Feb. 5, 1952 W. GALEAZI 2,584,691

AUTOMATIC TEMPERATURE REGULATION

Filed Feb. 16. 1948 2 SHEETS—SHEET 1

Fig. 1.

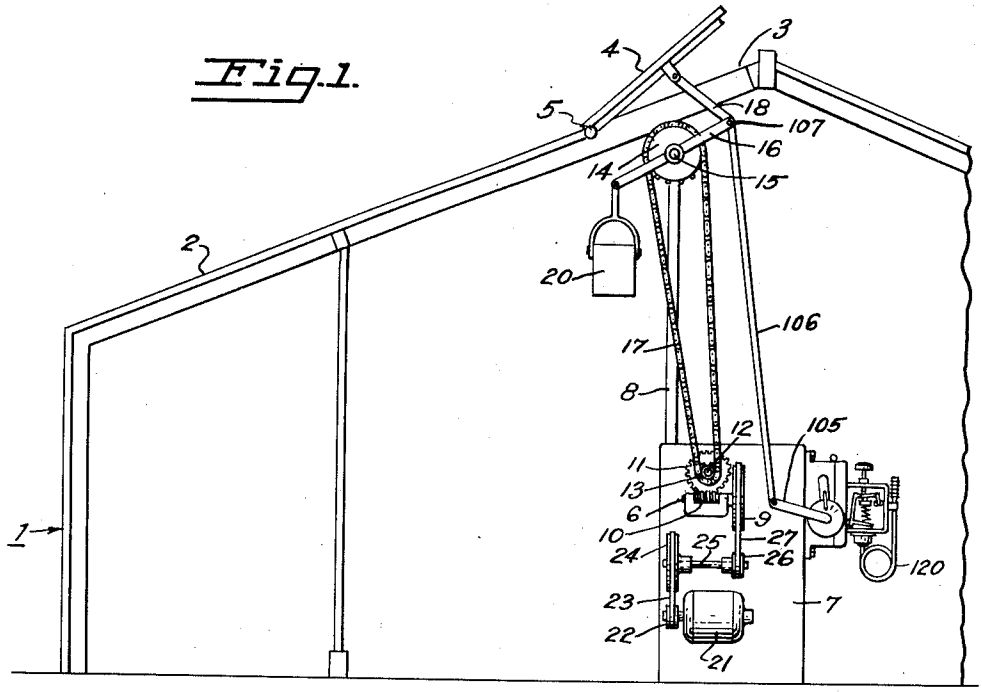
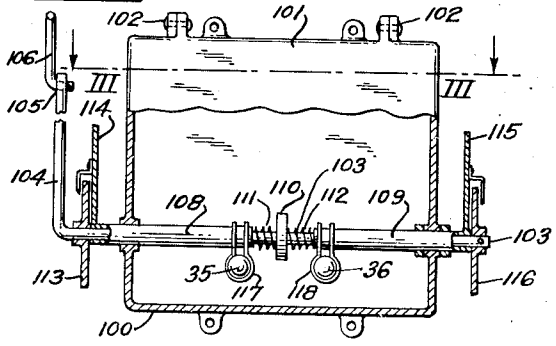


Fig. 2.



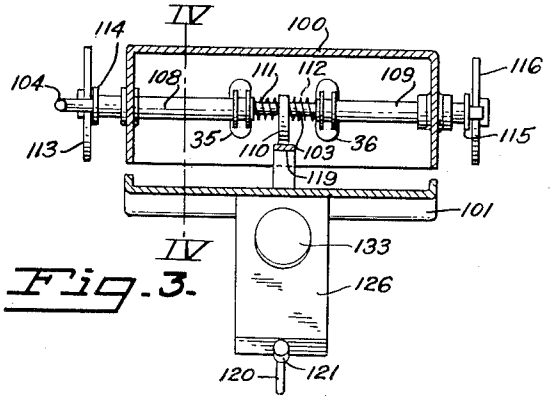
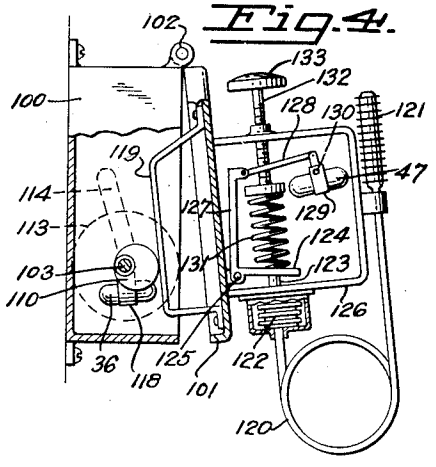


Fig. 3.

Fig. 4.



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AUTOMATIC TEMPERATURE REGULATION

Filed Feb. 16, 1948 2 SHEETS—SHEET 2

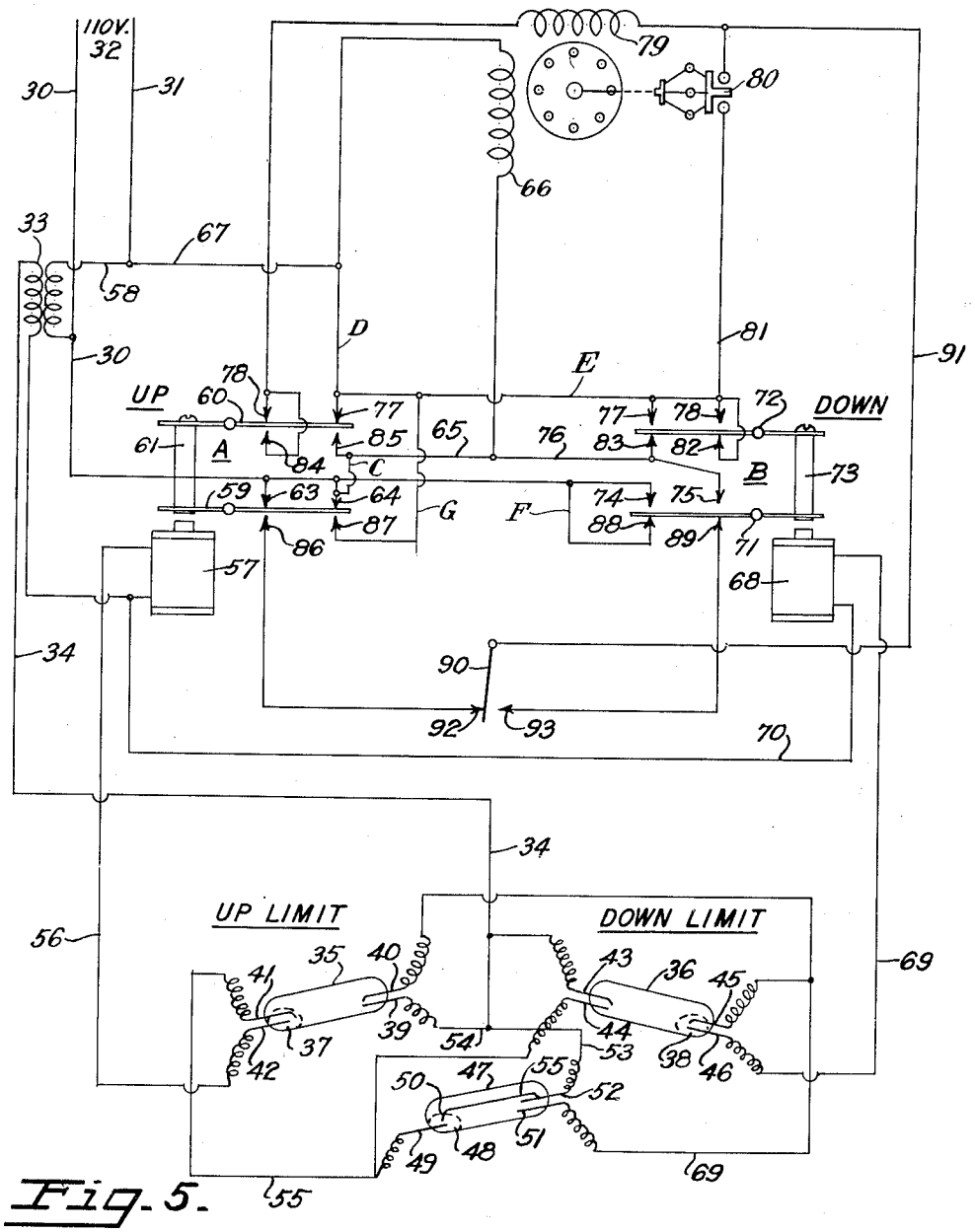
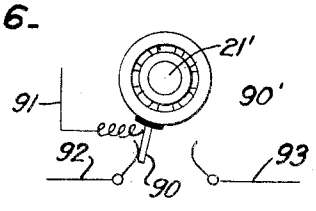


Fig. 5.

Fig. 6.



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Patented Feb. 5, 1952 2,584,691

UNITED STATES PATENT OFFICE

2,584,691

AUTOMATIC TEMPERATURE REGULATION

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Application February 16, 1948, Serial No. 8,598

3 Claims. (Cl. 236—49)

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This invention relates to automatic temperature regulation and more particularly to thermostatically actuated electro-mechanical controls for pivotal greenhouse sashes.

Among the objects of the invention is the provision of modulated temperature controls within selective ranges, for meeting changing climatic conditions, by automatically regulating the volume of ventilation in enclosed spaces, such as greenhouses for plant growth.

Another object is the substitution of the more accurate thermostatic control of ventilation for the variable judgment of manual control.

Other objects and advantages will appear as the description proceeds. In the specification and the accompanying drawings the invention is disclosed in its preferred form. But it is to be understood that it is not limited to this form; because it may be embodied in other forms within the spirit of the invention as defined in the claims following the specification.

In the two sheets of drawings:

Fig. 1 is an interior view diagrammatically illustrating the general structure of a conventional greenhouse, having this invention installed therein.

Fig. 2 is an enlarged detail in front elevation of the relay switch box and thermostatically actuated modulator switch for the motor control circuit, with the hinged cover partially broken away.

Fig. 3 is a plan view of the same in horizontal section on the line III—III, Fig. 2.

Fig. 4 is a side view of the same in vertical section on the line IV—IV, Fig. 3.

Fig. 5 is a wiring diagram of the various electric circuits, with the electrical instrumentalities symbolically indicated therein.

Fig. 6 is a front elevation detail of the starting torque switch on the motor shaft.

In detail the structure shown in Fig. 1 comprises the greenhouse 1, having the roof 2 with the sash opening 3 therethrough. This opening is closed by the sash 4, hinged at 5 to the frame of the opening. The roof, sides and ends of the greenhouse, and the frame of the sash are glazed in the usual manner to freely admit light, but admitting atmosphere only under controlled conditions.

The sash 4 is swung on its pivotal hinges at 5, by the motor driven shaft 6 mounted on the control board 7 attached to the vertical supporting post 8, extending between the floor and ceiling structure of the greenhouse. The shaft 6 has the pulley 9, and the gear worm 10 meshing with the worm gear 11, on the countershaft 12.

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The sprocket 13 on this countershaft drives the larger sprocket 14 on the stud shaft 15, rotatably mounted on the supporting post 8. The lever arm 16 has its hub fixed on the shaft 15 and moves with the sprocket 14, actuated by the sprocket chain 17 encircling the sprockets 13 and 14.

The link 18 pivoted to the outer end of the arm 16 is pivoted at 19 to the lower side of the sash frame 4, so that the sash is swung on its pivot 5, when the pulley 9 is rotated forward or backward to raise or lower the sash to the radial angle desired. The opposite end of the arm 16 has the pendant weight 20 which counterbalances the weight of the sash 4.

The pulley 9 is driven by the motor 21, through the pulley 33, the belt 23, the larger pulley 24 on the countershaft 25, and the smaller pulley 26 and the belt 27, which drives the pulley 9 at greatly reduced motor speed.

The electric motor circuit shown in Fig. 5, has the inlet wire 30, and the outlet wire 31 from and back to the generator at 32, in the usual manner. The transformer 33 is introduced into the main line to reduce the voltage to a safe value for the moist and wet environment of a greenhouse.

From the transformer 33 the wire 34 leads to the up limit switch and the down limit switch each having the double ended mercury contact switches 35 and 36 respectively, consisting of sealed glass tubes with a body of free mercury 37 and 38 therein, respectively. The switch 35 has a pair of internal contacts 39, 40 at one end and 41, 42 at its opposite end. The down limit switch 36 has a pair of internal contacts 43, 44 at one end and 45, 46 at its opposite end. The thermostatic reversing switch has a similar sealed glass tube 47 with a globule of mercury 48 therein, and the end contacts 49, 50 and 51, 52.

The incoming transformer current flows over the wire 34, the wire 53, through the mercury 48, the wire 55, through the mercury 37 in the up limit switch, over the wire 56, the solenoid at 57 and outward through the transformer 33 and the wire 58 to the outlet wire 31. This completes the low voltage transformer circuit for controlling the higher voltage motor circuit.

The solenoid relay up switch lifts the bus bars 59, 60 mounted on the dielectric base 61 which is actuated by the core of the solenoid 57, in the usual manner. The bus bar 59 bridges the contacts 63, 64 and current flows directly from the main circuit over the wire 30, the contact 63, the bus bar 59, the contact 64, the wire 65 the field winding 66 of the splitphase motor 21, and the

wire 67 to the outlet wire 31 of the main circuit of the generator 32. This energizes the motor to lift the sash 4 through the speed reduction gear 22—13 driving the sprocket chain 17 and lifting the sash 4, as in Fig. 1.

The solenoid relay down switch 68 operates synchronously with the similar up switch at 57, but in opposed relation, that is when "up" is open "down" is closed and vice versa, both being actuated through the modulating thermostatic control switch assembly at 47 interposed between the up limit and down limit switches and responding to variation in temperature, from the selected temperature determined by the manually adjusted modulating tension of the spring in the thermostatic switch, as later described in detail.

When the mercury 48 in the thermostatic switch 47 is erected in neutral position and out of contact with the pairs of contacts at the opposite ends of the switch, the motor circuit is open and the sash 4 remains in its then position. When the switch 47 is tilted by a drop in temperature the mercury 48 rolls into contact with the contacts 51, 52. The incoming current flows over the wire 34 to 53, through the mercury 48, with the down limit switch closed, across the contacts 45, 46, over the wire 69, the solenoid 68, the wire 70, through the transformer 33, and the wire 53 to the outlet wire 31 of the generator 32.

The solenoid 68 lifts the bus bars 71, 72, joined by the dielectric base 73, and the current flows in over the wire 30, to the contact 74 across the bus bar 71 and the contact 75, the wire 76 to the motor field winding 66 and out over the wire 67 and the outlet wire 31 to the generator 32. The motor 21 is reversely energized by the starting winding circuit described hereinafter, which lowers the sash 4, and reduces the ventilation through the sash opening.

The motor has a sub-circuit winding to provide the starting torque, which is automatically cut out when the motor attains maximum speed. This winding is energized through both relay up and down switches whenever the motor circuit is closed, through the respective bus bars 59, 60, and 71, 72. From the motor field winding 66, current flows through the contact 77, the bus bar 60, the contacts 78 through the starting winding 79, across the automatic switch 80, controlled by a centrifugal governor on the motor shaft, of conventional design common to this type of motor, thence over the wire 81 to the contact 82, across the bus bar 72 to the contact 83, and over the wire 76 to the field winding 66. Similar contacts are arranged at 84, 85, relative to the bus bar 60, with like results, when the up and down switches are opened or closed by the thermostatic control assembly. See similar contacts 86, 87, and 88, 89, relative to bus bars 59 and 71 respectively.

The motor starting torque switch 90 is interposed in the starting torque winding 79 by the wire 91 cut in ahead of the automatic starting switch 80 and leading to the motor torque switch 90 having two separated and insulated contacts 92, 93. The contact 92 represents the forward direction of the motor. When the switch 90 is swung to the contact 93, the motor is reversed by the action of the relay down switch which reverses the flow of current through the motor starting torque winding. This starting torque switch shown in Fig. 6 comprises the ball bearing 90' with its center ring fixed on the end 21' of the motor shaft. The switch contact 90 is

dielectrically mounted on the outer ring of the ball bearing, between the contacts 92, 93.

When the up switch at 57 is closed the motor is running in the normal clockwise direction to lift the sash 4, as in Fig. 1, with the contacts 90, 92 closing the circuit through the starting torque winding 79, until this circuit is automatically opened by the governor switch at 80.

When the down switch 68 is closed the motor is reversed and the contact 90 moves into contact with 93 and closes the down circuit to reverse the motor and lower the sash 4. This movement of the center pole contact 90, is the result of the initial friction within the grease packed ball bearing 90', which causes the outer ring of the ball bearing to respond to the rotation of the inner ring fixed on the motor shaft. The slack in the several belts 23 and the reduction gearing permits the motor shaft to rotate a few degrees to actuate the contact 90 before the motor picks up its load under the starting torque winding 79.

The mechanical structure of the switches in the various electric circuits above described, includes the enclosing case 100 mounted upon the control board 7, and having the cover 101, hinged at 102. The case has the transverse shaft 103 protruding from both sides of the case, one end being bent into the swing arm 104 pivoted at 105 to the link 106, having its upper end pivoted at 107 to the end of the arm 16 of the sash control; whereby the rise and fall of the sash 4, swings the shaft 103.

This shaft passes through the separated sleeves 108, 109, having their outer ends projecting beyond the sides of the case 100. The cam 110 is fixed on the shaft 103 intermediate the inner ends of these sleeves, with the expansive springs 111, 112 interposed between the sides of the cam 110 and the adjacent inner ends of the sleeves 108, 109, forcing them against the dials 113, 116, respectively fixed on the exposed ends of the shaft 103. The indicators 114, 115 are fixed on their respective tubes 108, 109, and register with the dials 113, 116 respectively.

The mercury switches 35, 36 are secured within the clamping bands 117, 118, attached to their respective sleeves 108, 109, in fixed relation to their respective indicators 114, 115, by means of which the mercury switches 35, 36 may be manually tilted relatively to the dials 113, 116 respectively. This adjustment of the switches 35, 36 relatively to the arm 104, enables a selective segment of operation relatively to the opening and closing radius of the sash 4, by means of which a selected range of temperature may be maintained within the greenhouse, by actuating the motor circuit to raise and lower the sash 4, when the selected temperature range is exceeded in either direction, up or down. For example: On a hot day it may be indicated to raise the sash open to 45 degrees, with a lower angle of 30 degrees, this segment of operation is determined by setting the up switch indicator at 114 to 45 on the dial 113, and the down switch indicator 115 at 30 on the dial 116. When the sash lowers to 30 degrees of pitch the switch mercury 38 will roll into neutral position and stop the motor. Contrawise on a cold day a sash opening segment range of five or ten degrees may be the selected segment indicated by the weather and the internal temperature of the greenhouse, which is controlled through the tension adjustment of the thermostatic switch 47.

The thermostatic switch assembly at 47 is mounted upon the cover 101, having the inner

bracket 119 resting upon the cam 110. When the arm 104 is lifted by the motor raised sash 4, the arm 104 swings the cam into the position shown in Fig. 4, and tilts the cover 101 as shown. This tilts the mercury switch 47 which opens the motor circuit and the motor stops.

The degree of tilt at which the switch 47 functions is determined by the tension applied at 133 for the selected temperature desired, 70 degrees for instance, within the greenhouse. This is controlled by the expansive medium within the coiled tube 120, having the finhead 121 for absorbing heat within the greenhouse. This expansion elongates the bellows 122 having the pin 123, bearing beneath the bellcrank 124 pivoted at 125 in the enclosing case 126 of the thermostatic valve. The upper extension of the bellcrank is linked at 128, to the band 129 which is pivoted to the case at 130, and tilts the mercury switch 47 when the temperature rises or falls within the greenhouse.

The thermostatic expansion of the bellows 122 is opposed by the expansive spring 131, which is controlled by the head on the end of the spindle 132 threaded in the top of the case 126. It has the handle 133 fixed upon its upper end, so that the tension of the spring may be adjusted to the selected tension, for controlling the rise and fall of the sash 4, within the modulated pitch range selected by turning the handle 133, to meet outside atmospheric conditions relative to the desired temperature within the greenhouse.

The disclosure of the invention has been confined to its application to the ventilating system of a conventional green house. It is equally applicable to other motorized units under thermostatic control, such as opening and closing valves, fire doors, and the like.

Having fully described this invention and its mode of operation, what I claim and desire to secure by Letters Patent is:

1. An automatic temperature regulator comprising a temperature control means including a split phase motor in circuit with a main electric circuit; a forward switch and a reverse switch in circuit with the main motor circuit; independent relay circuits having means in circuit therewith for alternately opening and closing the forward and reverse switches; a switch box having a swing shaft mounted therein and controlled by a swing arm linked to said temperature control means; a mercury up limit switch and a mercury down limit switch each adjustably mounted upon the swing shaft; manual means for independently adjusting the mercury switches on the shaft relative to the swing arm, for automatically changing the direction of rotation of the shaft of said motor; and a thermostatically actuated switch in circuit with the relay circuits between said up limit and said down limit switches, for changing the direction of rotation of said motor shaft in accordance with a rise or fall of the surrounding temperature.

2. An automatic temperature regulator comprising a temperature control means including a split phase motor in circuit with a main electric circuit; a forward switch and a reverse switch in circuit with the main motor circuit; independent relay circuits having means in circuit therewith for alternately opening and closing the forward and reverse switches; a switch box having a swing shaft mounted therein and controlled by a swing arm linked to the temperature control means; a pivotal cover on the switch box operated by a cam on the swing shaft; a mercury up limit switch and a mercury down limit switch, each mercury switch being adjustably mounted upon the swing shaft; manual means for independently adjusting the mercury switches on the shaft relative to the swing, for automatically changing the direction of rotation of the shaft of the motor; and a thermostatically actuated mercury switch mounted on the pivotal cover of the switch box and in circuit with the relay circuits between the up limit and the down limit switches, for automatically changing the direction of rotation of the motor shaft in accordance with a rise or fall of the surrounding temperature.

3. An automatic temperature regulator comprising an enclosed structure having a ventilating opening and a closure therefor and mechanical means for moving said closure relative to said opening and operated by a single split phase motor in circuit with a main electric circuit; a forward switch and a reverse switch in circuit with the main motor circuit; independent relay circuits having means in circuit therewith for alternately opening and closing the forward and reverse switches; a switch box provided with an attached movable closure having a swing shaft mounted therein and controlled by a swing arm linked to said closure; a mercury up limit switch and a mercury down limit switch in circuit with the relay circuits respectively, and adjustably mounted upon the swing shaft; manual means for independently adjusting the mercury switches on the shaft relative to the swing arm for selectively determining the range of operation of the closure relative to the ventilating opening by automatically changing the direction of rotation of the shaft of the motor within said selected range of operation of the closure; and a thermostatically actuated mercury modulating switch pivoted to the switch box and operated by the movement of the swing arm and in circuit with the relay circuits between the up limit and the down limit switches, for changing the direction of rotation of the motor shaft in accordance with a rise or fall of the surrounding temperature within said enclosed structure.

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