in cooling and ventilation months, in some aspects only in cooling and ventilation months; controls that if desired, can prevent a compressor from running during night ventilation/cooling mode; use of low energy usage systems such as evaporative cooling, night/day ventilation to off-set compressor operation; use of low energy usage systems such as solar hot water to off-set compressor operation; heat pumps used secondarily, not primarily, as the source of heating and cooling; water (dehumidification/condensate) recovery for grey water, for AG or toilets, or purification on site; combined use of passive and active monitored elements to achieve optimum results, energy wise; use of multiple compressors running simultaneously to lower demand; waste heat used from interior spaces, garages, laundries, kitchens for production of hot water, air conditioning and water recovery; interlocking of self powered and grid powered ac/ de devices to achieve maximum energy efficiency and function; fan speed adjustment on supply air in response to temperature drop vs. time temperature rise vs. time; system optimizing energy trimming; monitoring power use of systems to assess, diagnose, optimize and maintain; monitor recovery of waste heat from multiple sources and recycle energy into system to optimize system.

[0196] Some aspects relate to new, surprising and unexpected methods that include two or more of automatically monitoring, controlling heat, cooling, ventilating systems independently of grid power. The methods can include indoor and outdoor sensors for example configured to or select for the least energy intensive means to achieve indoor comfort for an inhabited space.

[0197] The technology, including any methods, systems, devices and combinations of components described herein can be operational with numerous other general purpose or special purpose computing system environments or configurations. Examples of well known computing systems, environments, and/or configurations that may be suitable for use with the invention include, but are not limited to, personal computers, server computers, hand-held or laptop devices, multiprocessor systems, microprocessor-based systems, programmable consumer electronics, network PCs, minicomputers, mainframe computers, distributed computing environments that include any of the above systems or devices, and the like.

[0198] As used herein, instructions refer to computer-implemented steps for processing information in the system. Instructions can be implemented in software, firmware or hardware and include any type of programmed step undertaken by components of the system.

[0199] A Local Area Network (LAN) or Wide Area Network (WAN) may be a corporate computing network, including access to the Internet, to which computers and computing devices comprising the system are connected. In one embodiment, the LAN conforms to the Transmission Control Protocol/Internet Protocol (TCP/IP) industry standard.

[0200] As used herein, media refers to images, sounds, video or any other multimedia type data that is entered into the system.

[0201] A microprocessor may be any conventional general purpose single- or multi-chip microprocessor such as a Pentium® processor, a Pentium® Pro processor, a

8051 processor, a MIPS® processor, a Power PC® processor, or an Alpha® processor. In addition, the microprocessor may be any conventional special purpose microprocessor such as a digital signal processor or a graphics processor. The microprocessor typically has conventional address lines, conventional data lines, and one or more conventional control lines.

[0202] The system is comprised of various modules as discussed in detail. As can be appreciated by one of ordinary skill in the art, each of the modules comprises various sub-routines, procedures, definitional statements and macros. Each of the modules are typically separately compiled and linked into a single executable program. Therefore, the description of each of the modules is used for convenience to describe the functionality of the preferred system. Thus, the processes that are undergone by each of the modules may be arbitrarily redistributed to one of the other modules, combined together in a single module, or made available in, for example, a shareable dynamic link library.

[0203] The system may be used in connection with various operating systems such as Linux®, UNIX® or Microsoft Windows®.

[0204] The system may be written in any conventional programming language such as C, C++, BASIC, Pascal, or Java, and ran under a conventional operating system. C, C++, BASIC, Pascal, Java, and FORTRAN are industry standard programming languages for which many commercial compilers can be used to create executable code. The system may also be written using interpreted languages such as Perl, Python or Ruby.

[0205] A web browser comprising a web browser user interface may be used to display information (such as textual and graphical information) to a user. The web browser may comprise any type of visual display capable of displaying information received via a network. Examples of web browsers include Microsoft's Internet Explorer browser, Netscape's Navigator browser, Mozilla's Firefox browser, PalmSource's Web Browser, Apple’s Safari, or any other browsing or other application software capable of communicating with a network.

[0206] Those of skill will further appreciate that the various illustrative logical blocks, modules, circuits, and algorithm steps described in connection with the embodiments disclosed herein may be implemented as electronic hardware, computer software, or combinations of both. To clearly illustrate this interchangeability of hardware and software, various illustrative components, blocks, modules, circuits, and steps have been described above generally in terms of their functionality. Whether such functionality is implemented as hardware or software depends upon the particular application and design constraints imposed on the overall system. Skilled artisans may implement the described functionality in varying ways for each particular application, but such implementation decisions should not be interpreted as causing a departure from the scope of the present disclosure.

[0207] The various illustrative logical blocks, modules, and circuits described in connection with the embodiments disclosed herein may be implemented or performed with a general purpose processor, a digital signal processor (DSP), an application specific integrated circuit (ASIC), a field programmable gate array (FPGA) or other programmable logic device, discrete gate or transistor logic, discrete hardware components, or any combination thereof designed to perform the functions described herein. A general purpose processor may be a microprocessor, but in the alternative, the processor may be any conventional processor, controller, microcontroller, or state machine. A processor may also be implemented as a combination of computing devices, e.g., a combination of a DSP and a microprocessor, a plurality of microprocessors, one or more microprocessors in conjunction with a DSP core, or any other such configuration.

[0208] In one or more example embodiments, the functions and methods described may be implemented in hardware, software, or firmware executed on a processor, or any combination thereof. If implemented in software, the functions may be stored on or transmitted over as one or more instructions or code on a computer-readable medium. Computer-readable media includes both computer storage media and communication media including any medium that facilitates transfer of a computer program from one place to another. A storage media may be any available media that can be accessed by a computer. By way of example, and not limitation, such computer-readable media can comprise RAM, ROM, EEPROM, CD-ROM or other optical disk storage, magnetic disk storage or other magnetic storage devices, or any other medium that can be used to carry or store desired program code in the form of instructions or data structures and that can be accessed by a computer. Also, any connection is properly termed a computer-readable medium. For example, if the software is transmitted from a website, server, or other remote source using a coaxial cable, fiber optic cable, twisted pair, digital subscriber line (DSL), or wireless technologies such as infrared, radio, and microwave, then the coaxial cable, fiber optic cable, twisted pair, DSL, or wireless technologies such as infrared, radio, and microwave are included in the definition of medium. Disk and disc, as used herein, includes compact disc (CD), laser disc, optical disc, digital versatile disc (DVD), floppy disk and Blu-ray disc where disks usually reproduce data magnetically, while discs reproduce data optically with lasers. Combinations of the above should also be included within the scope of computer-readable media.

[0209] The foregoing description details certain embodiments of the systems, devices, and methods disclosed herein. It will be appreciated, however, that no matter how detailed the foregoing appears in text, the systems, devices, and methods can be practiced in many ways. As is also stated above, it should be noted that the use of particular terminology when describing certain features or aspects of the invention should not be taken to imply that the terminology is being re-defined herein to be restricted to including any specific characteristics of the features or aspects of the technology with which that terminology is associated.

[0210] It will be appreciated by those skilled in the art that various modifications and changes may be made without departing from the scope of the described technology. Such modifications and changes are intended to fall within the scope of the embodiments. It will also be appreciated by those of skill in the art that parts included in one embodiment are interchangeable with other embodiments; one or more parts from a depicted embodiment can be included with other depicted embodiments in any combination. For example, any of the various components described herein and/or depicted in the Figures may be combined, interchanged or excluded from other embodiments.

[0211] With respect to the use of substantially any plural and/or singular terms herein, those having skill in the art can translate from the plural to the singular and/or from the singular to the plural as is appropriate to the context and/or application. The various singular/plural permutations may be expressly set forth herein for sake of clarity.

[0212] It will be understood by those within the art that, in general, terms used herein are generally intended as "open" terms (e.g., the term "including" should be interpreted as "including but not limited to," the term "having" should be interpreted as "having at least," the term "includes" should be interpreted as "includes but is not limited to," etc.). It will be further understood by those within the art that if a specific number of an introduced claim recitation is intended, such an intent will be explicitly recited in the claim, and in the absence of such recitation no such intent is present. For example, as an aid to understanding, the following appended claims may contain usage of the introductory phrases “at least one” and “one or more” to introduce claim recitations. However, the use of such phrases should not be construed to imply that the introduction of a claim recitation by the indefinite articles “a” or “an” limits any particular claim containing such introduced claim recitation to embodiments containing only one such recitation, even when the same claim includes the introductory phrases “one or more” or “at least one” and indefinite articles such as “a” or “an” (e.g., “a” and/or “an” should typically be interpreted to mean “at least one” or “one or more”); the same holds true for the use of definite articles used to introduce claim recitations. In addition, even if a specific number of an introduced claim recitation *is* explicitly recited, those skilled in the art will recognize that such recitation should typically be interpreted to mean *at least* the recited number (e.g., the bare recitation of “two recitations,” without other modifiers, typically means *at least* two recitations, or *two or more* recitations). Furthermore, in those instances where a convention analogous to “at least one of A, B, and C, etc.” is used, in general such a construction is intended in the sense one having skill in the art would understand the convention (e.g., “a system having at least one of A, B, and C” would include but not be limited to systems that have A alone, B alone, C alone, A and B together, A and C together, B and C together, and/or A, B, and C together, etc.). In those instances where a convention analogous to “at least one of A, B, or C, etc.” is used, in general such a construction is intended in the sense one having skill in the art would understand the convention (e.g., “a system having at least one of A, B, or C” would include but not be limited to systems that have A alone, B alone, C alone, A and B together, A and C together, B and C together, and/or A, B, and C together, etc.). It will be further understood by those within the art that virtually any disjunctive word and/or phrase presenting two or more alternative terms, whether in the description, claims, or drawings, should be understood to contemplate the possibilities of including one of the terms, either of the terms, or both terms. For example, the phrase “A or B” will be understood to include the possibilities of “A” or “B” or “A and B.”

[0213] While various aspects and embodiments have been disclosed herein, other aspects and embodiments will be apparent to those skilled in the art. The various aspects and embodiments disclosed herein are for purposes of illustration and are not intended to be limiting.

WHAT IS CLAIMED IS:

1. A method of controlling the temperature of a structure, the method comprising:

sensing a temperature of ambient air outside the structure;

determining whether the sensed temperature is below a first pre-determined value, above the first pre-determined value and below a second pre-determined value, or above the second pre-determined value;

pressurizing the structure with ambient air if the sensed temperature is below the first pre-determined value;

cooling ambient air with an evaporative cooling system if the sensed temperature is above the first pre-determined value and below the second pre-determined value;

pressurizing the structure with the cooled ambient air if the sensed temperature is above the first pre-determined value and below the second pre-determined value; and

using a heat pump to cool the structure if the sensed temperature is above the second pre-determined value.

2. The method of Claim 1, wherein the evaporative cooling system comprises an indirect evaporative cooling system.

3. The method of Claim 1, wherein the first pre-determined value is about 75 degrees Fahrenheit.

4. The method of Claim 1, wherein the second pre-determined value is about 90 degrees Fahrenheit.

5. The method of Claim 1, further comprising exhausting air from the structure, the exhausted air having a temperature greater than the first pre-determined value.

6. A method of controlling the temperature of a structure, the method comprising:

providing a solar hot air panel;

heating ambient air with the solar hot air panel and directing the heated air into the structure;

sensing a temperature of air within the structure at night;

determining whether the sensed temperature is below a first pre-determined value;

using a heat pump to heat air within the structure if the sensed temperature is below the pre-determined value.

7. The method of Claim 6, further comprising:

sensing a temperature of an attic disposed over the structure during the day;

determining whether the sensed temperature is above a second pre-determined value; and

circulating ambient air through the structure if the sensed temperature is above the second pre-determined value.

8. A method for efficient cooling control of a building, the method comprising:

circulating untreated ambient air within a structure when ambient conditions are within a first pre-determined temperature range;

treating ambient air to cool the ambient air to a desired temperature when ambient conditions are in a second pre-determined temperature range, wherein treating the ambient air comprises indirect or direct evaporative cooling;

circulating the treated ambient air within the structure when ambient conditions are within the second pre-determined temperature range;

exhausting air from the structure

managing attic temperature to assist in cooling the building, wherein the temperature is managed by venting warmed attic air and circulating untreated ambient air to maintain attic temperatures at or below ambient temperatures; and,

circulating cooled building air throughout the building when ambient temperatures are within a third pre-determined temperature range, wherein the building air is cooled through indirect evaporative cooling.

9. A method for efficient heating control of a building, the method comprising:

circulating untreated ambient air when ambient conditions are within a pre-determined temperature range;

heating ambient air to obtain a desired temperature when ambient temperatures are in a second pre-determined temperature range, wherein heating of ambient air comprises solar heating;

managing attic temperature to assist in heating the building, wherein the temperature is managed by circulating warmed attic air into the building and cool building air into the attic to maintain a desired temperature; and,

circulating heated building air throughout the building when ambient temperatures are within a third pre-determined temperature range.

10. A method of maximizing building efficiency, the method comprising:

circulating untreated ambient air when ambient conditions are within a pre-determined temperature range;

cooling ambient air to obtain a desired temperature when ambient conditions are in a second pre-determined temperature range, wherein cooling of ambient air comprises cooling through indirect evaporative cooling;

managing attic temperature to assist in cooling the building, wherein the temperature is managed by venting warmed attic air and circulating untreated ambient air to maintain attic temperatures at or below ambient temperatures;

circulating cooled building air throughout the building when ambient temperatures are within a third pre-determined temperature range, wherein the building air is cooled through indirect evaporative cooling;

heating ambient air to obtain a desired temperature when ambient temperatures are in a second pre-determined temperature range, wherein heating of ambient air comprises solar heating;

managing attic temperature to assist in heating the building, wherein the temperature is managed by circulating warmed attic air into the building and cool building air into the attic to maintain a desired temperature;

circulating heated building air throughout the building when ambient temperatures are within a third pre-determined temperature range; and,

heating water with excess heat captured from building activities; wherein the heat is captured through the use of heat pumps, wherein the hot water is further used for providing additional building climate control or for providing heated water, and wherein water generated through the heat capture activities is utilized in connection with the building.

11. A method of utilization of an environmental cycle by a climate control system to decrease energy required to maintain a desired condition within a defined volume, the method comprising:

sensing a parameter of the defined volume;

comparing the sensed parameter of the defined volume to a desired parameter for the defined volume;

sensing a parameter of the environment surrounding the defined volume;

comparing the sensed parameter of the environment surrounding the defined volume to the sensed parameter of the defined volume and the desired parameter for the defined volume;

altering the parameter of the defined volume to match the desired parameter for the defined volume in part via heat or energy transfer to or from the environment.

12. The method of Claims 1, 6, 8, 9, 10, or 11, wherein two or more electrical devices are managed to avoid simultaneous start and thus to reduce electrical demand penalties.

13. The method of Claim 12, wherein the two or more electrical devices comprise compressors.

14. The method of Claims 1, 6, 8, 9, 10, or 11, wherein heat is extracted from high heat sources with a heat pump.

15. The method of Claim 14, wherein the heat pump comprises an air-to water heat pump.

16. The method of Claim 14, wherein the heat is extracted from at least one of a kitchen, laundry, pool, from areas around compressors, or from electrical equipment.

17. The method of Claim 14, wherein moisture is simultaneously extracted from high heat areas.

18. The method of Claim 11, wherein the defined volume comprises the internal volume of a structure.

19. The method of Claim 18, wherein the structure comprises a residential structure.

20. Then method of Claim 19, wherein the residential structure comprises a mobile home.

21. The method of Claim 18, wherein the structure comprises a non-residential structure.

22. The method of Claim 11, wherein the defined volume comprises the internal volume of a tank.

23. The method of Claim 22, wherein the tank comprises a water tank.

24. The method of Claim 11, wherein the parameter of the defined volume comprises a temperature.

25. The method of Claim 11, wherein the parameter of the defined volume comprises a relative humidity.

26. The method of Claim 11, wherein the parameter of the environment comprises a temperature.

27. The method of Claim 11, wherein the parameter of the environment comprises a relative humidity.

28. The method of Claim 11, wherein altering the parameter of the defined volume comprises replacing a portion of the air of the defined volume with air from the environment.

29. The method of Claim 11, wherein altering the parameter of the defined volume comprises utilizing captured energy to heat the contents of the defined volume.

30. The method of Claim 29, wherein solar energy is captured via a solar heating system.

31. The method of Claim 30, wherein the solar heating system comprises a solar hot air panel.

32. The method of Claim 30, wherein the solar heating system comprises a solar hot water panel.

33. The method of Claim 11, wherein altering the parameter of the defined volume comprises non-environmentally based cooling.

34. The method of Claim 32, wherein the non-environmentally based cooling comprises evaporative cooling.

35. The method of Claim 32, wherein the non-environmentally based cooling comprises use of a heat pump.

36. The method of Claim 11, wherein altering the parameter of the defined volume comprises non-environmentally caused heating.

37. The method of Claim 36, wherein the non-environmentally based heating comprises use of a heat pump.

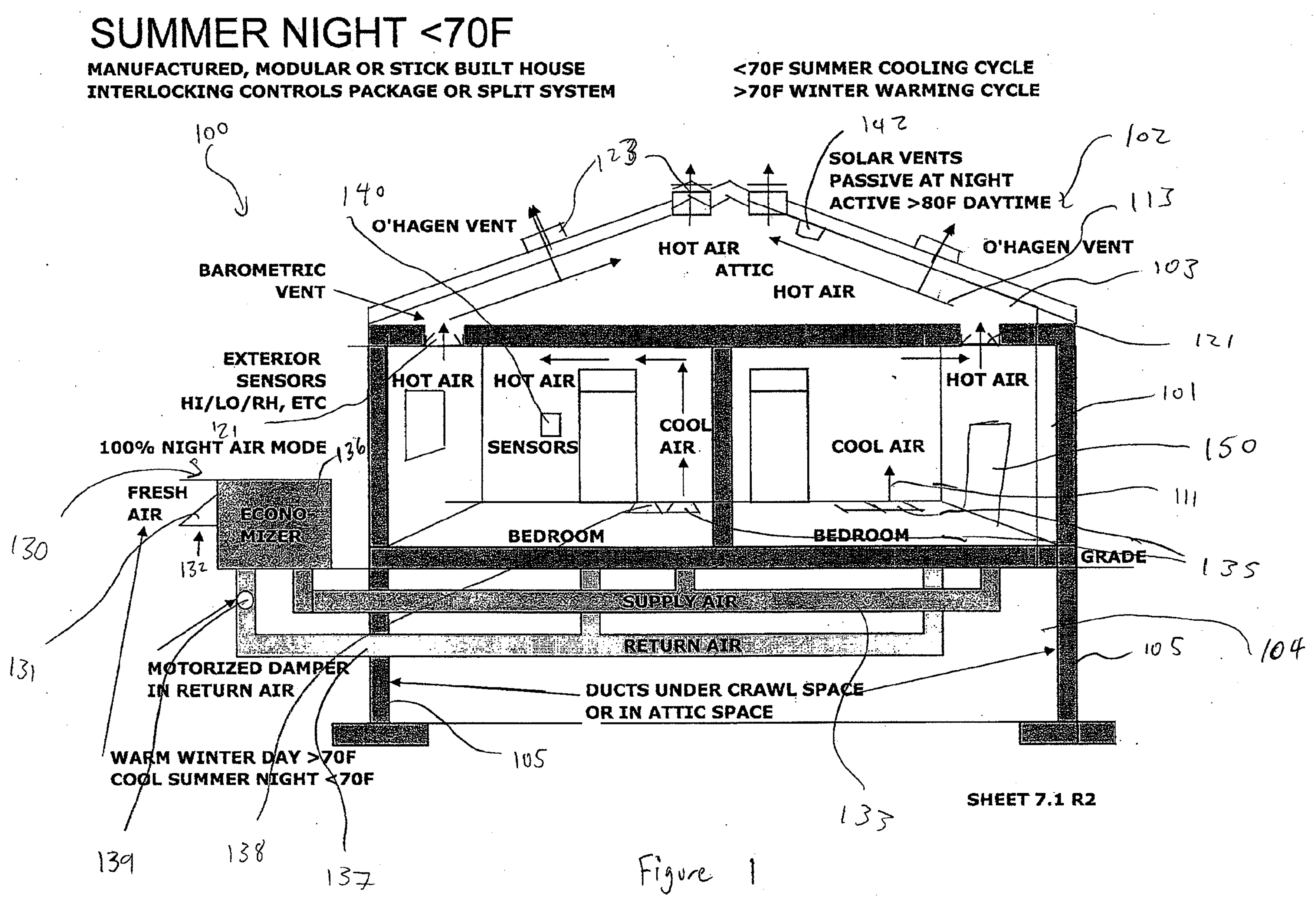

SUMMER NIGHT <70F
MANUFACTURED, MODULAR OR STICK BUILT HOUSE
INTERLOCKING CONTROLS PACKAGE OR SPLIT SYSTEM
<70F SUMMER COOLING CYCLE
>70F WINTER WARMING CYCLE
100
140
123
142
102
113
103
121
101
150
111
135
104
105
133
137
138
139
131
130
132
136
121
SOLAR VENTS
PASSIVE AT NIGHT
ACTIVE >80F DAYTIME
O'HAGEN VENT
O'HAGEN VENT
HOT AIR
ATTIC
HOT AIR
BAROMETRIC VENT
EXTERIOR SENSORS HI/LO/RH, ETC
HOT AIR
HOT AIR
SENSORS
COOL AIR
COOL AIR
HOT AIR
100% NIGHT AIR MODE
FRESH AIR
ECONO-MIZER
BEDROOM
BEDROOM
GRADE
SUPPLY AIR
RETURN AIR
MOTORIZED DAMPER IN RETURN AIR
DUCTS UNDER CRAWL SPACE OR IN ATTIC SPACE
WARM WINTER DAY >70F
COOL SUMMER NIGHT <70F
SHEET 7.1 R2

Figure 1

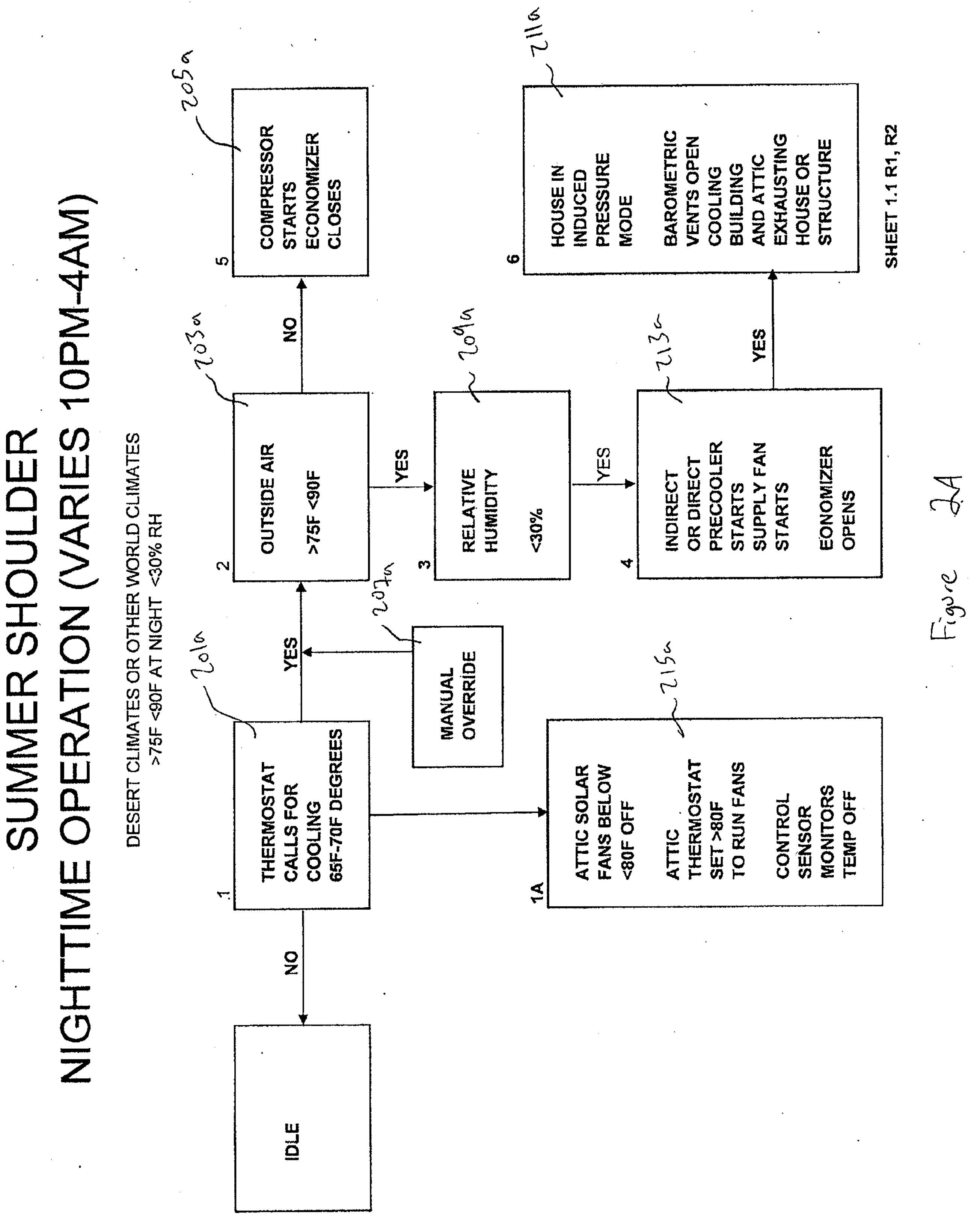

SUMMER SHOULDER
NIGHTTIME OPERATION (VARIES 10PM-4AM)
DESERT CLIMATES OR OTHER WORLD CLIMATES
>75F <90F AT NIGHT <30% RH
IDLE
NO
1
THERMOSTAT CALLS FOR COOLING 65F-70F DEGREES
201a
YES
MANUAL OVERRIDE
207a
2
OUTSIDE AIR
>75F <90F
203a
NO
5
COMPRESSOR STARTS ECONOMIZER CLOSES
205a
YES
3
RELATIVE HUMIDITY
<30%
209a
YES
4
INDIRECT OR DIRECT PRECOOLER STARTS SUPPLY FAN STARTS
EONOMIZER OPENS
213a
YES
6
HOUSE IN INDUCED PRESSURE MODE
BAROMETRIC VENTS OPEN COOLING BUILDING AND ATTIC EXHAUSTING HOUSE OR STRUCTURE
211a
1A
ATTIC SOLAR FANS BELOW <80F OFF
ATTIC THERMOSTAT SET >80F TO RUN FANS
CONTROL SENSOR MONITORS TEMP OFF
215a
SHEET 1.1 R1, R2

Figure 2A

SUMMER SHOULDER DAYTIME OPERATION

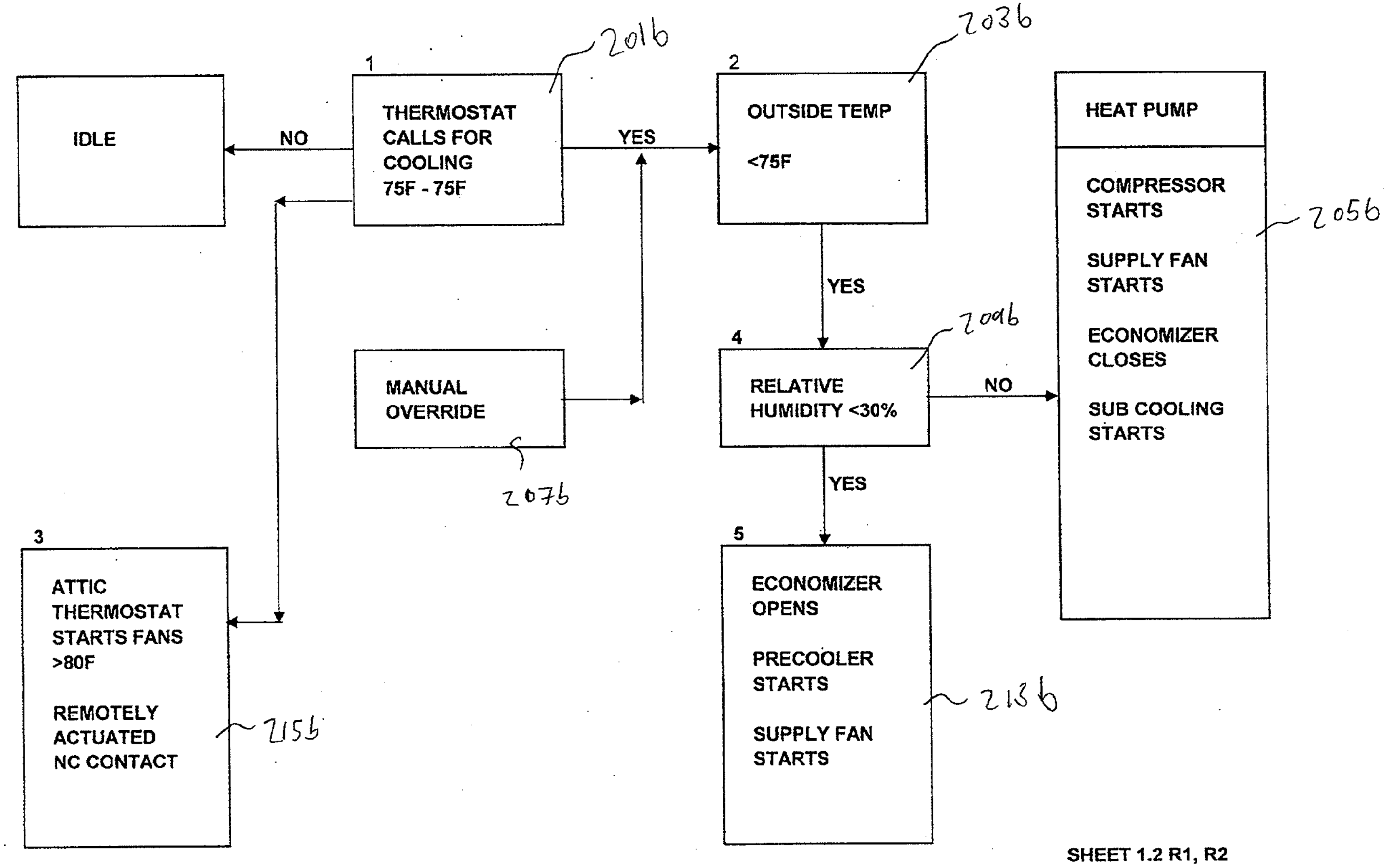
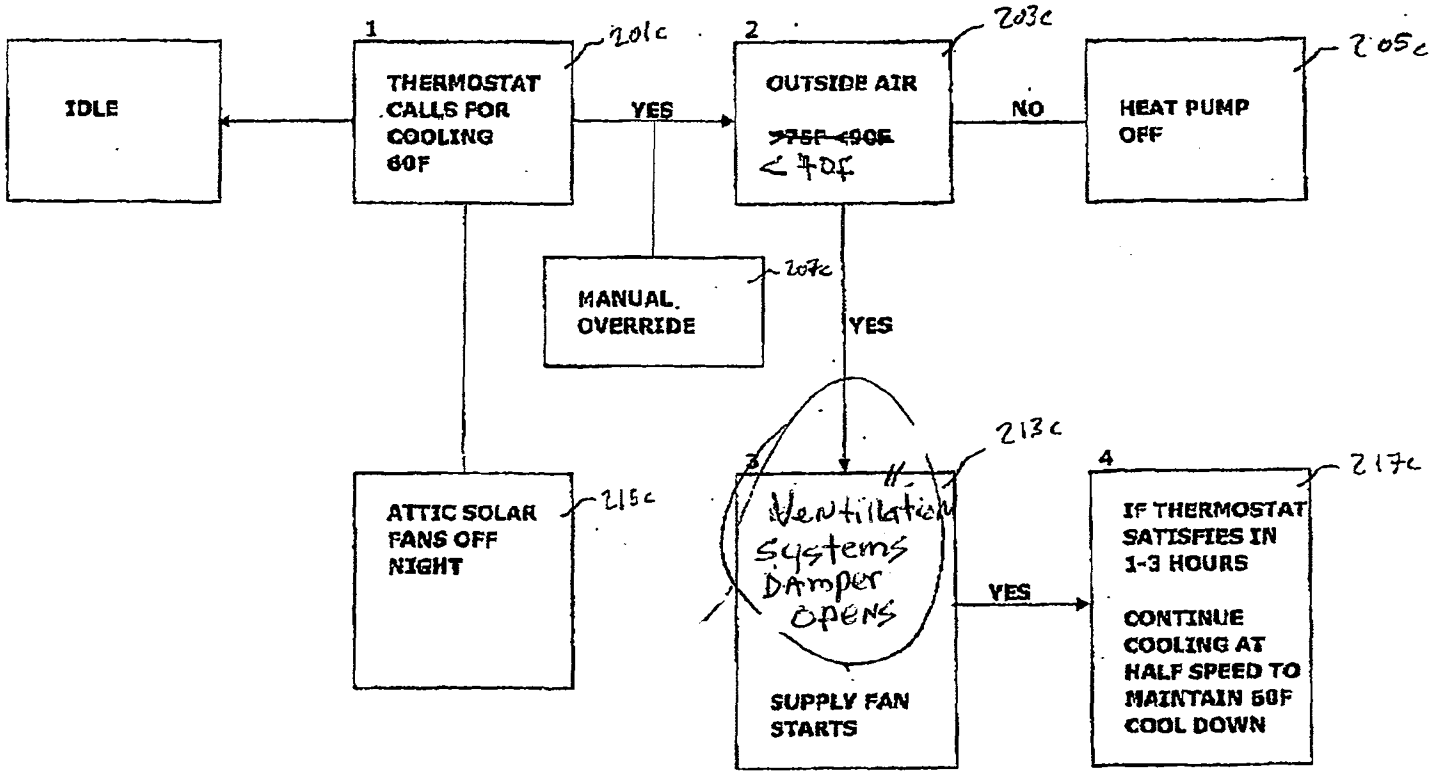


Figure 2B

SUMMER/SHOULDER
NIGHTTIME OPERATIONS (VARIES 10PM - 4AM)

FOR DESERT, COASTAL OR MOUNTAIN CLIMATES
NIGHTTIME TEMPS <65F <30% RH FOR 6 HRS OR MORE



SHEET 1.3 R1, R2

Figure 2C

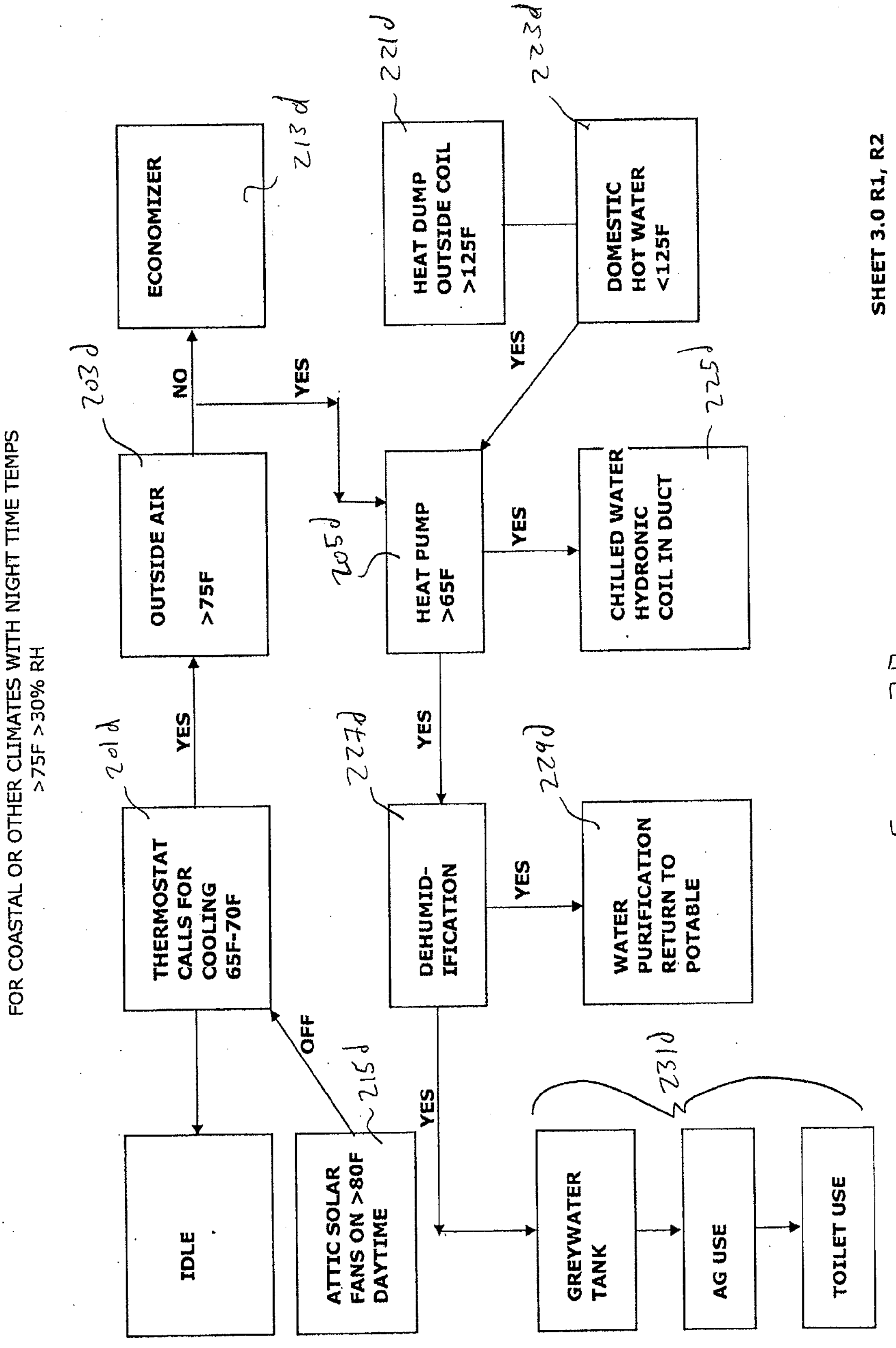
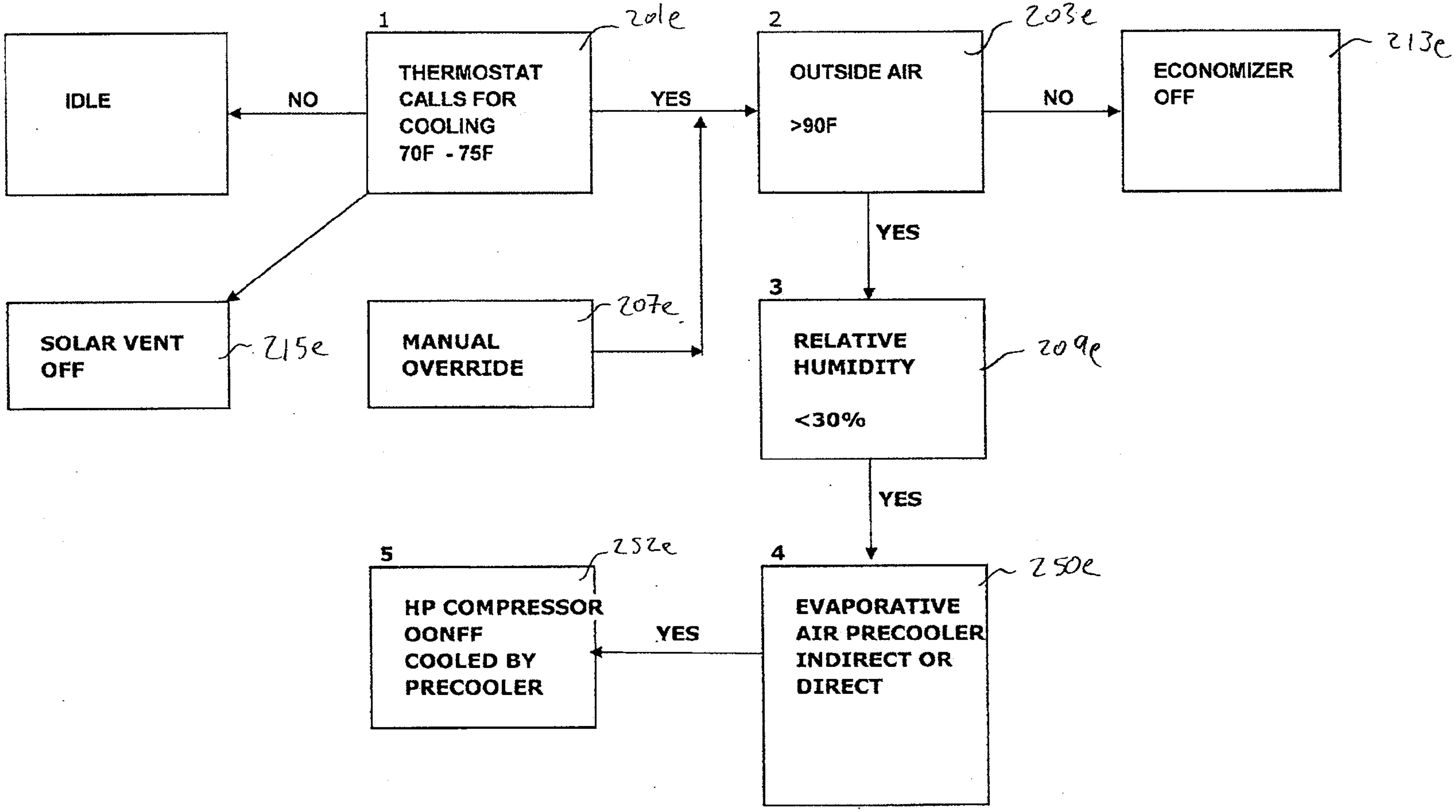

FOR COASTAL OR OTHER CLIMATES WITH NIGHT TIME TEMPS
>75F >30% RH
THERMOSTAT CALLS FOR COOLING 65F-70F
201d
YES
OUTSIDE AIR >75F
203d
NO
ECONOMIZER
213d
YES
HEAT PUMP >65F
205d
YES
CHILLED WATER HYDRONIC COIL IN DUCT
225d
HEAT DUMP OUTSIDE COIL >125F
221d
DOMESTIC HOT WATER <125F
223d
YES
YES
DEHUMID-IFICATION
227d
YES
WATER PURIFICATION RETURN TO POTABLE
229d
IDLE
ATTIC SOLAR FANS ON >80F DAYTIME
215d
OFF
YES
GREYWATER TANK
AG USE
TOILET USE
231d
SHEET 3.0 R1, R2

Figure 2D

SUMMER DAY OR NIGHTTIME OPERATION

DESERT OR OTHER CLIMATES
>75F <90F AT NIGHT <30% RH DAY OR NIGHT



SHEET 4.1

Figure 2E

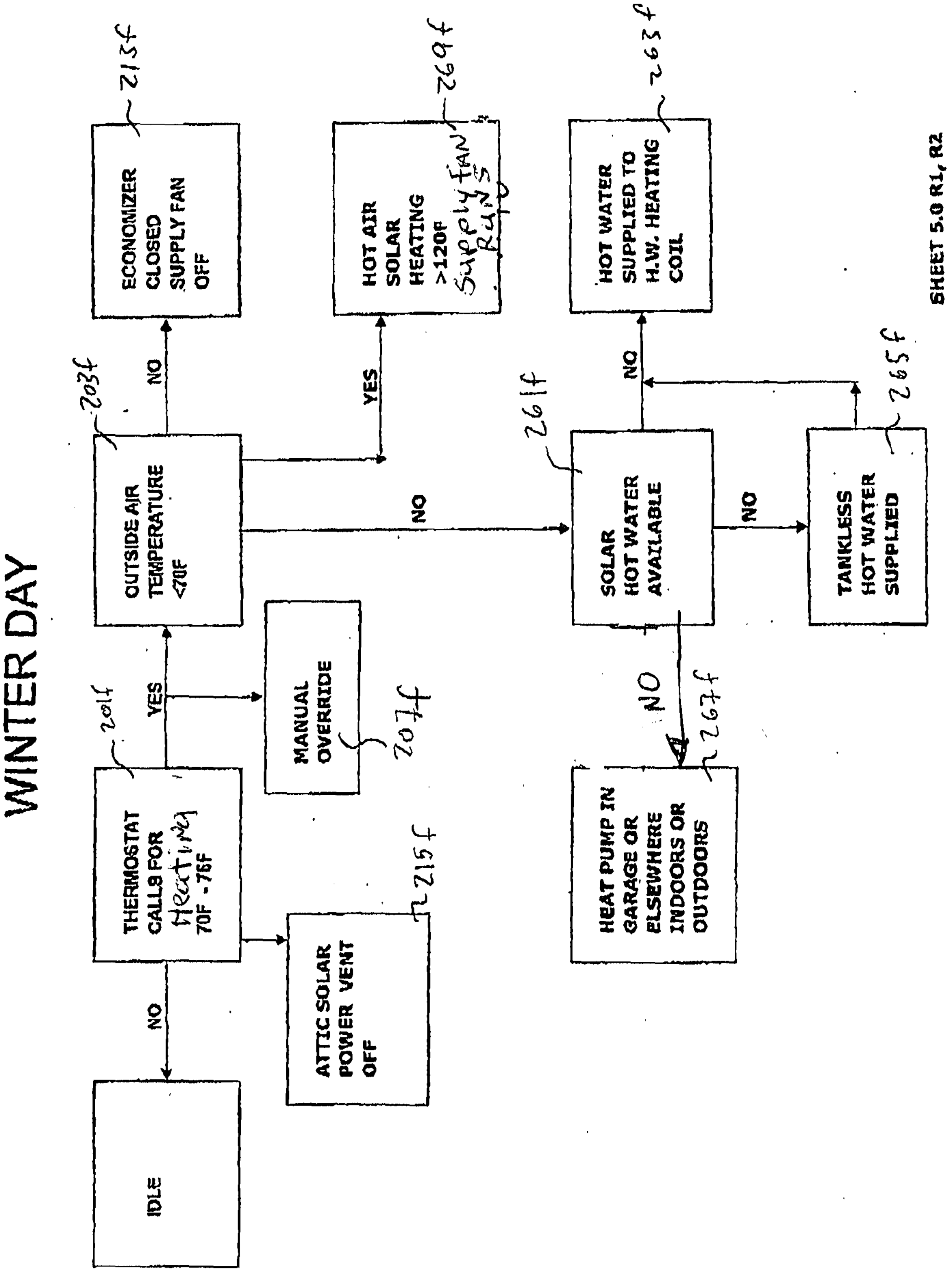

WINTER DAY
THERMOSTAT CALLS FOR Heating 70F - 76F
201f
YES
NO
IDLE
ATTIC SOLAR POWER VENT OFF
215f
MANUAL OVERRIDE
207f
OUTSIDE AIR TEMPERATURE <70F
203f
NO
ECONOMIZER CLOSED SUPPLY FAN OFF
213f
YES
HOT AIR SOLAR HEATING >120F Supply fan Runs
269f
NO
SOLAR HOT WATER AVAILABLE
261f
NO
HOT WATER SUPPLIED TO H.W. HEATING COIL
263f
NO
TANKLESS HOT WATER SUPPLIED
265f
NO
HEAT PUMP IN GARAGE OR ELSEWHERE INDOORS OR OUTDOORS
267f
SHEET 5.0 R1, R2

Figure 2F

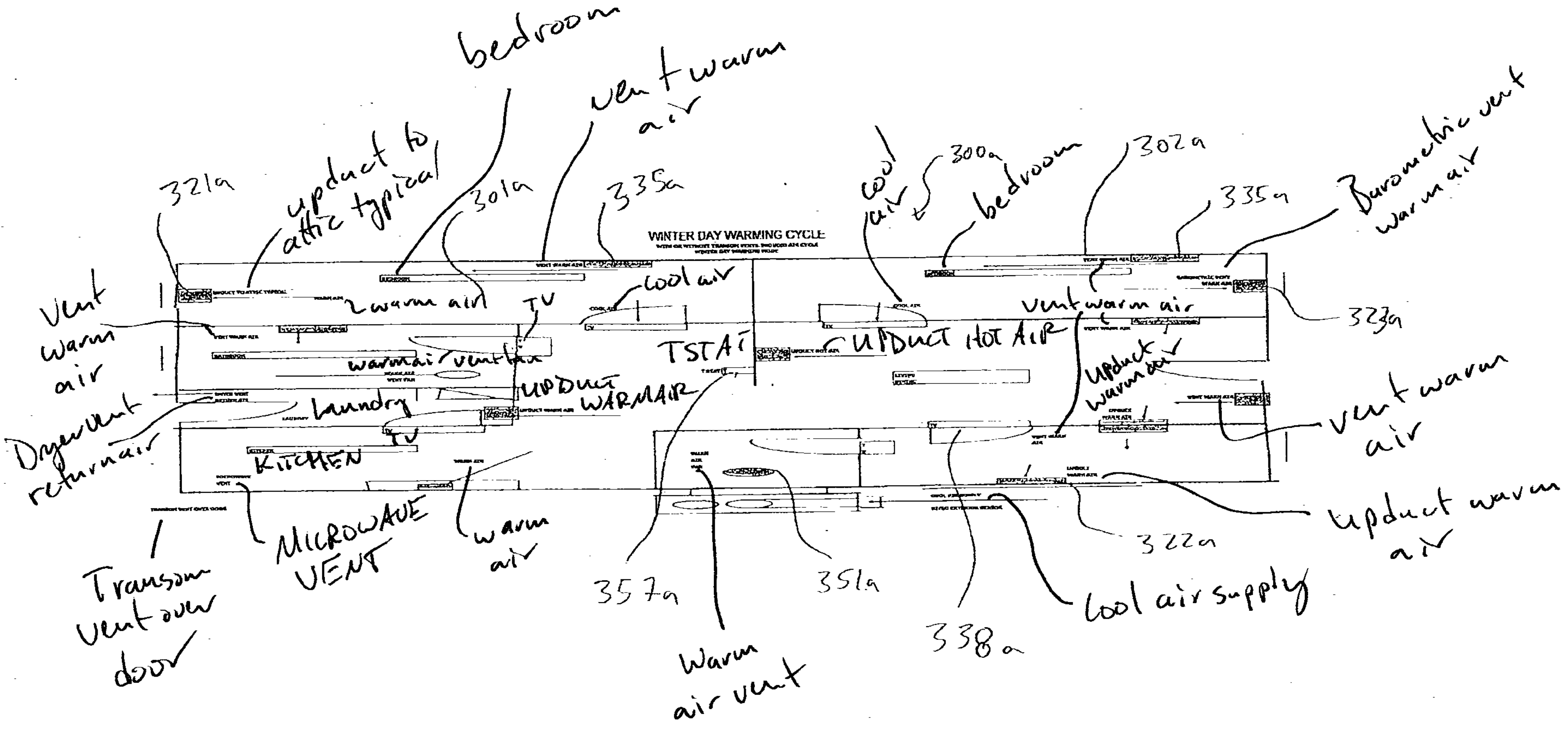

WINTER DAY WARMING CYCLE
321a
updauct to attic typical
bedroom
301a
vent warm air
335a
Vent warm air
warm air
TV
cool air
warmair vent fan
UPDUCT WARMAIR
TSTAT
Dryer vent returnair
laundry
TV
KITCHEN
MICROWAVE VENT
warm air
Transom vent over door
357a
Warm air vent
351a
cool air
300a
bedroom
UPDUCT HOT AIR
302a
vent warm air
335a
Barometric vent warm air
323a
updauct warm air
vent warm air
322a
updauct warm air
cool air supply
338a

Figure 3A

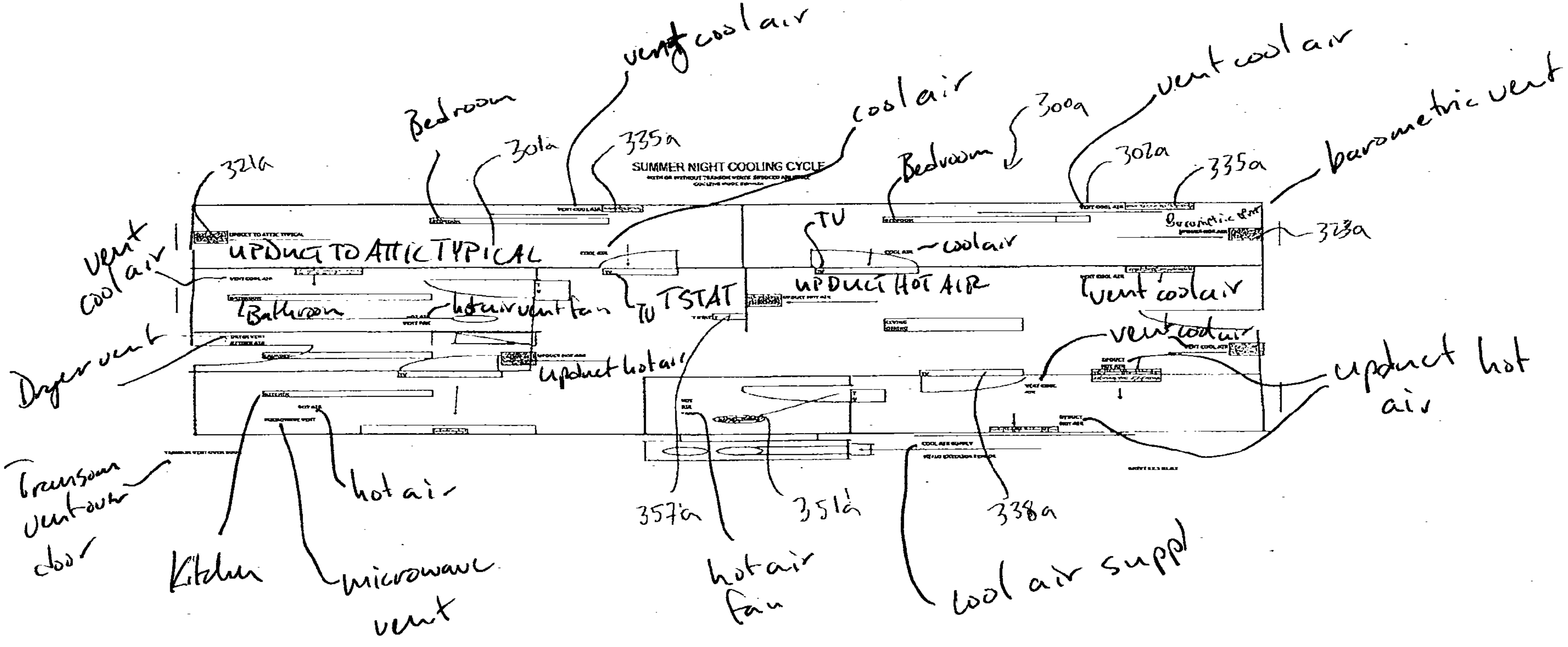

SUMMER NIGHT COOLING CYCLE
Bedroom
vent cool air
301a
335a
321a
cool air
Bedroom
300a
vent cool air
302a
335a
barometric vent
323a
TV
cool air
vent cool air
UPDUCT TO ATTIC TYPICAL
Bathroom
bathroom vent fan
TO TSTAT
UPDUCT HOT AIR
vent cool air
Dryer vent
updunct hot air
vent cool air
updunct hot air
Transom vent over door
Kitchen
microwave vent
hot air
357a
hot air fan
351a
cool air suppl
338a

Figure 3B

ATTIC VENTILATION STRATEGY

FOR MANUFACTURED HOMES, MODULAR OR STICK BUILT HOMES COMMERCIAL AND INDUSTRIAL ATTICS

EXTRA O'HAGANS

SOLAR VENTS DRAW AIR IN OHAGANS OUT THRU SOLAR VENTS

VENTING TYPICAL BOTH SIDES OF ROOF

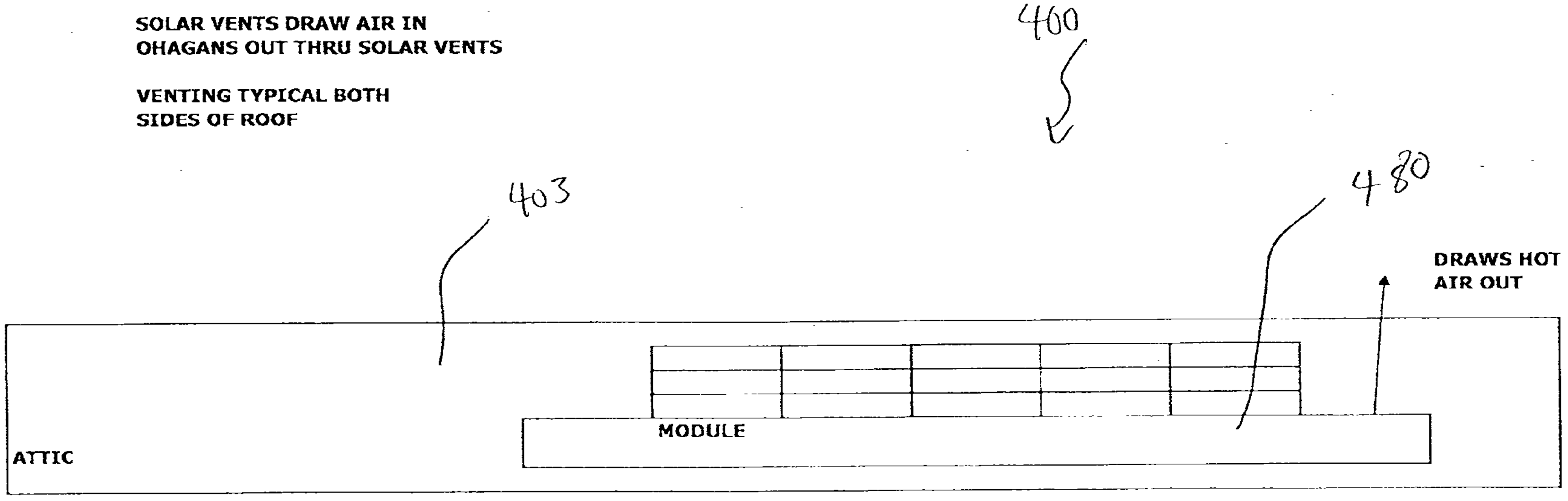


Figure 4

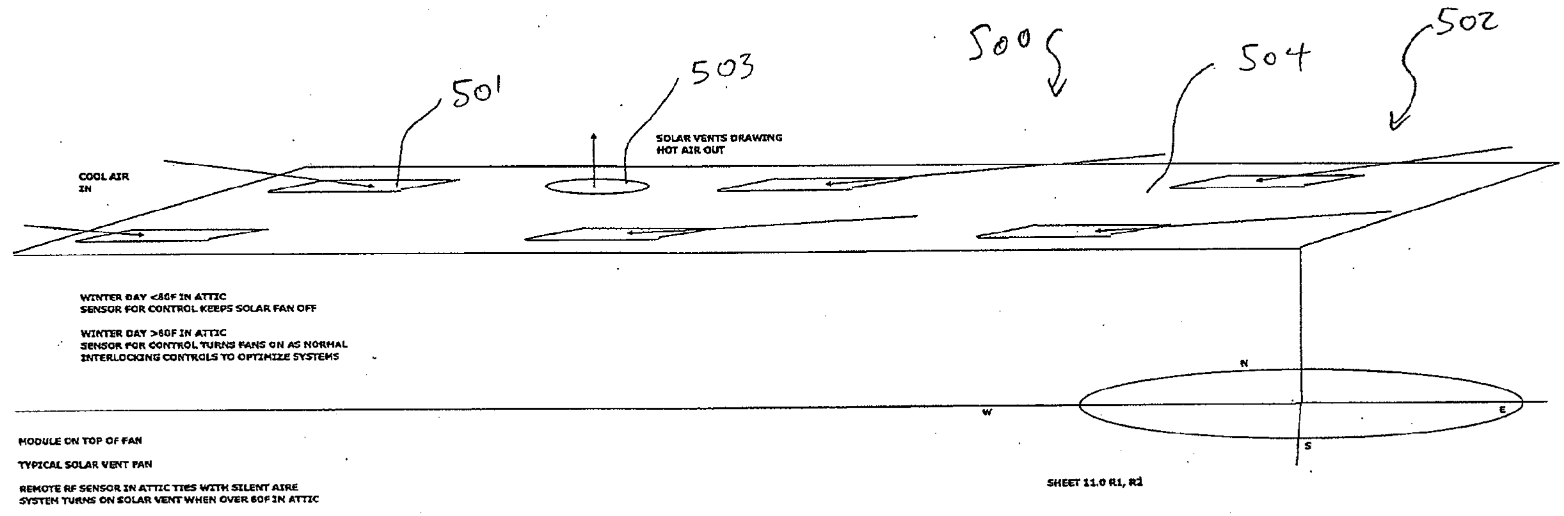

500
501
502
503
504
COOL AIR
IN
SOLAR VENTS DRAWING
HOT AIR OUT
WINTER DAY <60F IN ATTIC
SENSOR FOR CONTROL KEEPS SOLAR FAN OFF
WINTER DAY >60F IN ATTIC
SENSOR FOR CONTROL TURNS FANS ON AS NORMAL
INTERLOCKING CONTROLS TO OPTIMIZE SYSTEMS
MODULE ON TOP OF FAN
TYPICAL SOLAR VENT FAN
REMOTE RF SENSOR IN ATTIC TIES WITH SILENT AIRE
SYSTEM TURNS ON SOLAR VENT WHEN OVER 60F IN ATTIC
N
W
E
S
SHEET 11.0 R1, R1

Figure 5A

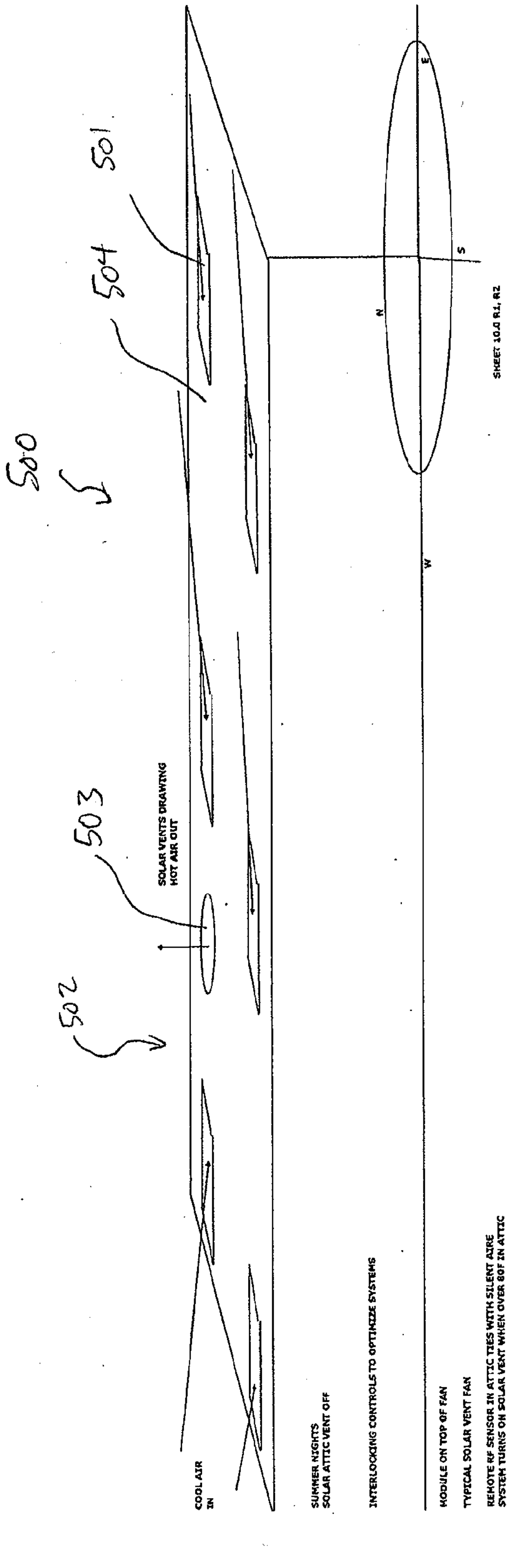

500
501
502
503
504
SOLAR VENTS DRAWING
HOT AIR OUT
COOL AIR
IN
SUMMER NIGHTS
SOLAR ATTIC VENT OFF
INTERLOCKING CONTROLS TO OPTIMIZE SYSTEMS
MODULE ON TOP OF FAN
TYPICAL SOLAR VENT FAN
REMOTE RF SENSOR IN ATTIC TIES WITH SILENT AIRE
SYSTEM TURNS ON SOLAR VENT WHEN OVER 80F IN ATTIC
N
S
E
W
SHEET 10.0 R1, R2

Figure 5B

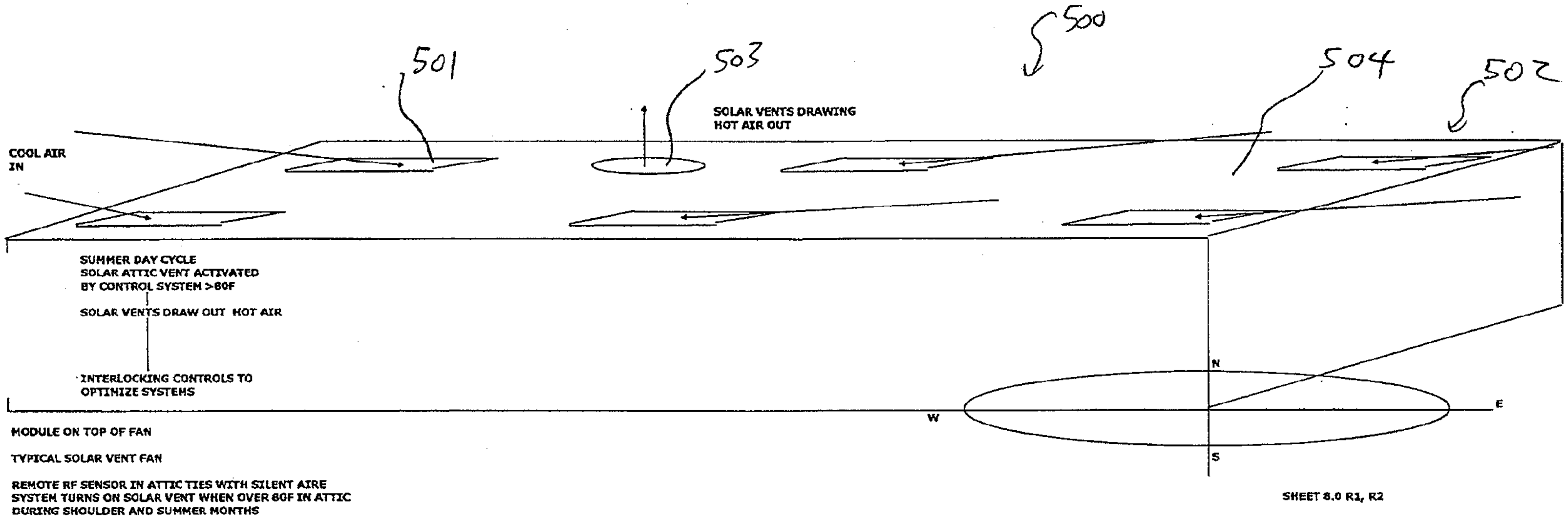

501
503
500
504
502
SOLAR VENTS DRAWING
HOT AIR OUT
COOL AIR
IN
SUMMER DAY CYCLE
SOLAR ATTIC VENT ACTIVATED
BY CONTROL SYSTEM >80F
SOLAR VENTS DRAW OUT HOT AIR
INTERLOCKING CONTROLS TO
OPTIMIZE SYSTEMS
MODULE ON TOP OF FAN
TYPICAL SOLAR VENT FAN
REMOTE RF SENSOR IN ATTIC TIES WITH SILENT AIRE
SYSTEM TURNS ON SOLAR VENT WHEN OVER 80F IN ATTIC
DURING SHOULDER AND SUMMER MONTHS
N
W
E
S
SHEET 8.0 R1, R2

Figure 5C

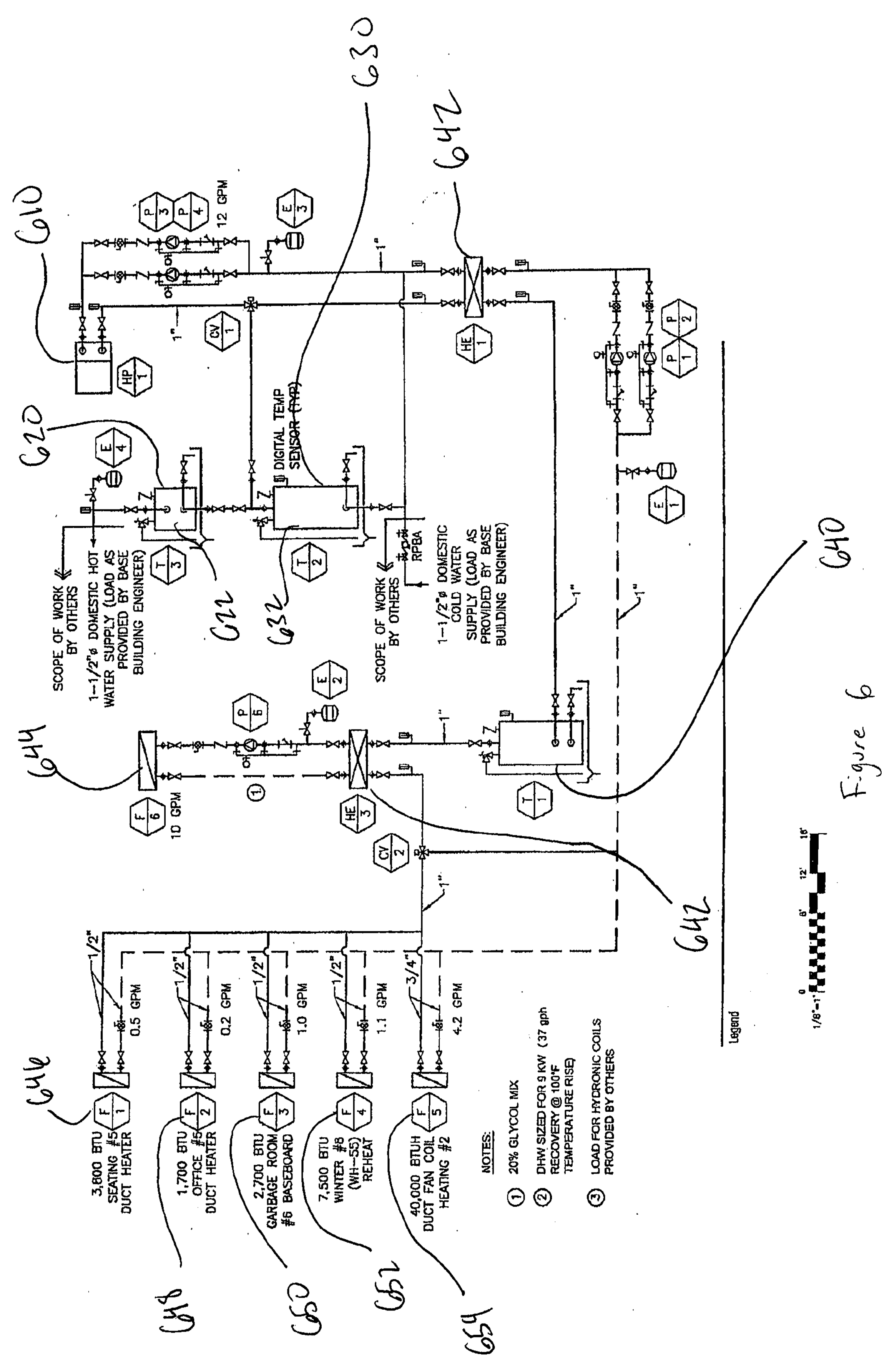

610
620
622
630
632
640
642
642
644
646
648
650
652
654
HP 1
P 3
P 4
12 GPM
E 3
CV 1
1"
HE 1
P 1
P 2
E 1
E 4
T 3
T 2
DIGITAL TEMP SENSOR (TYP)
RPBA
SCOPE OF WORK BY OTHERS
1-1/2"ø DOMESTIC HOT WATER SUPPLY (LOAD AS PROVIDED BY BASE BUILDING ENGINEER)
SCOPE OF WORK BY OTHERS
1-1/2"ø DOMESTIC COLD WATER SUPPLY (LOAD AS PROVIDED BY BASE BUILDING ENGINEER)
P 6
E 2
F 6
10 GPM
①
HE 3
CV 2
T 1
1/2"
0.5 GPM
1/2"
0.2 GPM
1/2"
1.0 GPM
1/2"
1.1 GPM
3/4"
4.2 GPM
F 1
F 2
F 3
F 4
F 5
3,600 BTU SEATING #5 DUCT HEATER
1,700 BTU OFFICE #5 DUCT HEATER
2,700 BTU GARBAGE ROOM #6 BASEBOARD
7,500 BTU WINTER #8 (WH-55) REHEAT
40,000 BTUH DUCT FAN COIL HEATING #2
NOTES:
① 20% GLYCOL MIX
② DHW SIZED FOR 9 KW (37 gph RECOVERY @ 100°F TEMPERATURE RISE)
③ LOAD FOR HYDRONIC COILS PROVIDED BY OTHERS
Legend
0 6' 12' 18'
1/8"=1'

Figure 6

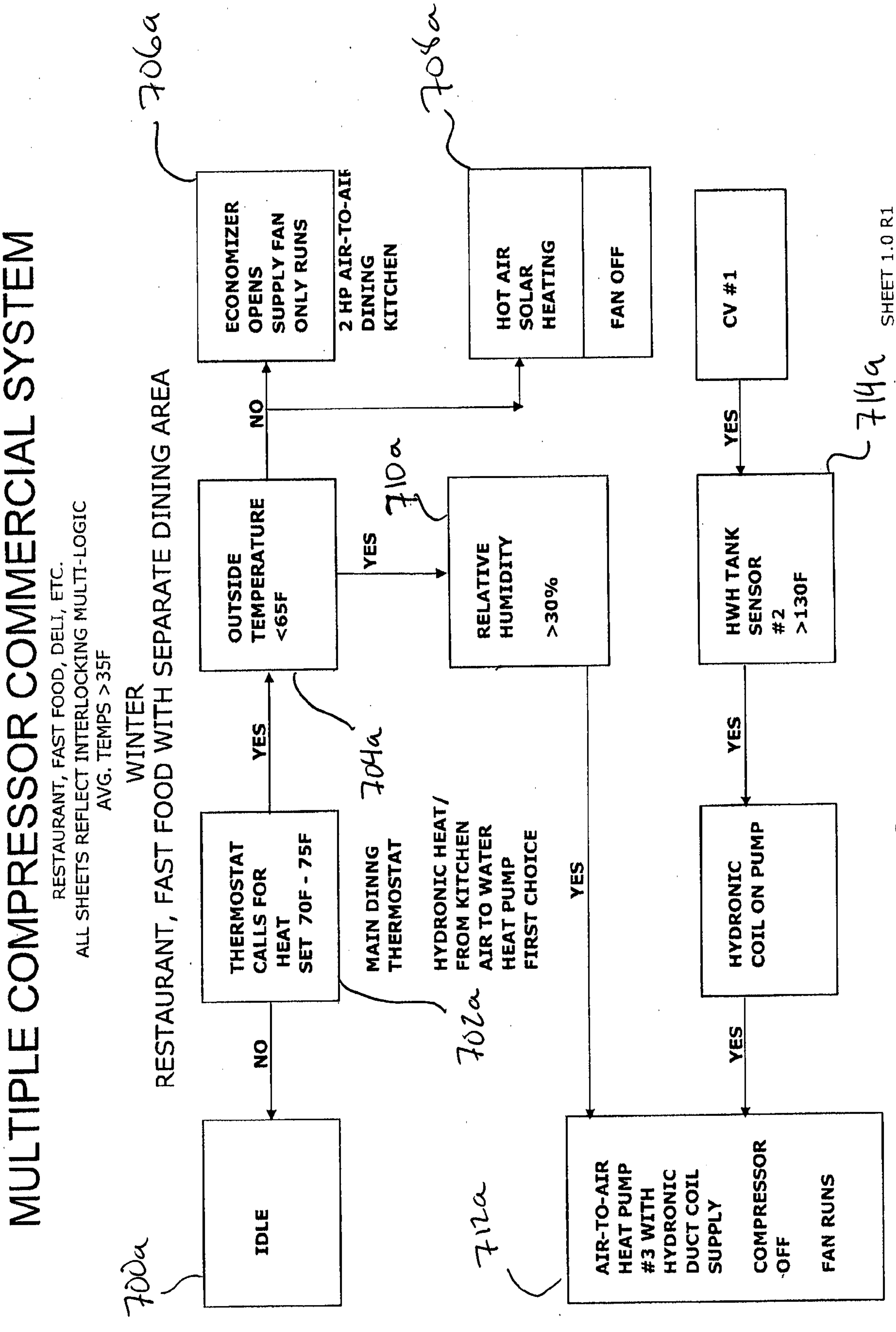

MULTIPLE COMPRESSOR COMMERCIAL SYSTEM
RESTAURANT, FAST FOOD, DELI, ETC.
ALL SHEETS REFLECT INTERLOCKING MULTI-LOGIC
AVG. TEMPS >35F
WINTER
RESTAURANT, FAST FOOD WITH SEPARATE DINING AREA
IDLE
700a
NO
THERMOSTAT CALLS FOR HEAT SET 70F - 75F
702a
MAIN DINNG THERMOSTAT
HYDRONIC HEAT/ FROM KITCHEN AIR TO WATER HEAT PUMP FIRST CHOICE
YES
OUTSIDE TEMPERATURE <65F
704a
NO
ECONOMIZER OPENS SUPPLY FAN ONLY RUNS
2 HP AIR-TO-AIR DINING KITCHEN
706a
HOT AIR SOLAR HEATING
FAN OFF
708a
YES
RELATIVE HUMIDITY >30%
710a
YES
AIR-TO-AIR HEAT PUMP #3 WITH HYDRONIC DUCT COIL SUPPLY
COMPRESSOR OFF
FAN RUNS
712a
YES
HYDRONIC COIL ON PUMP
YES
HWH TANK SENSOR #2 >130F
714a
YES
CV #1
SHEET 1.0 R1

Figure 7A

MULTIPLE COMPRESSOR COMMERCIAL SYSTEM

RESTAURANT, FAST FOOD, DELI, ETC.
ALLFPUOR SHEETS REFLECT INTERLOCKING MULTI-LOGIC

AVG. TEMPS >35F
WINTER KITCHEN

RESTAURANT, FAST FOOD WITH SEPARATE DINING AREA

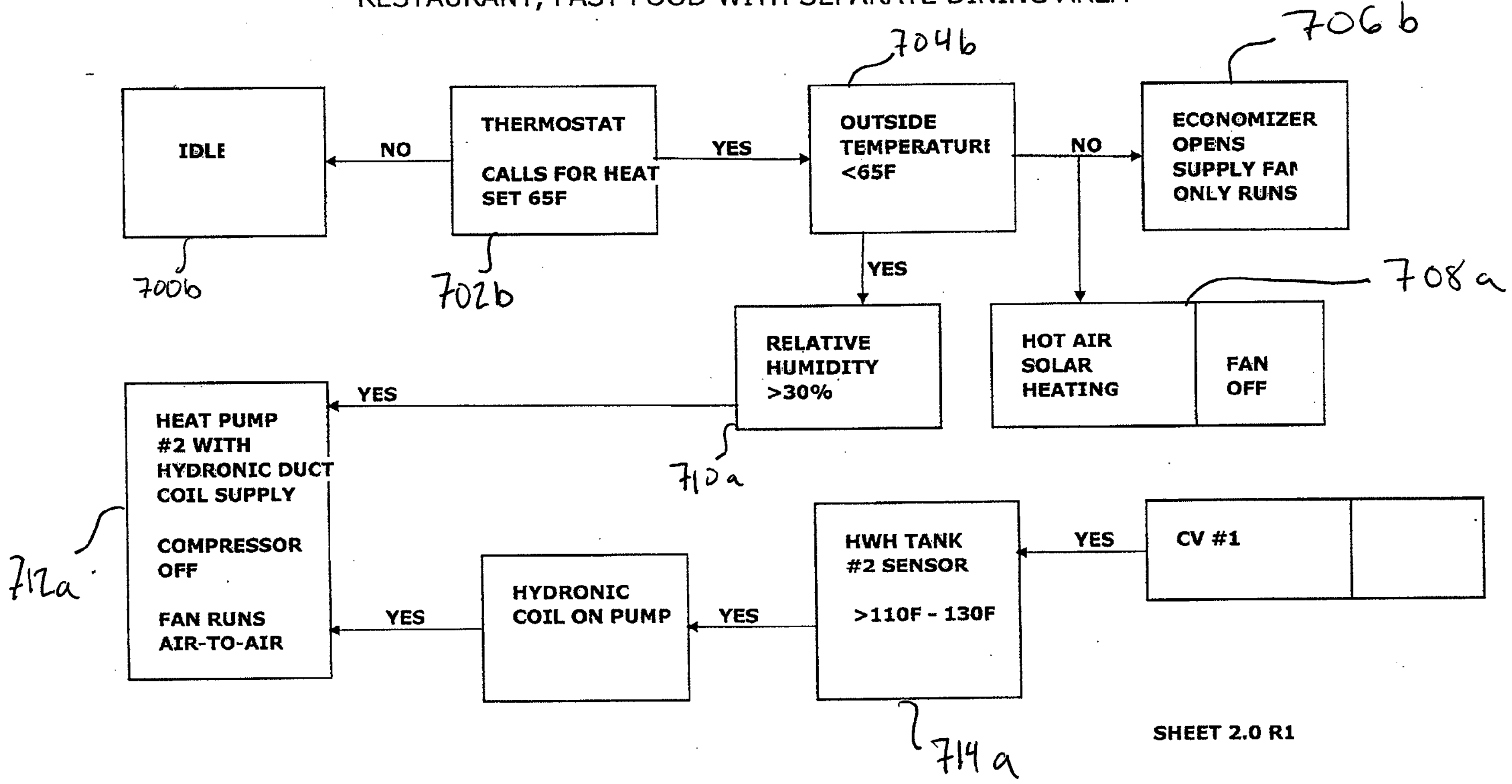


Figure 7B

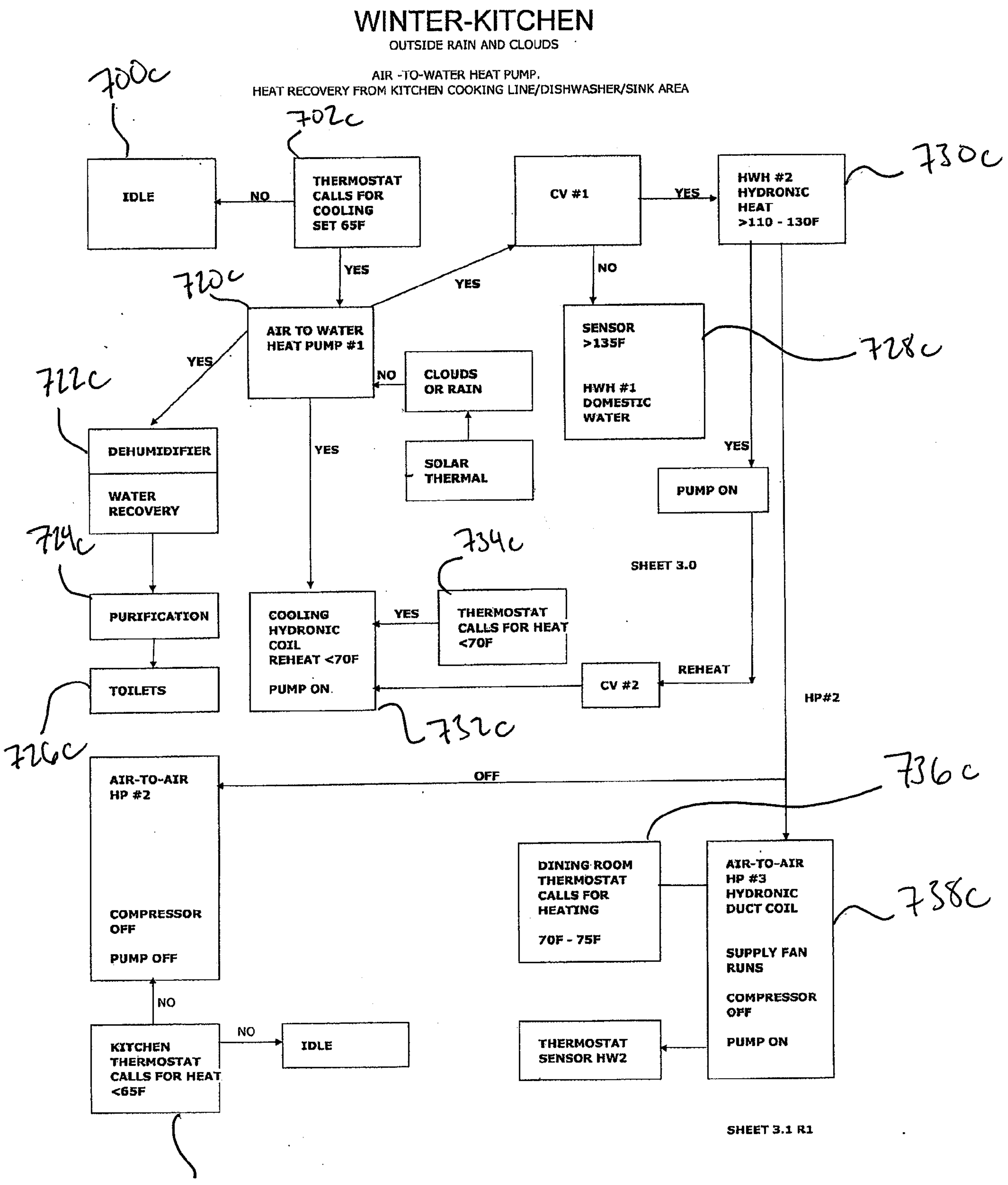

WINTER-KITCHEN
OUTSIDE RAIN AND CLOUDS
AIR -TO-WATER HEAT PUMP,
HEAT RECOVERY FROM KITCHEN COOKING LINE/DISHWASHER/SINK AREA
700c
702c
IDLE
NO
THERMOSTAT CALLS FOR COOLING SET 65F
CV #1
YES
HWH #2 HYDRONIC HEAT >110 - 130F
730c
YES
YES
NO
720c
AIR TO WATER HEAT PUMP #1
SENSOR >135F
HWH #1 DOMESTIC WATER
728c
YES
722c
NO
CLOUDS OR RAIN
YES
SOLAR THERMAL
DEHUMIDIFIER
WATER RECOVERY
YES
PUMP ON
724c
734c
SHEET 3.0
PURIFICATION
COOLING HYDRONIC COIL REHEAT <70F
PUMP ON.
YES
THERMOSTAT CALLS FOR HEAT <70F
REHEAT
TOILETS
CV #2
HP#2
732c
726c
736c
OFF
AIR-TO-AIR HP #2
COMPRESSOR OFF
PUMP OFF
DINING ROOM THERMOSTAT CALLS FOR HEATING
70F - 75F
AIR-TO-AIR HP #3 HYDRONIC DUCT COIL
SUPPLY FAN RUNS
COMPRESSOR OFF
PUMP ON
738c
NO
NO
KITCHEN THERMOSTAT CALLS FOR HEAT <65F
IDLE
THERMOSTAT SENSOR HW2
SHEET 3.1 R1
740c

Figure 7C

SPRING/SUMMER/SHOULDER KITCHEN

OUTSIDE CLEAR SKY HOT >80F <30 RH

AIR -TO-WATER HEAT PUMP.
HEAT RECOVERY FROM KITCHEN COOKING LINE/DISHWASHER/SINK AREA
COOLING MODE HUMIDITY IS VERY LOW, DAY IS HOT
EXTERNAL SOLAR THERMAL IS SUFFICIENT FOR T-2 & T-3, COOLING BY AIR TO AIR BHP-3

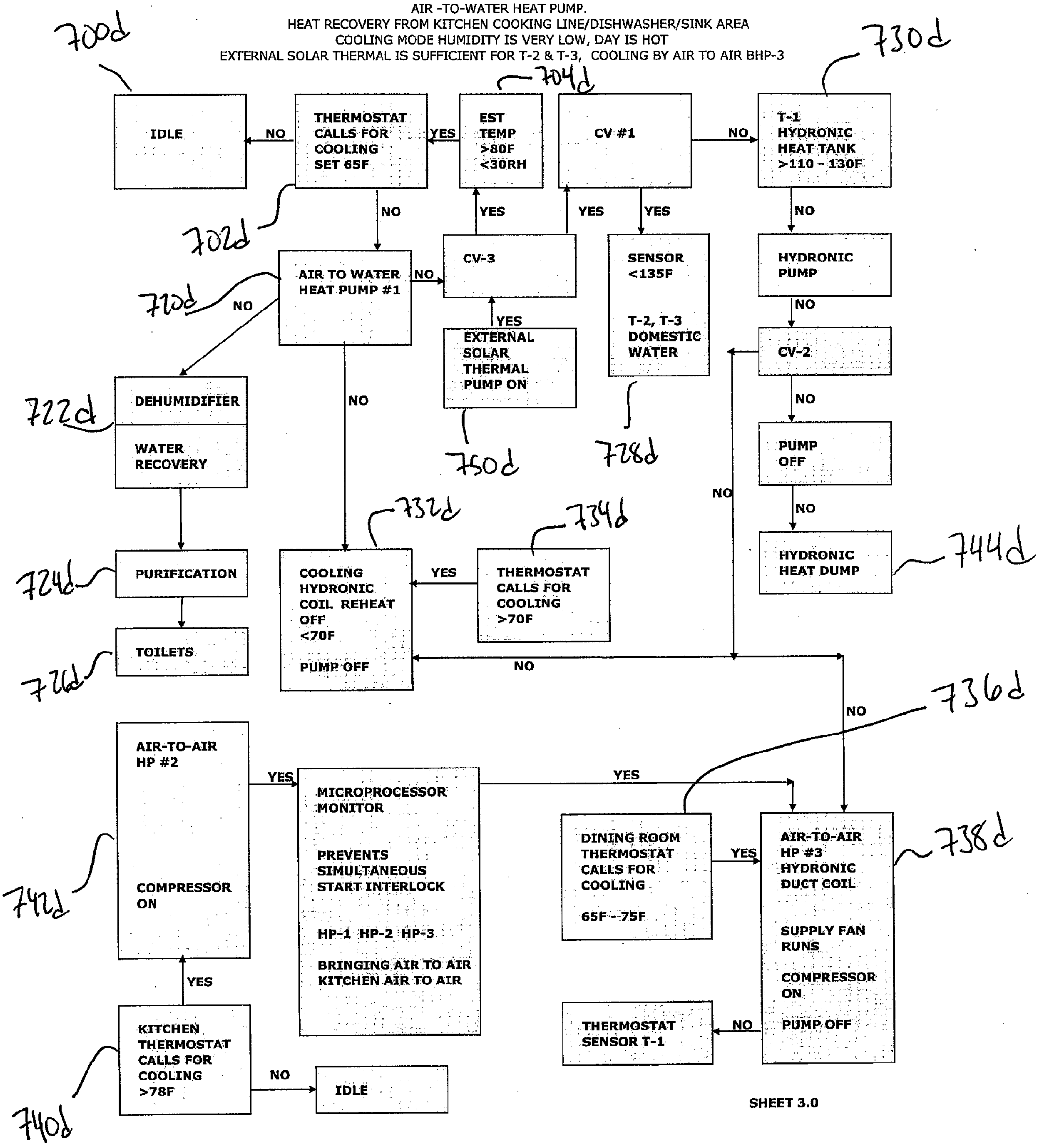


Figure 7D

SPRING/SUMMER/SHOULDER KITCHEN

OUTSIDE CLEAR SKY HOT >80F >30 RH

AIR -TO-WATER HEAT PUMP.
HEAT RECOVERY FROM KITCHEN COOKING LINE/DISHWASHER/SINK AREA
COOLING MODE HUMIDITY IS VERY LOW, DAY IS HOT
EXTERNAL SOLAR THERMAL IS SUFFICIENT FOR T-2 & T-3, COOLING BY AIR TO AIR BHP-3

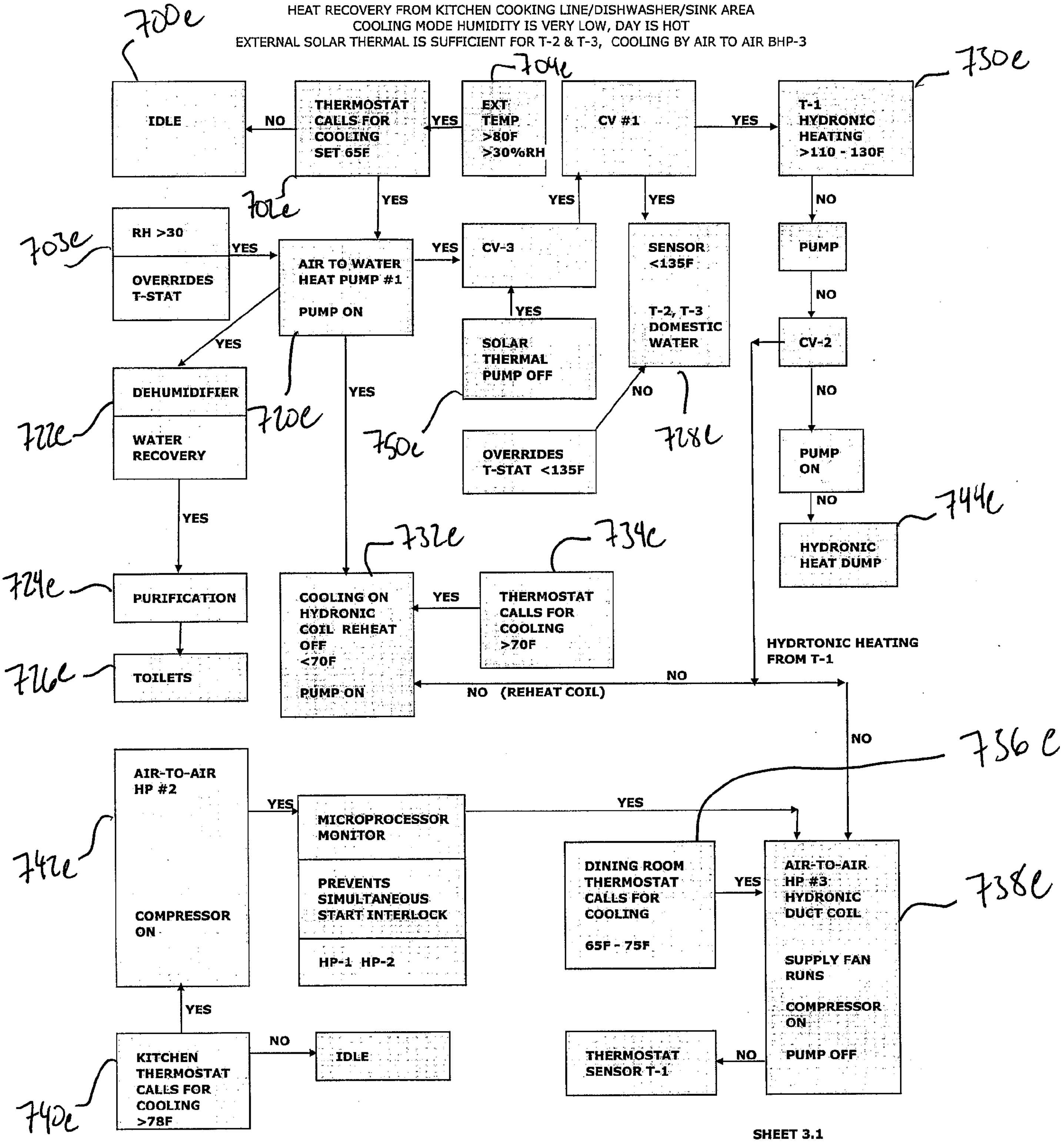


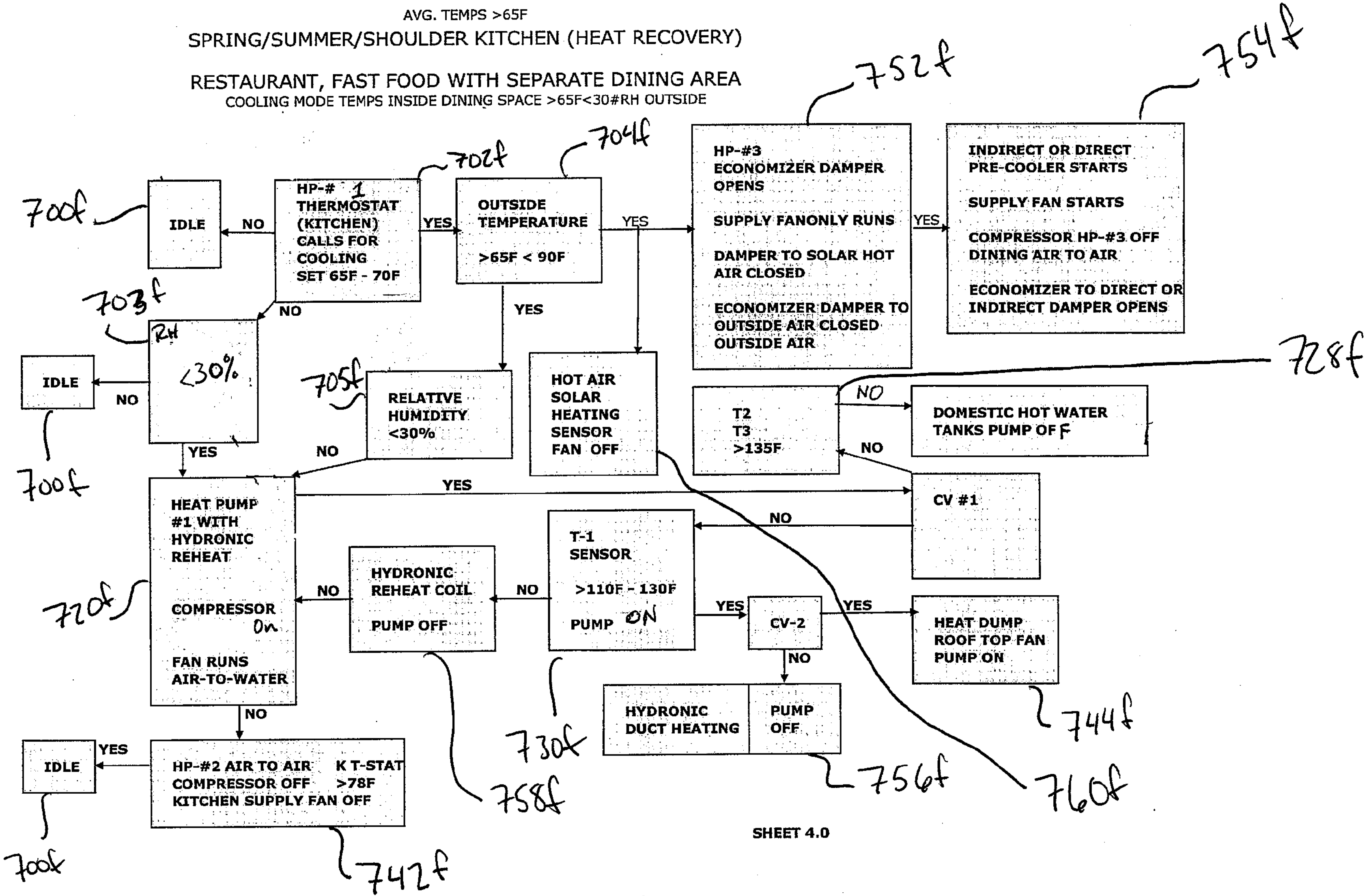
Figure 7E

MULTIPLE COMPRESSOR COMMERCIAL SYSTEM

RESTAURANT, FAST FOOD, DELI, ETC.
ALL SHEETS REFLECT INTERLOCKING MULTI-LOGIC

AVG. TEMPS >65F
SPRING/SUMMER/SHOULDER KITCHEN (HEAT RECOVERY)

RESTAURANT, FAST FOOD WITH SEPARATE DINING AREA
COOLING MODE TEMPS INSIDE DINING SPACE >65F<30#RH OUTSIDE



SHEET 4.0

Figure 7F

COOLING MODE TEMPS INSIDE DINING SPACE >65F, >30%RH

RESTAURANT, FAST FOOD, DELI, ETC.
ALL SHEETS REFLECT INTERLOCKING MULTI-LOGIC

AVG. TEMPS >65F

SPRING/SUMMER/SHOULDER KITCHEN (HEAT RECOVERY)

RESTAURANT, FAST FOOD WITH SEPARATE DINING AREA
COOLING MODE TEMPS INSIDE DINING SPACE >65F <30%RH

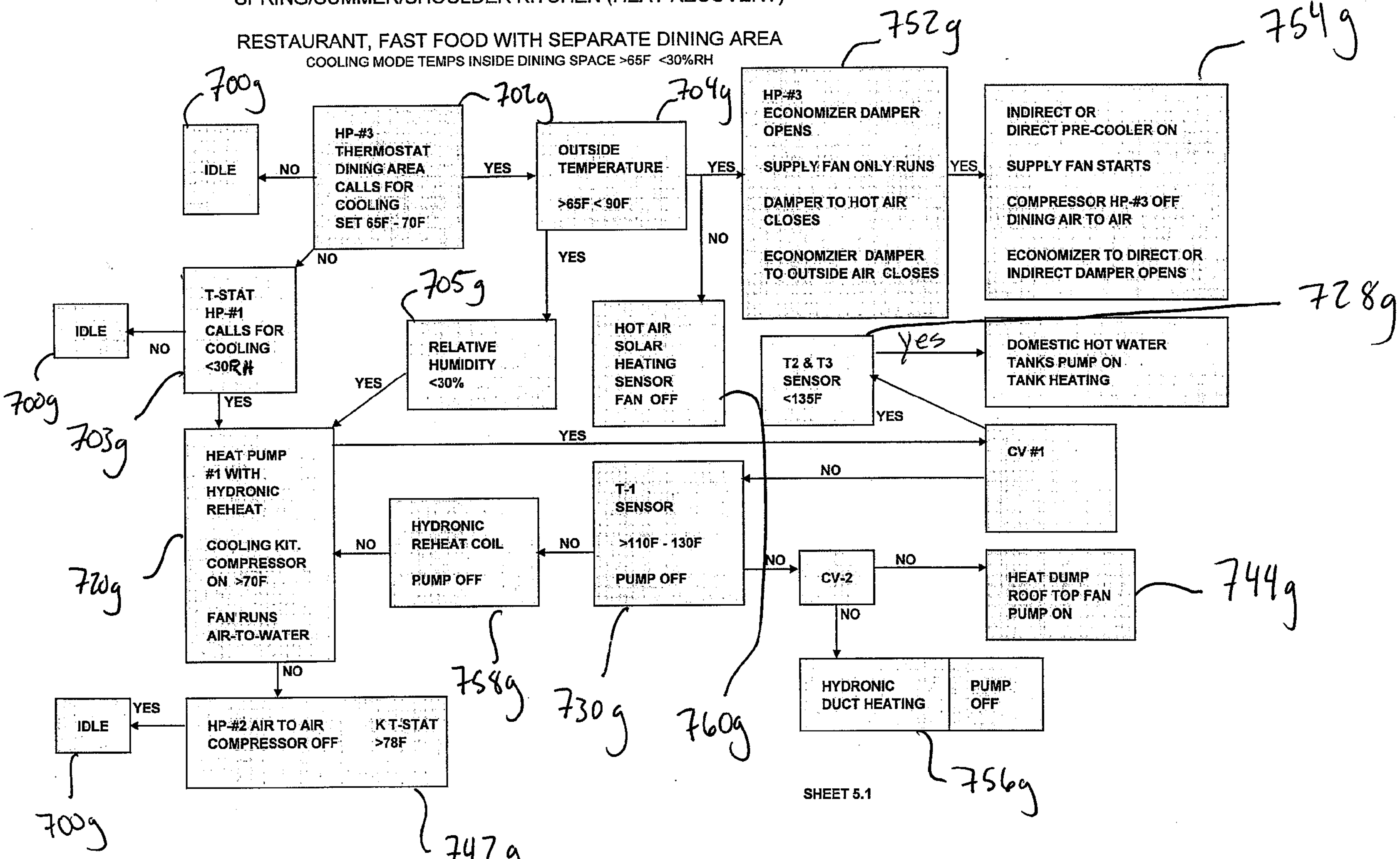


Figure 7G

MULTIPLE COMPRESSOR COMMERCIAL SYSTEM

RESTAURANT, FAST FOOD, DELI, ETC.
ALL SHEETS REFLECT INTERLOCKING MULTI-LOGIC

AVG. TEMPS >65F <90F

SPRING/SUMMER/SHOULDER KITCHEN (HEAT RECOVERY)
RESTAURANT, FAST FOOD WITH SEPARATE DINING AREA

COOLING MODE TEMPS INSIDE DINING SPACE >65F <30%RH

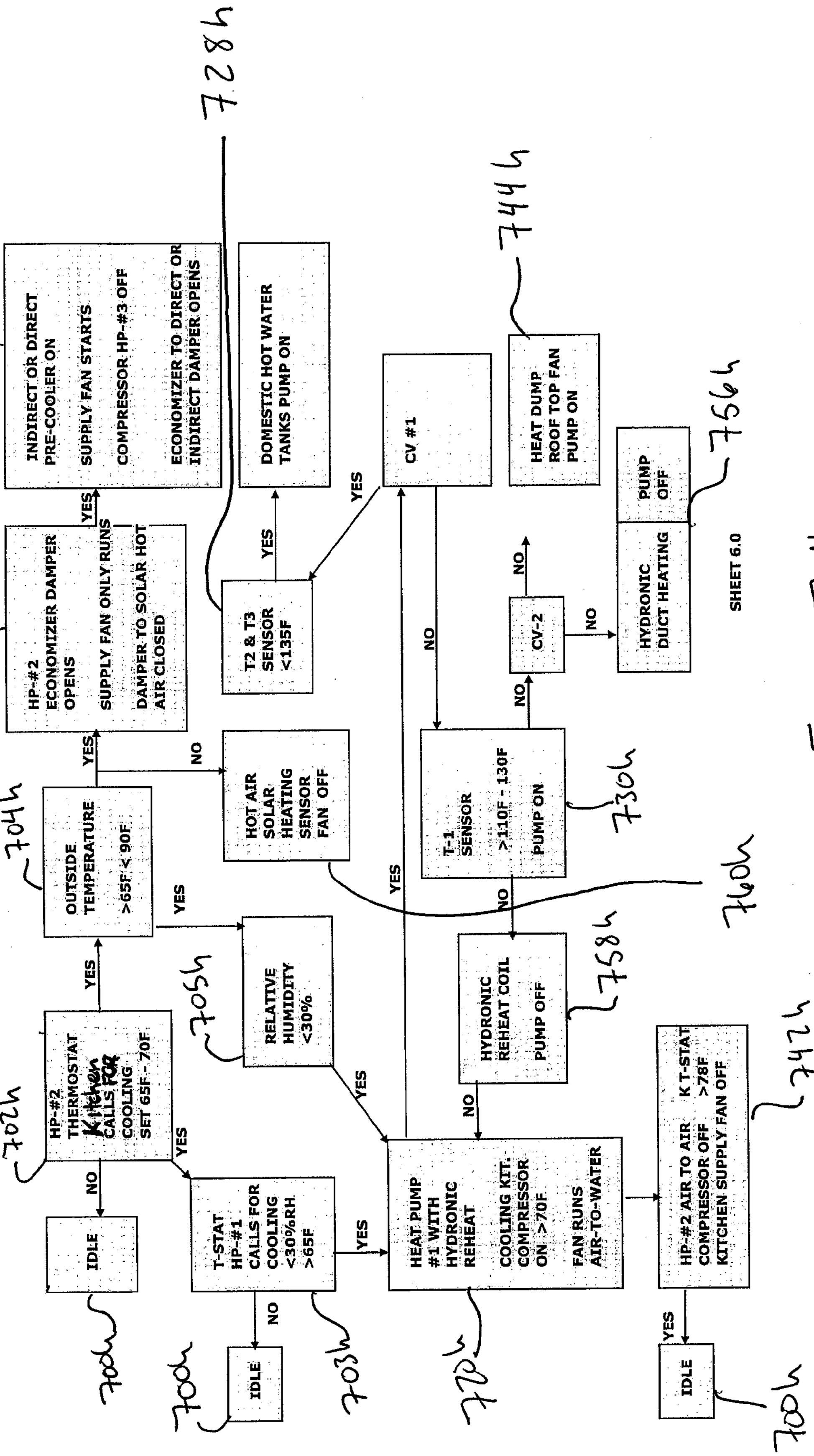


Figure 7E

MULTIPLE COMPRESSOR COMMERCIAL SYSTEM

LAKE EFFECT, MARITIME,MONSOONAL EFFECT OR DESERT CLIMATE, CANADA,USA OR GLOBAL
CLIMATE ZONES CAN BE VARIABLE
RESTAURANT, FAST FOOD, DELI, ETC.
ALL SHEETS REFLECT INTERLOCKING MULTI-LOGIC

AVG. TEMPS >50F<65F <30%RH

SPRING/SUMMER/FALL KITCHEN
RESTAURANT, FAST FOOD WITH SEPARATE DINING AREA
SUN IS OUT, TEMPS ARE 55F, <30% RH WARM UP BY NOON SWITCHES TO COOLING
SHOULDER SEASON MOVING INTO FALL MORNINGS TIME CALLS FOR HEATING*
BUSY DAY DOORS OPENING A LOT, CHILLY WEATHER

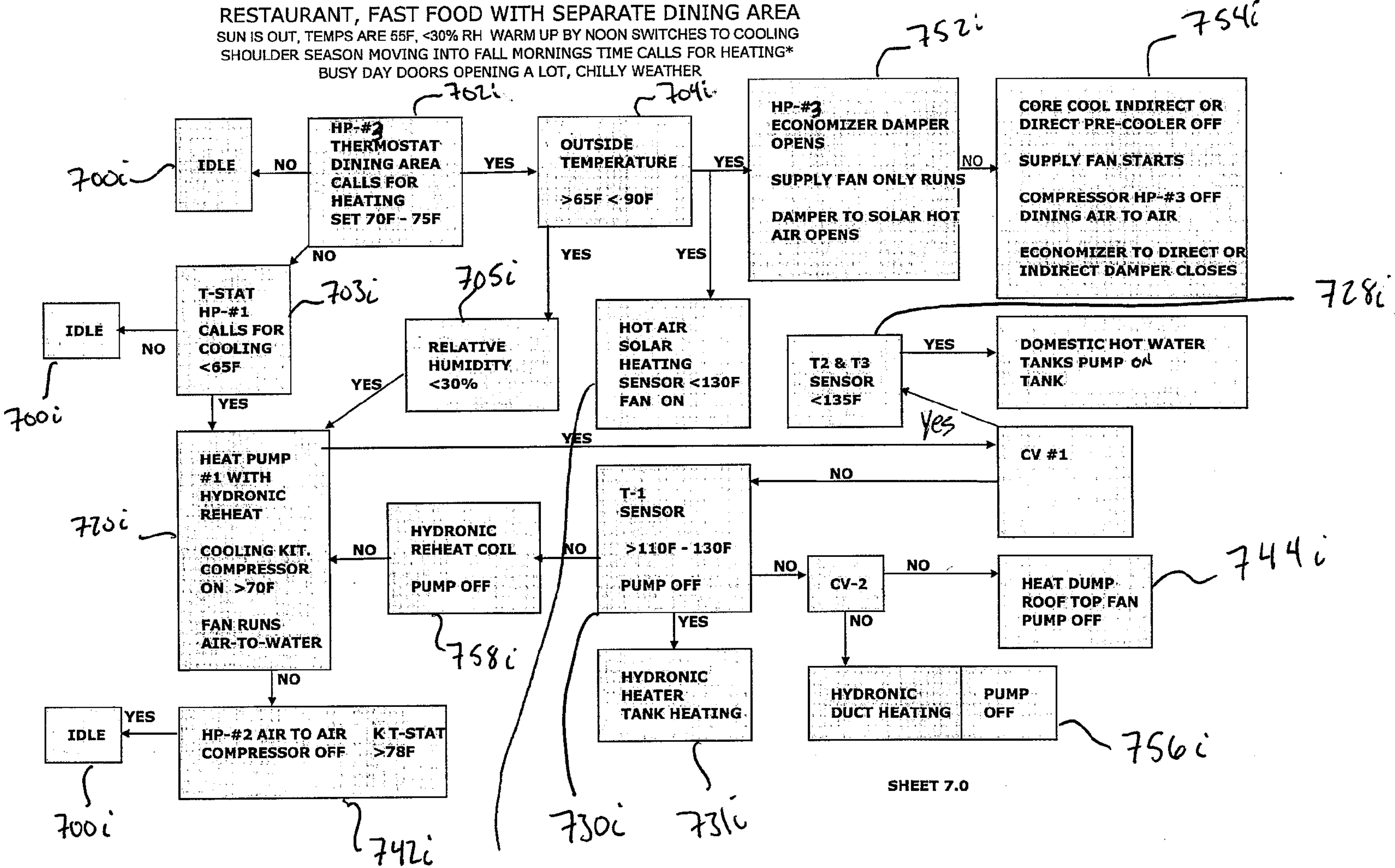


Figure 7I

MULTIPLE COMPRESSOR COMMERCIAL SYSTEM

RESTAURANT, FAST FOOD, DELI, ETC.
ALL SHEETS REFLECT INTERLOCKING MULTI-LOGIC

AVG. TEMPS >60F - 65F

SPRING/SUMMER/SHOULDER KITCHEN

RESTAURANT, FAST FOOD WITH SEPARATE DINING AREA
HYDRONIC HEATING WITH SOLARHOT AIR ASSIST

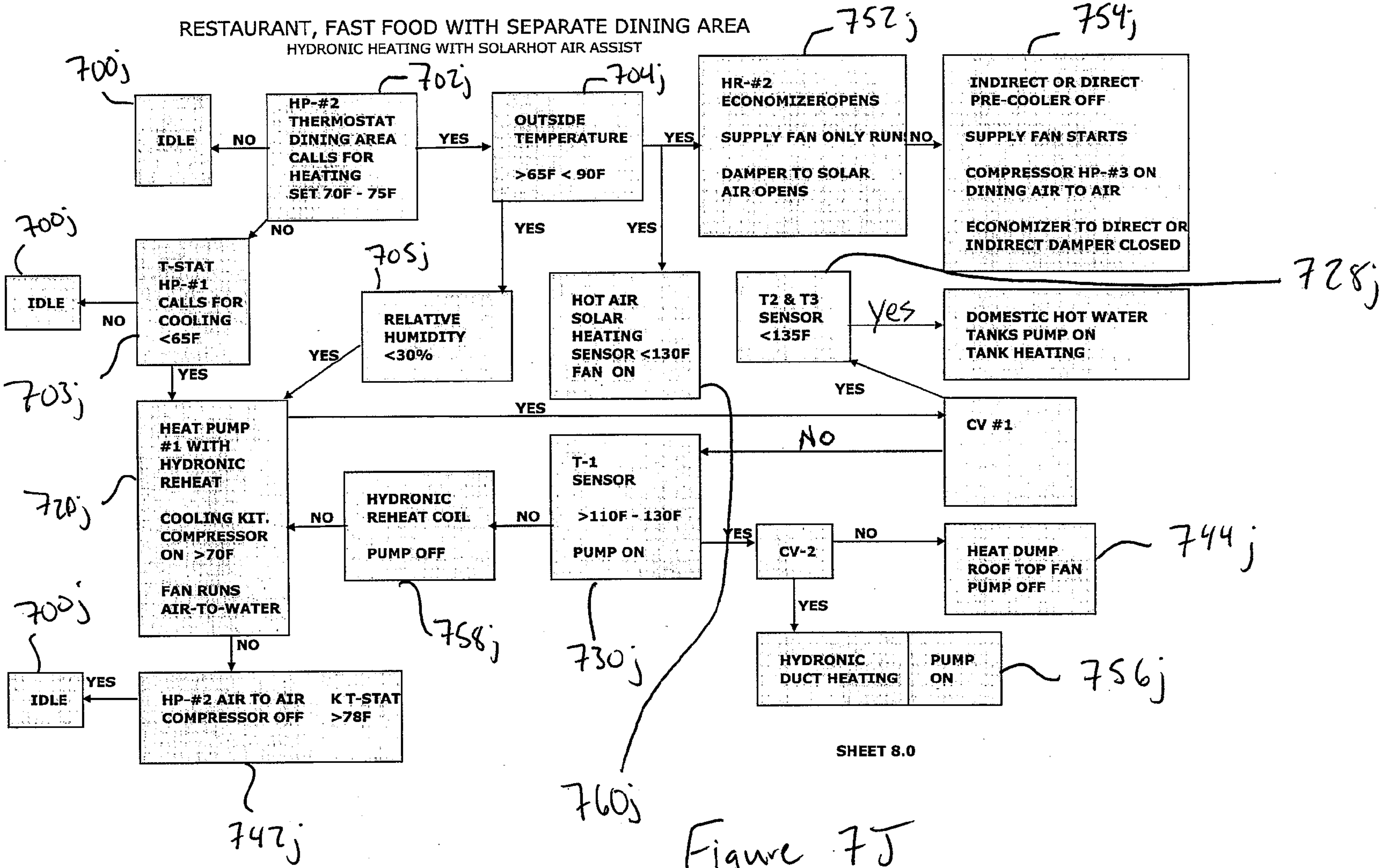


Figure 7J

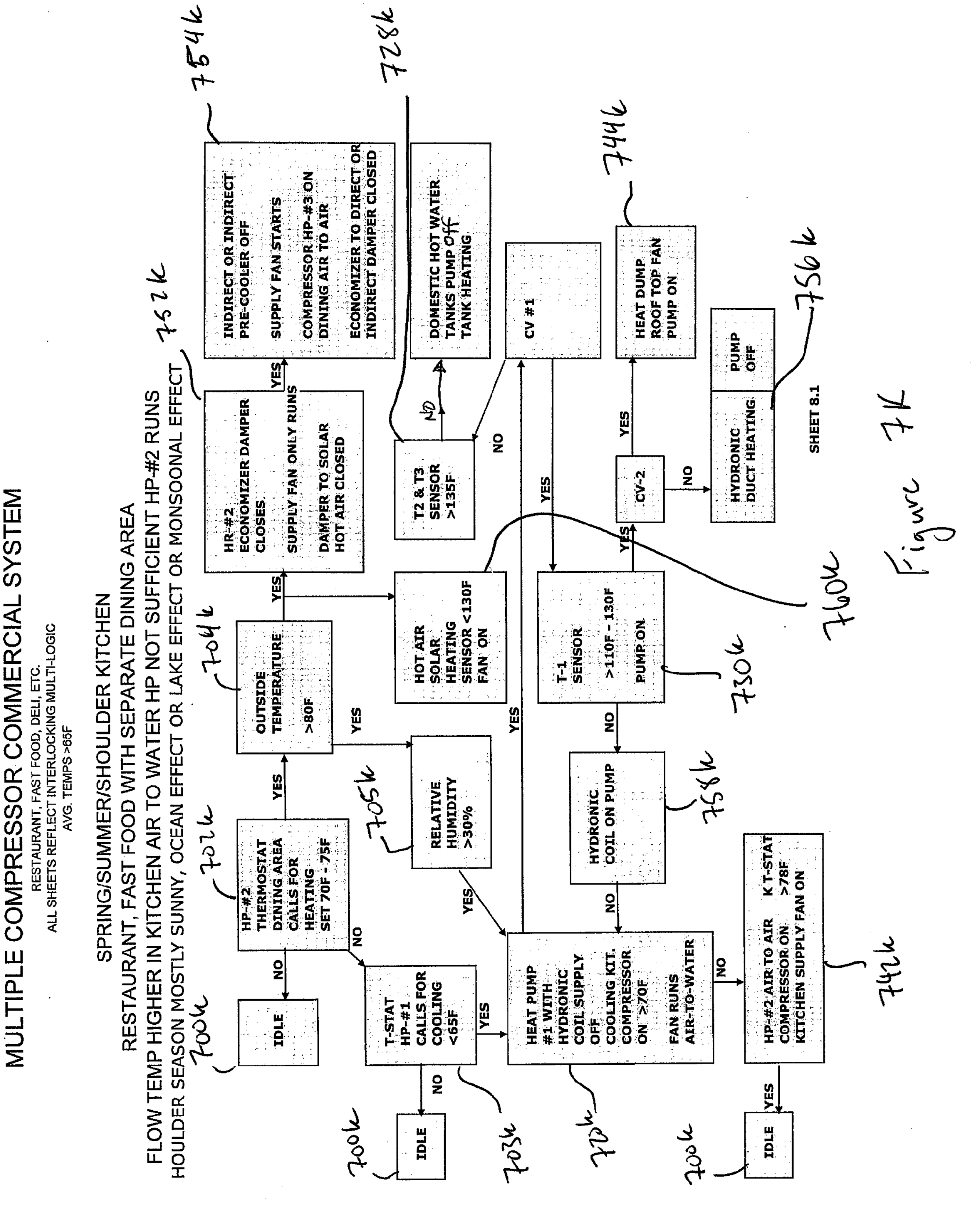
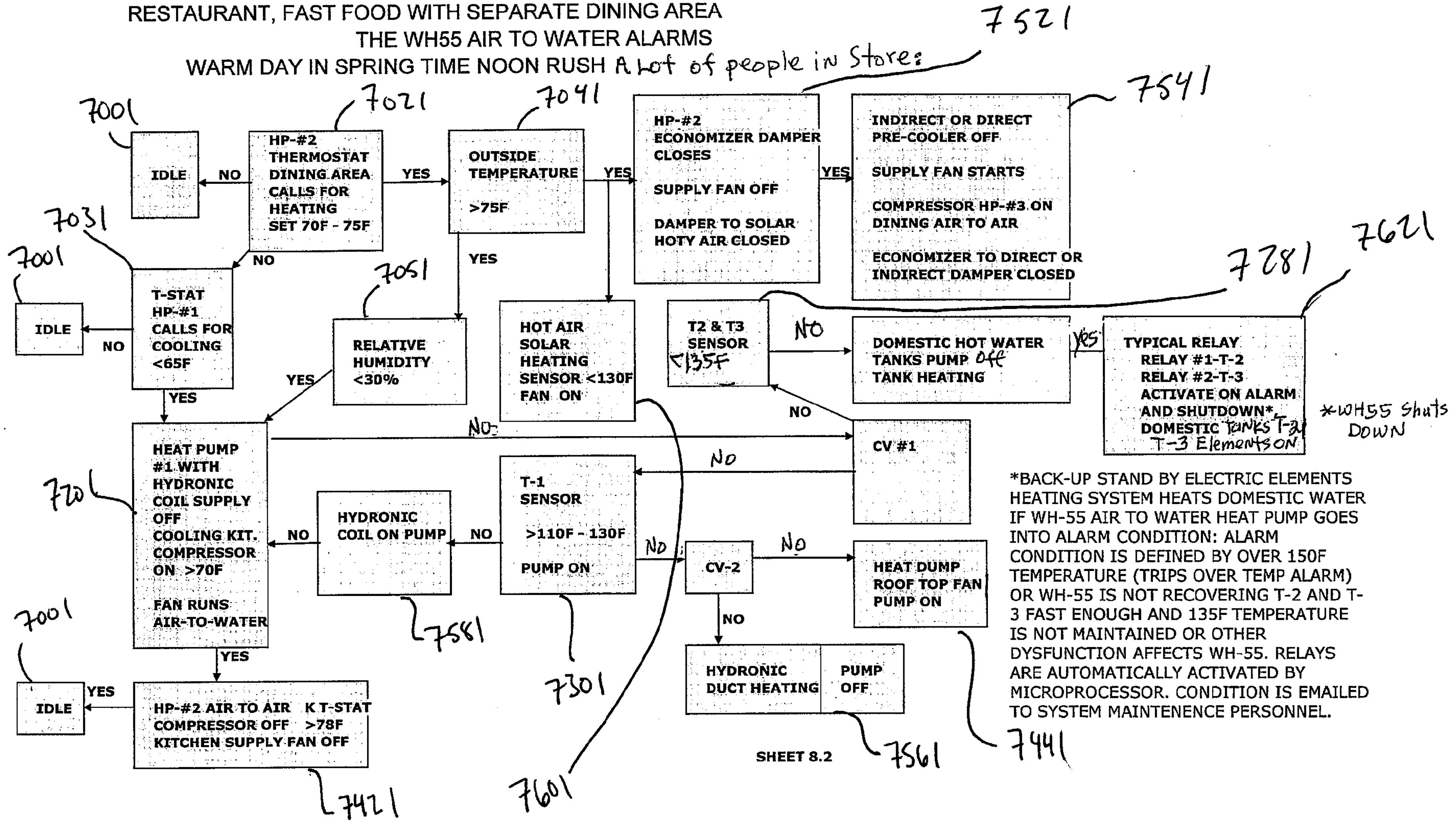

MULTIPLE COMPRESSOR COMMERCIAL SYSTEM
RESTAURANT, FAST FOOD, DELI, ETC.
ALL SHEETS REFLECT INTERLOCKING MULTI-LOGIC
AVG. TEMPS >65F
SPRING/SUMMER/SHOULDER KITCHEN
RESTAURANT, FAST FOOD WITH SEPARATE DINING AREA
FLOW TEMP HIGHER IN KITCHEN AIR TO WATER HP NOT SUFFICIENT HP-#2 RUNS
HOULDER SEASON MOSTLY SUNNY, OCEAN EFFECT OR LAKE EFFECT OR MONSOONAL EFFECT
IDLE
700k
NO
HP-#2 THERMOSTAT DINING AREA CALLS FOR HEATING SET 70F - 75F
702k
YES
OUTSIDE TEMPERATURE >80F
704k
YES
HR-#2 ECONOMIZER DAMPER CLOSES SUPPLY FAN ONLY RUNS DAMPER TO SOLAR HOT AIR CLOSED
752k
YES
INDIRECT OR INDIRECT PRE-COOLER OFF SUPPLY FAN STARTS COMPRESSOR HP-#3 ON DINING AIR TO AIR ECONOMIZER TO DIRECT OR INDIRECT DAMPER CLOSED
754k
YES
RELATIVE HUMIDITY >30%
705k
YES
NO
T-STAT HP-#1 CALLS FOR COOLING <65F
703k
NO
IDLE
700k
YES
HEAT PUMP #1 WITH HYDRONIC COIL SUPPLY OFF COOLING KIT. COMPRESSOR ON >70F FAN RUNS AIR-TO-WATER
720k
NO
HP-#2 AIR TO AIR COMPRESSOR ON KITCHEN SUPPLY FAN ON
K T-STAT >78F
742k
YES
IDLE
700k
YES
HOT AIR SOLAR HEATING SENSOR <130F FAN ON
760k
T2 & T3 SENSOR >135F
NO
DOMESTIC HOT WATER TANKS PUMP off TANK HEATING
728k
NO
CV #1
YES
T-1 SENSOR >110F - 130F PUMP ON
730k
NO
HYDRONIC COIL ON PUMP
758k
NO
YES
CV-2
YES
HEAT DUMP ROOF TOP FAN PUMP ON
744k
NO
HYDRONIC DUCT HEATING
PUMP OFF
756k
SHEET 8.1

Figure 7K

MULTIPLE COMPRESSOR COMMERCIAL SYSTEM
RESTAURANT, FAST FOOD, DELI, ETC.
ALL SHEETS REFLECT INTERLOCKING MULTI-LOGIC
AVG. TEMPS >65F

SPRING/SUMMER/SHOULDER KITCHEN
RESTAURANT, FAST FOOD WITH SEPARATE DINING AREA
THE WH55 AIR TO WATER ALARMS
WARM DAY IN SPRING TIME NOON RUSH A Lot of people in Store:



*BACK-UP STAND BY ELECTRIC ELEMENTS HEATING SYSTEM HEATS DOMESTIC WATER IF WH-55 AIR TO WATER HEAT PUMP GOES INTO ALARM CONDITION: ALARM CONDITION IS DEFINED BY OVER 150F TEMPERATURE (TRIPS OVER TEMP ALARM) OR WH-55 IS NOT RECOVERING T-2 AND T-3 FAST ENOUGH AND 135F TEMPERATURE IS NOT MAINTAINED OR OTHER DYSFUNCTION AFFECTS WH-55. RELAYS ARE AUTOMATICALLY ACTIVATED BY MICROPROCESSOR. CONDITION IS EMAILED TO SYSTEM MAINTENENCE PERSONNEL.

Figure 7L

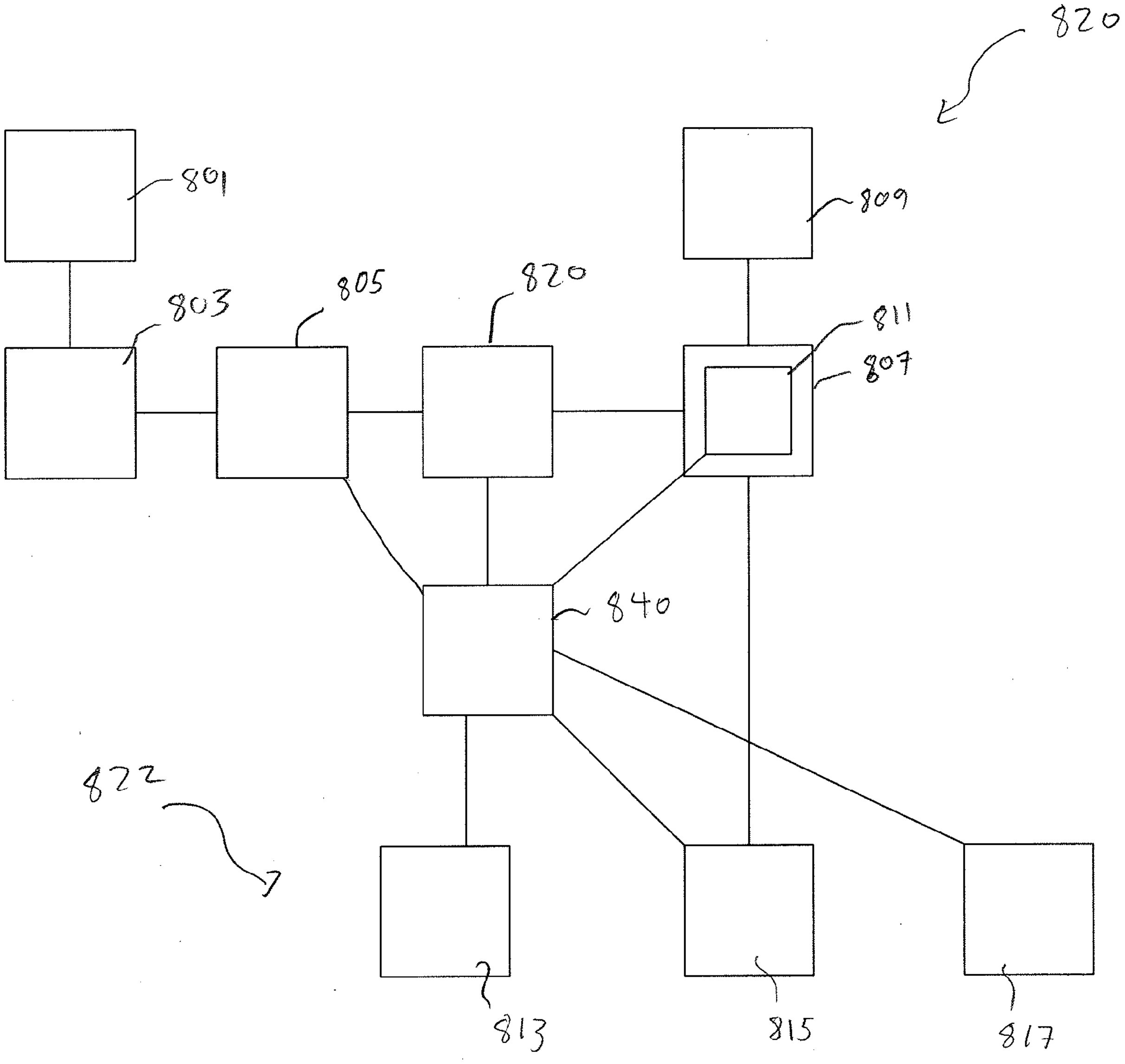
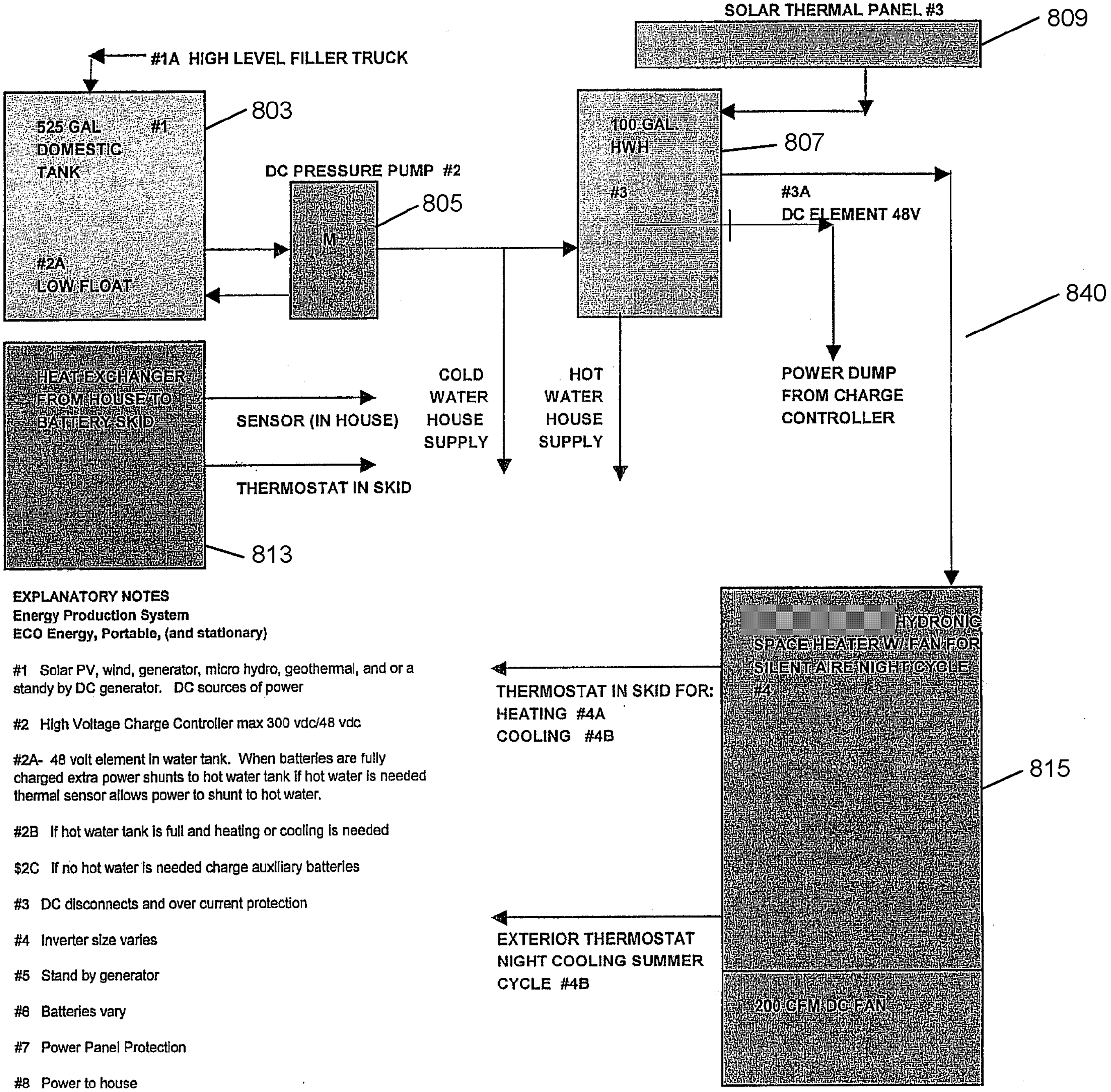


Figure 8A

ENERGY PRODUCTION SYSTEM

FLOW CHART OF MULTIPLE FUNCTIONS OF Entertopia multi-function utility shed
SOLAR POWER, GENERATOR BACK-UP, SOLART THERMAL, HOT WATER, HOT AIR, SPACE HEATING
COMMUNICATIONS,AND CLIMATE CONTROL OF BUILDINGS
TRANSPORTABLE SKID SYSTEM (FOUNDATION MOUNTABLE, PIER MOUNTABLE AND TRAILER MOBILE)



EXPLANATORY NOTES
Energy Production System
ECO Energy, Portable, (and stationary)

#1 Solar PV, wind, generator, micro hydro, geothermal, and or a standy by DC generator. DC sources of power

#2 High Voltage Charge Controller max 300 vdc/48 vdc

#2A- 48 volt element in water tank. When batteries are fully charged extra power shunts to hot water tank if hot water is needed thermal sensor allows power to shunt to hot water.

#2B If hot water tank is full and heating or cooling is needed

$2C If no hot water is needed charge auxiliary batteries

#3 DC disconnects and over current protection

#4 Inverter size varies

#5 Stand by generator

#6 Batteries vary

#7 Power Panel Protection

#8 Power to house

Figure 8B

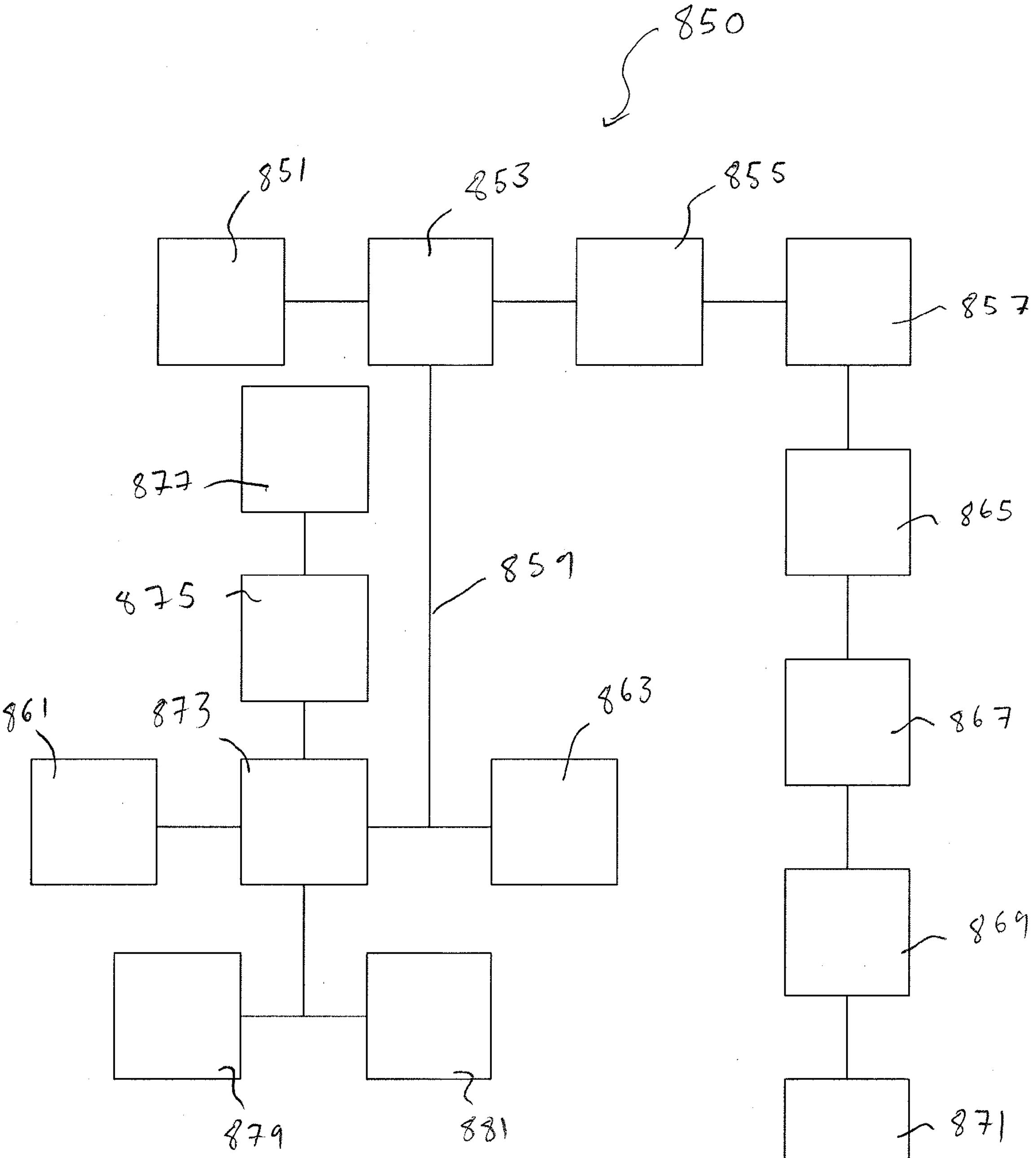
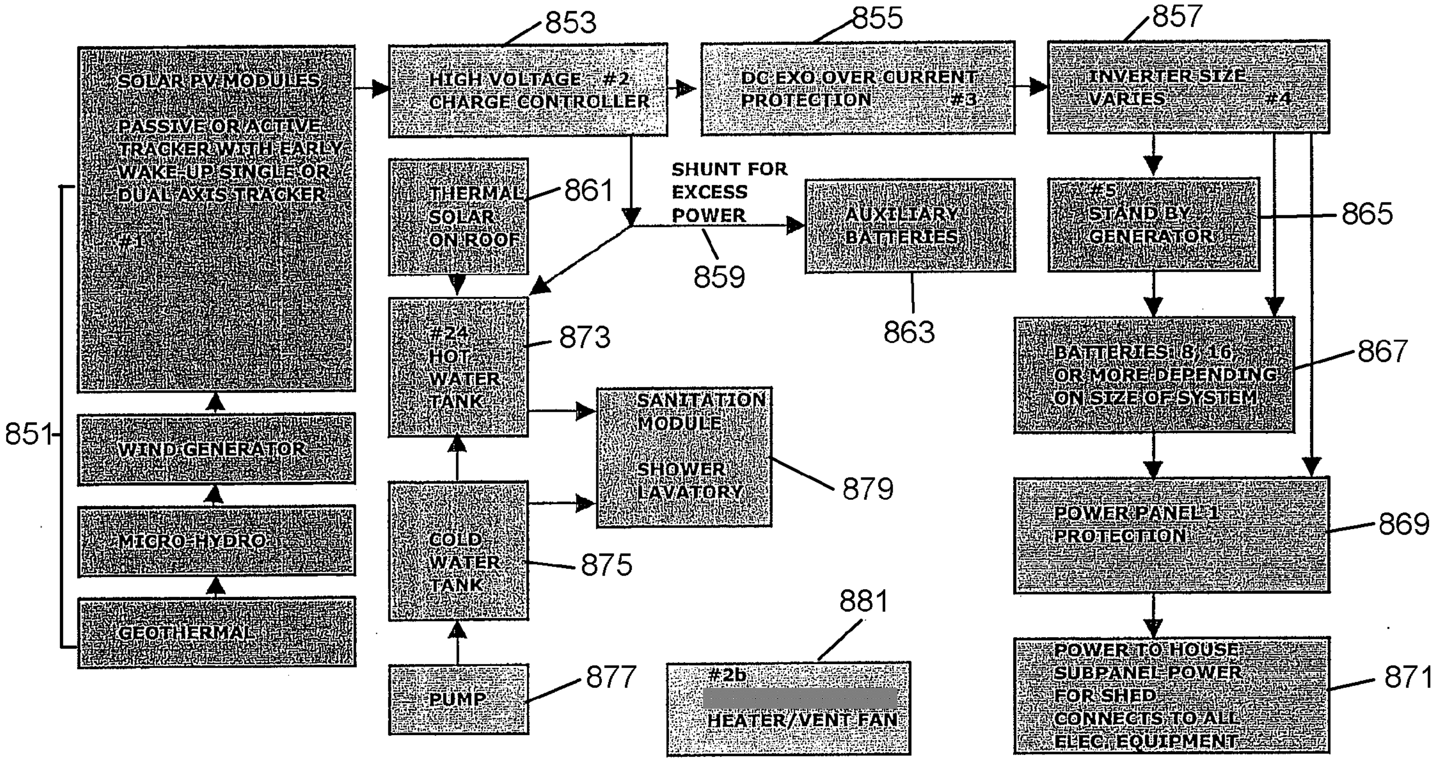

850
851
853
855
857
877
859
875
865
861
873
863
867
869
879
881
871

Figure 8C

CLIMATE CONTROL

FLOW CHART OF MULTIPLE FUNCTIONS OF Entertopia multi-function utility shed
SOLAR POWER, GENERATOR BACK-UP, SOLAR THERMAL, HOT WATER, HOT AIR, SPACE HEATING
COMMUNICATIONS AND CLIMATE CONTROL OF BUILDINGS
TRANSPORTABLE SKID SYSTEM (FOUNDATION MOUNTABLE, PIER MOUNTABLE AND TRAILER MOBILE)



EXPLANATORY NOTES

Explanation of Flow Chart of Multiple Functions - 08/13/10
Climate Control, Hot Water, Hot Air, Space Heater, Communications

1 - Domestic water tank passive thermal flywheel
1A - Hi level fill, float in tank tie to pump
2 - DC pressure pump
2A - Low level float shuts off pressure pump if water level is low in tank
3 - Solar hot water heater
3A - DC Element 48v
4 - Thermo matrix hydronic space heater with fan, or silent aire night cycle
4A - Heating cycle interior stat
4B - Cooling cycle exterior stat
5 - Winter mode - day or night heat exchanger from house to skid. Sensor in house and t-stat in skid
6 - Solar hot air panel built in fan and solar module **(SAME AS NO. 4?)**
7 - Roof water catchment divert into domestic water tank

Figure 8D

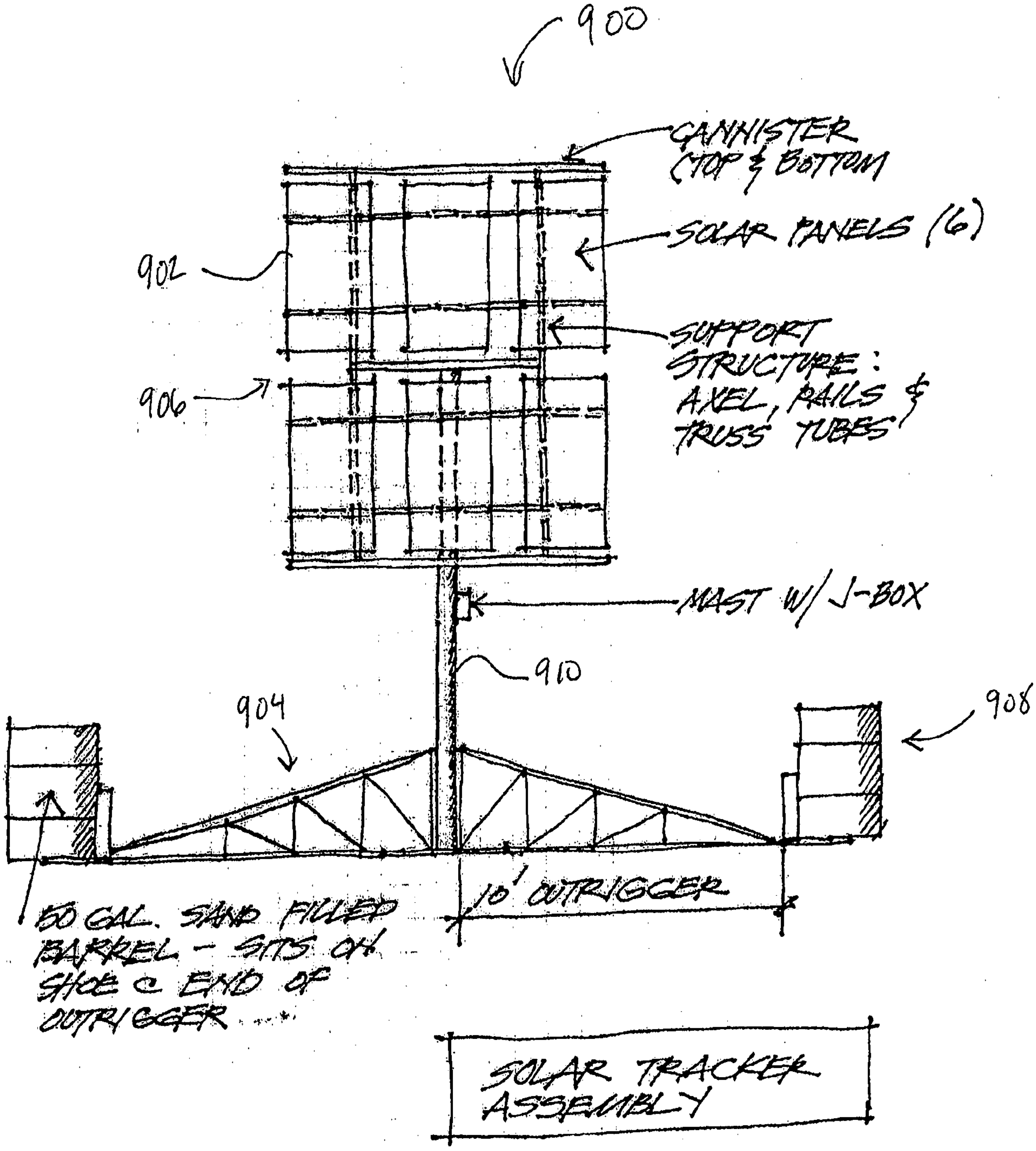

900
CANNISTER (TOP & BOTTOM)
SOLAR PANELS (6)
902
SUPPORT STRUCTURE: AXEL, RAILS & TRUSS TUBES
906
MAST W/ J-BOX
910
904
908
10' OUTRIGGER
50 GAL. SAND FILLED BARREL - SITS ON SHOE @ END OF OUTRIGGER
SOLAR TRACKER ASSEMBLY

Figure 9

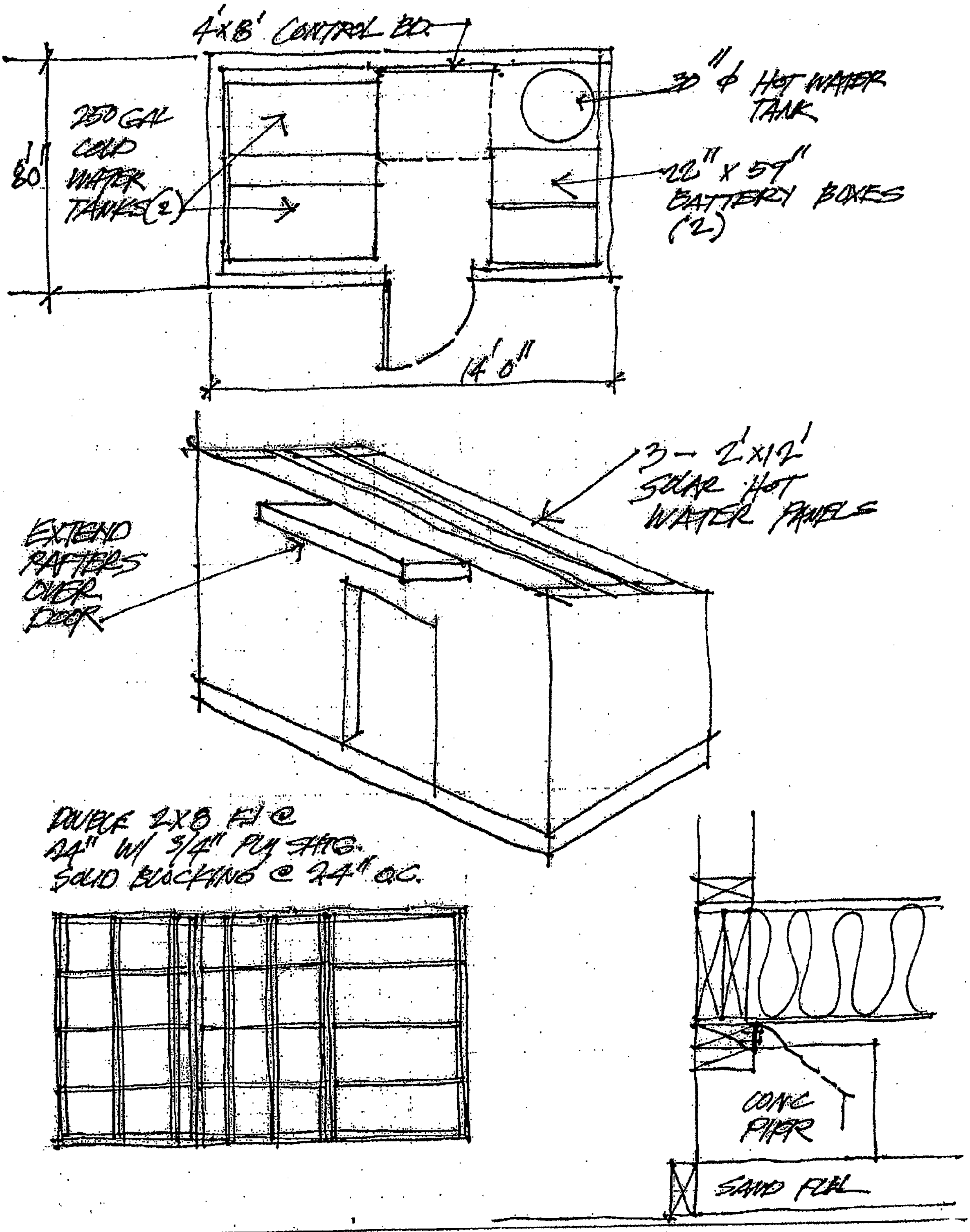
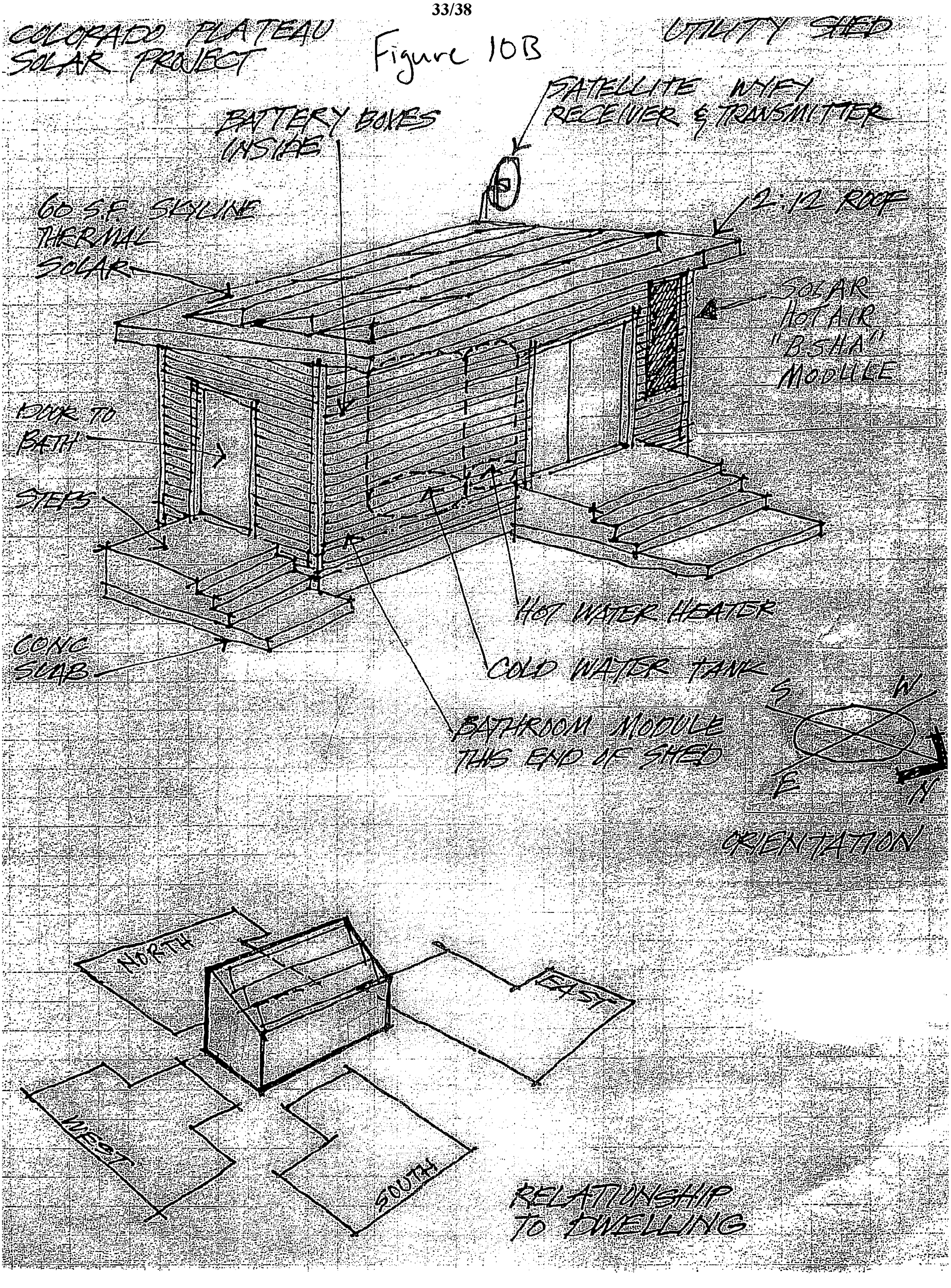

4'x8' CONTROL BD.
250 GAL COLD WATER TANKS (2)
8'0"
30" ϕ HOT WATER TANK
22" x 59" BATTERY BOXES (2)
14'0"
3 - 2'x12' SOLAR HOT WATER PANELS
EXTEND RAFTERS OVER DOOR
DOUBLE 2X8 FJ @ 24" W/ 3/4" PLY SHTG. SOLID BLOCKING @ 24" O.C.
CONC PIER
SAND FILL

Figure 10A

Figure 10B


COLORADO PLATEAU SOLAR PROJECT
UTILITY SHED
SATELLITE WIFI RECEIVER & TRANSMITTER
BATTERY BOXES INSIDE
60 S.F. SKYLINE THERMAL SOLAR
2:12 ROOF
SOLAR HOT AIR "B.S.H.A." MODULE
DOOR TO BATH
STEPS
CONC SLAB
HOT WATER HEATER
COLD WATER TANK
BATHROOM MODULE THIS END OF SHED
S
W
E
N
ORIENTATION
NORTH
EAST
WEST
SOUTH
RELATIONSHIP TO DWELLING

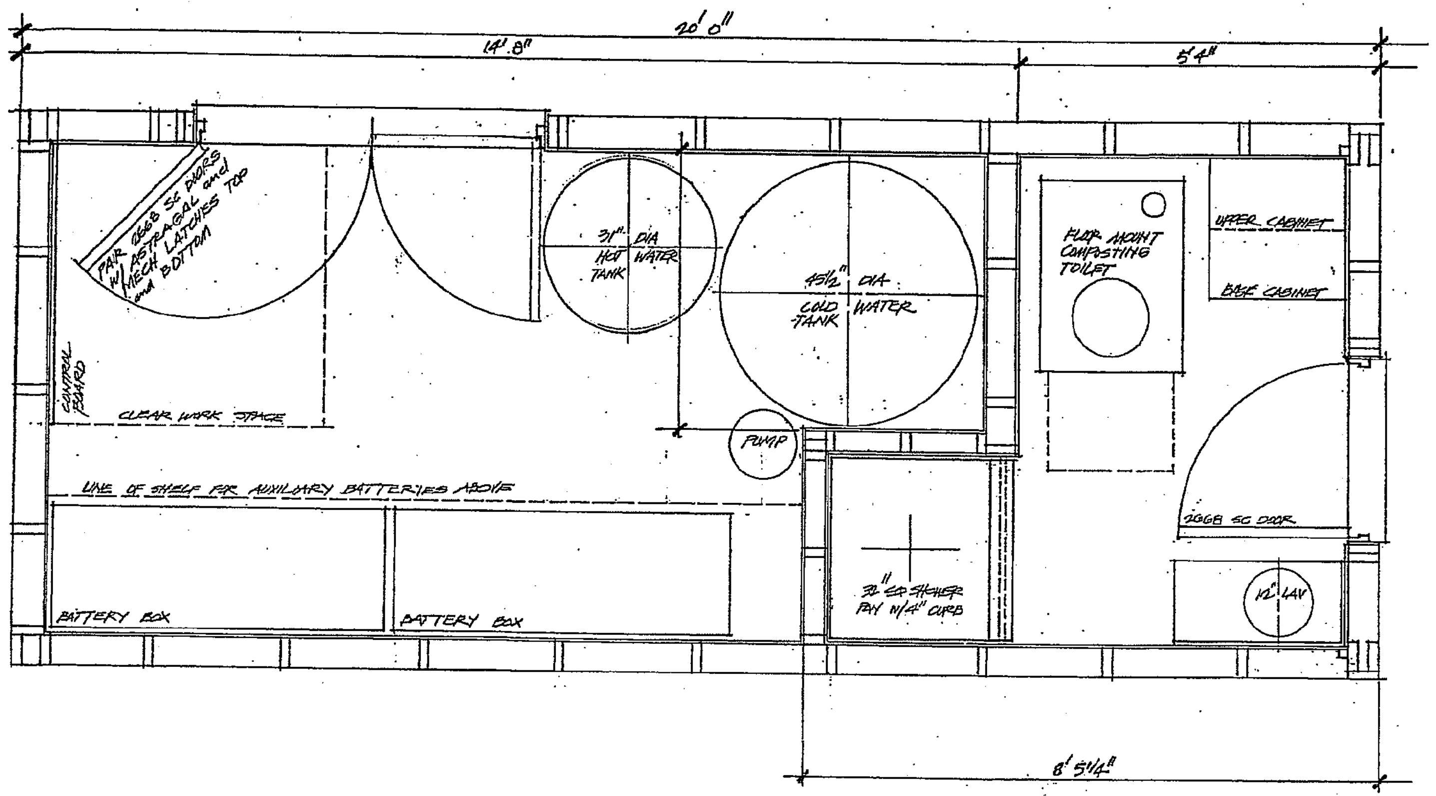

20'0"
14'8"
5'4"
PAIR 2668 SC DOORS W/ ASTRAGAL and MECH LATCHES TOP and BOTTOM
CONTROL BOARD
CLEAR WORK STAGE
31" DIA HOT WATER TANK
45½" DIA COLD WATER TANK
PUMP
FLOR MOUNT COMPOSTING TOILET
UPPER CABINET
BASE CABINET
2668 SC DOOR
12" LAV
LINE OF SHELF FOR AUXILIARY BATTERIES ABOVE
32" SQ SHOWER PAN W/4" CURB
BATTERY BOX
BATTERY BOX
8'5¼"

Figure 10C

FIGURE 11

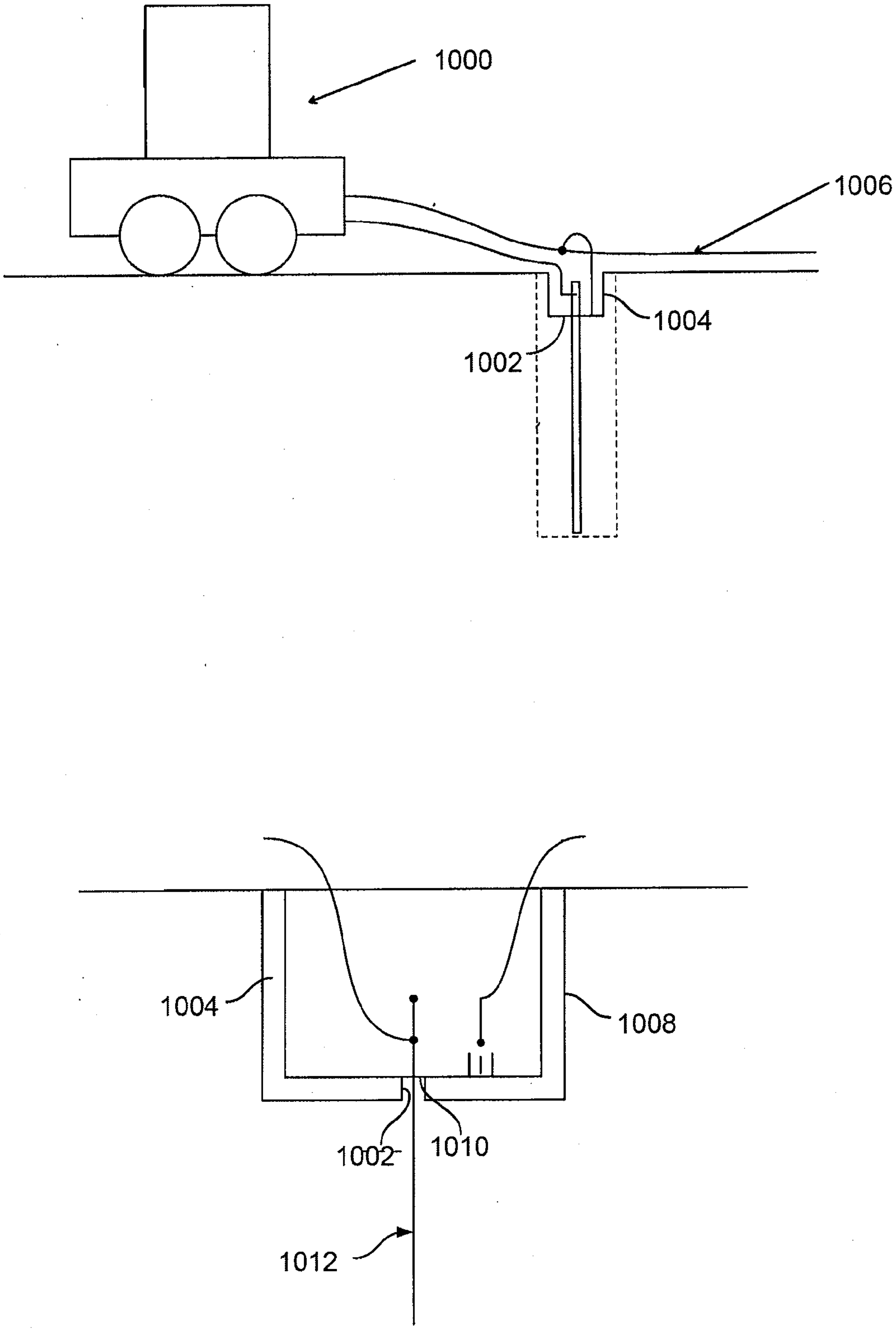


FIGURE 12

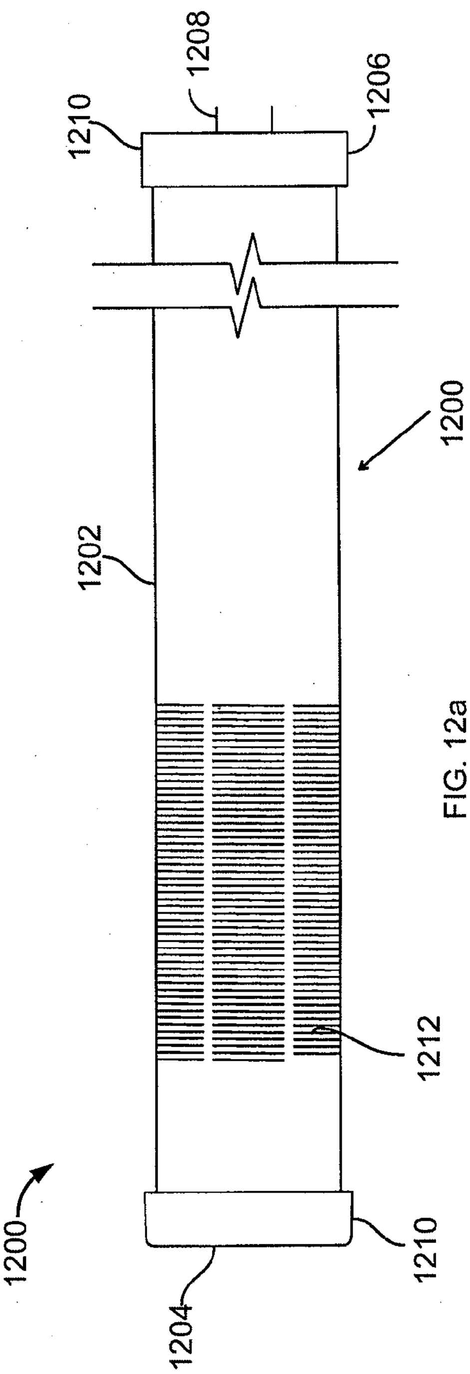


FIG. 12a

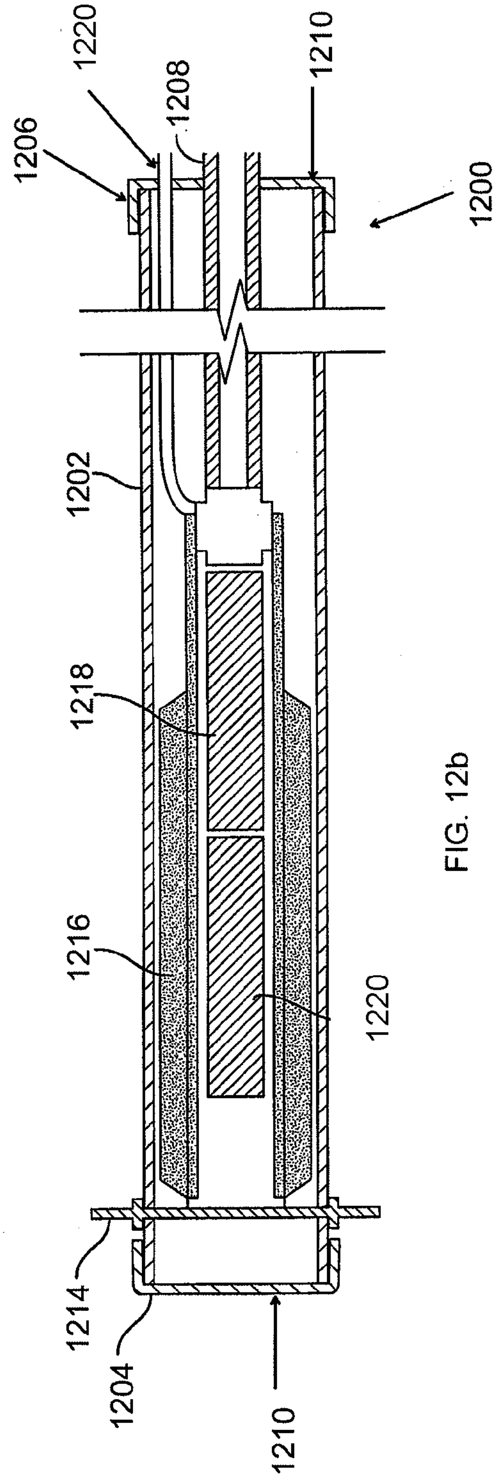


FIG. 12b

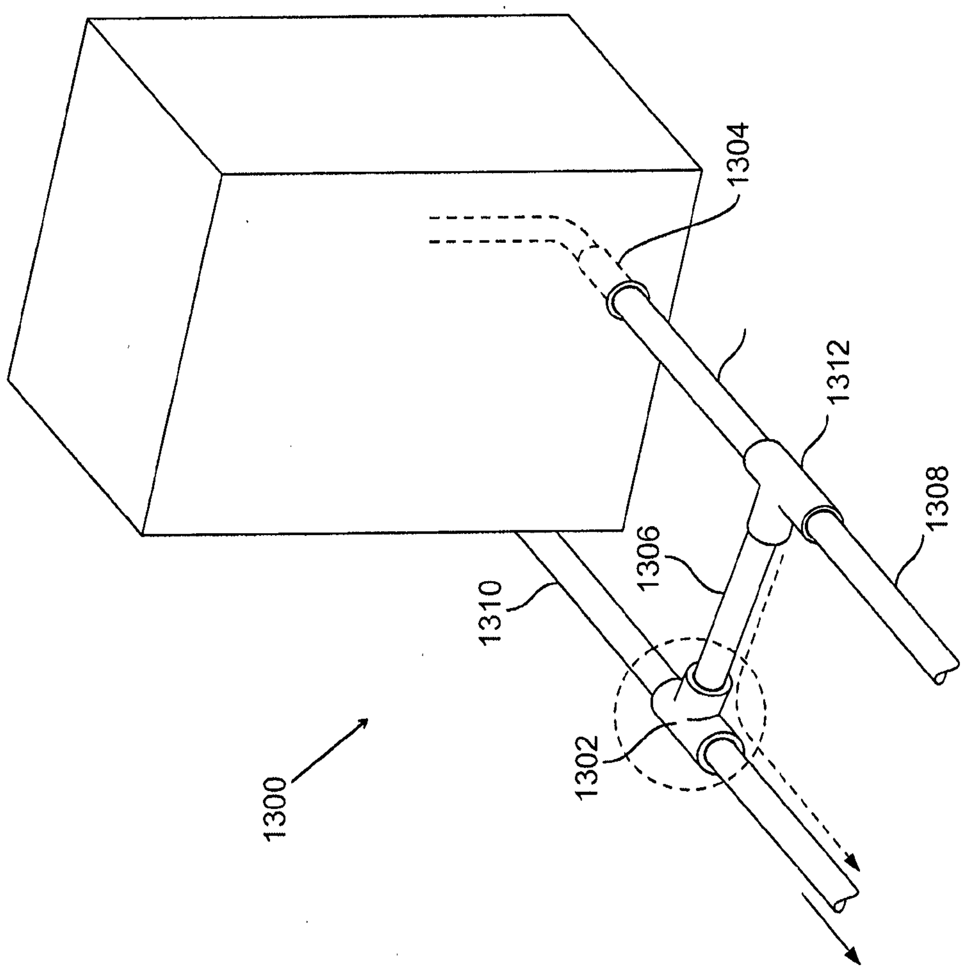


FIGURE 13

FIGURE 14