United States Patent

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[54] APPARATUS FOR INDICATING THERMAL AND AIR VELOCITY CONDITIONS OF AIR IN THE PLENUM OF A CENTRAL AIR-CONDITIONING SYSTEM

8 Claims, 4 Drawing Figs.

[52] U.S. Cl. 62/126, 62/127, 62/130, 62/158
[51] Int. Cl. F25b 49/00
[50] Field of Search 62/125, 126, 127, 129, 130, 131, 158; 236/51, 91; 165/11

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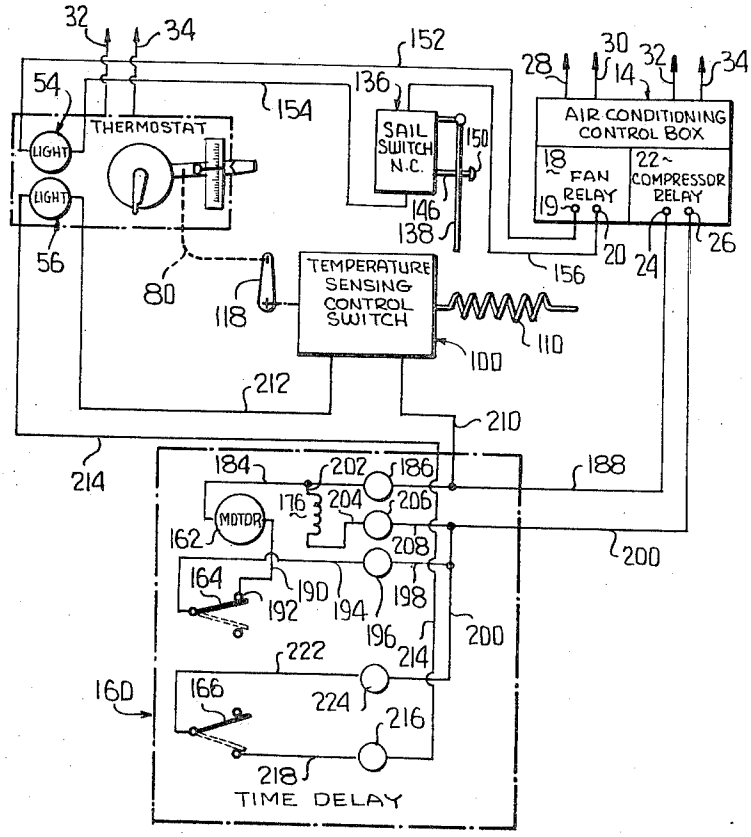
ABSTRACT: Thermal and air velocity responsive electrical switch means disposed in the plenum of a central air-conditioning system and electrically connected in a signal system, the apparatus being operable to actuate indicating or signal means calling attention to fan and/or motor-compressor malfunction or failure.



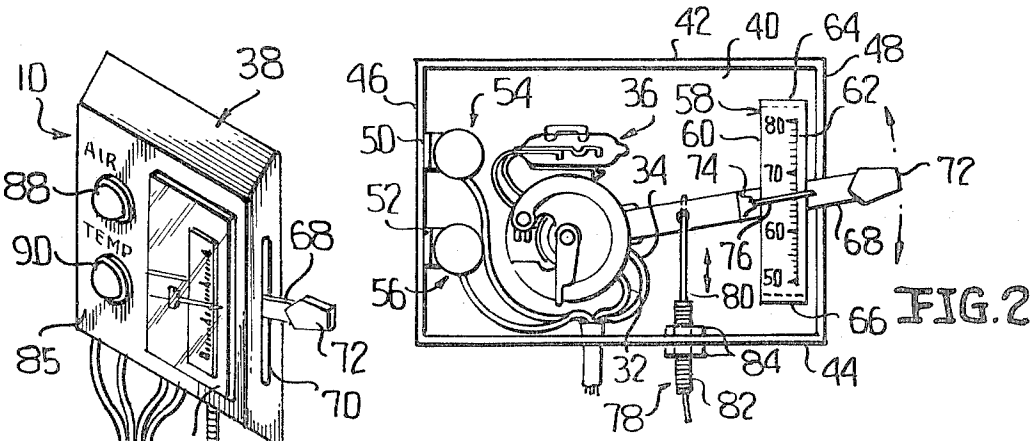


FIG.2

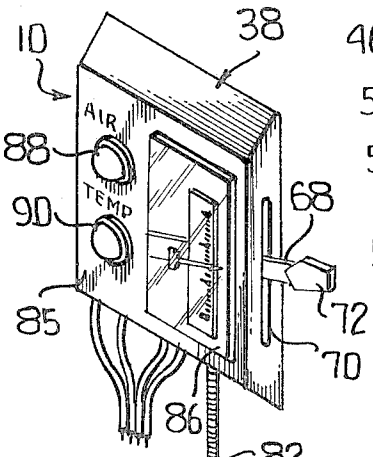


FIG.1

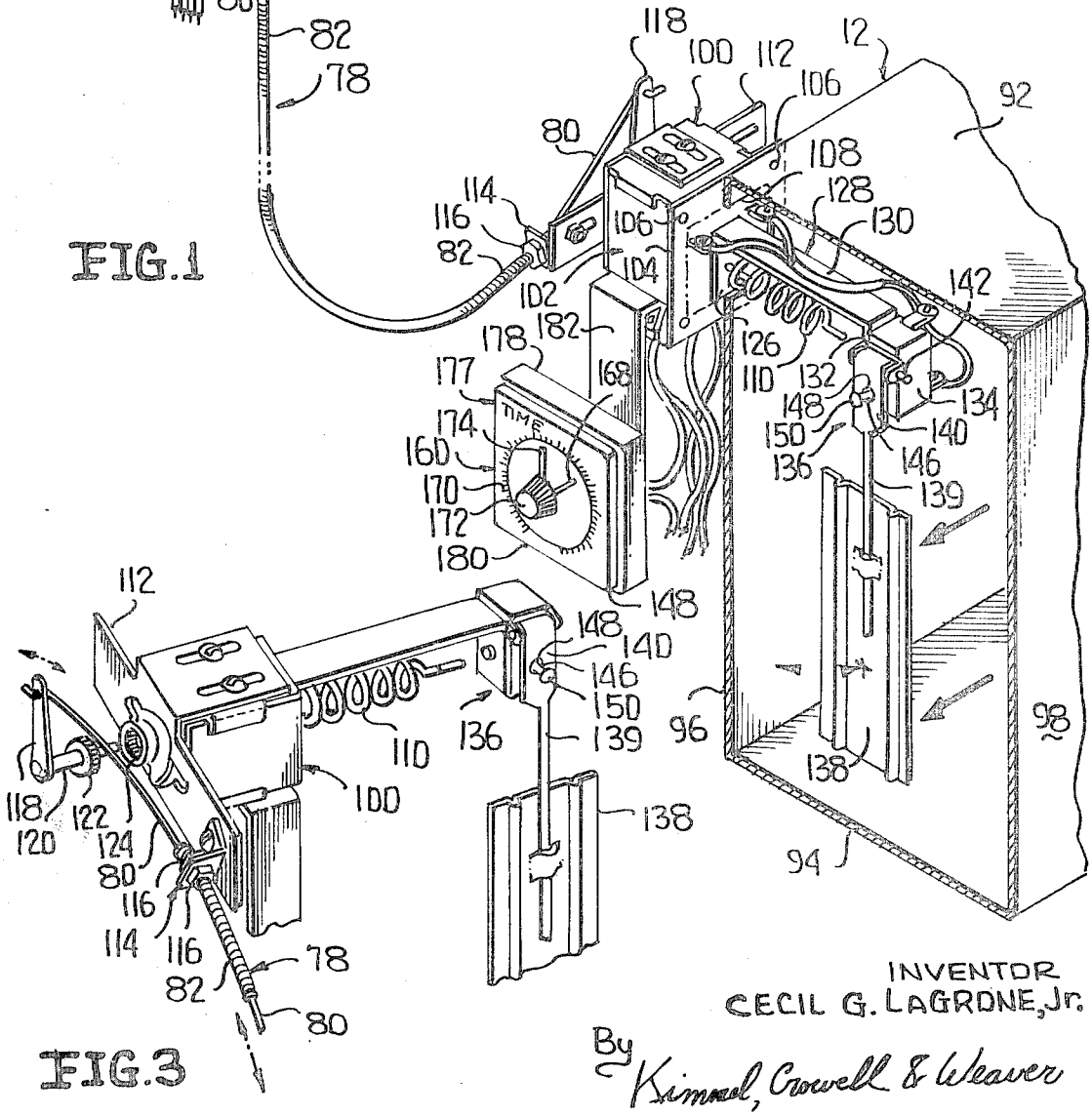


FIG.3

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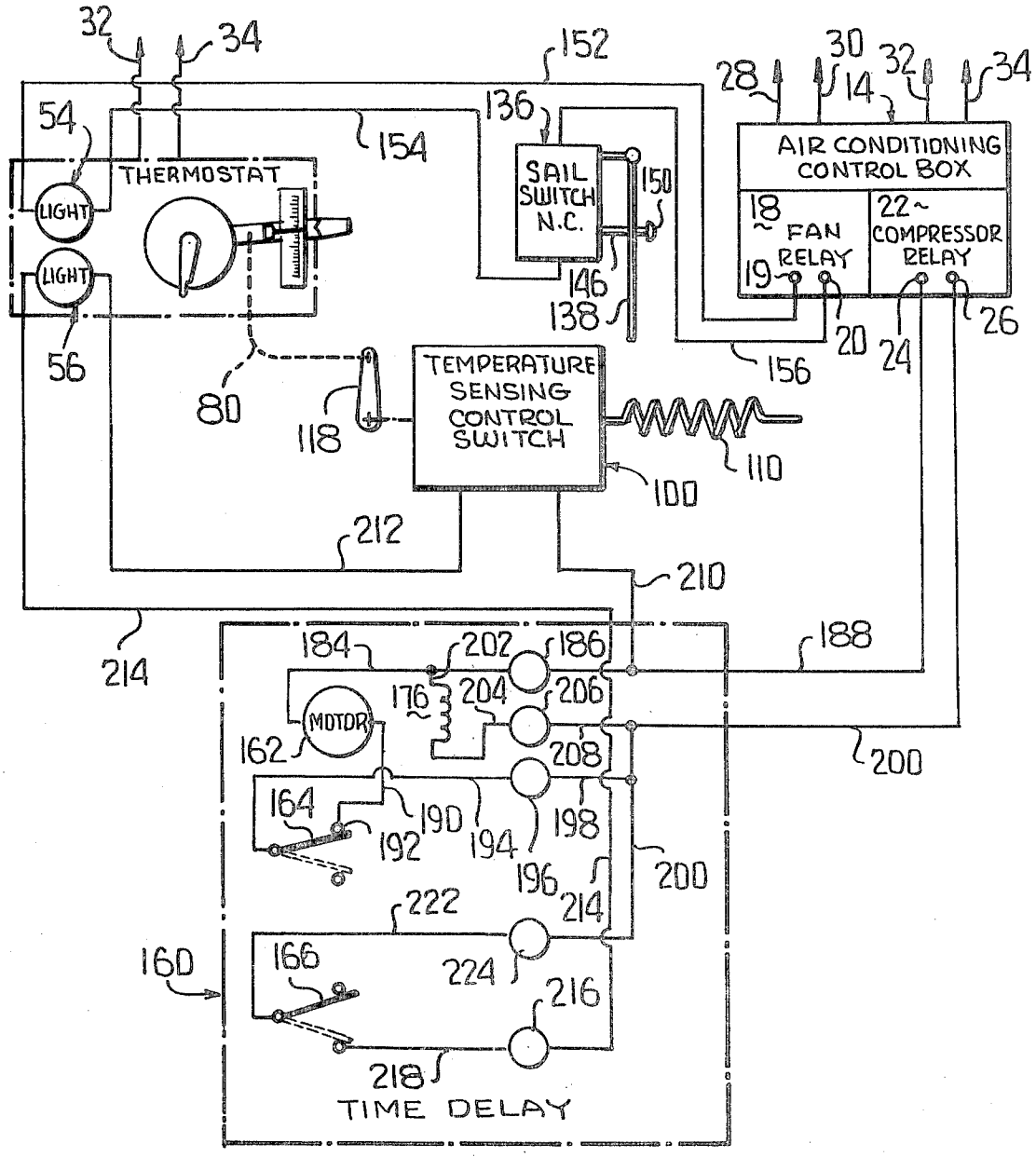

FIG. 4

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APPARATUS FOR INDICATING THERMAL AND AIR VELOCITY CONDITIONS OF AIR IN THE PLENUM OF A CENTRAL AIR-CONDITIONING SYSTEM

BACKGROUND OF THE INVENTION

1. Field of the Invention

In accordance with the present classification of inventions as established by the U.S. Pat. Office, it is believed that this invention would be classified in the main class of "Refrigeration" class 62 and, more specifically, in its subclass 129 relating to condition sensing indicators.

2. Description of the Prior Art

The prior art is replete with disclosures relating, for example, to thermostatic control means for air-conditioning systems of all types, and specific reference thereto need not be here given by virtue of their widespread and substantially uniform or conventional construction. For the purpose of this disclosure it may be observed that most conventional central thermostatically controlled air-conditioning sytems include air inlet means, a motor-compressor unit (which may be self-contained), an expansion valve, a condenser, fan or blower means for forcing air across an evaporator or cooling coil for discharge into a plenum or main air duct at a preselected temperature and velocity. In conventional installations, when the thermostat switch closes it completes a low-voltage circuit to a fan relay switch which, in turn, operates a high-Voltage switch to connect the fan or blower with a high-voltage power source. In a like manner, the closing of the thermostatic switch energizes the low-voltage motor compressor relay switch, and the latter, in turn, operates a high-voltage switch to connect the motor-compressor in a high-voltage circuit. The actuation of these relay switches is, substantially, instantaneous upon the closing of the thermostatic switch.

Conventional central air-conditioning system are designed to discharge-conditioned (cooled) air from their respective plenums at predetermined velocities and temperatures. As a general rule, air in the plenum is normally cooled to a temperature of 15° below the operating temperature set on the thermostatic control, and the velocity of the conditioned air in the plenum chamber is usually considered to be normal with an air displacement of 3,600 cubic feet of air per minute (c.f.m.) for a 3-ton air-conditioning unit and 6,000 c.f.m. for a 5-ton unit. It thus becomes essential to the successful operation of the air-conditioning unit that the motor-compressor be capable of operation to reduce the temperature of the conditioned air to the desired point, and further that the fan or blower means be capable of delivering air at the desired volume and velocity.

The refrigeration or air-cooling art includes many patents which have been issued for energizing signal means in the presence of abnormal heating of compartments, reduced pressure in given lines, et cetera. Examples of such alarm and signalling devices may be found in the U.S. Pats. to Frank E. Cobb, No. 2,144,794, Carson H. Beane, No. 2,741,099, Roscoe D. Bean, No. 2,439,331 and Charles H. McLeay, No. 1,573,450. These patents are considered to be merely of interest and not at all germane with respect to the present invention which proposes to indicate, from signals generated in or adjacent to the plenum of a conventional air conditioner, the satisfactory or unsatisfactory working condition of the cooling unit and fan means.

SUMMARY OF THE INVENTION

This invention relates to the provision of indicating means for central air-conditioning systems wherein the indicators are responsive to sensors disposed in the plenum or air duct and in the path of the conditioned air moving therethrough. The apparatus includes a first indicator light connected in an electric circuit energized by the presence of voltage in the fan relay switch circuit and which operates in response to the air velocity in the plenum. The switch is normally closed, and remains closed until the air-conditioning unit is energized and the velocity of the conditioned air reaches the desired value for which the system was designed. At that time, the switch will open causing the light to become deenergized indicating that the blower portion of the system is operating at its proper capacity.

The apparatus of this invention also contemplates a second indicator light connected in an electric circuit energized by the presence of voltage at the compressor relay switch circuit, and this indicator light is connected in series with two series connected switches.

One of these last mentioned switches is a thermoresponsive switch and includes a sensor disposed in the plenum or main duct disposed in the path of the cooled air. This switch is normally closed and remains closed until the temperature in the plenum reaches 15° below the set room control thermostat and at this temperature it will open.

The second of these switches is a time delay switch, normally open, and which closes at the expiration of a predetermined and timed-out period. If the thermoresponsive and time delay switches close, the indicator light in this series circuit will be energized, and its illumination will indicate to the operator a malfunction or failure in the motor-compressor unit. If at the end of the timed-out period the light in the circuit is not energized, the lack of its illumination indicates that the motor-compressor unit has functioned properly.

This invention contemplates, as a further object thereof, the provision of indicating apparatus for central air-conditioning units as generally referred to above, and wherein the apparatus is noncomplex in construction and assembly, inexpensive to manufacture, and which is rugged and durable in use.

Other and further objects and advantages of the present invention will become manifest from a consideration of the following specification when read in conjunction with the annexed drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an exploded perspective view, partly in cross section, and illustrating the apparatus forming the system comprising this invention;

FIG. 2 is a front elevational view of the room control thermostat shown in FIG. 1, the cover of the thermostat having been removed;

FIG. 3 is a perspective view of the thermoresponsive switch and of the air velocity responsive switch means; and

FIG. 4 is a schematic wiring diagram illustrating the electric circuitry involved in the apparatus of this system.

DESCRIPTION OF THE PREFERRED EMBODIMENT

As has been heretofore stated, the instant invention is concerned with the provision of apparatus forming a system to be used in conjunction with a central air-conditioning system of conventional design and construction. For the purposes of brevity and clarity, the annexed drawings illustrated only those portions of such a system as are relevant to the invention, it being taken for granted that such systems and their components are old and well known.

Thus, reference numeral **10** (see FIGS. 1, 2 and 4) designates, generally, the room control thermostat for a central air-conditioning system, and the system further includes, as components not illustrated, an electrically driven motor-compressor and fan. When the system is energized, cool air is delivered to the plenum or main air duct **12** (see FIG. 1) at a desired temperature and velocity. In a conventional 3-ton system and 5-ton system, the duct **12** is sized to deliver 3,600 and 6,000 cubic feet of air, respectively, per minute.

Now the compressor and fan or blower in such a system are energized and deenergized in response to the position of certain electrical relay switches disposed in a control box **14** (see FIG. 4) normally located on or adjacent to the air-conditioning equipment. The air-conditioning control box **14** usually includes two separate normally open relay switches; one relay switch, schematically illustrated and assigned the reference numeral **16**, controls the energization and deenergization of

the fan or blower (not shown) and includes the terminals 18, 20. The other relay switch, also schematically illustrated and bearing the reference numeral 22, controls the energization and deenergization of the motor-compressor (not shown) and is provided with the terminals 24, 26.

The air-conditioning control box 14 also houses a conventional electric power voltage step down transformer (not shown) which has its primary winding connected with a main power source through the main lines 28, 30, and its secondary winding furnishing 24 volts.

The wires 32, 34 (see FIGS. 1 and 4) connect the thermostat switch 36 of the thermostat 10 in any suitable and conventional electric circuit (not shown) which includes the transformer's secondary and the relays' pairs of terminals 18, 20 and 24, 26, respectively, for applying the low voltage (24 volts) across each pair thereof when the thermostat 10 calls for cooling. The relay switches 16, 22 are usually electromagnetic (although any conventional relay switch may be employed) and upon the closing of the normally open thermostatic switch 36, the windings (not shown) of the relay switches 16, 22 become instantly energized causing these switches to close and to close high-voltage switches (not shown) connecting the fan and motor compressor with a high-voltage power source to effect the energization of the fan and motor-compressor.

When the thermostat 10 no longer calls for heat, its switch 36 opens thereby opening the secondary circuit effecting the consequent loss of voltage across the terminals 18, 20 and 24, 26 respectively. With the disappearance of the secondary voltage, the relay switches 16 22 are deenergized and open, and as these open, the high-voltage switches open causing the deenergization of the motor-compressor and fan or blower.

The foregoing description relates to conventional central air-conditioning apparatus, its operation and function—all well known in the art. However, this background information is essential to the understanding of the present invention for the apparatus of the system constructed in accordance with the teaching of this invention depends, in part, upon the presence or absence of voltage across the pairs of terminals 18, 20 and 24, 26, respectively.

The thermostat may be wall mounted, if desired, in any location suitable to the user and wherein it is clearly visible in order to serve a function to be described. The thermostat 10 includes a housing 38 in which the thermostatic switch 36 is suitably encased and supported. As is seen in the drawings, the housing 38 comprises a back wall 40 from which laterally and forwardly project an opposed pair of top and bottom walls 42, 44, and an opposed pair of sidewalls 46, 48, respectively.

The housing further includes mountings 50, 52 for low-voltage (24 volt) indicator lights 54, 56 to which reference will be made further below. A U-shaped bracket is indicated at 58. The bracket 58 includes a normally upright bight 60 on which is marked a temperature scale 62, the scale reading from 50° to 80°. The bight 60 is held in forwardly spaced relationship relative to the backwall 40 by vertically spaced rearwardly projecting legs 64, 66 having their respective outer ends fixedly connected thereto by conventional means (not shown).

The thermostatic switch-setting arm is indicated by reference numeral 68, the arm having an outer end portion projecting through an upright slot 70 formed in the sidewall 48 and terminating in handle means 72. An offset shoulder 74 is fixedly connected to the arm 68. A pointer 76 fixedly connected to the shoulder 74 extends longitudinally of the arm 68 in the direction of the handle means 72, and in forwardly spaced relationship relative to the arm 68. The arm 68 passes behind the bight 60 and the pointer 76 extends in front thereof in order that the pointer may sweep the scale 62 as the handle means 72 is manipulated causing the thermostat switch 36 to set to operate (close) at the desired set temperature. In FIG. 2, the thermostat 10 is shown as being set for switch closing when the room temperature is 65°.

A Bowden cable 78 has one end of its operating rod 80 connected to the arm 68 intermediate the ends of the latter, and the rod 80 and its sheath 82 extends tranversely through the bottom wall 44 with the sheath 82 secured against movement relative thereto by conventional means, the latter here being illustrated as the lock nuts 84. The forward end of the thermostat 10 is closed by a conventional front wall 85 provided with a transparent window 86 disposed forwardly of the indicator 76. The front wall 85 may also be provided with transparent lenses, 88, 90 disposed in juxtaposition relative to the lights 54, 56, respectively.

The Bowden cable 78 is extended to the plenum or main air duct 12 which is usually remotely located relative to the thermostat 10, and it is within and on the plenum that certain sensing apparatus, essential to this invention, is disposed.

In FIG. 1 the plenum or main air duct 12 is shown as being substantially hollow and rectangular in configuration, and is defined by the opposed pair of top and bottom walls 92, 94 and an opposed pair of sidewalls 96, 98, respectively.

Mounted on the sidewall 96 by conventional means is a thermoresponsive normally closed switch 100. The switch is adjustable to open at any desired predetermined temperature, and in the present disclosure it will be assumed that it will open at 50°, 15°, below the thermostat setting shown in FIG. 2.

The switch 100 may be selected from those of anyone of a number of manufacturers such as, for example, switches manufactured by RANCO, Inc., Columbus, Ohio 4,3201, as illustrated in their published instruction sheet No. 1,771-3, OPCO, and with specific reference to their model A30-450, which is incorporated by reference herein.

The switch 100 includes a housing 102 having a backwall 104 connected to the exterior side of the plenum sidewall 96 by conventional fasteners 106. The sidewall 96 is formed with a transversely extending opening 108 spanned by the backwall 104 to receive the temperature and sensing capillary coil 110 therethrough in such a manner as to be positioned in the path of conditioned air in plenum 12, the path being indicated by the arrows shown in FIG. 1.

The switch front mounting panel 112 is modified to include a bracket 114 (see FIG. 3) which receives and supports the other end of the sheath 82 of the Bowden cable. The relative movement between the sheath 82 and the bracket 114 is prevented by the conventional anchor or lock nuts 116. The other end of the rod 80 is connected with one end of a lever 118 and the other end of the lever 118 is connected on one end of a shaft 120 having a pinion gear 122 fixedly mounted thereon for rotation therewith.

The pinion gear 122 is adapted to be received and mesh with the socket gear 124 which, in turn, is operative to effect the setting for the switch cutout (opening).

For expediency and convenience, one end 126 of a substantially U-shaped hanger bracket 128 is connected to the backwall 104, the bight portion 130 thereof spanning the coil 110 in the direction of its axial elongation. The other end 132 of the hanger bracket 128 supports the casing 134 of a normally closed sail switch 136 from which depends a substantially rectangular air impervious sail 138, the sail being disposed in the plenum 12 in the path of air travel as is indicated by the arrows in FIG. 1.

The switch 136 may be selected from many on the market, among which is the model E28 single-pole, single-throw switch as manufactured by the Cherry Electric Corporation, Highland Park, Ill. Brochures of the switch are available, and the structure thereof is herein incorporated by reference.

The sail 138 is mounted on one end of a rod 139, the other end of the rod 139 being enlarged to form a head pivotally supported on a pivot pin 142 mounted on a bracket 144 secured on the casing 134.

A switch actuator rod 146 extends through an opening 148 formed in the head 140 and terminates in an abutment 150 spaced away from the head 140 and larger than the opening 148. In the presence of an airflow in the plenum at a preselected velocity, the sail 138 will pivot or turn clockwise, reference being made to FIG. 1, causing the head 140 to engage the abutment 150 to thereby draw the actuator rod 146 outwardly and in such a manner as to effect the opening of the switch 136 to serve a function to be described.

The switch 136 is connected in series with the light 54, the circuit including (see FIG. 4) the terminal 18 and wire 152 to one side of the light 54. Wire 154 connects the other side of the light 54 with one side of the normally closed sail switch 136, and the other side of the switch 136 connects by wire 156 with the terminal 20.

Thus, when the thermostat switch 36 closes to apply a low voltage across the terminals 18, 20 causing the fan relay to operate the high-voltage switch connecting the fan with its power supply, series circuit to the light 54 is energized and the light will illuminated. Normally, the illumination of the light 54 will be considered as fan failure or malfunction in that it signals that the fan is not moving the desired volume of air at the desired velocity.

It must be realized, however, that with the air conditioning shut down, the air in the plenum is substantially static. Consequently, when the fan is first energized, relatively small amounts of air at a low velocity will be delivered to the plenum. However, and after the expiration of 3 to 5 seconds, the fan of the conventional air-conditioning system should be delivering air to the plenum in the desired amount and velocity. Under these circumstances, the air will impinge on the sail 138 causing it to pivot to engage the head 140 against the abutment 150, and to thus move the switch actuator 146 opening the switch 136. This deenergizes the circuit to the light 54 and the operator now knows that the fan side of the air-conditioning unit is working properly. Should the light 54 remain illuminated beyond a time period of 3 to 5 seconds after the thermostat switch 36 closes, the operator will understand that the fan side of the air-conditioning unit is improperly functioning or has failed.

The indicating light 56, like the indicating light 54, is not ordinarily illuminated if the motor-compressor side of the air-conditioning system is properly functioning. The light 56 is controlled by the thermoresponsive switch 100 described above, and by a time delay relay switch 160. The switches 100, 160 and the light 56 are connected in series with one another and, for the purpose of this description, are to be considered as being normally closed and open, respectively, when the thermostat switch 36 is open.

The time delay switch 160 is of the type manufactured by The A. W. Haydon Company, Waterbury, Conn., 06720, and is of the type as published in their Catalog Time Delay Relay L41,300 series, wiring diagram No. 4, dated July 6, 1966, Code Identification No. 82,227, and including sheets 1 and 2 thereof. The disclosure of this time delay switch is incorporated by reference herein, but a brief explanation of its operation in conjunction with this invention is provided below.

The time delay switch 160 includes an electrically energized timing motor 162. A time delay setting pointer 168 is provided, the pointer 168 being adapted to be set across a time scale 170 by a knob 172. A progress pointer 174 for indicating the time remaining is also included in the switch 160. The switch 160 is further provided with a solenoid-type clutch 176 which, when energized, holds the motor 162 in its timed-out period. The time delay action of the switch 160 begins with the absence of voltage across the clutch solenoid.

The timing motor 162 and its associated clutch 176 are disposed within a suitable casing 177 including a backwall 178 and a front wall 180 on which a time scale 170 is inscribed or supported. The backwall 178 is fixedly connected to the lower end of a support bracket 182, the upper end of the latter being secured to the thermoresponsive switch housing 102. The casing 117 also encloses circuitry and connectors to which reference will be made immediately below.

Wire 184 connects one side of the motor 162 with a connector 186. An external wire 188 connects the terminal 24 with the connector 186. A wire 190 connects the other side of the motor 162 to a fixed switch contact 192 which is normally engaged by the switch arm 164, as is shown in full lines in FIG. 4. The switch arm 164 connects by wire 194 to the connector 196, and the latter, by external wires 198, 200 is connected to the terminal 26. Thus, when a voltage is impressed across the terminals 24, 26 and with the switch arm 164 engaged in the contact 192, the motor 162 will be energized.

Wire 202 connects one side of the clutch solenoid 176 with the terminal 24 via wire 184, connector 186, and wire 188. Wire 204 connects with the other side of the solenoid and on a connector 206. Wire 208 connects the connector 206 with the external wire 200 which, as has been stated above, connects with the terminal 26. Thus, voltage across the terminals 24, 26 will be impressed across the solenoid 176.

As has been stated above, the indicator light 56 is connected in series with the temperature responsive switch 100 and the time delay switch 160. This is accomplished by connecting one side of the switch 100 by the external wire 210 to the wire 188 which is connected to the terminal 24. Wire 212 connects the other side of the thermoresponsive switch 100 with one side of the light 56. External wire 214 connects the other side of the light 56 with the connector 226, and the latter connects by wire 218 to the fixed switch contact 220. When the switch arm 166 moves to its dotted line position of FIG. 4, it connects through the wire 222 with the connector 224 and with the external wire 200. Mention has been made of the fact that the wire 200 is connected with the terminal 26.

Thus, with voltage impressed across the terminals 24, 26 and with the switch arm 166 in its dotted line position shown in FIG. 4, the light 56 will be energized assuming that the thermoresponsive switch 100 is closed.

These then are the elements of this invention and the indicating system operates in the following manner.

Let is be assumed that the thermostat has been installed in a room or other enclosure and that the temperature of the ambient air therein is to be controlled by the conventional air-conditioning system. The operator will set the switch 36 of the thermostat 10 by moving the arm 68 and the pointer 76 in such a manner that the pointer will register against the temperature sought to be maintained in the room. In the embodiment herein illustrated, this temperature is indicated as being 65°. As the arm 68 is set by manipulation of the handle 72, the rod 80 of the Bowden cable 78 will shift, in one direction or the other as indicated by the arrows in FIG. 3, causing the lever 118 to pivot in the same direction and to effect the setting of the thermoresponsive switch 100.

As has been remarked above, the thermoresponsive switch 100 is normally closed, and is adjusted to open when the capillary tube 110 senses a temperature in the plenum 12, 15° below the set temperature of thermostat 10.

Let it now be assumed that the thermostat 10 senses a temperature in the room above 65°. This will cause the thermostat switch 36 to close, and with the closing of this switch a voltage is impressed across the fan and motor-compressor relay switch terminals 18, 20 and 24, 26, respectively, all in the manner explained above. The fan and motor-compressor of the air-conditioning unit should now substantially instantly be activated.

The indicator light 54 connected in the fan relay switch circuit will now be immediately energized since the sail switch 136 is normally closed. The light 54 will remain illuminated for a short interval of time, usually not more than 5 seconds, if the fan is operating properly delivering air to the plenum 12 in the desired quantity and velocity. As this air builds up to its required velocity, its impingement against the sail 138 will cause the same to pivot and to thereby open the switch 136. This air build up time usually takes not more than 5 seconds if the fan is operating properly. If the light 54 remains energized longer than this time period, the operator should then check the fan side of the air-conditioner unit for malfunction or failure.

When the thermostat switch 36 opens indicating that the air in the room to be conditioned has reached its temperature of 65°, voltage across the terminals 18, 20 will disappear (as will voltage across the terminals 24, 26) and the air-conditioner unit ceases to function. With the air in the duct 12 now no longer moving, the sail switch will pivot in a reverse direction to depend substantially vertically in its position shown in FIG. 1, thereby again closing the sail switch 136.

When the temperature of the air in the room in which the thermostat **10** is installed causes the switch **36** to close and effect actuation of the air-conditioning equipment, voltage is also applied across the terminals **24, 26**. It must now be borne in mind that the thermoresponsive switch **100** is normally closed since the air in the plenum **12** before the air conditioner is activated will be at a higher temperature than the 50° temperature for which the switch **100** has been preset to open.

Assuming that the switch **100** is closed at the time of the operation of the air-conditioning unit is initiated, the switch arm **166** will be in its open position shown in full lines in FIG. **4**. The series circuit to the light **56** is, thus, open.

Upon the closing of the thermostat switch **36**, voltage will be impressed across the terminals **24, 26** causing the motor-compressor side of the air-conditioning unit to become activated. This voltage is also impressed across the motor **162** to energize the same as well as the solenoid clutch **176** to initiate the timed-out or time delay period. In the present case, the timing mechanism is assumed to be set for a 15 minute time delay. The switch arms **164, 166** are in their full line positions and will so remain until the expiration of the time delay period. The temperature of the air in the plenum will be above 50° and, consequently, the thermoresponsive switch **100** will be closed. However, since the switch arm **166** is not engaged with the contact **220**, the circuit to the light **56** is not energized immediately upon the appearance of voltage across the terminals **24, 26**. When the thermostat switch **36** closes to effect the operation of the motor-compressor unit, air in the conduit **12** will commence cooling. If the motor-compressor unit is working properly, the temperature in the plenum **12** will be reduced and when it reaches 50°, the thermoresponsive switch **100** will open. This cooling operation normally requires approximately 15 minutes and corresponding to the time delay period set on the switch **160**.

If the air in the plenum **12** cools to 50° within the 15 minute time period, the thermoresponsive switch **100** will open and the light **56** will not be energized.

However, if at the end of the 15 minute interval of time delay, the switch **100** is still closed and the time delay switch **160** operates, the switch arm **166** will close against the contact **220** and thereby complete the series circuit to the light **56** which becomes energized and illuminates calling attention to malfunction or failure in the motor-compressor unit.

The switches **100, 160** will hold in their described closed positions after the expiration of the time interval and until the air in the plenum **12** reaches 50° and the temperature of the ambient air in the room in which the thermostat is located cools to 65°, and when these conditions have been reached the switch **36** will open and take the circuit to the terminals **24, 26**.

But the continued illumination of the light **56** after the expiration of the time delay period should give the operator some concern if, after checking motor-compressor unit and finding the same to be satisfactory, the light **56** remains lit.

When the air in the room to be air conditioned reaches 65°, the thermostat switch **36** opens and deenergized the motor **162** and the clutch solenoid **176** causing the timer to instantly reset to its 15 minutes time delay interval.

The indicating system according to this invention finds further utility in connection with air-conditioning systems when the weather is mild and the air-coniditioning system need not operate at full capacity or rather infrequently. For example, let it be assumed that the apparatus of this invention is in its illustrated and described positions and conditions prior to the closing of the thermostat switch **36**.

When the thermostat switch **36** closes to effect actuation of the air-conditioning equipment, the motor **162** is energized as well as the clutch solenoid **176** to initiate the time delay period, all in the manner described above. The switch **100** will be closed, but the light **56** will not be energized because the switch air **166** has not moved against the contact **220**.

Now if the air in the room controlled by the thermostat **10** cools to 65° in the time period of less than 15 minutes, the switch **36** opens, breaking the circuit to the terminals **24, 26** thereby deenergizing the motor **162** and the clutch solenoid **176** and resets the timing mechanism. In this brief interval of time, the temperature of the air in the plenum **12** will not be reduced to 50° and, while the switch **100** is closed, the light **56** will not be energized since the switch arm **166** has not made engagement with the contact **220**. This prevents the operator of the air-conditioning system from obtaining an incorrect signal concerning the operation of the motor-compressor unit.

Having described an illustrated one embodiment of this invention in detail, it will be understood that the same is offered merely by way of examples, and that this invention is to be limited only by the scope of the appended claims.

What is claimed is:

1. In combination with a central air-conditioning unit including a plenum, electrically energizable fan means for forcing cooled air through said plenum at a predetermined volume and velocity for discharge into an enclosure remotely positioned relative to said plenum and in which air is to be maintained at a preselected cooled temperature, electrically energizable motor-compressor means for cooling air delivered to said plenum, a normally open thermostat control first switch disposed in said enclosure and being preset to close when the air temperature in said enclosure rises above said preselected temperature, a first electric circuit including said first switch, a first electric power source, and electrically operable means for electrically connecting said fan and motor-compressor means with a second power source to effect energization thereof substantially simultaneously with the closing of said first switch and the consequent energization of said first circuit; and first means for indicating the malfunction or failure of said motor-compressor means when said first switch is closed energizing said first circuit, said fan and motor-compressor means, said indicating means comprising:

electrically energizable first signal means;

a normally closed thermoresponsive second switch having switch actuating sensing means disposed in said plenum, said second switch being preset to open when the air in said plenum sensed by said actuating means is cooled to a preselected temperature below the preset actuating temperature of said first switch;

a second electric circuit connecting said first signal means in series with said second switch and connected across said first circuit; whereby

said second circuit and its said first signal means are simultaneously energized with the closing of said first switch and the energization of said first circuit, said first signal means and second circuit being deenergized when said second switch opens.

2. The combination of claim **1** and:

said normally open thermostat control first switch including manually operable means for setting said first switch to close at a preselected temperature; and

adjustable means extending between and connecting said manually operable means with said second switch to set said second switch to open at an adjusted temperature below the closing temperature of said first switch, said adjustable means being operable simultaneously with the setting of said first switch.

3. The combination of claim **2** wherein:

said manually operable means includes a temperature setting arm on said first switch;

a temperature setting lever on said second switch; and

flexible rod means extending between and connected with said arm and lever.

4. The combination of claim **3** and:

a normally open time delay third switch;

means electrically connecting said third switch in series with said second switch in said second electrical circuit;

said third switch closing at the expiration of its time delay period to energize said second circuit and said first indicating means when said second switch is closed.

5. The combination of claim 4 and means for indicating the malfunction or failure of said fan means, said second indicating means comprising:

electrical energizable second signal means;

normally closed air velocity responsive third switch means disposed in said plenum in the path of air passing therethrough; and

a third electrical circuit connecting said second signal means and said third switch means in series with one another and across said first electric circuit.

6. The combination of claim 5 wherein said third switch means includes switch actuating means comprising a sail disposed in said path of air travel and movable thereby to open said third switch and to thereby deenergize said third electric circuit.

7. The combination of claim 6 and:

a casing for said normally open thermostat control first switch; and

means in said casing to receive and support said first and second signal means.

8. The combination of claim 7 wherein:

said first and second signal means comprise electrcially energizable lights.

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