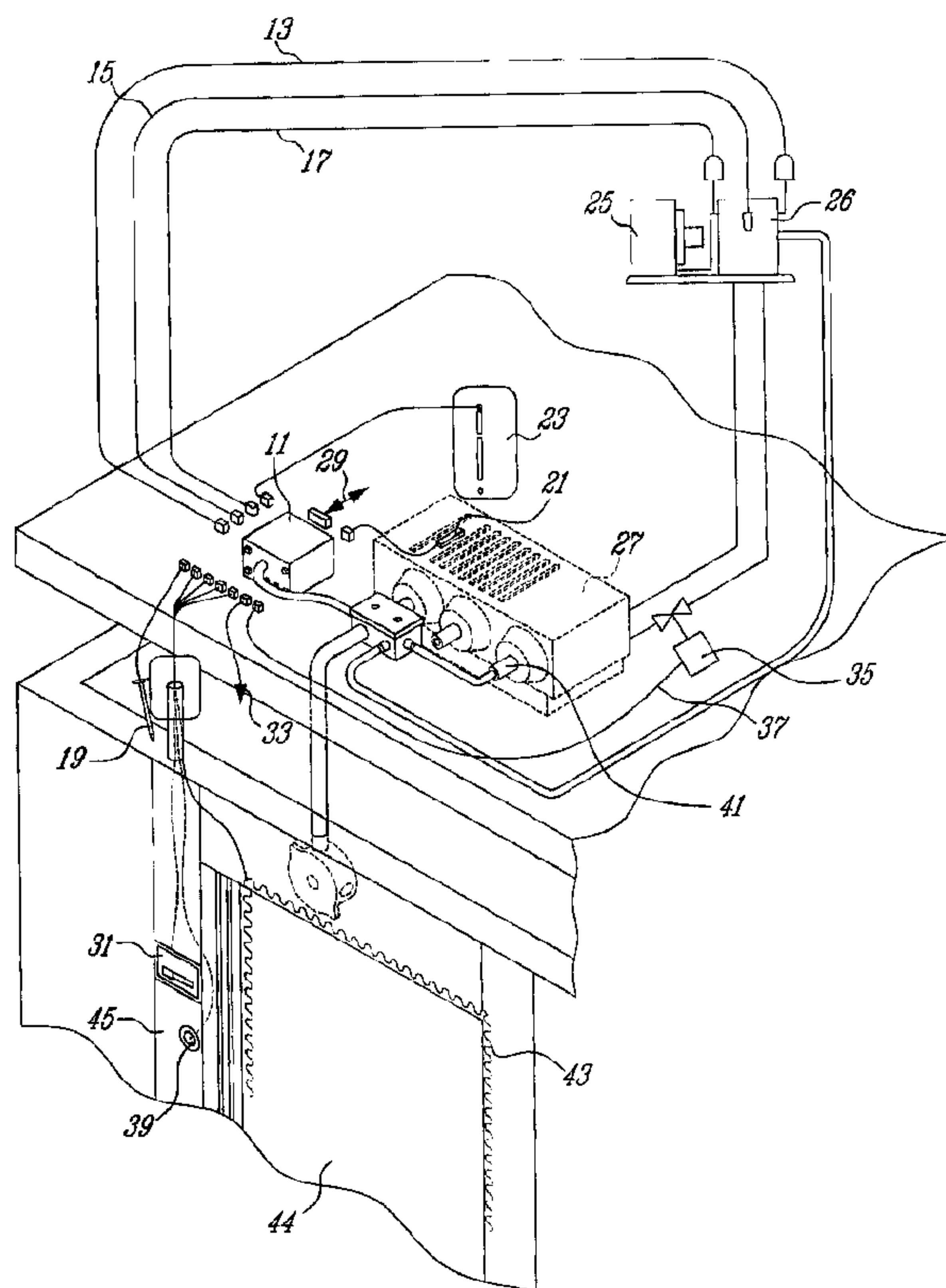




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(54) Titre : SYSTEME DE COMMANDE ET DE SURVEILLANCE DE CHAMBRE FROIDE  
(54) Title: WALK-IN COOLER CONTROL AND MONITORING SYSTEM



(57) **Abrégé/Abstract:**

A system, device and method that integrate all functions related to the control, the monitoring the food safety and the energy saving in a walk-in cooler or freezer (cold room) (i.e., a walk-in refrigeration unit) by using a software based electronic controller combined with different peripheral as input signals, output signals, keyboard and data communication with outside sources such as a modem or a computer. In order to answer today's needs in food safety programs such as HACCP, it becomes essential to monitor and record the different parameters in a walk-in cooler or freezer. This also applies to any environment controlled areas and may also involve other parameters such as humidity.

## **ABSTRACT**

A system, device and method that integrate all functions related to the control, the monitoring the food safety and the energy saving in a walk-in cooler or freezer (cold room) (i.e., a walk-in refrigeration unit) by using a software based electronic controller combined with different peripheral as input signals, output signals, keyboard and data communication with outside sources such as a modem or a computer. In order to answer today's needs in food safety programs such as HACCP, it becomes essential to monitor and record the different parameters in a walk-in cooler or freezer. This also applies to any environment controlled areas and may also involve other parameters such as humidity.

## **Walk-in refrigeration unit control and monitoring system**

### **Field of invention**

[0001] The invention relates to walk-in refrigeration units. More specifically, the invention relates to the control and monitoring of various parameters of walk-in refrigeration units.

### **Background of invention**

[0002] The device described in US patent 6,401,466 B1 (hereby incorporated by reference) is a good example of the present state-of-the-art in the field of walk-in refrigeration units. Many improvements can be made to such existing devices to render walk-in refrigeration units more efficient.

[0003] There is therefore a need in the industry to provide such improved systems, methods and devices.

### **Objects and summary of the invention**

[0004] The concept is to integrate all functions related to the control, the monitoring the food safety and the energy saving in a walk-in cooler or freezer (cold room) (i.e., a walk-in refrigeration unit) by using a software based electronic controller combined with different peripheral as input signals, output signals, keyboard and data communication with outside sources as modem or computer. In order to answer today's needs in food safety programs as HACCP, it becomes essential to monitor and record the different parameters in a walk-in cooler or freezer. This also applies to any environment controlled areas and may also involve other parameters such as humidity.

[0005] The intent of this invention is then to create a system that incorporates all those features in a single unit, thus allowing interrelation between the different elements.

[0006] The object of this invention is to provide a single module to manage entirely the different elements/parameters of a cold room as refrigeration

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(temperature) control, defrost control, fan control, temperatures & pressures monitoring and data logging, energy saving features as light control, anti-sweat heater control, door open alarm and finally safety alarms as panic alarm and temperature alarm.

[0007] In a preferred embodiment, the present invention provides a walk-in refrigerating unit comprising an evaporator having a coil, a fan and defrost elements, a condenser or compressor, a liquid solenoid valve, a light internal said unit, an audible alarm device, a door frame having an anti-sweat heating element, and a controller for monitoring and controlling at least one operating parameter of said unit, said controller being connected to at least one peripheral monitoring said at least one operating parameter, said at least one peripheral being selected from the list comprising:

- a. a temperature probe to read air temperature inside said unit;
- b. a temperature probe to read food temperature inside said unit;
- c. a temperature probe to read evaporator coil temperature;
- d. a temperature probe to read condenser or compressor temperature;
- e. a suction pressure probe at the inlet of the compressor;
- f. a compressor pressure probe at the outlet of the compressor;
- g. a backlit push button installed inside said unit;
- h. a door detector switch;
- i. a user interface device installed outside said unit;
- j. an output to said light;
- k. an output to the evaporator fan;
- l. an output to control either the liquid solenoid valve or the compressor;
- m. an audible alarm device;
- n. an output to control the defrost elements; and
- o. an output to control the anti-sweat heater element.

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[0008] The controller of the walk-in refrigeration unit may further comprise an input and output means for interfacing with external data communication devices.

[0009] In another embodiment, the present invention provides a walk-in refrigeration unit comprising:

- a. a temperature probe located inside said unit for obtaining a temperature reading inside said unit;
- b. a door frame having a heating element that reduces humidity in the vicinity of said door frame;
- c. a controller obtaining said temperature reading and sending a control signal to said heating element to control an amount of heat generated by said heating element.

[0010] In yet another embodiment, the present invention provides a walk-in refrigerating unit having an alarm management capability.

[0011] In yet another embodiment, the present invention provides a walk-in refrigerating unit a memory for logging data regarding operating parameters of said unit.

### **Brief description of the drawings**

[0012] Figure 1 is a schematic diagram showing perspective view of an embodiment of the invention; and

[0013] Figure 2 is a block diagram of another embodiment of the invention.

### **Detailed description of the invention**

[0014] In a cold room, there are different ways to control and/or monitor the temperature either with mechanical devices or with electronic controls. Door frames in a cold room often requires an anti-sweating heating element to eliminate condensation in the door perimeter and it could be of a variable

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power for energy saving. There are also devices available on the market to manage safety and energy saving features. With the latest technologies on the market, using electronics, there are at least 4 different devices required to achieve those functions;

1. An electronic refrigeration controller to control precisely the temperature in the cold room and manage the defrost cycles
2. An alarm system to monitor and provide alarm if low or high temperature are reached
3. A thermostat or a dimmer to control the power level of the anti-sweating heater
4. An energy saving device to manage automatically the lighting inside the cold room triggered by the opening of the door. It manages the interruption of the operation for the evaporator fans and the solenoid valve when the door is opened or if people needs to work inside the cold room. It also provides door open alarm as well as panic alarm.

[0015] It uses a software based electronic controller with internal memory and RTC (real time clock) for data logging and different inputs/outputs as well as interfaces to communicate with peripheral as modems and computers. It includes a power failure back-up either by using battery or capacitor to maintain the vital functions of the system as monitoring, data logging and alarm signal during the power failures. The inputs/outputs and peripheral are as follow:

1. A temperature probe to read air temperature inside the cold room to allow monitoring, alarm and data logging. It also triggers the operation of the anti-sweat heater which is not required at higher temperature.
2. A temperature probe to read food temperature inside the cold room to allow monitoring, alarm and data logging.
3. A temperature probe to read evaporator coil temperature to control defrost cycles.
4. A temperature probe to read condenser or compressor temperature for equipment safety and trouble shooting purpose.

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5. A suction pressure probe at the inlet of the compressor for equipment safety and trouble shooting purpose.
6. A compressor pressure probe at the outlet of the compressor for equipment safety and trouble shooting purpose.
7. A backlit push button to be installed inside the cold room, beside the door opening and recessed flush into the door frame, with all the wiring embedded in the insulation and leading out of the cold room for sanitary purpose. This button controls the lighting in different modes, to shut temporarily the evaporator fans and/or to activate a panic alarm.
8. A door detector, beside the door opening and recessed flush into the door frame, with all the wiring embedded in the insulation and leading out of the cold room for sanitary purpose. The detector triggers the automatic lighting control and/or the interruption of the evaporator fan & solenoid while the door is left opened.
9. A keyboard to be installed outside the cold room, beside the door opening and recessed flush into the door frame, with all the wiring embedded in the insulation and leading out of the cold room for sanitary purpose. The keyboard includes push buttons (or keys) with multi-functions, data display readout and status indicators. The push buttons allow control of different parameters manually such as lighting control, select data to be displayed on the readout, acknowledge or reset alarm and access the menu mode that allow to configure the system and set the variables as timers, set points, alarm levels and operation modes. The menu also allows viewing the data logged into the memory. The display allows viewing temperature, pressure, internal registers value accessed by the menu, logged data, and short messages. The status indicators show the status of different parameters of the systems, indicates modes of operation and alarm status.
10. An output to control the lighting inside the cold room based on the sequence programmed in the controller and the status of the inputs.

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11. An output to control the evaporator fan based on the sequence programmed in the controller and the status of the inputs.
12. An output to control either the liquid solenoid valve or the compressor itself based on the sequence programmed in the controller and the status of the inputs.
13. An audible alarm signal wired to either a buzzer, a horn or both.
14. An output to control the defrost elements in the evaporator based on the sequence programmed in the controller and the status of the inputs.
15. An output to control the anti-sweat heater wire to the proper level of power based on the environmental requirement. This allows energy saving with less heating requirement and prevents excess heating from being compensated by the refrigeration system.

[0016] With the different inputs, outputs and data communication capability all linked together on the controller, it open for a tremendous amount of features and functionality that will increase the efficiency of the overall operation in terms of accuracy, energy saving, safety, maintenance and traceability. Using a single controller will lead in a cost saving as opposed to independent controlling and monitoring devices. The following are some features and functionalities that can be performed by the system. From the architecture of the system, additional features and functionality may be added simply by revising the software in the electronic controller.

1. Depending on the end-user preference, lighting could work in three different modes (user defined in the configuration menu). In manual mode the user presses a keyboard light key or inside button momentarily to turn light on or off. In semi-auto mode, the light is turned on or off by the keyboard or the inside button and it is automatically turned off when the door is closed, after a user defined delay (by the menu mode). Holding the keyboard or inside button for 1.5 seconds will prevent the lighting from being turned off automatically. The auto mode allows turning on the light simply by

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opening the door of the cold room, all the semi-auto features also apply. A status indicator shows the mode of operation and another status indicator shows if the light is either on, off or in a count down cycle (blinking). In a large operation where the lighting shall stay on all day, a fourth mode would allow to control the lighting based on the time of the day. As an example, the lights would be automatically turned on at 7:00 am and turned off at 6:00 pm. In this mode, the lighting could still be controlled manually by the on/off buttons. In order to prevent the light to shut off while there is somebody inside, the buzzer would warn for few minutes before shutting off.

2. The anti-sweat heater wire is controlled by the electronic unit and activated if temperature is lower than a user defined temperature. In order to apply the proper amount of heating, the output is cycled on and off in time, for example, at 50% the output is on half of the time. Both activation temperature and power level are configurable by the menu mode.
3. There are 4 types of alarms generated by the system; high or low temperature alarm, door open alarm, panic alarm and refrigeration system malfunction or failure alarm. Using the menu mode, each of the alarm can be enabled or disabled and each one can be configured to send or not an outside signal through a dry contact. When an alarm occurs, the appropriate status indicator flashes on the keyboard and a local buzzer is activated according to the type of alarm (1 beep to 4 beeps sequence). The buzzer can be silenced temporarily by pressing an acknowledge button on the keyboard, the status light will still blink and the outside signal will remain energized if selected. If the alarm is still active after a user defined delay, the buzzer will be reactivated. It can be permanently silenced by pressing twice the acknowledge button on the keyboard.

The Hi/Lo temperature alarm level and the delay before activation are defined in the menu mode by the user.

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The door open alarm is activated when the door is left open after a user defined delay. In order to avoid false alarm to the outside signal during normal operation, the outside signal, if selected, will be activated only after 3 times the preset delay that initiate the alarm.

The panic alarm can only be activated when the door is closed, by holding the inside button for a couple of seconds. Since the lighting control is also triggered by the inside button, the sequence will be that the light will turn on permanently if not already and then the panic alarm will be activated. The alarm is cancelled by opening the door or by pressing the acknowledge key on the keyboard.

The refrigeration system alarm is detected by the two pressure probes and the two temperature probes located in the evaporator coil and on compressor/condenser temperature probe. Monitoring those parameters will allow to detect gas leak, dirty condenser or ice build-up in the evaporator coil.

4. The refrigeration system is completely managed by the electronic controller and includes temperature regulation, defrost cycles and evaporator fan interruptions. The temperature regulation is achieved by measuring the air temperature inside the cold room (or the product temperature probe) and, based on the user defined set point and hysteresis, controlled by either the solenoid valve or the compressor. The number of defrost cycles and their duration are user defined and the controller will manage the solenoid valve, the fans and the defrost elements based on the evaporator coil temperature or maximum defrost time defined by the user. Through the keyboard, a manual defrost could also be initiated.

The evaporator fan interruption that is required when the door is opened (triggered by the door switch) or when a user is working inside the cooler (triggered by the keyboard) is managed considering the inside temperature as a priority. This means that if because of the fan and solenoid valves are turned off, the temperature rises at or over the high temperature alarm level, the fan and solenoid will resume into

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normal operation to lower the temperature in the cold room back to its temperature set point. If the door is left opened for longer than the door open alarm delay, the fan and solenoid valve will also resume into normal operation.

The system also features an option that manages the initial start-up of the refrigeration system. In order to prevent ice build-up in the evaporator coil that some times occurs in the first cool down, the system lowers the temperature in incremental temperature steps and will initiate a defrost cycle in between each steps until the final temperature is reached. This option will be selected by the menu mode and the range of the step will be user defined.

5. The electronic system includes a data memory as well as a Real Time Clock (RTC) allowing data logging of different parameters of the system related to the date and time. The configuration and the information recorded are accessible through the menu mode. The system logs any alarm status combined with time, period and value of the parameter being in fault. The system is also configured to log, at given time intervals, some variables of the system such as inside cold room temperature, product temperature, evaporator coil temperature, compressor/condenser temperature, suction pressure and compressor pressure. The system also has the capability to log for a time interval (ex. In 24 hours), different status of the system as running time of the compressor, running time of the fans, running time for the defrost cycle, door open time and "light on" time. The system logs the highest and the lowest value reached of all analog inputs. The system is programmed to also log any combination of the status or value from the inputs and outputs of the system.
6. The system features one or few data ports that will allow communication with other peripheral as computer, modem or any other communication device. The link could be either by cable or infrared port. The communication ports allows downloading logged data to a computer, sending alarm signals on line, allowing remote monitoring of

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any parameters of the system and allowing controlling the system or modifying its parameters remotely. The data port also allows to link similar system into a network (require a second data port). The program, the configuration, any upgrade or revisions of the system could also be loaded by the communication port.

## Claims:

1. A walk-in refrigerating unit comprising an evaporator having a coil, a fan and defrost elements, a condenser or compressor, a liquid solenoid valve, a light internal said unit, an audible alarm device, a door frame having an anti-sweat heating element, and a controller for monitoring and controlling at least one operating parameters of said unit, said controller being connected to at least one peripheral monitoring said at least one operating parameter, said at least one peripheral being selected from the list comprising:
  - a. a temperature probe to read air temperature inside said unit;
  - b. a temperature probe to read food temperature inside said unit;
  - c. a temperature probe to read evaporator coil temperature;
  - d. a temperature probe to read condenser or compressor temperature;
  - e. a suction pressure probe at the inlet of the compressor;
  - f. a compressor pressure probe at the outlet of the compressor;
  - g. a backlit push button installed inside said unit;
  - h. a door detector switch;
  - i. a user interface device installed outside said unit;
  - j. an output to said light;
  - k. an output to the evaporator fan;
  - l. an output to control either the liquid solenoid valve or the compressor;
  - m. an audible alarm device;
  - n. an output to control the defrost elements; and
  - o. an output to control the anti-sweat heater element.
2. The walk-in refrigeration unit of claim 1, wherein the controller further comprises an input and output means for interfacing with external data communication devices.
3. A walk-in refrigeration unit comprising:

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- a. a temperature probe located inside said unit for obtaining a temperature reading inside said unit;
  - b. a door frame having a heating element that reduces humidity in the vicinity of said door frame;
  - c. a controller obtaining said temperature reading and sending a control signal to said heating element to control an amount of heat generated by said heating element.
4. A walk-in refrigerating unit having an alarm management capability.
  5. A walk-in refrigerating unit a memory for logging data regarding operating parameters of said unit.

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