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DEW-POINT INDICATOR AND CONTROLLER

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Fig. 1

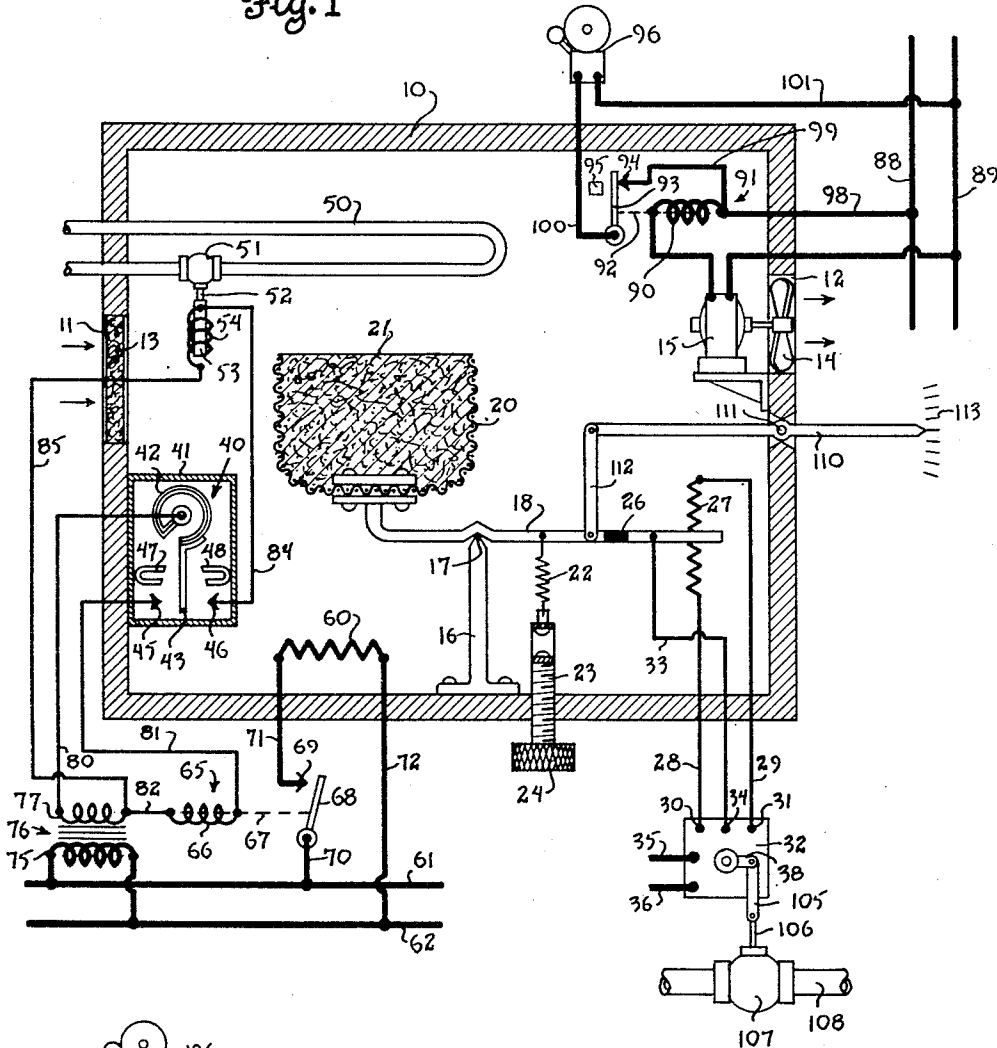
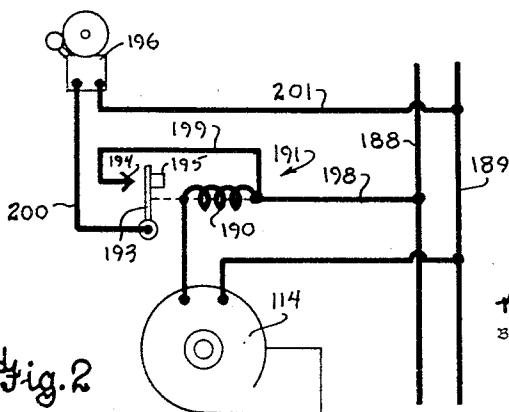


Fig. 2



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DEW-POINT INDICATOR AND CONTROLLER

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This invention relates to a simple and accurate method for obtaining an indication of the vapor pressure or dew-point of air within a space being conditioned and for controlling the humidity of the air in said space.

In carrying out my invention, I make use of the fact that certain materials such as lithium iodide have a very strong affinity for water vapor and will change their moisture content materially with variations in the vapor pressure of the air affecting them. The chemical is spread over a large superficial area and the air whose moisture content is to be sensed is circulated over the same. The weight of the chemical will change in accordance with variations in the moisture content of the air, and this change is utilized to give an indication of the vapor pressure or the dew-point and to exercise a control function. Means are also provided to maintain the air passing in contact with the chemical at a substantially fixed temperature so that a true indication of the vapor pressure or dew-point of the air may be obtained even though the temperature of the air in the space may not remain constant.

It is an object of my invention to provide a simple apparatus for accurately indicating the vapor pressure or dew-point of air.

Another object of my invention is to provide a simple apparatus for accurately controlling a suitable conditioning means in accordance with the vapor pressure or dew-point of the air to be conditioned.

Another object is the provision of means utilizing the affinity of certain materials for water vapor for accurately controlling and indicating the vapor pressure or dew-point of the air in a space to be conditioned.

Other objects will become apparent upon a study of the specification and claims in connection with the accompanying drawing in which:

Figure 1 is a schematic view of one form of my invention, certain parts being illustrated in cross section, and

Figure 2 is a view of a portion of Figure 1 illustrating a modification thereof.

Referring more particularly to Figure 1, a casing 10 is provided through which the air whose dew-point or vapor pressure is to be sensed is circulated. Air is drawn into the casing through an inlet 11 and is exhausted through an outlet 12. A filter 13 which is of the closely matted type is provided for removing all dirt particles from the air. A fan 14 driven by a motor 15 is located at the outlet 12 and serves to cause a circulation of air through the chamber.

A bracket 16 may be suitably secured to a wall of the casing 10, the upper portion 17 of this bracket serving as a fulcrum for a lever 18. Carried at the left end of the lever 18 is a receptacle 20 made of any suitable foraminous material and secured to the lever in any suitable manner. The receptacle 20 contains a suitable porous or fibrous material 21 which may be impregnated with a suitable chemical such as lithium chloride or lithium iodide or any other suitable chemical having a strong affinity for the water vapor in the air.

A spring 22 is connected to the lever 18 at the other side of the fulcrum 17 from the end on which the receptacle 20 is mounted, this spring being suitably connected to an adjusting screw 23 provided with a suitable operating handle 24 whereby the tension of the spring 22 may be adjusted. The end of the lever opposite that on which the container 20 is mounted is suitably insulated from the rest of the lever by insulating material 26 and is arranged to sweep across a resistance element 27. This resistance element may be connected by means of conductors 28 and 29 to terminals 30 and 31 of a motor 32. The end of the lever 18 may be connected by means of a conductor 33 to terminal 34 of the motor 32. Line wires 35 and 36 are provided for supplying power to the motor, these wires being connected to a suitable source of power (not shown). This motor may be a proportioning motor of the type illustrated and described in Patent No. 2,028,110, issued to D. G. Taylor on January 14, 1936. An arm 38 is operated by the motor and its position is determined by the position of the right end of lever 18 with respect to the resistance 27 in the manner described in the Taylor patent.

Suitably mounted within the chamber 10 is a temperature responsive device 40 provided with a shielding means 41. Thermostat 40 may comprise a bimetallic element 42 carrying an arm 43 and causing movement of the arm 43 in response to changes in temperature of the air in the casing 10. A fall in temperature in the casing 10 causes the arm 43 to move toward the left and into engagement with a contact 45. A second fixed contact 46 is engaged by the arm 43 when the temperature within the casing 10 rises to a predetermined high value. Suitable magnets 47 and 48 may be provided for giving a snap action to the arm 43 in a manner well known in the art to provide a suitable operating differential for the thermostat. The contacts 45 and 46 may be spaced sufficiently far apart so that when the arm is midway between the contacts it will

be equally attracted by the two magnets and will remain in mid position until the temperature rises or falls to predetermined values.

Mounted in the upper portion of the casing 10 is a cooling coil 50 through which a suitable cooling medium flows, the flow of the cooling medium being controlled by a valve 51. This valve may include a valve stem 52 having an armature 53 connected thereto, this armature being surrounded by a solenoid 54. Energization of the solenoid 54 will attract the armature 53 and cause the valve to move to open position. Upon deenergization of the solenoid 54, the valve is moved to closed position under the influence of a suitable biasing means (not shown).

Near the lower portion of the casing 10 is a heating element 60 which, for purposes of illustration, has been shown in the form of an electrical heating element. It will be understood of course that any other suitable form of heating means may be provided in place of the electrical heating element. Lines 61 and 62 are provided for supplying power to the heating element 60, these lines being connected to a suitable source of power (not shown). The flow of current to the heating element 60 is controlled by a relay indicated at 65, this relay comprising a relay coil 66, an armature 67, a relay arm 68, and a fixed contact 69 cooperating with the arm 68. Upon energization of the coil 66 the arm 68 is moved into engagement with the contact 69 and the heating element 60 is energized, current flowing from the line wire 61 through conductor 70, switch arm 68, contact 69, conductor 71, heating element 60, and conductor 72 to the line wire 62. Upon deenergization of the relay coil 66, the arm 68 moves out of engagement with the contact 69 under the influence of gravity or any suitable biasing means (not shown), whereupon the heating element 60 is deenergized. Connected to the line wires 61 and 62 is the high tension primary 75 of a step-down transformer 76. The secondary 77 of the transformer 76 is provided for supplying power to the relay coil 66 and the solenoid 54. When the arm 43 of thermostat 42 is moved into engagement with the contact 45 the relay coil 66 is energized through the following circuit: from the secondary 77 through conductor 80, bimetallic element 42, arm 43, contact 45, conductor 81, coil 66, and conductor 82 of the other side of secondary 77. Energization of coil 66 causes arm 68 to move into engagement with the contact 69, thus energizing the heating element 60. When the arm 43 moves out of engagement with contact 45 in response to a rise in temperature in the chamber, the relay 65 is deenergized thus causing the heater 60 to be deenergized. Upon a further rise in temperature the arm 43 will engage contact 46 and cause the energization of solenoid 54 as follows: from secondary 77 of transformer 76 through conductor 80, bimetallic element 42, arm 43, contact 46, conductor 84, solenoid 54, and conductor 85 to the other side of secondary 77. Energization of solenoid 54 causes the opening of valve 51 whereupon cooling medium flows through the cooling coil 50. It will accordingly be seen that the temperature within the chamber 10 is maintained within fixed limits by the thermostat 40 controlling the cooling element 50 and the heating element 60.

Lines wires 88 and 89 are provided for supplying power to the motor 15 for driving the fan 14. In the circuit to the motor 15 is provided a coil 90 of a relay 91. Relay 91 also includes an arma-

ture 92 and a relay arm 93. Energization of the relay coil 90 causes arm 93 to move into engagement with a fixed contact 94. Upon deenergization of the relay coil 90, the arm 93 moves into engagement with a stop 95 under the influence of gravity or any suitable biasing means (not shown). A bell 96 or any other suitable alarm device is controlled by the arm 93 and contact 94. It will be apparent that when the relay coil 90 is energized the bell 96 will be energized through the following circuit: from the line wire 88 through conductors 98, 99, contact 94, arm 93, conductor 100, bell 96, and conductor 101 to the line wire 89. The purpose of this bell 96 is for giving an indication of the filter 13 becoming clogged with dirt and impeding the passage of air therethrough. When the filter 13 is clean and permits a maximum flow of air through the filter, the load on the motor 15 will be at a minimum since the fan is operating at a low differential. The current through the coil 90 of relay 91 will be insufficient when the load on the motor 15 is low to maintain the arm 93 in engagement with contact 94. However, as the filter 13 gradually becomes clogged with dirt and other foreign matter there will be a lesser flow of air through the filter and accordingly, since the fan 12 is operating at a higher differential, the load on the motor 15 will increase and hence the current through the coil 90 will increase. When the current through the coil 90 has increased to a predetermined value by reason of a large amount of dirt in the filter 13 the current through the coil 90 will be sufficient to move the arm 93 into engagement with the contact 94 thus energizing the alarm device 96 and warning the attendant that the filter 13 is in need of being cleaned.

The motor 32 may be connected by means of a link 105 to a stem 106 of a valve 107 which may control the flow through the pipe 108 of a suitable medium for varying the humidity in the space which is being controlled. Since the particular form of apparatus for varying the humidity forms no part of the present invention it has not been illustrated herein. It will be understood that a suitable refrigerant may flow through the pipe 108 to a suitable cooling coil in the air conditioning chamber, water for a suitable cooling spray may flow through the pipe 108, steam for a reactivator for a chemical dehumidifying system may flow through the pipe 108 or any other suitable well known form of humidity changing apparatus may be controlled by the motor 32.

As the vapor pressure of the air passing through the chamber 10 varies, the material 21 in the receptacle 20 will absorb or give off moisture according to whether the vapor pressure of the air is increasing or decreasing. Thus as the vapor pressure of the air is increased a greater amount of moisture will be absorbed by the material 21 in the receptacle 20 which causes the weight of the material to increase and the left end of lever 18 to move downwardly thus causing the right end of lever 18 to move upwardly over resistance 27. Motor 32 will now operate in a direction to cause the apparatus controlled thereby to lower the humidity in the space being controlled. Conversely as the vapor pressure of the air decreases the material in receptacle 20 will give off moisture and lose weight whereupon the right end of lever 18 moves downwardly under the influence of spring 22 and motor 32 is operated to cause the apparatus controlled thereby to

increase the humidity of the air. It is essential that the temperature of the air passing through the chamber 10 be maintained at a substantially fixed value in order that the arm 18 will accurately control the motor 32 in accordance with the vapor pressure of the air. If the temperature in the space whose humidity is being controlled should vary, the device 20 would not accurately respond to the vapor pressure unless the temperature of the air around the receptacle 20 were maintained at a fixed value since the amount of moisture the material 21 absorbs will depend both upon the humidity and the temperature of the air passing thereover.

A suitable indicating device may also be operated by the lever 18 to give a visual indication of the vapor pressure or dew-point of the air. This indicator may comprise a lever 110 pivoted at 111 in a wall of the chamber 10, one end of this lever being connected by a link 112 to the lever 18. The opposite end of the lever 111 is arranged to sweep over a graduated scale 113. This scale 113 may be graduated in terms of vapor pressure or dew-point or two scales for indicating both vapor pressure and dew-point, may, if desired, be provided. As the receptacle 20 increases or decreases in weight in response to changes in vapor pressure of the air, the right end of the lever 110 will move over the scale 113 and give an accurate indication of the vapor pressure or dew-point of the air. The adjusting screw 23 provides for adjustment of the device so that it will accurately control and indicate the vapor pressure of the air. Should, for any reason, the material in receptacle 20 become contaminated it may be necessary to adjust the tension of spring 22 by the screw 23 to bring the device back into proper calibration. However, with filter 13 kept in place and maintained clean this last contingency should not arise under normal conditions.

The superficial area of the material 21 within the receptacle 20 should be very large in order that the material will rapidly respond to variations in the vapor pressure of the air.

In Figure 2 the alarm circuit is illustrated in connection with a centrifugal fan designated by the reference character 114 which may be provided for causing a circulation of air through the chamber 10 in place of the fan 14. Whereas, the load on the driving motor for a screw or propeller type fan as illustrated in Figure 1 increases as the supply of inlet air to the fan decreases by reason of the increase in the differential across the fan blades, a centrifugal fan acts in the opposite manner. In other words, when the supply of air to a centrifugal fan is diminished, the load on the fan driving means decreases. Accordingly when a centrifugal fan is used in place of the fan 14 in Figure 1 the load on the driving motor will decrease when the filter 11 becomes clogged in contrast to the increasing load on the motor 15 of Figure 1 when a fan of the type shown in that figure is provided for circulating air through the chamber 10.

The relay 191 of this figure may be a low voltage release relay of any suitable type as for example of the type shown in Patent 2,101,548 issued to C. G. Kronmiller on December 7, 1937. When the filter 11 is clean and the fan is drawing a maximum amount of air through the chamber 10 the load on the fan driving motor will be at a maximum so that a maximum amount of current flows through the relay coil 190, and

relay arm 193 is maintained in engagement with the fixed stop 195 and no current flows through the alarm device 196. As the filter becomes clogged and the amount of air drawn into the casing decreases, the load on the fan motor will decrease until the amount of current flowing through the coil 190 will be insufficient to maintain the arm 193 in engagement with the stop 195. The arm will now move under the influence of gravity or any suitable biasing means into engagement with the fixed contact 194 whereupon current will flow through the alarm device 196 as follows: from the line 188 through conductors 198, 199, contact 194, arm 193, conductor 200, alarm device 196, and conductor 201 to the line 189. The operation of the alarm device will now indicate that the filter is in such a dirty condition that it should be replaced or cleaned. It will thus be seen that the alarm device may be operated to indicate a dirty condition of the filter with either a centrifugal fan or a propeller type fan by suitably positioning the stop 94 and contact 95 of Figure 1.

It will now be seen that I have devised a relatively simple but accurate device for indicating vapor pressure or dew-point of air and for exercising a control over suitable air conditioning apparatus to control the humidity of the air, the device responding very rapidly to changes in the vapor pressure.

Having described the preferred form of my invention, many modifications may become apparent to those skilled in the art and I wish it to be understood therefore that my invention is limited only by the scope of the appended claims.

I claim as my invention:

1. In a device of the class described, a chamber, means for circulating air through said chamber, means for filtering the air before it enters said chamber, a quantity of a porous material impregnated with a hygroscopic substance located within said chamber, a control device operated in accordance with variations in weight of said porous material occasioned by varying degrees of humidity in the air passing through said chamber, and means responsive to the load on said circulating means for indicating a dirty condition of said filtering means.

2. In a device of the class described, a chamber having an air inlet and an air outlet, filtering means in said air inlet, fan means for drawing air into said chamber through said filtering means, means operated in response to the load on said fan means for indicating a dirty condition of said filtering means, and means responsive to the moisture content of the air passing through the chamber for indicating the moisture content thereof.

3. In a device of the class described, a chamber having an air inlet and an air outlet, filtering means in said air inlet, fan means for drawing air into said chamber through said filtering means, means operated in response to the load on said fan means for indicating a dirty condition of said filtering means, means for indicating the moisture content of the air, means for controlling the moisture content of the air, and means within said chamber responsive to the moisture content of the air in control of said last two mentioned means.

4. In a device of the character described, a chamber having an inlet and an outlet, means for drawing air through said inlet and exhausting it through said outlet, cooling means near

the upper portion of said chamber, heating means near the lower portion of said chamber, temperature responsive means in said chamber in control of said heating and cooling means, a foraminous container within said chamber between said heating and cooling means, said container containing material having hygroscopic properties, and means controlled by the weight of said material for indicating and controlling the moisture content of the air entering said chamber.

5. In a device of the character described, a chamber having an inlet and an outlet, means for drawing air through said inlet and exhausting it through said outlet, cooling means near the upper portion of said chamber, heating means near the lower portion of said chamber, temperature responsive means in said chamber in control of said heating and cooling means, a foraminous container within said chamber between said heating and cooling means, said container containing material having hygroscopic properties, means controlled by the weight of said material for indicating and controlling the moisture content of the air entering said chamber, a filter in said inlet, and means responsive to the load on the means for drawing air through said inlet for indicating a dirty condition of said filter.

6. In a device of the character described, a chamber having an inlet and an outlet, means for drawing air through said inlet and exhausting it through said outlet, cooling means near the upper portion of said chamber, heating means near the lower portion of said chamber, temperature responsive means in said chamber in control of said heating and cooling means, a foraminous container within said chamber between said heating and cooling means, said container containing material having hygroscopic properties, filter means for removing impurities from the air entering said chamber, means controlled by the weight of said material for indicating the moisture content of the air entering said chamber, and means for indicating a dirty condition of the filter, which dirty condition of the filter reduces the air flow through said chamber and renders the means for indicating the moisture content of the air ineffective to indicate accurately.

7. In a device of the character described, a chamber having an inlet and an outlet, means for drawing air through said inlet and exhausting it through said outlet, cooling means near the upper portion of said chamber, heating means near the lower portion of said chamber, temperature responsive means in said chamber in control of said heating and cooling means, a foraminous container within said chamber between said

heating and cooling means, said container containing material having hygroscopic properties, filter means for removing impurities from the air entering said chamber, means controlled by the weight of said material for indicating and controlling the moisture content of the air entering said chamber, and means for indicating a dirty condition of the filter, which dirty condition of the filter reduces the air flow through said chamber and renders the moisture content indicating and controlling means ineffective to properly indicate and control the moisture content of the air entering said chamber.

8. In a device of the character described, a chamber, said chamber having an inlet and an outlet for facilitating the flow of air through said chamber, cooling means in said chamber, heating means in said chamber, means responsive to the temperature within said chamber for controlling said cooling means and heating means to maintain said temperature at a substantially constant value, means within said chamber having hygroscopic properties, and means movable in response to variations in the weight of said hygroscopic means.

9. In a device of the class described, a chamber having an air inlet and an air outlet, filtering means in said air inlet, fan means for drawing air into said chamber through said filtering means, means for operating said fan including a motor and an electrical circuit therefor, means for indicating the existence of a dirty filter, said indicating means being responsive to a predetermined variation of a characteristic of said electrical circuit for said fan means and including means operated by said fan operating circuit in response to a predetermined load on said fan.

10. In combination comprising, a filtering means for air, a fan for causing a flow of air through said filtering means, an electric motor driving said fan, means for indicating a dirty condition of said filtering means, and means responsive to the amount of current drawn by said motor for operating said means for indicating a dirty condition of the filtering means.

11. In combination comprising, a filtering means, a fan for causing a flow of a gaseous medium through said filtering means, an electric motor driving said fan including an electrical circuit therefor, means for indicating a dirty condition of said filtering means, and means responsive to a predetermined variation of a characteristic of said electric circuit for operation of the fan driving motor for operating said means for indicating a dirty condition of the filtering means.

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