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(54) **An Alerting Device**

(57) An alerting device is adapted to detect liquid in a cooling chamber. Liquid may accumulate in a cooling chamber due to several causes. There may be a malfunction so that temperature in the cooling chamber is warmer than necessary to freeze the contents and so the contents melt. There may be an excess of moisture in the air in the cooling chamber which condenses more quickly than it can drain. There may be a blockage in the drain either due to flotsam and jetsam in the liquid or because the liquid freezes in the drain. The alerting device comprises a liquid detector and a temperature monitoring sensor. If the liquid detector detects liquid materials or ice at a level above the preset limit, the alerting devices provides a signal, this will also occur if the temperature sensor falls below a preset temperature set point. The alerting device also comprises a heater. If the liquid freezes, the heater may melt a portion of the ice formed so that liquid may be readily detected, this will also keep the sensor free of frost and ice to ensure correct operation and detection.

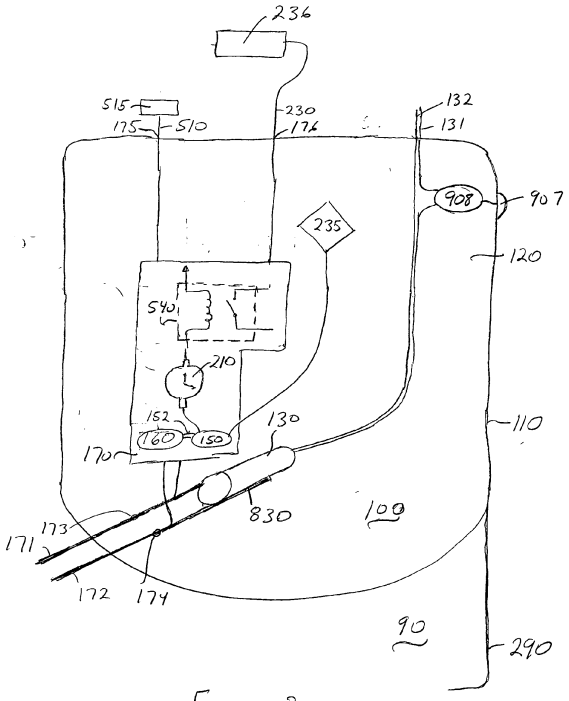

Figure 3

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Description

Field of the Invention

[0001] This invention relates generally to an alerting device that provides a signal or alarm as a consequence of detection of a specific condition. More particularly the invention relates to an alerting device for use in a cooled chamber, such as for example a cooling chamber, refrigeration or freezer

Background

[0002] Debris and other unwanted material may accumulate in a cooling chamber due to several reasons.

[0003] For example there may be a refrigeration malfunction, so that the cooling chamber contents melt and become unusable or contents of containers may be spilt or drip into the cooling chamber. Alternatively there may be repeated occurrences of moisture from the air entering the cooling chamber and condensing on inside surfaces of the cooling chamber than condensate drain can be drained away resulting in an accumulation of water and debris which flows to a lower region, sump or condensate drain of the chamber, often resulting in blockage of the condensate drain and so leading to build up of water.

[0004] Condensed water may freeze on the evaporator of a cooling chamber or cooling chamber preventing air from flowing efficiently over it and being cooled. To overcome this, the evaporator may be temporarily heated and to melt off the ice. This water can build up in the bottom of the cooled chamber. Sometimes the water surface freezes when the evaporator becomes cold again, but the underlying water remains and turns putrid.

[0005] This may be aggravated by a blockage in the drain either due to detritus in the liquid or because the liquid freezes in the drain.

[0006] Unwanted ice in a cooling chamber or water in a cooling chamber or air conditioner may not be discovered until someone, often by chance, finds the cooled chamber partially full of water and ice, or defrosted contents.

Prior Art

[0007] There have been attempts to prevent ice and water build up in cooled chambers and refrigerators.

[0008] Chinese patent application CN - A - 101280992 (Hansheng) provides a cooling chamber water and frost removing overflow alarm apparatus. The invention aims at resolving a problem caused by thawed ice in cooling chambers failing to be discharged. The apparatus is designed to give an automatic alarm to indicate when the water outlet is blocked. The alarm warns a user to clear the drain, thereby avoiding overflow.

[0009] Chinese patent application CN - Y - 201093837 (Xuzhou Jingying) describes an ice house safety protection device. The device comprises a defrosting temperature switch which is arranged on an evaporator to collect the evaporator temperature, a shunt tripping device, a circuit breaker, a warning circuit and an alarm. When the temperature collected by the defrosting temperature switch exceeds a set point, the defrosting temperature switch outputs a switch value to energize the shunt tripping device coil to operate the circuit breaker.

[0010] United States patent US-B-5729990 (Danfoss) teaches a temperature dependent resistor as a liquid sensor which detects the presence of liquid at a level above a cooling chamber drip tray provided with a drain channel. The temperature dependent resistor is mounted external to the liquid sensor because it must be in direct contact with liquid. Electric power is provided to heat the resistor. The relative temperature change before and after the resistor is heated provides a clear indication as to whether the liquid sensor is surrounded by water or ice or by air.

[0011] United States patent US-B5965814 (French) reveals an electrical circuit control system with multiple sensing probes used to detect the presence of an excessive level of overflow of condensation in its in its liquid or frozen form.

[0012] Complex and expensive means have been devised to detect the level of a material in a chamber, but they have been generally unsuitable as a simple inexpensive device that will operate reliably in the harsh and cold environment of a cooling chamber or cooling chamber.

[0013] In light of the foregoing prior art, there is a need for a reliable device to prevent the build-up of a specific material in a cooling chamber that is able to withstand the temperature conditions and is still effective if the phase of specific material changes.

Summary of the Invention

[0014] According to a first aspect of the present invention there is provided an alerting device for detecting the presence of material in a cooled chamber so as to issue an alert signal, comprises: an enclosure within which is housed a heater and from which at least one monitoring probe extends, **characterized in that**, in use, heat is conducted from the enclosure via the at least one monitoring probe to melt material in the cooled chamber that is in contact with the at least one monitoring probe, whereupon melted material conducts an electrical current to the at least one monitoring probe so as to trigger the alert signal.

[0015] Ideally the alerting device includes two monitoring probes (171, 172) that act as electrodes so as to define a continuous path therebetween when connected by melted material.

[0016] Preferably the enclosure is formed from a thermally insulating material, such as a layered composite or synthetic plastics or a combination of materials, so as to minimise heat loss from the enclosure. Both radiative and conductive heat losses are minimised by this mate-

rial.

[0017] Advantageously the heater is located in an interior of the enclosure and adapted to simultaneously heat components in the interior and portions of a sensor probe located inside and outside the enclosure.

[0018] Preferably the alerting device provides an alert signal to the presence of material that exceeds a preset height limit in a cooled chamber, comprises: a heater adapted to melt frozen material, and a material sensor adapted to detect the material above the preset limit.

[0019] The sensor probe comprises an electrode. The alerting device detects electrical current conducted by the material through the electrode.

[0020] Generally the material in its liquid form is a much better electrical conductor than in its frozen solid form. Therefore and advantageously the monitoring probes are heated so that they melt solid frozen material upon contact.

[0021] The alerting device does not require two material detectors whereas some previous did: one was to detect ice and another to detect water.

[0022] If there is continuity between sensing elements, this is detected by the material sensing circuit and causes the alerting device to provide the alert signal.

[0023] Advantageously an indication of the type of material detected can be obtained from the level of current detected which is indicative of the type of material detected.

[0024] The heater is contained within the enclosure and the enclosure also contains thermally sensitive devices such as electronics. Therefore an advantage of the heater is it also serves to maintain the operational integrity of the devices inside the alerting device.

[0025] Advantageously the electronic components are maintained within their operational temperature range by the heater even when the alerting device is in use in a very cold cooling chamber. Therefore if the condensed or melted material freezes, the alerting device still detects

[0026] Prior art detectors that depend upon a thermally sensitive resistor, such a revealed in patent US-B-5 729 990 do not enjoy this advantage of the present invention. The thermally sensitive resistor must be located outside an enclosure because it must be cooled by contact with the material it detects.

[0027] The alerting device is fixed to a location within the cooled chamber that gives the alerting device the capability to determine if a preselected amount of the material has been reached within the cooled chamber.

[0028] The alerting device provides an alert signal when it detects the material. The alert signal may be communicated locally, for example by way of an audible/visual alarm and/or it may be transmitted to a remote location, for example, by way of a pager or mobile communication device.

[0029] The material to be detected is usually water that condenses in the cooled chamber. Sometimes the material is foodstuff that melts if the cooled chamber malfunctions.

[0030] The condensed or melted material flows down to the bottom of the cooled chamber where it accumulates. When it reaches the level to which the alerting device is positioned, then the material sensor detects presence of melted material and provides the alert signal.

[0031] According to another aspect of the invention there is provided a method of preventing excess accumulation of material in a cooled chamber by triggering an alert at a predefined instant. The method provides for an alert when a preset amount of material has been exceeded. The method uses the alerting device which is fixed in a location that allows the material sensor to detect when material has exceeded a preset threshold inside the cooled chamber.

[0032] A heater is adapted to maintain the integrity of the alerting device. That is the heater keeps the alerting device sufficiently warm to operate regardless of the temperature in the cooled chamber. The alerting device provides a signal as a consequence of the specific material exceeding a preset threshold. If the specific material does not exceed the preset threshold then a different signal is provided or none is provided.

[0033] Preferably the alerting device also melts a portion of the specific material or maintains a portion of the specific material in the liquid state. In this embodiment the heater enables the alerting device to operate if the material freezes by ensuring the material is always in the liquid form when in contact with the material sensor.

[0034] Alternatively the alerting device comprises a power supply and associated hardware, a delay timer (to prevent spurious alarms), a signaling relay and a temperature sensor input.

[0035] Advantageously the alerting device can be connected one to another to create an alerting system that comprises a plurality of alerting devices connected by a network to a central alert station which receives information sent by the alerting devices, stores and displays the information provided by the alerting devices, and provides an alarm and data indicative of the location of the alert device and optionally information as to the nature of detected material.

[0036] The invention is further explained, by way of examples only, by the following description, to be read in conjunction with the appended drawings, in which:

Brief Description of the Figures

[0037]

Figure 1A reveals a plurality of views of the internal and external components of a sensor assembly comprising two monitoring probes and a heating element housed within a sealed compartment; and

Figure 1 B reveals a plurality of views of the external components of a sensor assembly comprising two monitoring probes and a heating element housed within a sealed compartment;

Figure 2 is a view showing an interface module comprising a material sensing circuit, power connection for the heater, sensor connection to the monitoring probes, and connections to a condition indicator.

Figure 3 is a view of an alerting device integrating components of the sensor assembly and the interface module into a single unit;

Figure 4 is a view of the sensor assembly installed in a cooled chamber;

Figure 5 is view of a connected sensor assembly, interface module, and alarm;

Figure 6 is an alerting device system comprising a plurality of alerting devices interlinked by a network;

Figure 7 shows an alternative embodiment of components of an alerting device within an enclosure;

Figure 8 shows an alternative embodiment of an alerting device installed in a cooled chamber;

Figure 9 shows an alternative embodiment of a sensor assembly for an alerting device; and

Figure 10 shows an alternative embodiment of an interface module for an alerting device.

Detailed Description of Preferred Embodiments of the **Invention**

[0038] Exemplary embodiments of the invention will now be described in detail and with reference to the following sections:

FIRST EMBODIMENT

SENSOR ASSEMBLY AND DEVICES CONTAINED WITHIN (FIGURE 1A AND 1B)

[0039] In a first embodiment an alerting device 90 comprises a sensor assembly 100 shown in Figure 1A and 1 B. This alerting device 90 also comprises a separate interface module 112 shown in Figure 2.

[0040] The sensor assembly 100 is installed in use in a cooled chamber and positioned within the cooled chamber to detect material.

[0041] Referring to Figure 1A and 1 B an enclosure 110 encloses internal components of the sensor assembly. The enclosure shields and protects the internal components from the external environment.

[0042] The internal components are sealed inside the enclosure by a sealing compound which is not shown and/or by a cap 111.

[0043] Material sensor monitoring probes 171 and 172 pass through orifices 173,174 in the enclosure 110 with a moisture proof seal.

[0044] A heater 130 is contained within the enclosure 110. As shown in Figure 1A the heater 130 is in thermal contact with the portion of the sensor probe 171 inside the enclosure. Material is detected by material sensor probes 171 and 172 when material comes into contact with them. A multiple conductor cable 509 electrically connects the sensor assembly 100 to the interface module 112 shown in Figure 2. The multiple conductor cable 509 carries electrical power for the heater 130. It also carries the signal which indicates whether or not material has been detected from the material sensor monitoring probes to the interface module.

[0045] Advantageously the sensor assembly 100 comprises hardy components of the alerting device which can easily withstand the physical abuse and temperature extremes within the cooled chamber.

INTERFACE MODULE AND DEVICES CONTAINED WITHIN (FIGURE 2)

[0046] In the first embodiment of the alerting device 90, when the alerting device 90 is in use, the interface module 112 is installed outside of the cooled chamber.

[0047] The interface module 112 comprises a conductor 510 arranged to receive electrical power from a power source which is either a DC power source an AC mains source.

[0048] The interface module 112 comprises a plurality of interface terminals 601, 602, 603, and 604. Each interface face terminal is arranged to accept a multiple conductor cable 509. Each multiple conductor cable is connects to a different sensor assembly. Therefore each interface module can be connected to four different sensor assemblies.

[0049] The interface module comprises within it a material sensor electronic circuit 170. The material sensor electronic circuit 170 is connected to each interface terminal 601, 602, 603, and 604.

[0050] The material electronic sensor circuit 170 is connected to an alarm signal wire 230 which is arranged to communicate a signal that material has or has not been detected to an audible or visible alarm 236.

[0051] Advantageously the interface module in use operates at a location outside the cooled chamber and so there is no risk that the delicate electronic components such as the material electronic sensor circuit 170 are subjected to physical abuse or temperature extremes, or moisture found within the cooled chamber.

[0052] The interface module 112, which the sensor assembly 100 connects to, is installed away from the chilled environment. The module provides visual indication of the status of the sensor assembly 100, power supply for the sensor assembly, and heater 130.

[0053] The interface module has a supply voltage of 90 - 264vAC at 47 - 63 HZ, so is suitable for all markets. The supply voltage is supplied through connection 1010.

SECOND EMBODIMENT

SINGLE ENCLOSURE 110 and DEVICES CONTAINED WITHIN (FIGURE 3)

[0054] The alerting device 90 comprises a single enclosure 110 which comprises the monitor probes 171, 172, the heater 130, and the material sensor electronic circuit 170 all in one sensor assembly 100.Referring to the Figures, there is shown in Figure 3 an alerting device 90. An enclosure 110, in use, encloses the alerting device so that its internal components can be kept separated from an external environment.

[0055] The enclosure 110 houses a material sensor electronic circuit 170. Connected to the material sensor electronic circuit 170 are material sensor monitoring probes 171 and 172. The monitoring probes 171 pass through water tight orifices 173,174 in the enclosure. These water tight orifices 173, 174 prevent moisture entering the enclosure 110.

[0056] A heater 130 is contained within the enclosure110. The heater 130 is in thermal contact with the portion of the sensor probe 171 inside the enclosure. Material is detected by material sensor probes 171 and 172 when material comes into contact with them.

[0057] A sealing compound, such as an elastomer sealant is used to seal the open end of the enclosure 110. This elastomer sealant hermetically seals the components inside the enclosure.

[0058] The enclosure 110 is formed from a shell 110 or capsule. The enclosure 110 is in the shape of a bottle cap or an open ended can. This simplifies manufacture as components can be easily placed inside the enclosure 110 before sealing it with the sealing compound. The enclosure surface is impermeable to water, ice, air, moisture, and other stuffs found in cold chambers.

[0059] Advantageously with the second embodiment the alerting device does not require a separate assembly 100 and interface module.

RELATIONSHIP OF THE FIRST EMBODIMENT COMPRISING SEPARATE SENSOR ASSEMBLY AND THE SECOND EMBODIMENT - SINGLE UNIFIED ALERTING DEVICE.

[0060] In subsequent discussions the technical description applies to both the first and second embodiments.

INSTALL LOCATION (FIGURE 4)

[0061] The alerting device sensor assembly 100 is fastened to a point of a cooled chamber 270 at the location of the level mark 250 shown in Figure 4.

[0062] A fastening arrangement 290, 80 is attached to the enclosure 110 by a tenon 82 and aids attaching the sensor assembly 100 to a wall 272 of the cooled chamber. The fastening arrangement 290 may be an extension from the enclosure containing a hole for attaching with a nut and bolt, a magnetic plate, an adhesive or any other suitable means.

[0063] The cooled chamber is a refrigerator, market store display cabinet, cold storage room in a building, cold storage room in a boat, airplane, or train, collector of frozen or defrosted material from a refrigeration unit, ice maker cabinet, or other compartment for operation with cooled material.

[0064] It is also possible for the alerting device 90 to be manufactured with a cooling chamber or a cooling chamber may be made with the alerting device formed as an integral part of the floor, ceiling, or a wall. Only the external portion of the sensor probe needs to be exposed within the cooled chamber.

[0065] A cooled chamber 270 can also be retrofitted with an alerting device.

[0066] The alert device may also be fixed inside a conduit leading from the cooled chamber such as a drain conduit.

PROBE (FIGURE 1A, FIGURE 1B, FIGURE 3)

[0067] As shown In Figure 1 and Figure 3 two conductivity sensor electrodes 171, 172 form a monitoring probe. In one embodiment the monitoring probe comprises a straw-like sleeve that encases the sensor electrodes 171, 172. Alternatively the monitoring probe comprises a single electrode 172 because the surface of the cooled chamber 270 may effectively define the other electrode.

[0068] The monitoring probe 171, 172 is shown passing from the hermetically sealed interior of the enclosure 110 through the enclosure 110 out via a sealed pathway 173, 174 to the exterior of the alerting device. The monitoring probe 171, 172 does not transmit the material itself from the exterior environment to the material sensing circuit inside the enclosure 110.

[0069] A material sensing circuit 170 is connected to the monitoring probe 171, 172 and detects when material contacts the electrodes 171, 172 by detecting that a current is flowing through the material. Material sensing circuit 170 applies a small voltage between the electrodes 171, 172. The voltage difference across the electrodes 171, 172 is low enough that a person can touch them without any danger from electrical shock.

[0070] The monitoring probe 171, 172 is made of a material with high electrical and thermal conductivity. The electrodes are made of stainless steel, copper, brass, aluminium or other metal that that does not rust. Where the monitoring probe 171, 172 is exterior to the enclosure it can be bent by hand.

[0071] In use the sensor assembly 100 is placed on a shelf or on a floor or in a receptacle or attached to a wall 272 in a refrigerated chamber 270. A bendable monitoring probe 171, 172 has the advantage that it can be bent to a shape so as to enable it to detect liquid in the refrigerated chamber depending on the placement location of the sensor assembly100 within the cooled chamber 270.

[0072] Where the monitoring probes 171, 172 are exterior to the cooled chamber 270, their length can be trimmed with wire cutters. Advantageously this allows the sensor assembly 100 to be placed in versatile locations within the cooled chamber to detect material.

[0073] The conductivity sensor electrodes 171, 172 of the monitoring probe are thereby also bent and trimmed to an appropriate shape.

[0074] In another embodiment the monitoring probe 171, 172 is not in the form of a long thin wire. Essential features of the monitoring probe 171, 172 are an electrically conductive sensor electrode 171, 172 and a thermally conductive path from the interior of alerting device 90 to the exterior. Advantageously a monitoring probe 171, 172 formed of metal wire is both electrically and thermally conductive which simplifies the monitoring probe 171, 172. The shape of the monitoring probe 171, 172 is adaptable to permit optimum sensing points of any materials to be detected within the cooling chamber.

[0075] A sensor i/p wire 231 electrically connects the monitoring probe 171, 172 in the enclosure 110 of the sensor assembly to the material sensor circuit 170 contained in the interface module112.

[0076] Sensor trigger resistance is <10 Mega Ohms. One conductivity sensor electrode 171 has a varying voltage applied to it at a few Kilohertz and the other conductivity sensor electrodes 172 acts as a pickup. Once the resistance between electrodes drops below 10M Ohms then an open collector output is triggered operating a fault relay 540 within the material sensor circuit 170. Thereby the alarm 236 indicates whether or not material has been detected. The sensor voltage supply is 5vDC +/-10%. Current draw is 1 ma without the heater.

HEATER (FIGURE 1A, FIGURE 1 B, FIGURE 3)

[0077] The enclosure 110 houses a heater 130. The heater is an electrical resistor, an electrical induction heater, a heat bulb, or other heating device. The heater is located inside the enclosure advantageously keeping the components inside it within their operating temperature range. Electricity is supplied to the heater 130 through heater electrical wires 131 and 132. These heater electrical wires pass through watertight heater wire orifices 500 in the enclosure 110 that prevent moisture entering the interior of the enclosure 110.Current draw is 100ma max at 5vDC with the heater in circuit.

HEATER ON and OFF SWITCH (FIGURE 2, FIGURE 3, FIGURE 5)

[0078] Preferably the alerting device 90 comprises means turns to the heater 130 off when the temperature external to the sensor assembly 100 is above a certain temperature and it turns the heater 130 on when the temperature external to the heater 130 is below a certain temperature.

[0079] In one embodiment the means to turn the heater 130 on and off is by connecting and disconnecting one of the heater electrical wires 131 or 132 to a power supply. In another embodiment the alerting device comprises a heater switch or a heater relay to turn the heater on and off.

[0080] The power output of the heater 130 is increased as the exterior temperature drops by a power management device. Only the needed amount of power to operate the heater 130 is used. The alerting device 90 comprises a power management device which takes as in input the exterior temperature.

[0081] In use the heater 130 consumes on the order of 0.1 W to 10 W per alerting device 90. The annual cost of this power is about £0.10 to £10. The capability to turn the heater on and off or regulate the heater 130 power is an economic advantage for an alerting device system that may comprise hundreds or thousands of alerting devices 90.

HEATER and PROBES COMBINATION (FIGURE 1A AND FIGURE 3)

[0082] The heater 130 is heats a portion of the sensor probe 172 inside the enclosure. The sensor probe conducts the heat it receives along its length through the sealed enclosure. So advantageously the portion of the sensor probe that is outside the enclosure is also heated.

[0083] When the alerting device 90 is operating in use the monitoring probes 171, 172 can be maintained by the heater 130 at a temperature above the freezing temperature of the material. Advantageously the heater 130 is arranged to heat the monitoring probe 171, 172 so that the monitoring probe 171, 172 is maintained frost free both interior and exterior to the enclosure 110. Advantageously the portion of the heated monitoring probe 171, 172 exterior to the enclosure 110 melts solid material on contact. Advantageously the melted material forms a liquid path between the monitoring probes electrodes 171, 172 through which current can pass so the material is detected.

[0084] In one embodiment shown IN Figure 1A and Figure 3 the heater 130 is in direct contact with a portion of the monitoring probe 171, 172 that is inside the enclosure 110. Advantageously there is long length of contact 830 between the heater 130 and the monitoring probe 171, 172 which enables effective heat transfer by conduction from the heater 130 to the monitoring probe 171, 172.

[0085] In one embodiment the heater 130 is arranged to radiate heat onto a portion of the monitoring probe 171, 172 that is inside the enclosure 110.

[0086] In one embodiment the heater 130 is arranged to inductively heat a portion of the monitoring probe 171, 172 that is inside the enclosure 110.

[0087] Heat is transferred by conduction from the heater 130 to the portion of the monitoring probe 171, 172 inside the enclosure. Heat is transferred by conduction from the heated portion of the monitoring probe 171, 172

inside the enclosure to the portion of the monitoring probe 171, 172 outside the enclosure 110. So that by this means the portion of the monitoring probe exterior to the enclosure is heated also.

[0088] Frost is prevented from forming on the monitoring probes 171, 172 both interior and exterior to the enclosure 110 as a result of the portion of the monitoring probes 171, 172 interior to the enclosure being heated by the heater 130. This is true even if the alerting device is operating in a cold cooling chamber so that the temperature exterior to the enclosure 110 is well below the temperature for frost to form. Advantageously a frost free monitoring probe 171, 172 does not send spurious information that could be confused as moisture being detected.

[0089] In an embodiment the enclosure 110 contains within it a battery with it terminals connected to the material sensor circuit 170 and or the heater 130. Advantageously the heater warms the interior of the enclosure 110 so that the battery is maintained within its operating temperature range while the sensor assembly is in use within the cooled chamber.

TEMPERATURE SENSOR (FIGURE 3)

[0090] The alerting device further comprises a temperature sensor 907 arranged to measure the temperature exterior to the enclosure 110. This enables monitoring for low temperature operating conditions which may result in the material freezing in the cooled chamber or cooled chamber drain. It also enables monitoring for low temperature operating conditions which could result in frost forming on the portion of the monitor probes 171, 172 exterior to the enclosure.

[0091] It also enables power to be supplied to the heater in sufficient quantity to heat the monitoring probe and prevent frost forming on the portion of the monitor probes 171, 172 exterior to the enclosure. It also enables power to be supplied to the heater in sufficient quantity to heat the monitoring probe to melt frozen material which comes into contact with the portion of the monitor probes 171, 172 exterior to the enclosure.

[0092] The temperature sensor provides a temperature signal exterior to the alerting device 90via a temperature signal wire.

[0093] The temperature sensor 907 provides a temperature signal to the power management device 908 interior to the enclosure 110.

ALARM (FIGURES 2 - 6)

[0094] The material sensing circuit 170 comprises a fault relay 540. When the resistant between the material sensor electrodes 171 and 172 drop below a predetermined resistance the material sensing circuit 170 operates the fault relay 540 to activate the alarm 236 alarm signal wire 230.

[0095] The interface module 112 of Figure 2 and the sensor assembly of Figure 3 have a variable time delay 210 for operation of the fault relay. This is a pot which can be set for a preselected time delay. Time delays selectable between 1 minute and 60 minutes are advantageous to adapt the alerting device 90 to operate in a variety of conditions.

[0096] The electronic circuit 170 comprises a comparator 150 which assists the material sensing circuit 170 in determining whether or not material has been detected. The material sensing circuit 170 also has a reference value input to provide the basis of comparison. This reference value input may be provided by a memory circuit 160 into which the reference value is programmed. If material is detected the material sensing circuit 150 triggers the alarm 236. The alarm 236 may be visible, audible, or a signal to a remote monitor via wireless transmitter 235 internal to the alerting device 90.

[0097] There is an electrical connection 151 between the material sensing circuit 170 and the electronic circuit 150. There is an electrical connection 152 between the electronic circuit 150 and the memory circuit 160.

[0098] Alerting device 90 comprises an alarm such as an LED (green) to indicate no material has been detected.

[0099] In one embodiment the temperature sensor is connected to a temperature indicator such as an audible or visual alarm 236. Where the portion of the monitoring probes 171, 172 exterior to the enclosure contact the material, the low voltage material sensing circuit 170 detects current that flows through the monitoring probe 171, 172 and then into the material and thereby detects that material is present.. This initiates adjustable delay timer 210. This event may activate an alert indicator such as an LED (amber).

[0100] Once the delay has timed out, the signal relay activates, delivering an alarm condition to one or more specified monitoring point(s), that are located around the refrigeration chamber and this activates alert indicator LED 236 colour (red). The alarm condition is also relayed through wireless signal transmitter 235. Contingency has been applied to deliver an alert condition. Should a user require this a delay is included prior to a full alarm. The alerting device 90 generates an alarm locally (audibly or visually), or remotely (for example to a monitoring bureau) or both.

[0101] The alerting device 90 can be configured or switched to provide a special alert, for example if the electrical conductivity of the material detected is within a preselected range.

SYSTEM OF ALERTING DEVICES (FIGURE 1A, FIGURE 5, FIGURE 6)

[0102] Referring to Figure 5, a sensor PCB 350 housed within the enclosure 110 is connected by sensor i/p wire 231 to the interface PCB 113 within the interface module 112. Wires 510 and 511 connect plus 5 volts and 0 volts from the interface PCB to the sensor PCB. Heater wire 131 supplies power for the heater 130 by connecting the

interface PCB to the sensor PCB. Multiple wire conductor 509 comprises wires 231, 511, 510, and 131 all within a single convenient conduit.

[0103] The monitor probes 171, 172 are connected to the sensor PCB 350 by probe connector 135.

[0104] The interface PCB comprises a power on switch indicator light 237 which is on when the plus 5 V supply 520 is connected to by 5 V supply wires 512, 513.

[0105] The interface PCB comprises an alarm activated indicator light 238 which is on when the plus 12 V supply 530 is connected to the interface PCB 113 by 12 V supply wire 235. Alarm 236 siren or beacon is connected to the interface PCB by the alarm wire 230. The alarm relay 540 is arranged to make operable the alarm by activating current through alarm wires 230 and 231. The alarm relay 540 is also arranged to operate a network connection to an alarm 1000.

[0106] Referring to Figure 6, the alerting device 90 is connected to a remote monitor or network 1000. A central alert station 2000 may be connected directly to the alerting device 90 or to the alerting device 90 via the network 1000, via wireless transmitter 235 or signal wire 230. When so deployed, the alerting device 90 becomes part of a system of alerting devices that is arranged to provide information obtained from multiple cooled chambers.

[0107] It is understood that the remote network may be a wireless, the internet 1000 or a telephone network 1000.

[0108] An ID for each alerting device is stored inside the enclosure 110 of each alerting device. This is a unique ID number stored in the memory circuit 160. When a temperature is detected by the temperature sensor, and/or an alert signal indicates whether or not the material has been detected, the ID of the alerting device is transmitted by way of transmitter 235. Optionally the ID of the location of the freezer/cooling chamber 270 may be included so that a maintenance engineer can be directed quickly to the location of the potential problem. Alternatively only the alarm condition is provided.

[0109] Referring to Figure 6 An alerting device system comprises a central alert station 4000 which receives information from a plurality of alerting devices 90 and stores and displays the information. Transmission of information to the central alert station 2000 is accomplished by direct communication from the alerting devices or indirectly through the internet. The ID of each alerting device is matched with its location on a database 2001 located at the central alert station.

[0110] In the embodiment shown in Figure 6 the alerting device system is located at the premises of an undertaking which operates several cooling chambers and cooling chambers utilizing the alerting devices. A person 3000 monitors alerting device system and when alert signals are sent to the system by these alerting devices, the person monitoring the alerting device system escalates the issue to a service department if it is urgent. The service department dispatches a technician to the cooled chamber identified by the alert signal.

[0111] Alerting device system automatically sends a message to a technician when material has been detected in one of the cooled chambers or if the temperature in one of the cooled chambers is outside of a desired range. This may be accomplished by sending a mobile phone text or short message service (SMS) from the central alert station to the technician's mobile phone 600 or portable communication device 600.

[0112] Central alert station comprises an alert station computer which determines the location of the nearest technician on duty to an alerting device with a particular ID. When information is received from that alerting device that material has been detected or that the temperature detected is above or below a predetermined limit, the central alert station sends a mobile phone text message to the mobile phone of the nearest technician on duty.

[0113] Alerting device system increases the efficiency of operating and maintaining several cooled chambers, which may be in different locations, by one or more technicians. The technicians only need to be dispatched to the cooling chamber or cooling chamber from where an alert signal has been provided by an alerting device.

[0114] In one embodiment of the alerting device system it also receives temperature information on the cooling chambers from the alerting devices and the alerting device system also sends this information to the technicians. Therefore they are informed if the trouble is due to a temperature being too warm or too cold or if the trouble is due to material, (such as ice, water, or potentially any defrosted product) being detected or a combination of the two.

[0115] Alerting device system decreases the cost and resources needed to operate cooled chambers, including cooling chambers and cooling chambers.

POWER and COMMUNICATIONS (FIGURE 3, FIGURE 4, FIGURE 1, FIGURE 2 FIGURE 6)

[0116] Referring to Figure 3 a power wire 510 and alarm signal wire 230 follow a path which passes out of the cooled chamber 270. The power wire 131, 132 connects to a power source terminal 515. The alarm signal wire 230 connects to a communication terminal 235, or directly to a warning device 236 such as flashing light, audible sounding device, and/or an audio/video status display. The warning device 236 may be internal or external to the cooled chamber.

[0117] Communication terminal 235 is a signal transmitter provided inside the enclosure. The signal transmitter is connected to the electronic devices 150.

[0118] The power wire 131 carries electricity for the heater inside the enclosure. The alarm signal wire 230 or wireless signal transmitter 235 carries an electrical or electromagnetic signal from electronic devices 150 inside the enclosure that indicates if the monitor probes are or are not in contact with the liquid to be detected and/or a temperature sensor reading.

[0119] An alarm signal wire 230 carries an alert signal

indicating material is detected is connected to the electronic devices 150. The alarm signal wire 230 passes through a water tight sealed orifice 176 in the enclosure.

[0120] The signal wire carries composite information comprising information that material has contacted the monitoring probe 171, 172. This is the alert signal and information of the temperature measured by the temperature sensor.

[0121] The enclosure 110 also has a sealed water tight power wire orifice 175 through which a power wire 510 passes through. The enclosure also has a sealed water tight signal wire orifice 176 for the alarm signal wire 230 that carries the alert signal. These signals and power can be carried on a single 1 x 4 cable comprising a 5 V and 0 V supply wire 510 and 511, a heater power wire 131, and a connector for material sensor signal wire 233.

[0122] Each interface terminal 604 comprises: a connectors for a 5 V and 0 V supply wire 510 and 511, a connector for a heater power wire 131, and a connector for material sensor signal wire 233.

METHOD OF RETROFITTING A COOLED CHAMBER WITH AN ALERTING DEVICE

[0123] Existing cooled chambers lack an alerting device 90 to give warning that material is present in a cooled chamber.

[0124] An existing cooled chamber 270 is retrofitted with an alerting device by attaching the sensor assembly 100 to an interior fixture of the cooled chamber. The interior fixture may be wall 272 or a shelf. The alerting device is placed at predetermined level 250 in the cooled chamber. The bracket 80 attached to the sensor assembly 100 is bolted to, glued to, or magnetically attached to, placed upon, or hung from the interior fixture.

[0125] A hole or aperture is drilled through a wall 270, floor, or ceiling, in the cooled chamber. A wire 509 connected to the sensor assembly is threaded through the hole. This wire 509 is adapted to carry electrical power and a signal indicating material is present. Exterior to the cooled chamber the wire is connected to a power source and an alarm 236. In some embodiments the wire 509 is connected to an interface module 112 which in turn provides a power source connection 1010 and a connection 230 to the alarm 236.

[0126] In some embodiments the sensor assembly 100 comprises a transmitter 235 to send a signal to the alarm or a network connected to the alarm.

[0127] Alternative embodiments are shown in Figures 7 to 10 in which like parts bear the same reference numerals.

[0128] The invention has been described by way of examples only. Variations may be made to them without departing from the scope of the invention. All such variations and modifications are intended to fall within the scope of the present invention as defined in the accompanying claims. For example, although reference has been made to a cooled chamber, it is understood that this term applies to refrigeration units on mobile trailers, industrial and domestic freezers and refrigerators, chiller cabinets found in shops and supermarkets, deep cold rooms and deep freezes and all other forms of cooler that may be used to chill food or other items.

[0129] The invention is made clear and further explained in the appended claims.

Claims

1. An alerting device (90) for detecting the presence of material in a cooled chamber (270) so as to issue an alert signal, comprises: an enclosure (110) within which is housed a heater (130) and from which at least one monitoring probe (172) extends, **characterized in that**, in use, heat is conducted from the enclosure (110) via the at least one monitoring probe (172) to melt material in the cooled chamber that is in contact with the at least one monitoring probe (172), whereupon melted material conducts an electrical current to the at least one monitoring probe (172) so as to trigger the alert signal.

2. An alerting device (90) according to claim 1 wherein monitoring probes comprises two sensor electrodes (171, 172) provided so as to define a continuous path therebetween when connected by melted material.

3. An alerting device (90) according to claim 1 or wherein the enclosure (110) is formed from a thermally insulating material so as to minimise heat loss from the enclosure (110).

4. An alerting device (90) according to any preceding claim wherein a thermometer (907) is provided to activate the heater (130) to maintain the, or each, monitoring probe (172) clear of ice.

5. An alerting device (90) according to any preceding claim comprising a delay timer (210) which prevents the alert signal from triggering until the presence of the material has been detected for a predetermined minimum time.

6. An alerting device (90) according to any preceding claim wherein the enclosure (110) is water proof.

7. An alerting device (90) according to any preceding claim wherein the portion of the monitoring probe (172) outside the enclosure is deformable.

8. An alerting device (90) according to any preceding claim wherein the portion of the monitoring probe (172) outside the enclosure is adapted to be cut to a desired length.

9. An alerting device (90) according to any preceding

claim arranged to transmit a signal indicative of: at least the identity of the alerting device and/or the identity of the cooled chamber where the alerting device is installed.

10. An alerting device (90) according to any preceding claim arranged to transmit a signal indicative of: the material detected.

11. An alerting device system comprising a plurality of alerting devices defined according to any of claims 1 to 10 in communication with a control station (2000) which receives information sent by the alerting devices (90), stores and displays the information provided by the devices (90) and transmits an alarm upon detection of the material.

12. A cooled chamber including the alerting device according to any of claims 1 to 10.

13. A method of retrofitting an alerting device in a cooled chamber comprising the steps of: attaching a sensor assembly 100 to an interior of the cooled chamber; forming a hole through a wall 270 of the cooled chamber; passing a wire 509 from the sensor assembly 100 through the wall 270 suitable for receiving electrical current.

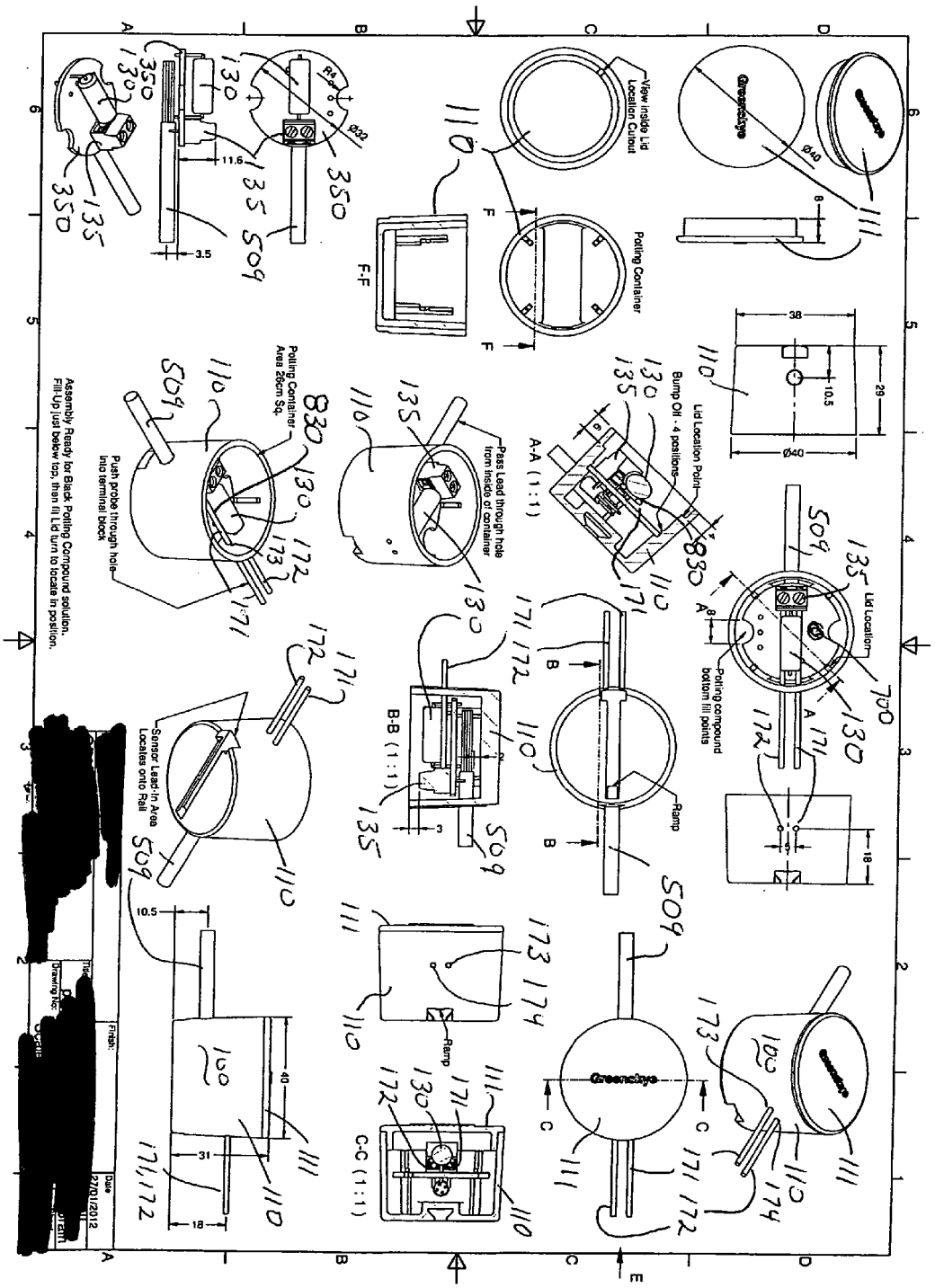
View inside Lid Location Cutout
Potting Container
F-F
A-A (1:1)
Bump Off - 4 positions
Lid Location Point
Lid Location
Potting compound bottom fill points
Pass Lead through hole from inside of container
Potting Container Area 26cm Sq.
Push probe through hole into terminal block
Assembly Ready for Black Potting Compound solution. Fill Up just below top, then fit Lid turn to locate in position.
B-B (1:1)
Ramp
Sensor Lead-in Area Locates onto Rail
C-C (1:1)
Greenstye
Date
27/01/2012

Figure 1A

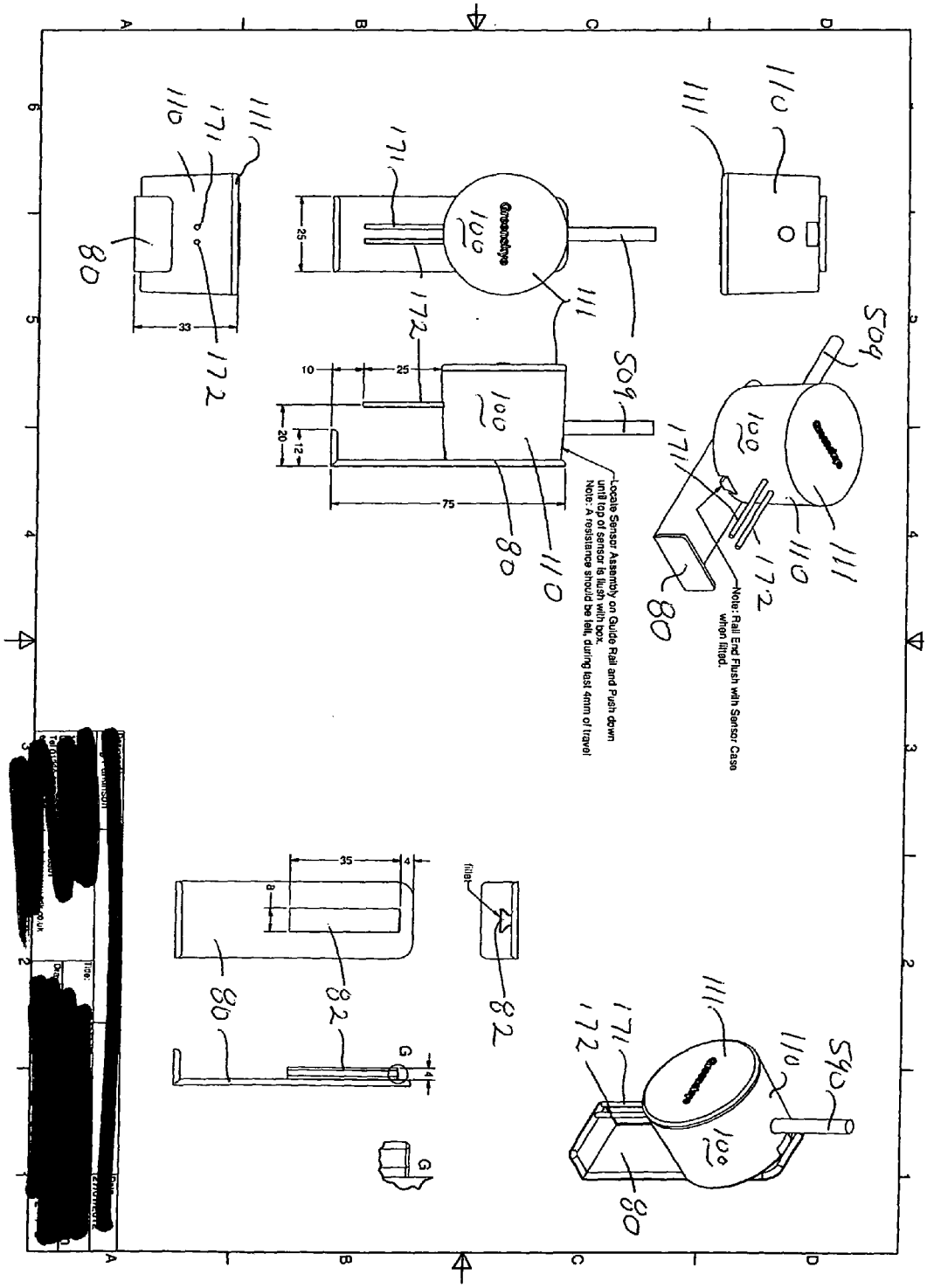
Locate Sensor Assembly on Guide Rail and Push down until top of sensor is flush with box.
Note: A resistance should be felt, during last 4mm of travel
Note: Rail End Flush with Sensor Case when lifted.
Groovelyte
100
110
111
171
172
80
82
509
590
25
33
10
20
12
75
35
4
8
fillet
G

Figure 18

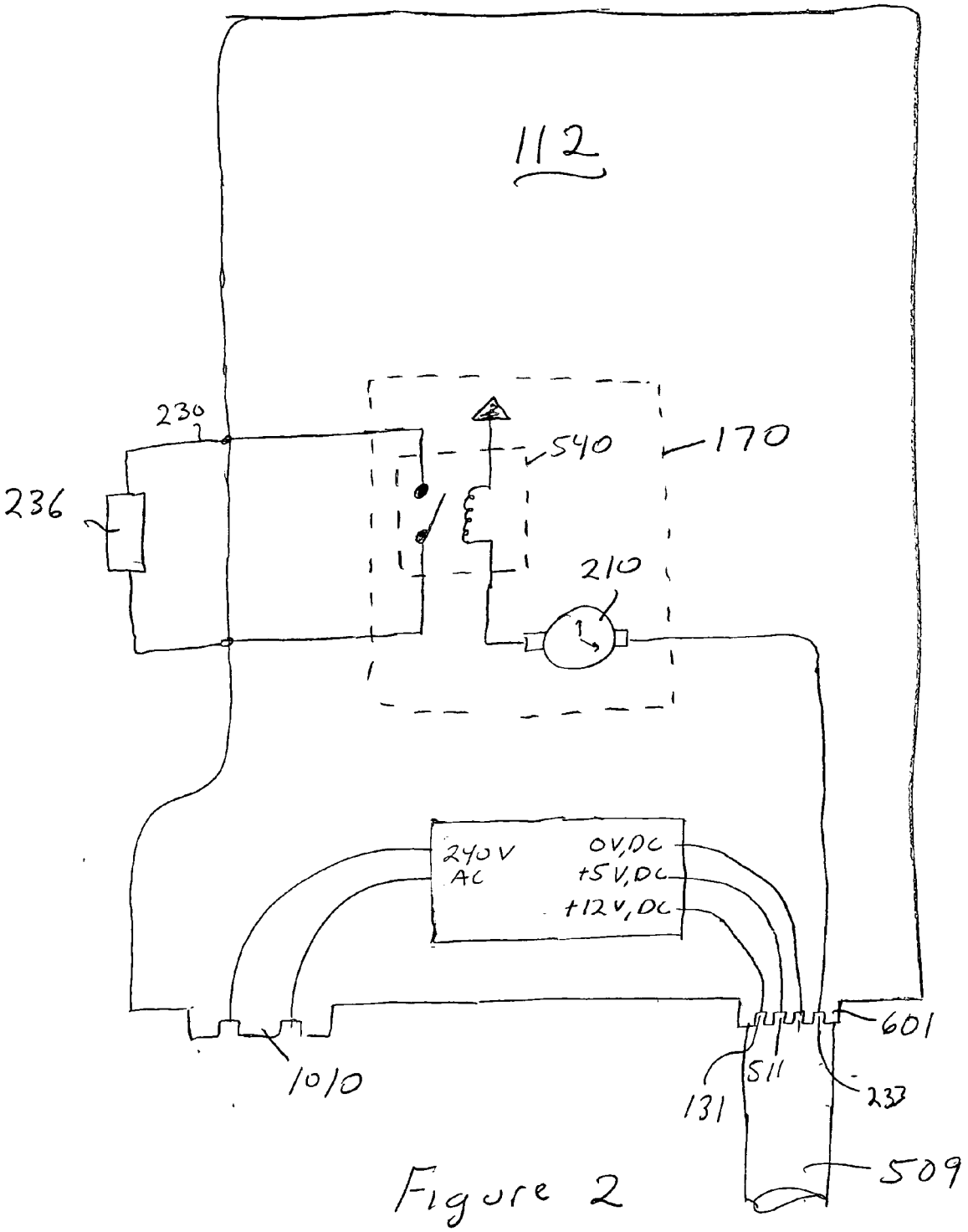
112
230
236
540
170
210
240V AC
0V,DC
+5V,DC
+12V,DC
1010
131
511
233
601
509

Figure 2

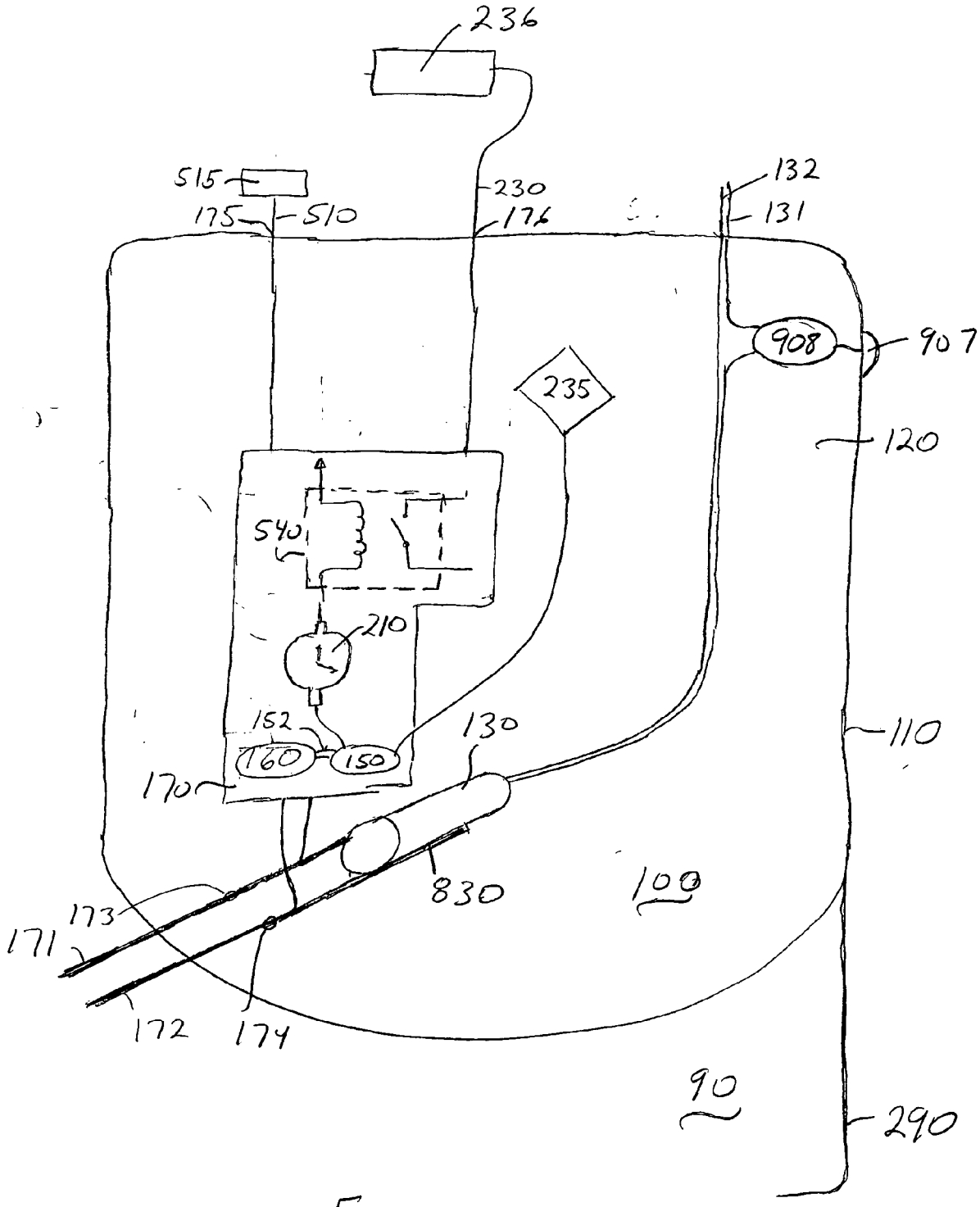
236
515
175
510
230
176
132
131
908
907
235
120
540
210
152
160
150
130
110
170
830
100
173
171
172
174
90
290

Figure 3

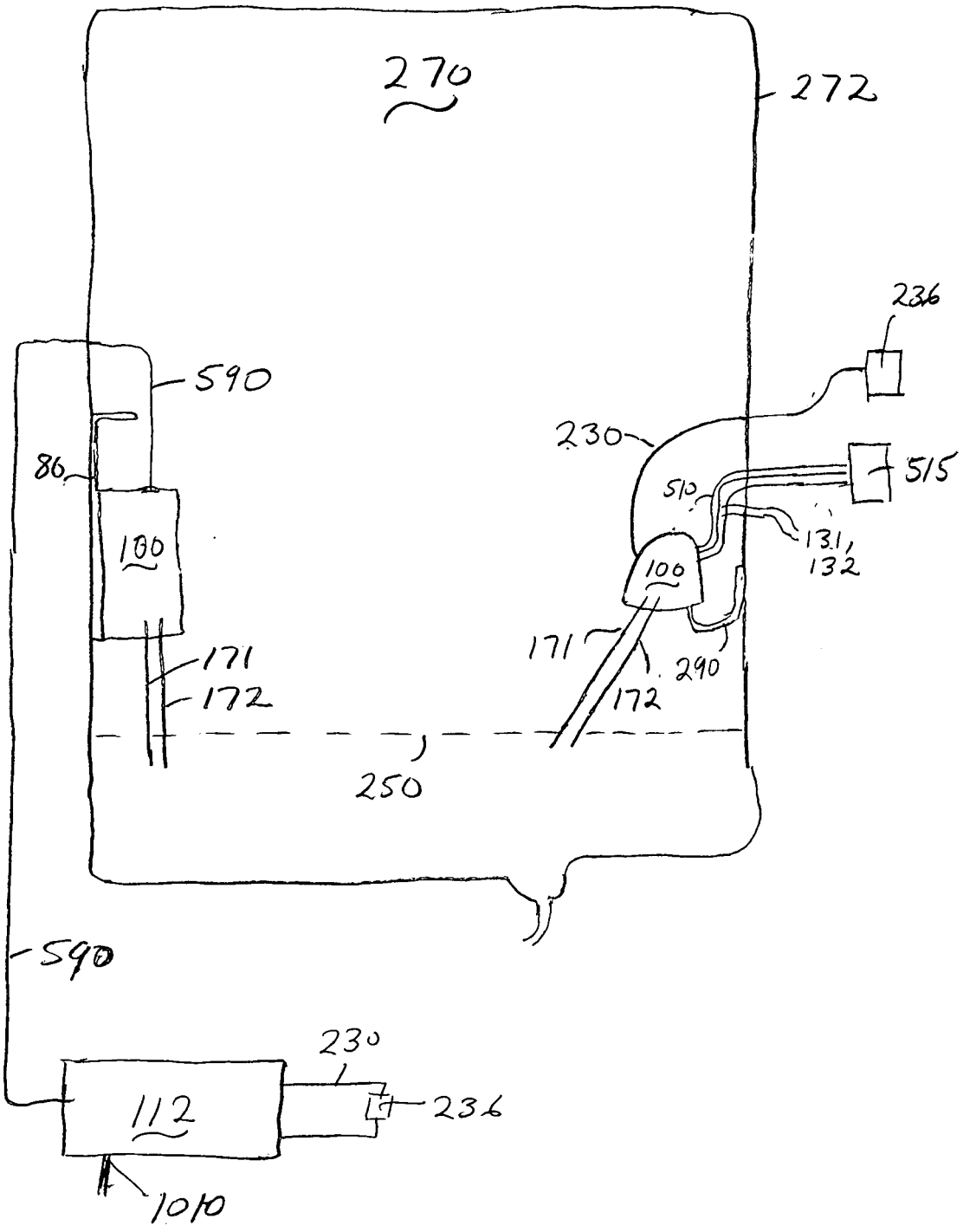
270
272
236
590
230
86
515
510
100
131,
132
100
171
172
171
290
172
250
590
230
112
236
1010

Figure 4

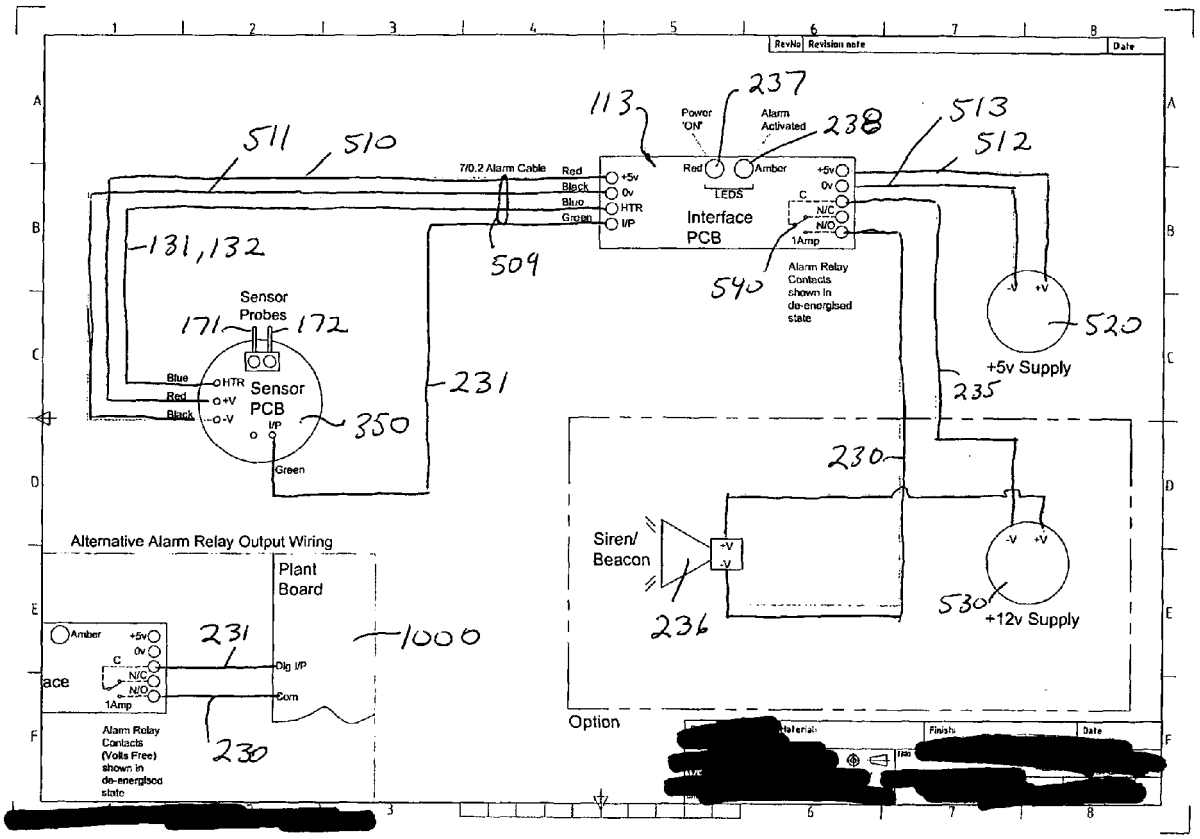
113
237
238
511
510
513
512
7/0.2 Alarm Cable
Red
Black
Blue
Green
+5v
0v
HTR
I/P
Power 'ON'
Alarm Activated
Red
Amber
LEDS
Interface PCB
+5v
0v
C
N/C
N/O
1Amp
131,132
509
540
Alarm Relay Contacts shown in de-energised state
520
+5v Supply
Sensor Probes
171
172
Sensor PCB
350
231
235
230
Siren/ Beacon
236
530
+12v Supply
Option
Alternative Alarm Relay Output Wiring
Plant Board
1000
Dig I/P
Com
Alarm Relay Contacts (Volts Free) shown in de-energised state
Revision note
Date
Material
Finish

Figure 5

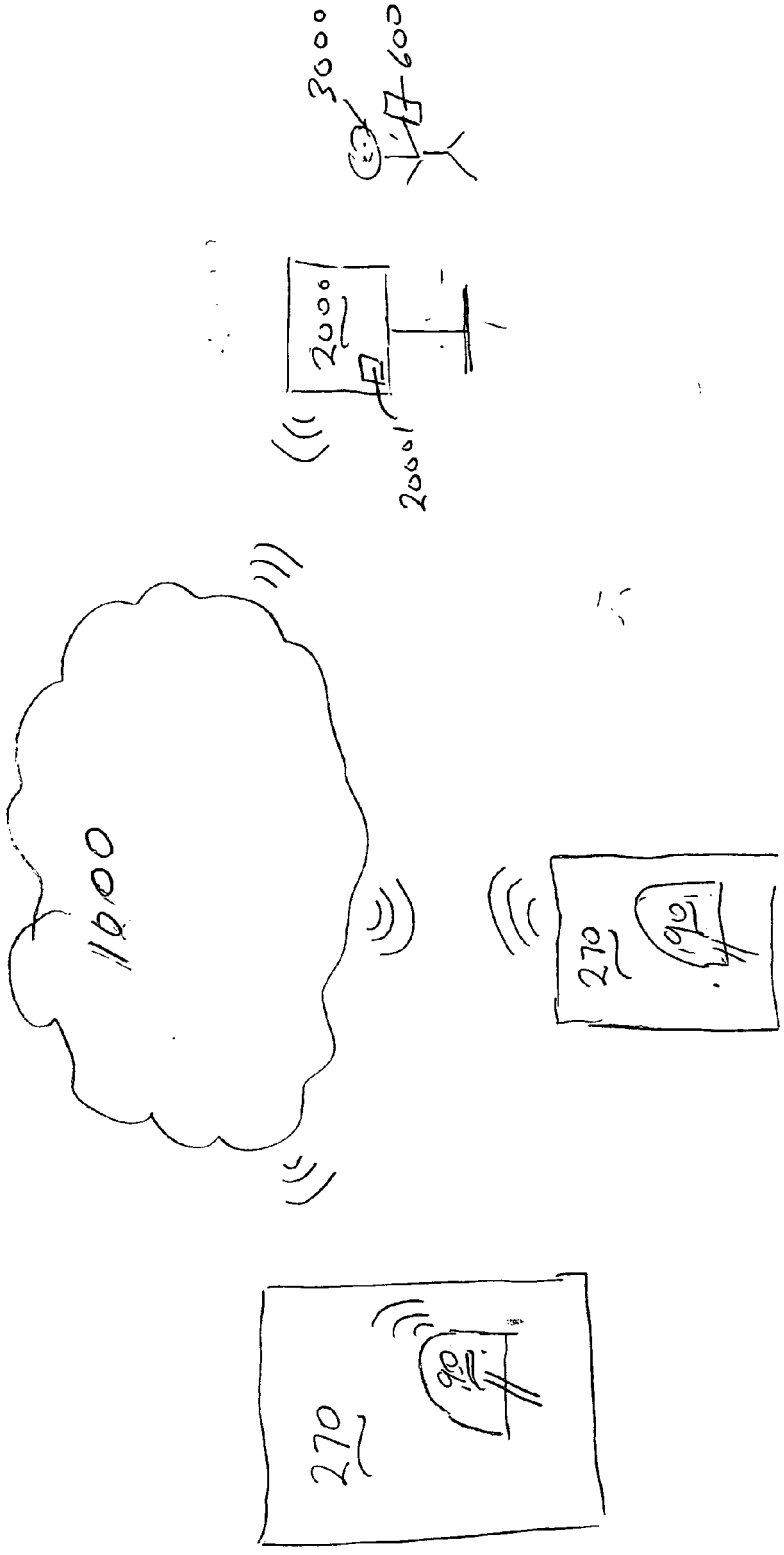

Figure 6

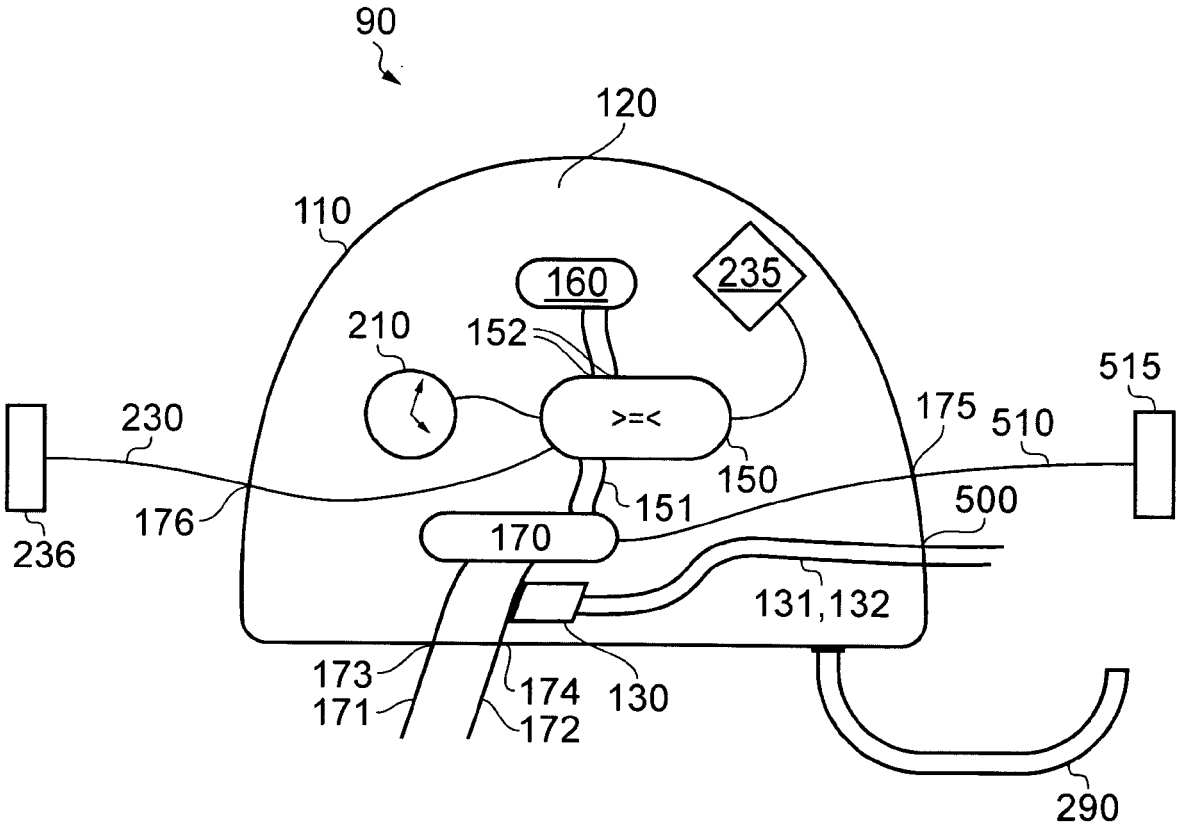
90
120
110
160
235
210
152
515
230
>=<
175
510
150
151
500
176
170
236
131,132
173
171
174
172
130
290

FIG. 7

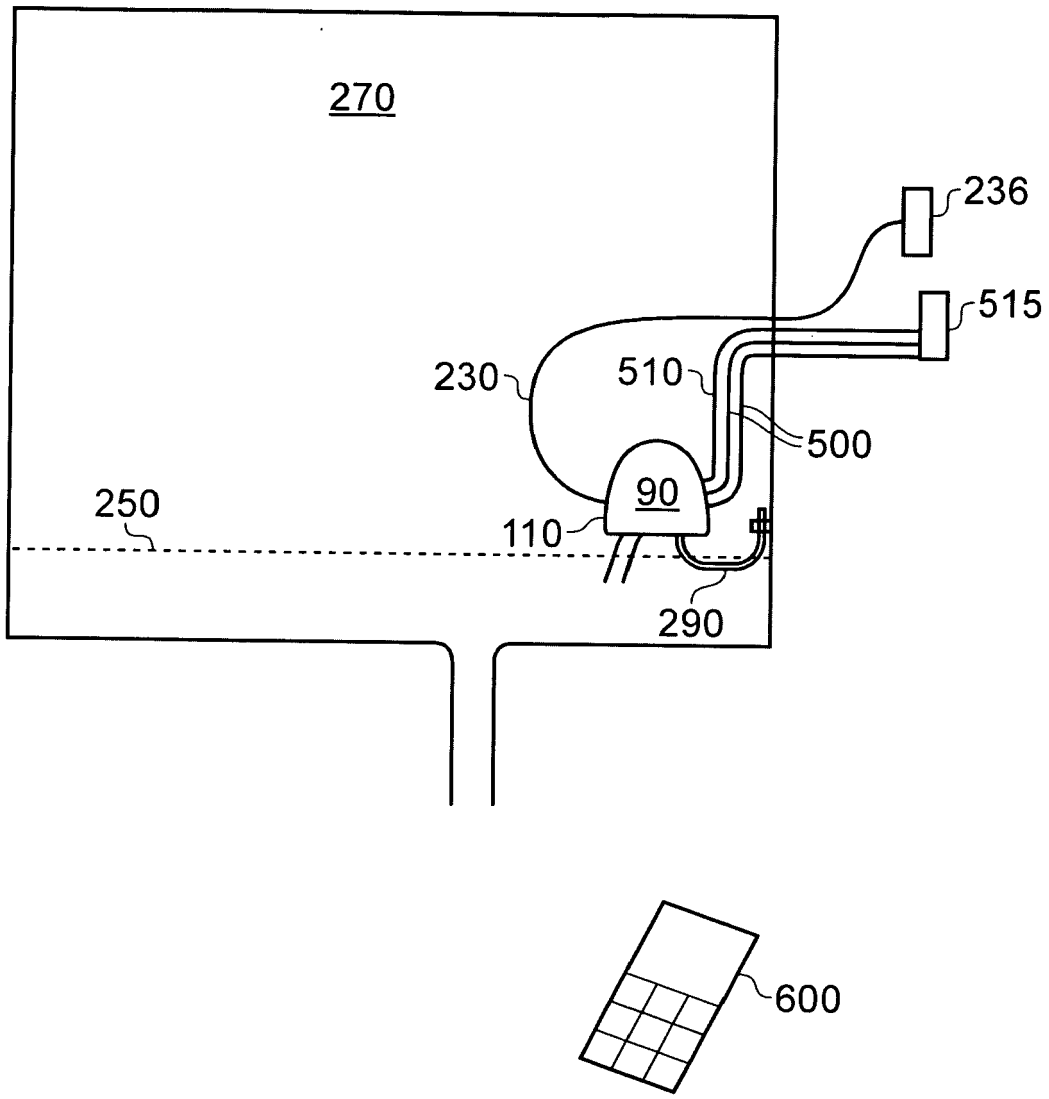

FIG. 8

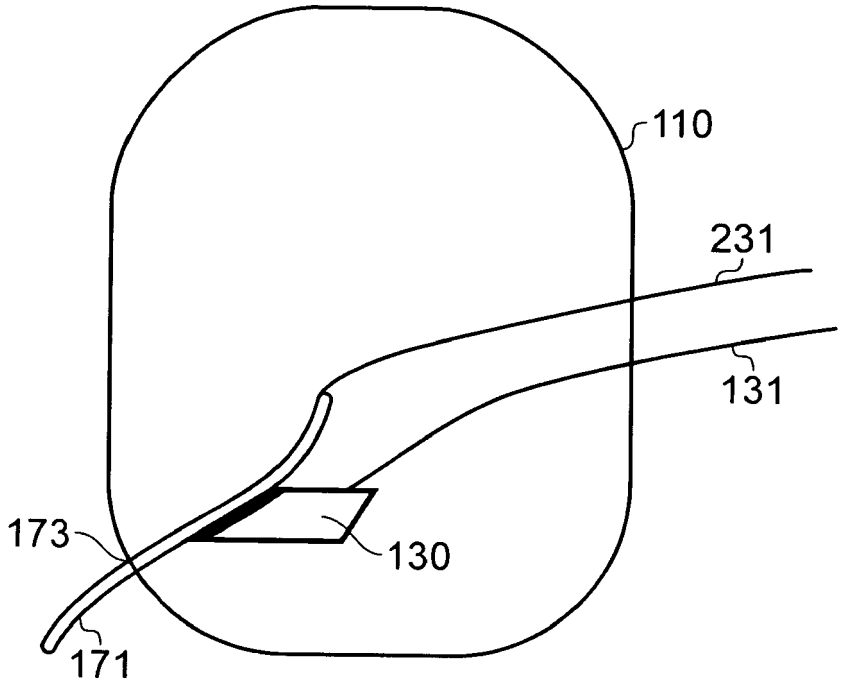

FIG. 9

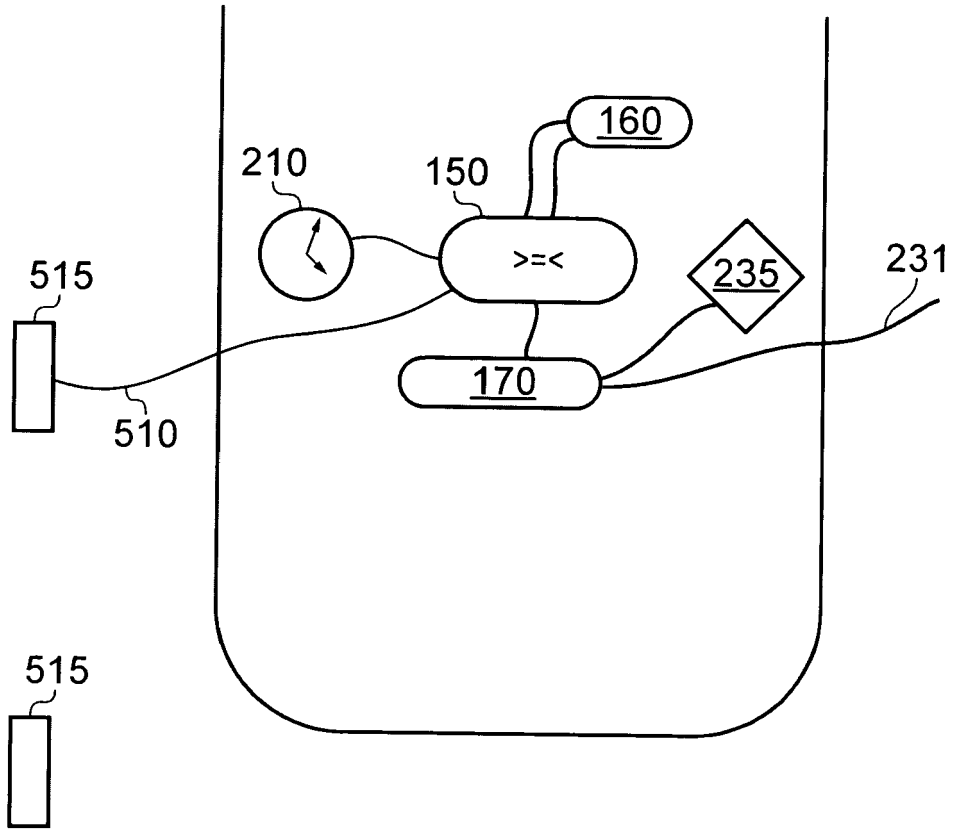

FIG. 10

REFERENCES CITED IN THE DESCRIPTION

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- US 5729990 B, Danfoss **[0010] [0026]**
- US 965814 B5, French **[0011]**