Feb. 9, 1954 E. D. HIDY 2,668,445

DEGREE-DAY REGISTERING DEVICE

Filed July 22, 1949

4 Sheets-Sheet 1

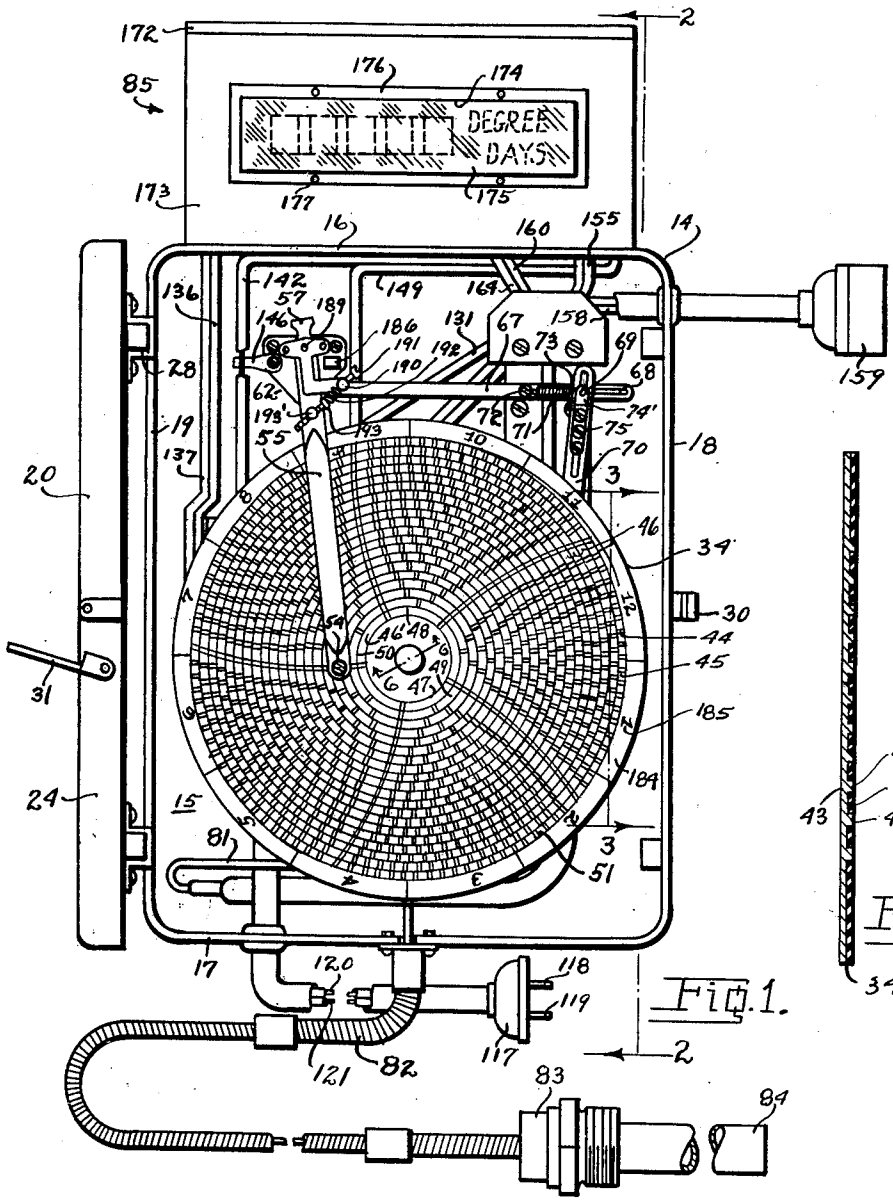


Fig. 1.

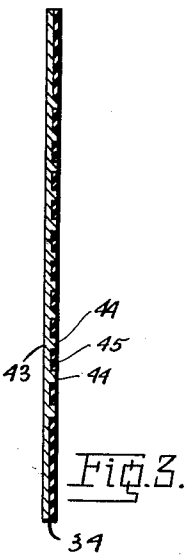


Fig. 3.

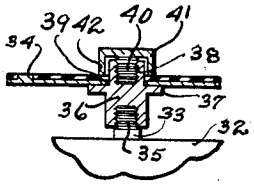


Fig. 6.

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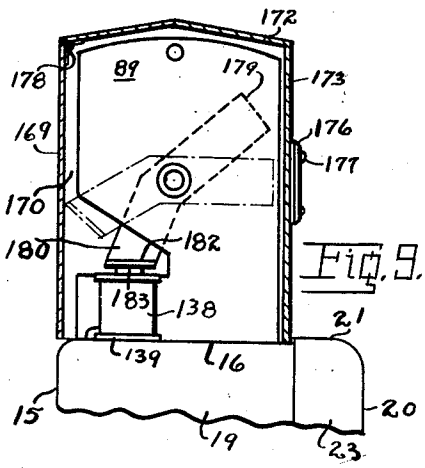


Fig. 9.

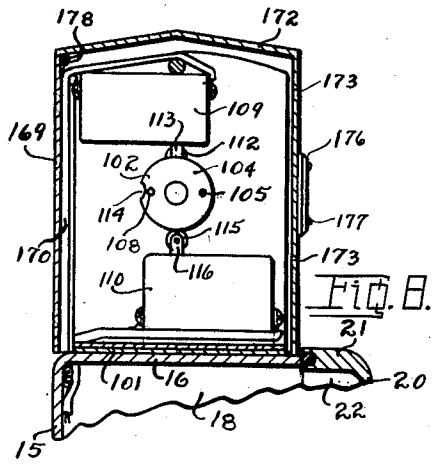


Fig. 8.

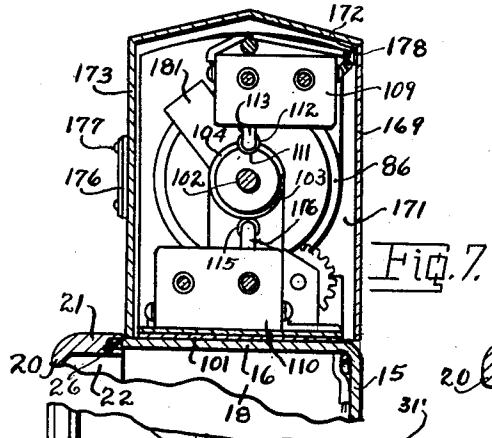


Fig. 7.

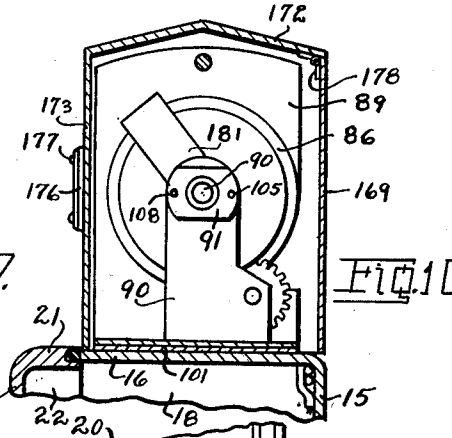


Fig. 10.

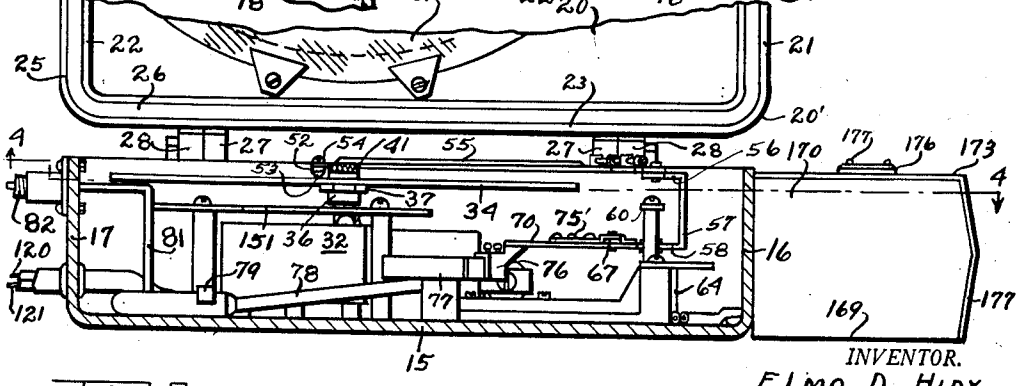


Fig. 2.

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DEGREE-DAY REGISTERING DEVICE

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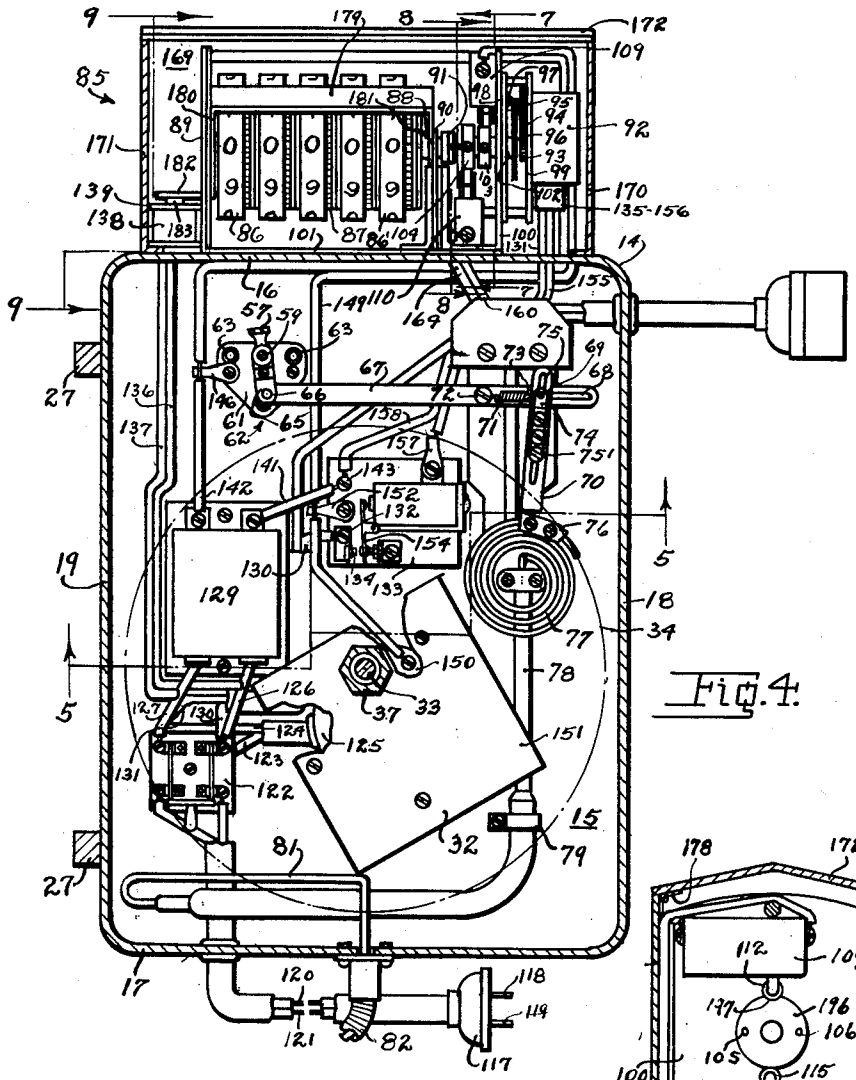


Fig. 4.

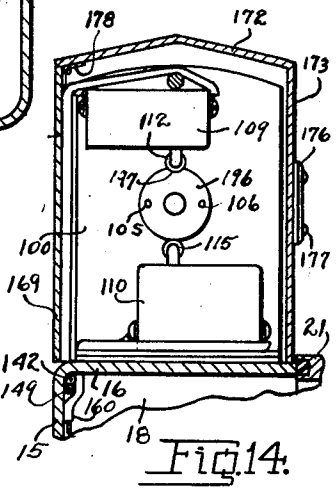


Fig. 14.

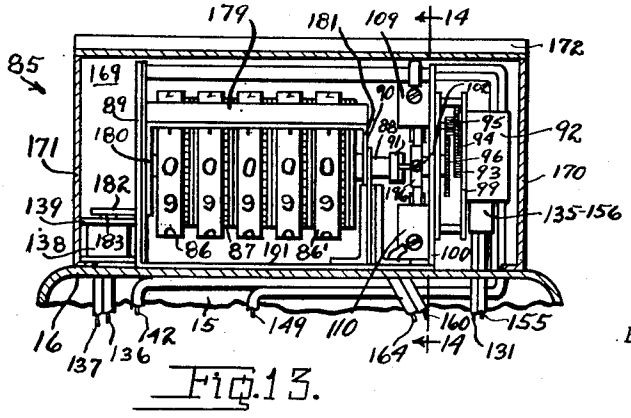


Fig. 13.

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DEGREE-DAY REGISTERING DEVICE

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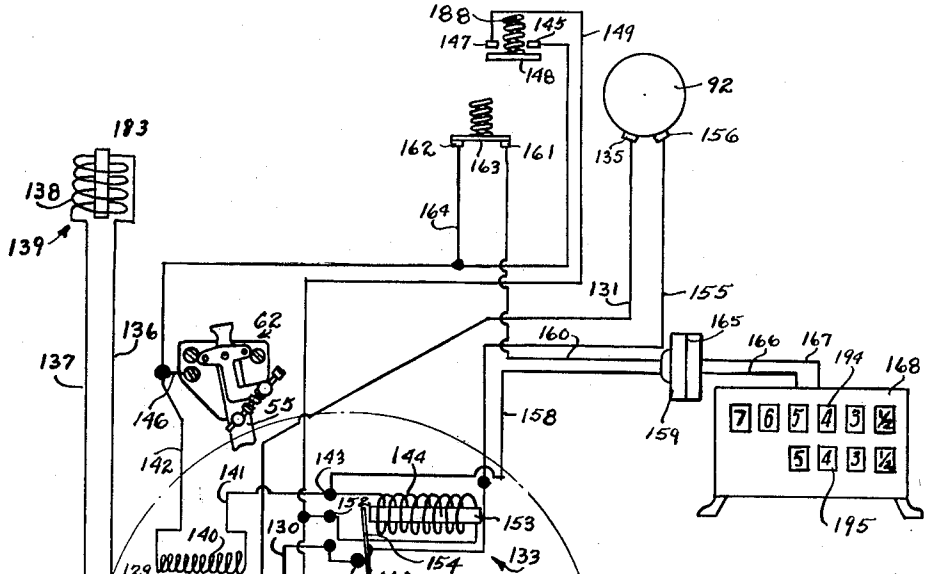


Fig. 12.

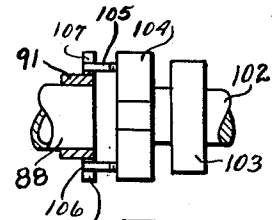


Fig. 11.

Fig. 5.

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2,668,445

UNITED STATES PATENT OFFICE

2,668,445

DEGREE-DAY REGISTERING DEVICE

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Application July 22, 1949, Serial No. 106,279

14 Claims. (Cl. 73—339)

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This invention relates to improvements in a degree-day registering device and particularly to a device of this character which automatically registers and accumulates the degree-days.

This invention relates to improvements in the structure and device disclosed in applicant's pending application Serial No. 10,651 filed February 25, 1948.

In view of the sensitiveness of the degree-day registering device and the atmosphere in which it may be employed, it was found that normal vibration and minute particles of dust and foreign material may cause inaccurate recordings in the structure. In order to avoid these possible inaccuracies the mechanism of the present invention was developed with particular reference to the operation of the counting mechanism as effected by the register.

The principal object, therefore, of this invention is the provision of a mechanism which will register only degree-day changes.

Another object of this invention is the provision of control mechanism for the accumulator or register which prohibits its operation except to register temperature change when it occurs.

A further object of this invention is the provision of a degree-day recording device including a counting mechanism wherein the operation of the counter is delayed to insure the registering of a degree-day instead of an inadvertent or false operation of the counter.

A still further object of this invention is the provision of a device for accomplishing the foregoing objects that is of simple yet sturdy construction commensurate with the purposes to be performed.

Other objects and advantages of the present invention should be readily apparent by reference to the following specification considered in conjunction with the accompanying drawings forming a part thereof and it is to be understood that any modifications may be made in the exact structural details there shown and described, within the scope of the appended claims, without departing from or exceeding the spirit of the invention.

In the drawings:

Fig. 1 is a front elevation of a degree-day register and accumulating device embodying the improvements of this invention.

Fig. 2 is a sectional view, as seen from line 2—2 thereon, through the housing or cabinet of the operating mechanism illustrating said mechanism in elevation.

Fig. 3 is an enlarged sectional view through a

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portion of the dial as seen from line 3—3 on Fig. 1.

Fig. 4 is a plan view of the operating mechanism and the counter or accumulating mechanism as seen from line 4—4 on Fig. 2, said view showing certain shafts and the enclosing cabinet or housing in cross-section.

Fig. 5 is a transverse sectional view through the operating mechanism as seen from line 5—5 on Fig. 4.

Fig. 6 is a fragmentary enlarged sectional view illustrating the mounting of the dial on the motor as seen from line 6—6 on Fig. 1.

Fig. 7 is a slightly enlarged sectional view through the counter actuating mechanism as seen from line 7—7 on Fig. 4.

Fig. 8 is an enlarged sectional view through the counter mechanism taken through a plane beyond that of Fig. 7 on line 8—8 on Fig. 4.

Fig. 9 is an enlarged sectional view through the counter mechanism taken in a plane beyond that of Fig. 8 on line 9—9 on Fig. 4.

Fig. 10 is an enlarged sectional view through the counter mechanism taken on line 8—8 on Fig. 4 but looking in the opposite direction from the arrows on said line 8—8.

Fig. 11 is an enlarged view partly in section and partly in elevation illustrating the coupling between the counting device and the motor or motor shaft.

Fig. 12 is a wiring diagram of the various electrical circuits in operation in the mechanism of the present invention.

Fig. 13 is a vertical sectional view through a counting mechanism illustrating a slight modification therein over that illustrated at the upper end of Fig. 4.

Fig. 14 is a sectional view through the modified counting mechanism as seen from line 14—14 on Fig. 13.

Throughout the several views of the drawings similar reference characters are employed to denote the same or similar parts.

In the use of oil for heating homes and the like use is made of a storage tank from which the said oil is fed to the burners. The burners are controlled by valves operated automatically from a thermostat or gauge located within the area being heated. The thermostat or other control device is set to maintain a given degree of heat regardless of the temperature exteriorly of the space being controlled.

It has been found that beyond a certain temperature, exteriorly, the temperature in the space being heated must be raised in order to be com-

fortable. In other words with exterior temperature down to 70° F. or 65° F. no inside heat need be generated but below these temperatures heat interiorly, or within the space being controlled, must be supplied and in the case of a heating unit utilizing oil as the fuel the burners will be automatically turned on upon reaching this said or minimum exterior temperature in order to maintain a predetermined or preestablished minimum interior temperature.

The exterior temperature which has been established as the norm is 65° F. which will be used as the norm in describing the present application.

It has been established, each heating plant will utilize a definite amount of fuel oil to maintain a given interior temperature for a given time period, a twenty-four hour day, for example, for each degree of temperature drop exteriorly. This rate of fuel oil consumption is established for each heating plant by observing the user for a given period of time and noting the amount of fuel oil consumed and the number of degree-days for this period whereby it can be determined how many degree-days will pass between the time of filling his reserve or storage tank and the next filling required. It is the purpose of the present invention to automatically count and register these degree-days so that a supplier can maintain an accurate record of the passing degrees and thereby maintain a record as to when additional fuel oil supply is required.

Specifically, the device of the present invention comprises a housing or casing 14 having a back 15 from which upstands a top 16, a bottom 17 and sides 18 and 19. The cabinet is adapted to be closed by a lid or cover 20' comprising a panel 20, see Fig. 2, of an area substantially equal to the area of the cabinet back 15 and having upstanding from the edges thereof flanges 21, 22, 23 and 24. The flanges 21–24 are channeled as at 25, see Fig. 5, to receive therein a rubber gasket 26 that is pressed into sealing engagement with the upper edges of the cabinet walls 16–19 when the cover 20' is closed. For convenience the cabinet side wall 19 has projecting therefrom hinge lugs 27 for alignment with similar hinge lugs 28 projecting from the cover flange 23 with said lugs having passing therethrough pivot or hinge bolts or pins 29. In order to lock the lid or cover in its closed position the cabinet side wall 18 is provided with a latch hook 30 cooperating with an elongated latch lever 31 on the cover wall or flange 24. The lid or cover panel 20 is provided centrally thereof with an opening covered by a glass window 31', see Fig. 2, through which the interior of the cabinet, particularly the operating dial, later to be made clear, may be observed.

Interiorly of the cabinet and carried by the back panel 15 is an electric clock 32 of the usual construction utilized in recording thermometers and having projecting therefrom a driven shaft 33. The clock 32 may be of a construction to make a single revolution of its shaft 33 in each twenty-four hours but preferably is so geared that the shaft 33 makes a complete revolution each twelve hours.

Secured to for rotation with the clock shaft 33 is a disc 34 and which connection may take any suitable or desirable construction. As shown in Fig. 6 this construction comprises the formation of screw threads 35 on the clock shaft 33 receiving a carrier 36 which has substantially mid-way of its height a radially projecting flange 37, which flange in plan view is preferably formed as hexagonal in shape so that it can readily be screwed home on the clock shaft 33. Upstanding from the radial flange 37 the carrier 35 has a counterbored post 38 of a diameter substantially equal to the diameter of a bore 39 substantially centrally of the disc 34. The post 38 is internally threaded to receive a stud 40 externally threaded and projecting from a cap member 41. The cap member 41 has a flange 42 for encircling the hollow post 38 whose free edge engages the disc 34 in clamping engagement around the aperture 39 therein.

From the foregoing it should be noted that the disc 34 makes a complete revolution with the clock shaft 33.

The disc 34 is adapted, as will presently be made clear, to form one side of an electrical circuit in registering degree-days and for this reason should have a surface that is normally non-conductive while permitting conduction through the disc at proper and desirable intervals. As shown in Figs. 1 and 3 the disc 34 has a back or body portion 43 from the forward face of which upstands a plurality of bars or contact strips 44. It is contemplated that the disc 34 will have its face etched between the bars 44 thereby providing for the major portion of the face of the disc to be recessed. After the said recesses are formed they are filled with insulating material 45 thereby making non-conductive areas between the upstanding bars or contact strips 44.

In practice the disc 34 is laid out in a series of theoretical concentric circular bands 46 from a point as near the center or aperture 39 as practical to the outer perimeter of the disc. Each circular band 46 radially from the center represents a drop of five degrees in temperature which is traversed by a stylus in the same manner that a recording thermometer traverses a recording dial. In other words the circle 47 on the inner edge of the band 46 and the circle 48 at the outer edge of the band 46 represents a drop in temperature from 65° F. to 60° F. In the same manner the next band 49 having its inner edge represented by the circle 48 and its outer edge by the circle 50 represent a further drop of five degrees temperature or a temperature of from 60° F. to 55° F. Each of the bands representing five degrees temperature drop is divided into segments by the bars or contact strips 44 that it is below the established norm. Since the band 46 represents a five degree drop in temperature below a norm of 65° F. it is provided with five bars or contact strips 44 with five insulating segments between said bars. The second band 49 representing a maximum of ten degrees drop below the norm of 65° F. is provided with ten bars or contact strips 44 and therefore ten segments of insulation. Each band of five degree temperature drop beyond the band indicated at 49 to the periphery of the disc is correspondingly divided wherefore the outermost band representing a temperature of between 25° F. and 30° F. below zero represents a maximum of 95° F. below the norm of 65° F. wherefore this band, indicated by the reference numeral 51, would be divided by ninety-five bars or contact strips 44 to establish ninety-five segments of insulating material therein. As will subsequently be made clear these bars or contact strips 44 are employed for registering the degree-days.

Cooperating with the dial 34 is a stylus comprising a head 52 having a ball point 53 secured in any suitable or desirable manner, as by a screw

54, to an arm 55. The arm 55 is formed as a spring member and biased to have a firm contact with the face of the dial 34. If desired, and to insure a firm contact between the stylus ball end or point 53 and the face of the disc 34 the said stylus may be spring backed.

The arm 55 is adapted to be swung away from the center of the dial 34 upon a decline in temperature and to be swung toward the dial center when the temperature rises and for which purpose the arm is carried by a bracket 56 which in turn, see Fig. 2, has a depending arm 57 attached through a finger 58 to a pivot shaft 59. The pivot shaft 59 is mounted for oscillatory movement in the top plate 60 and bottom plate 61 of a supporting bracket indicated in general by the reference numeral 62. Any suitable or desirable means such as posts 63 are utilized to separate the said top and bottom plates from one another while suitable means such as pillars 64 may be employed for securing the bracket 62 in operative position to the cabinet back panel 15. The chief purpose of this bracket 62 and the parts just described is to provide a sensitive pivoted mounting for the stylus arm 55.

The pivot shaft 59 is oscillated upon an increase and decrease in the outside temperature for which purpose it has secured to it, intermediate its ends, a lever 65 to the outer end of which is pivotly connected, as at 66, one end of a link 67. The link 67 at its other end is provided with an elongated aperture 68 through which projects a pin 69 associated with an operating arm 70.

The pin 69 is retained, yieldably, against the inner, right-hand, as seen in Fig. 4, end of the elongated aperture 68 by yielding means which may take any suitable or desirable form of construction for a purpose presently to be made clear. Specifically, this means comprises a spring 71 having one end anchored, as at 72, to the link 67 and its other end 73 secured to a carrier 74 adjustably secured through an elongated aperture 75 to arm 70. Screws 75' are employed to secure the carrier 74 in position with the pin 69, carried thereby, in its desired position with respect to link elongated aperture 68.

The arm 70 is secured through an enlargement 76, at its lower end, to a coil 77 which is a hollow tube-like member under coil spring tension and adapted to be uncoiled as pressure therein, due to reduction in outside temperature, is varied or changed.

The coil 77 is formed at the end of a tube 78 which is secured or anchored in position by a clamp 79 to the cabinet back 15. The tube 78 is illustrated as having at its inner end a very small diameter tube 81 which passes outwardly through the cabinet bottom 17 into a sheath cable 82. The cable 82 and tube 81 may be of any desired length and terminate in a mounting coupling 83 which in turn carries the member 84 which is sensitive to temperature changes in the surrounding atmosphere and which member 84 is commercially known as a mercury bulb. The changing density of the mercury in the mercury bulb sets up the pressure in the tubes 81 and 78 which permits the uncoiling of the coil 77 or causes same to coil thereby oscillating the arm 70 and causes the shifting of the link 67.

The mechanism hereinbefore described for actuating the link 67 and the stylus arm 55 are known having been employed in substantially this form in recording thermometers.

Mounted on the top wall 16 of the operating

mechanism cabinet is the degree-day counting mechanism indicated in general by the reference numeral 85. The counting mechanism comprises a plurality of rolls or counting wheels 86 each having on its periphery the numerals 1 through 0 (10) and which numerals are to be successively moved, one at a time, as is usual in counting devices, to a given position for reading purposes. In order to actuate said counting wheels 86 they have each associated therewith a gear 87 operated by a pinion (not shown) associated with and driven by a shaft 88. The shaft 88 has its ends rotatably mounted in a bracket end plates or uprights 89 and 90. The shaft 88 is driven through a disc 91 at the forward end thereof with said disc receiving its power or rotative force from an electric motor 92 through any suitable or desirable transmission train such as will be presently described. The counting device just briefly described is well known and forms no part of the present invention except in combination.

As seen in the drawings the transmission train between the motor 92 and counter driving shaft actuating disc 91 comprises a pinion 93 on the shaft of motor 92 driving a gear 94 which has associated therewith for rotation therewith a pinion 95 which in turn meshes with a gear 96. The gear 94 and its pinion 95 are mounted for rotation about the axis of a shaft 97 rotatably journaled between spaced plates 98 and 99. The plate 98 is carried by the housing of the motor 92 while the plate 99 is carried by an upright 100 forming a part of the counter mounting bracket which includes the uprights 89 and 90 joined by the bracket base 101.

The gear 96 is keyed or otherwise secured to one end of a shaft 102 which is journaled for rotation in plate 99 and bracket upright 100 to project therebeyond and have secured thereto discs 103 and 104. The disc 104, see Fig. 11, has projecting therefrom a pair of driving pins 105 and 106 which are adapted to enter slots 107 and 108 in the counter driving shaft disc 91.

From the foregoing, it will be noted that rotation of the motor 92 through the gear train 93—96 rotates the shaft 102 which through the disc 104 and its projecting driving pins 105 and 106 rotates the counter driving shaft disc 104 to thereby effect the operation of the counting wheels 86. The driving pins 105 and 106 with the slots 107 and 108 in the disc 91 constitutes one form of an Oldham coupling which is employed to compensate for slight eccentricity or out of alignment between driving and driven tandem shafts. It should be noted that the connection between the counter driving shaft 88 and the first counting wheel 86' is such that a complete revolution of said shaft 88 and the motor driven shaft 102 rotates the said counting wheel 86' one-tenth of a revolution for thereby advancing, successively, the numbers thereon to a given position. The connection between the counting wheel 86' and its adjacent counting wheel 86, and including the gear 87 therebetween, as well as the connection between each of the succeeding counting wheels 86 and including the gear 87 of each of said rollers, is such that a complete revolution of each counting wheel is necessary for the advancement of the next following counting wheel and then only through a tenth of a revolution with said movement being effected during the last tenth of a revolution of the preceding counting wheel, this construction being well known in counters.

The disc 103, in addition to establishing a con-

nection between the shaft 102 and the shaft 88, and the disc 104, respectively operate an electric switch 109 and 110, such switches being of the type known commercially as "micro" switches. For this purpose the disc 103, see Fig. 7, is provided in its periphery with a notch 111 into which may be positioned a roller 112 at the end of a plunger or switch arm 113 associated therewith for operating the mechanism of the microswitch 109. Similarly, the disc 104, see Fig. 8, is provided in its periphery with a notch 114, similar to the notch 111 in the disc 103, for receiving therein a roller 115 carried by the operating plunger or arm 116 of the microswitch 110. As will presently be described the microswitch 109 controls the rotation of the counter actuating mechanism motor 92 while the switch 110 controls one or more magnetic counter mechanisms that may be positioned at points remote from the actuating mechanism.

The electric current for the degree-day recorder and accumulator is obtained from any suitable source through plug part or connecting member 117 which has its prongs 118 and 119 respectively connected with insulated wires 120 and 121 which terminate in a double pole, single throw switch 122 conveniently mounted on the base or back 15 of the housing. Extending from the switch 122 are wires 123 and 124 that are connected at their other ends with the clock motor 125 in a manner usual in electric clock motor construction.

Extending also from the switch 122 are wires 126 and 127 which terminate at the opposite ends of the primary coil 128, see Fig. 12, of a step-down transformer 129 that supplies low voltage current for additional counters and the control circuits. Further extending from the switch 122 are wires 130 and 131 the former wire 130 terminating in a connection 132 of a relay switch assembly 133 and which connection 132 has associated therewith a fixed electrical contact 134, while the latter wire 131 terminates in a terminal, see Fig. 12, 135 of the clock motor 92. Finally extending from the switch 122, preferably from the wires 126 and 127, are wires 136 and 137 which terminate in the coil 138 of an electromagnet 139 mounted adjacent the counting mechanism for a purpose presently to be made clear.

The transformer 129 has extending from the ends of its secondary coil 140 wires 141 and 142. The wire 141 has its end attached to a terminal 143 of the relay switch 133 and to which terminal is likewise connected one end of the coil 144 of said relay 133. The wire 142 has its end connected to a fixed contact 145 of the microswitch 109 with a connection or wire 146 extending from the wire 142, intermediate its ends, to the bracket 62 which has associated therewith the stylus arm 55 and since this arm has metal to metal contact with the bracket 62 it is electrically connected with the wire 42.

The microswitch 109 is adapted to have its fixed contact 145 bridged with a second fixed contact 147 by a movable contact 148 which is operated and controlled by the plunger or lever 113, see Fig. 12. Extending from the fixed contact 147 of the microswitch 109 is a wire 149 that terminates in a connector 150 carried by the plate 151 of the clock motor 32. Since this plate 151 has a metal to metal contact with the disc 43 due to the connection of said disc with the flange 37 of the carrier 36 the said wire 149 is thereby electrically connected with the disc 43. The wire 149 is, intermediate its ends, attached to a connector 152 associated with the relay 133 and the said connector 152 has likewise connected therewith the other end of the relay switch coil 144.

Centrally of the coil 144, as is usual practice, is a core 153 adapted to be magnetized upon current flow through the coil 144, as seen in Fig. 12. The core 153 is adapted to actuate a movable contact 154 into engagement with the fixed contact 134 of the relay 133. Extending from the relay movable contact 154 is a wire 155 that terminates at its end in a connector 156 associated with the counter actuating motor 92, see Fig. 12.

The wire 155 is illustrated in Fig. 4 as connected with a connector 157 associated with the relay 133 and it is this connector 157 that is connected with the relay movable contact 154.

Extending from the connector 143 of the relay switch is a second wire 158 that terminates in a plug part 159 and which plug part, as will presently be made clear, is adapted to be connected with a second or remote counter such as a magnetic counter. Extending from the plug part 159 is a second wire 160 terminating in a fixed contact 161 of the microswitch 110. The fixed contact 161 is adapted to be bridged to or connected with a second fixed contact 162 by a movable contact 163 which is associated with and operated by the plunger or lever 116. The fixed contact 162 of the microswitch 110 has extending therefrom a wire 164 which has its other end connected with the wire 142 and therefore the other side of the transformer secondary coil 140.

As seen in Fig. 12 the plug part 159 has adjacent thereto and connected therewith a plug part 165 from which extends wires 166 and 167, which are in effect continuations of wires 158 and 160, and which wires, 166 and 167, terminate in the actuating mechanism (not shown) of the magnetic counter 168.

The counting mechanism 85 and its drive are suitably housed in an enclosing housing which is conveniently formed of two parts, the one part including the housing back 169 from the ends of which outwardly project the end walls 170 and 171. The second housing part includes the top 172 and front 173 in which is formed an opening or window 174 suitably closed by a transparent member such as a sheet of glass 175. Any suitable or desirable means may be employed for securing the glass window 175 in position such as a frame 176 secured to the housing front 173 by screws or the like 177. In order to gain access to the interior of the counting mechanism housing the free edge of the housing top 172 is hingedly connected to the upper edge of the housing back 169 by means of a hinge 178. From the foregoing it will be noted that the housing top 172 and front 173 are actuated as a unit about the axis of the hinge 178. The said housing top 172 and front 173 are prevented from being inadvertently opened by the operating mechanism cabinet front which has its flange 21 arranged to extend above the cabinet top 16 as seen in Figs. 7, 8 and 10.

Mounted within the counter mechanism housing is a shutter which is employed to notify the operator when a current interruption has occurred which of course would mean that the mechanism may have been out of operation for a time and that the recorded degree-days may not be correct. The shutter is substantially

U-shaped and comprises a body member 179 having arms 180 and 181 depending from the opposite ends of the body member 179. The shutter arms 180 and 181 are rotatably or oscillatably journaled on the counting wheels drive shaft 88. In order that the shutter may be retained in its operative position it is provided with a foot 182 for engagement with the holding magnet core 183 of holding magnet 139.

When the switch 122 is turned on the holding magnet 139 is energized whereupon the shutter is manually moved to the solid line position thereof in Fig. 9 thereby bringing the magnet core 183 and shutter foot 182 into operative engagement whereupon the magnet holds the shutter in its operative position with the body member 179 thereof in the position illustrated in Fig. 4. Current interruption in the circuit will deenergize the magnet core 183 whereupon the shutter falls to the position illustrated in phantom lines in Fig. 9 which brings the body member 179 in front of the window 174 to prevent reading of the numerals on the counting wheels 86. As desired the forward face of the shutter body member 179 may be provided with a suitable legend informing the operator of the current interruption and possible inaccurate recording of degree-days, the inaccurate recording being occasioned by the fact that any degree-days that occurred during the current interruption would not be recorded or included in the figure of degree-days. In this event the operator will have to consult weather records and charts to determine the number of degree-days that occurred during the shut-off of current and will have to adjust the device to indicate the proper number of degree-days which can be done manually by actuating the driven disc 91.

The operation of the complete device is as follows:

The cabinet housing the operating mechanism is mounted in position so that the mercury bulb 84 will be subjected to the outside temperature or atmosphere preferably on the north wall of the building. The wires 120 and 121, through their plug part 117, are connected with an electric current source whereupon the switch 122 is closed. The counting mechanism shutter is then positioned as above described to permit observation of the counting wheels 86 through the window 174. The magnetic counter mechanism 168 is then positioned at any desirable point where it can be observed, in the event that a magnetic counter is employed. The point of mounting of the magnetic counter 168 may be on a desk or other support considerably removed from the operating mechanism and since the circuit which operates it is of a low voltage, no appreciable problem of installation is encountered. It should be noted that any number of magnetic counters may be employed, they being connected in parallel in the wires 166 and 167 or a suitable outlet plug 159 may be employed into which a plurality of plug parts 165 may be connected with each of said plug parts being connected with a separate magnetic counter 168.

The closing of switch 122 effected the energization of the clock motor 32 which caused a rotation of the dial 34. It should be noted that the dial 34 around its periphery and beyond the last temperature band 51 is provided with a band 184 which may be conveniently divided into segments representing the hours in a complete revolution of the disc and since it is desirable that the disc make a complete revolution each twelve hours, the disc, illustrated in the drawings, is so divided with each segment carrying a numeral 185 indicating the hour. The said segments and hour indications cooperate with a suitable marker preferably provided on the cabinet cover window 31'. At the time of starting the degree-day recorder the disc is adjusted prior to being secured to the carrier 36 to indicate the proper time after which it will remain in proper time position except during current interruption and which disc will then indicate the elapsed time during the interruption.

During the rotation of the dial 34 the changes in the atmosphere acting on the mercury bulb 84 cause the arm 55 to swing outwardly of the dial center, or to the left as seen in Fig. 1, upon a decline in said temperature. If the temperature is above the norm, 65° F., the arm 55 will be swung toward the center of the disc 34 inwardly of the circle 47 which forms the inner edge of temperature band 46. The said inward swinging of the arm 55 will continue until a stop 186, upstanding from the bottom plate 61 of the supporting bracket 62, is encountered. The reason for this is that no purpose is gained by swinging the arm past the center of the disc 34, or to the right thereof, as at this time the temperature is above that at which additional heat within the building is desired or needed. In order to permit of the holding of the arm 55 by the stop 186 the spring 71 is expanded thereby allowing the operating arm 70 to move its actuating pin 69 in the link elongated aperture 68.

Assuming that the temperature acting on the mercury bulb 84 is between 50° F. and 55° F. the arm stylus 52 will be in the temperature band outwardly of the band 49, as illustrated in the drawings, and which temperature band 55—50, representing a maximum of 15° F. below the norm of 65° F., will have therein fifteen bars or contact points 44. As the dial 34 is rotated it successively makes contact with the bars or contact points 44 through the stylus point 53 and thereby makes or completes an electrical circuit as follows: from one end of the step-down transformer secondary coil 140 through wire 108, wire or connector 146, bracket 62, stylus arm 55, stylus 52, disc contact or bar 44 and disc back 43, carrier 36 and metallic parts of the clock motor 32, clock plate 151, connector 150, wire 149, wire or connector 152, relay switch coil 144, wire or connector 143, and wire 142 to the other end of said transformer secondary coil 140.

The energization of the relay coil 144 through its core 153 actuates the movable contact 154 for completing an electrical circuit to the counter motor 92. This circuit to the counter motor 92 is as follows: from the switch 122 through the wire 130 to a wire or connector 134 associated with the relay 133, fixed contact 134, movable contact 154, wire 155, motor contact 156, motor contact 135, wire 131 to the switch 122. This then starts the motor 92 in operation for driving the gear train 93—96 and therefrom the shaft 102 and the print wheel 86'.

It is presumed that the electrical circuit which energized the relay switch 133 was made between the stylus point 53 and contact strip or bar 44 and that this contact was a solid one. If the counter was of the magnetic type a registering would have been made immediately and if the stylus chattered on the strip or bar 44 each chatter would have been registered as a degree-day and thereby set up a false total. As was pointed out above the face of the dial is etched to provide the bars 44 with the portions of the face between

said bars as recesses filled with an insulation material to prevent electrical contact. In the event that the said etching was not complete enough to remove all material but allowed minute portions to project from the back 43 of the disc and this were engaged by the stylus point 53 a circuit would have been completed and the register actuated thereby again setting up a false total and reading on the counter. In the event that one of these possible difficulties was present and closed the electrical circuit which operated the counter motor 92 had occurred as soon as the circuit was again broken the relay switch coil 144 would have been deenergized thereby allowing the movable contact 154 to fall away from the fixed contact 134 by gravity or be yieldably separated as by spring 138, see Fig. 12, thereby breaking the circuit to the motor 92 and stopping the counting mechanism. If, however, the circuit was made in proper order, that is, by engagement of the stylus point 53 with a bar 44, the motor 92 is started and a holding circuit is established so that if the circuit is then broken by a piece of foreign material on the dial bar 44, or for some other reason, the counting mechanism will continue to operate until the recorder has properly recorded the degree-day.

This is accomplished by the cam disc 103 on the shaft 102 which, as noted above, has therein the depression or seat 111 and in which is disposed the roller 112 of the switch 109 which upon being rotated causes the roller 112 to be ejected from the depression or seat 111 and gradually force the plunger 113 to a switch closing position which is the bridging of contacts 145 and 147 by the movable contact 148. It will be appreciated that the counter motor 92 will of necessity have to operate for a reasonable time before the switch 109 is closed to complete the holding circuit for the motor 92. This holding circuit is as follows: from one end of the transformer secondary coil 140 through wire 141 to the connector 143, relay switch coil 144, wire or connector 152, wire 149, switch fixed contact 147, movable contact 148, fixed contact 145 and wire 142 to the other end of said secondary coil 140 for thereby energizing the coil 144 of the relay switch 133. It will be noted that the breaking of the circuit which includes the arm 55, stylus point 52 and disc contact bars 44 cannot now break the circuit so that the counter motor 92 continues to rotate. This rotation of the counter motor 92 continues until the cam disc seat 11 again registers with the roller 112 whereupon the switch 109 is broken and thereby deenergizes the relay switch coil 144 for stopping the rotation of said counter motor 92. It should be noted that the cam disc 103 made one complete revolution which advanced the counting wheel 86' to register the next number thereon and that the time consumed for this purpose was sufficient to permit a rotation of the disc or dial 34 so that the contact bar 44, which initiated the operation of the counter motor, is now beyond the stylus point 53 so that the circuit including the said stylus point 53 and cam bar 44 is broken which permitted the counter motor 92 to be stopped upon the opening of the switch 109.

The magnetic counter 168 was operated during the rotation of the motor 92 but was only operated after the electrical circuit had been completed for insuring the operation of the counter motor 92 through a complete revolution and after it had been determined that the contact was a true and not a false one.

It will be noted from Fig. 12 that the circuit to the magnetic counter 161 is normally closed and this circuit is as follows: from one end of transformer secondary coil 140 through wire 141, connector 143, wire 158, plug parts 159 and 165, wire 166, magnetic counter actuating mechanism (not shown in the drawings), wire 167, plug parts 165 and 159, wire 160, fixed contact 161, movable contact 163, fixed contact 162, and wires 164 and 142 to the other end of the secondary coil 140. The cam disc 104 is rotated in unison with the cam disc 103 and, as noted above, has in its periphery a depression or seat 104, radially displaced with respect to the seat 111 in cam disc 103, which during the rotation thereof and after the closing of the switch 109 is brought into registry with the roller 115 on the plunger or arm 116 of the switch 110 which permits the said plunger 116 to operate for breaking the contact of movable contact 163 from the fixed contacts 161 and 162 thereby permitting a resetting of the magnetic counter operating mechanism (noted above as not shown in the drawings). Continued rotation of the cam disc 104 ejects the roller 115 from the depression or seat 114 for thereby again bridging contacts 161 and 162 by the movable contact 163 and complete the normally complete circuit and operate the magnetic counter operating mechanism for indicating on said magnetic counter an additional degree-day.

From the foregoing it will be noted that the magnetic counter 168 is actuated only when the counting wheels 86 are actuated so that the counting mechanisms are always in agreement.

From the foregoing it will be noted that the counting mechanisms or devices are delayed or may be stopped except when a degree-day is to be registered and that false readings are prevented which may occur if a direct connection is maintained between the dial and the operating mechanism.

In those rare instances where something may happen or occur to prevent the oscillation of the arm 55 to the left, or when manually holding the arm 55 in a position to permit adjustment of the dial 34, and in order to prevent springing or damaging of the arm 51, or link 67 and parts connected and operated thereby, there is provided a yielding or cushioning connection between the arm 55 and the link 67. This connection comprises the bracket 56 pivoted at 189 to one end of the arm 55 and which bracket 56 has pivoted to and upstanding therefrom a stud 190 through which loosely passes a screw 191. The screw 191 is encircled by a compressible spring 192 which abuts on one end with the stud 190 and on the other end with an abutment 193 integral with or secured to the screw intermediate its ends. The screw 191 has adjustable threaded engagement with a second stud 193' pivoted to and upstanding from the arm 55.

As seen from Fig. 4 the operation of this yielding connection is as follows: assuming a movement to the left of the link 67, an oscillation of the bracket 56 will be effected and a movement of the stud 190 along the screw 191 will occur and compress the spring 192 between the said stud 190 and the collar 193. It is to be understood that this is merely a safety measure and in no wise interferes with the normal operation of the parts.

It is to be understood that a degree-day is a drop of one degree below the established norm in a twenty-four hour period, wherefore if the temperature were 50° F. for a twenty-four hour period there would be fifteen degree-days in said twenty-four hour period. By utilizing a clock

and dial that make a complete revolution in twelve hours and with the dail marked off in divisions for each degree of drop the recorder would register twice for each degree of temperature drop. To compensate for this the counter 85 may be supplied with a counting wheel or register utilizing one-half digits as disclosed in the magnetic counter in Fig. 12 and requiring the contact of the stylus 52 with two successive bars or contacts 44 in order to register a whole degree-day.

The magnetic counter 168, shown semi-diagrammatically in Fig. 12, is provided with an upper set or series of windows 194 and a second or lower set or series of windows 195. The second set or series of windows 195 may be employed for indicating the number of degree-days in short periods of time such as daily or weekly while the first set of windows 194 would be employed for indicating the total number of degree-days in a normal heating season, such as from the first of September to the last of the following June. The magnetic counter 168 is shown as utilizing the one-half digits in the first windows or openings of each series and it is to be understood that the digits or figures which appear in said windows 194 and 195 to the left of the one-half character accumulate in the same manner as any counter, accumulating the full degree-days in each twenty-four hour period. It is also to be understood that the counter includes mechanism whereby the indicating characters or digits may be returned to zero at the ends of given periods, those in the windows 195, as above noted, and if so desired, at the end of each day or week while those in the windows 194, again as noted above, at the end of the heating season.

In the above description the counting motor switch 109 is described as controlled by the cam disc 103 while the magnetic counter switch is described as controlled by the cam disc 104 said disc being driven in unison for sequential operation of said switches. As illustrated in Figs. 13 and 14 the discs 103 and 104 may be combined into a single disc 196 which has therein a single notch 197. In this case the microswitches 109 and 110 are mounted in vertical alignment with the switch actuating roller 112, of the switch 109, in the notch 197 and the switch actuating roller 115, of the switch 110, in peripheral contact with the cam disc 196. The said cam disc 196 has projecting therefrom the driving pins 105 and 106 for the same purpose as such pins carried by the cam disc 104.

The operation of the modified construction in Figs. 13 and 14 is identical with that above described with the microswitch 109 being utilized for maintaining the rotation of the counter motor 92 and the microswitch 110 being employed after a degree-day has been recorded for operating the magnetic counter 168.

It is believed now evident that there has been provided a degree-day register and accumulator that otherwise accomplishes the objects initially set forth.

What is claimed is:

1. In a device of the class described the combination with means for detecting temperature degree changes within a given range during a given time interval, of a primary electric circuit completed upon the detection of each temperature degree change, and means for maintaining the primary circuit complete and operative for a time interval following the temperature degree change detection, comprising a circuit closing relay in said primary electrical circuit energizable upon the completion of said primary circuit, a registering mechanism including a driving motor therefor for accumulatively registering the detected temperature degree changes, a motor electric circuit including said motor completed by the energization of said relay in the primary circuit, and a holding circuit for the motor circuit for maintaining the motor circuit after the primary circuit has been broken upon the inoperativeness of the primary circuit maintaining means and during the registering of the detected temperature degree change.

2. In a device of the class described the combination with means for detecting temperature degree changes within a given range during a given time interval, of a primary electric circuit completed upon the detection of each temperature degree change, and means for maintaining the primary circuit complete and operative for a time interval following the temperature degree change detection, comprising a circuit closing relay in said primary electrical circuit energizable upon the completion of said primary circuit, a registering mechanism including a driving motor therefor for accumulatively registering the detected temperature degree changes, a motor electric circuit including said motor completed by the energization of said relay in the primary circuit, and a holding circuit for the motor circuit for maintaining the motor circuit after the primary circuit has been broken upon the inoperativeness of the primary circuit maintaining means and during the registering of the detected temperature degree change, said holding circuit including a normally open switch closed by the operation of the motor during the time interval the primary circuit is maintained closed after the detection of a temperature degree change.

3. In a device of the class described the combination with means for detecting temperature degree changes within a given range during a given time interval, of a primary electric circuit completed upon the detection of each temperature degree change, and means for maintaining the primary circuit complete and operative for a time interval following the temperature degree change detection, comprising a circuit closing relay in said primary electrical circuit energizable upon the completion of said primary circuit, a registering mechanism including a driving motor therefor for accumulatively registering the detected temperature degree changes, a motor electric circuit including said motor completed by the energization of said relay in the primary circuit, and a holding circuit for the motor circuit for maintaining the motor circuit after the primary circuit has been broken upon the inoperativeness of the primary circuit maintaining means and during the registering of the detected temperature degree change, said holding circuit including a normally open switch, means for closing said normally open switch, and means for connecting the switch closing means with the motor so that said switch closing means is operated after the motor has been in operation for a given time period but during the time interval following detection of a temperature degree change.

4. In a device of the class described the combination with means for detecting temperature degree changes within a given range during a given time interval, of a primary electric circuit completed upon the detection of each temperature degree change, and means for maintaining the primary circuit complete and operative for a

time interval following the temperature degree change detection, comprising a circuit closing relay in said primary electrical circuit energizable upon the completion of said primary circuit, a registering mechanism including a driving motor therefor for accumulatively registering the detected temperature degree changes, a motor electric circuit including said motor completed by the energization of said relay in the primary circuit, and a holding circuit for the motor circuit for maintaining the motor circuit after the primary circuit has been broken upon the inoperativeness of the primary circuit maintaining means and during the registering of the detected temperature degree change, said holding circuit including a normally open switch, means for closing said switch, and a cam associated with said motor and operable thereby for actuating the switch closing means within the time interval of maintenance of the primary electrical circuit following the detection of a temperature degree change.

5. In a device of the class described the combination with means for detecting temperature degree changes within a given range during a given time interval, of a primary electric circuit completed upon the detection of each temperature degree change, and means for maintaining the primary circuit complete and operative for a time interval following the temperature degree change detection, comprising a circuit closing relay in said primary electrical circuit energizable upon the completion of said primary circuit, a registering mechanism including a driving motor therefor for accumulatively registering the detected temperature degree changes, a motor electric circuit including said motor completed by the energization of said relay in the primary circuit, a holding circuit for the motor circuit for maintaining the motor circuit after the primary circuit has been broken upon the inoperativeness of the primary circuit maintaining means and during the registering of the detected temperature degree change, an electro-magnetic counter, and means operable by said motor during the rotation thereof by the holding circuit for energizing the electro-magnetic counter.

6. In a device of the class described the combination with means for detecting temperature degree changes within a given range during a given time interval, of a primary electric circuit completed upon the detection of each temperature degree change, and means for maintaining the primary circuit complete and operative for a time interval following the temperature degree change detection, comprising a circuit closing relay in said primary electrical circuit energizable upon the completion of said primary circuit, a registering mechanism including a driving motor therefor for accumulatively registering the detected temperature degree changes, a motor electric circuit including said motor completed by the energization of said relay in the primary circuit, a holding circuit including a normally open switch for the motor circuit for maintaining the motor circuit after the primary circuit has been broken upon the inoperativeness of the primary circuit maintaining means and during the registering of the detected temperature degree change, an electro-magnetic counter, a circuit including a normally closed spring operated switch which must be operated for energizing the electro-magnetic counter, and means operable by the motor for closing the normally open switch and completing the motor holding circuit and operating the normally closed switch to energize the electro-magnetic counter.

7. In a device of the class described the combination with means for detecting temperature degree changes within a given range during a given time interval, of a primary electric circuit completed upon the detection of each temperature degree change, and means for maintaining the primary circuit complete and operative for a time interval following the temperature degree change detection, comprising a circuit closing relay in said primary electrical circuit energizable upon the completion thereof, a registered mechanism including a driving motor therefor for accumulatively registering the detected temperature degree changes, a motor electric circuit including said motor completed by the energization of said relay in the primary circuit, a holding circuit including a normally open switch for the motor circuit for maintaining the motor circuit after the primary circuit has been broken upon the inoperativeness of the primary circuit maintaining means and during the registering of the temperature degree change, an electro-magnetic counter, a circuit including a normally closed spring operated switch which must be operated for energizing the electro-magnetic counter, a plunger associated with the motor holding circuit normally open switch and adapted to operate the same, a second plunger associated with the electro-magnetic counter circuit spring actuated normally closed switch and adapted to operate the same, and cams operable by the motor for actuating the switches' plungers.

8. In a degree-day register, a counting circuit having parts adapted to be put in and out of electric contact to energize said circuit, a totalizing register, means adapted to operate said register in response to energization of said circuit, degree-day detecting means which detects each degree day as it occurs by causing electrical contact between said parts, the arrangement of said circuit, parts, register, register-operating means and detecting means being such that the electrical contact between the parts must remain undisturbed for a finite time after each contact caused by detection of a degree day in order that the said degree-day be registered accurately, and means operated by the first said means when said circuit is energized to maintain energization of the first said means only for a sufficient time and independently of whether the said parts are in contact to permit each detected degree-day to be properly registered by said register.

9. In a degree-day register, a detector for detecting each degree day as it occurs and formed by parts which are adapted to come into contact when a degree-day is detected and remain in undisturbed contact a finite time after each contact, a primary electric circuit including the coil of an electromagnetic relay and which circuit is closed and said coil energized by the coming together of said parts as each degree day occurs, a register for registering each degree day as it occurs, means connected with and adapted to operate said register, an electric operating circuit including switch contacts associated with the primary circuit electromagnetic relay and connected therewith for actuating the register operating means and which operating circuit is energized by the primary circuit through the electromagnetic relay therein, and a normally open holding circuit completed by the register operating means for maintaining said register operating means operating circuit complete only

for a sufficient time and independently of whether the said parts are in contact to permit each detected degree day to be properly registered by the register.

10. In a degree-day register, a detector for detecting each degree day as it occurs and formed by parts which are adapted to come into contact when a degree-day is detected and remain in undisturbed contact a finite time after each contact, a primary electric circuit including the coil of an electromagnetic relay and which circuit is closed and said coil energized by the coming together of said parts as each degree day occurs, a register for registering each degree day as it occurs, means connected with and adapted to operate said register, an electric operating circuit including switch contacts associated with the primary circuit electromagnetic relay and connected therewith for actuating the register operating means and which operating circuit is energized by the primary circuit through the electromagnetic relay therein, a normally open holding circuit including a normally open switch closed by the register operating means for maintaining said register operating means operating circuit complete only for a sufficient time and independently of whether the said parts are in contact to permit each detected degree day to be properly registered by the register, and means operable by the register operating means for closing said normally open switch and which switch closing is effected during the aforementioned finite time that the parts are in contact.

11. In a degree-day register, a detector for detecting each degree day as it occurs and formed by parts which are adapted to come into contact when a degree-day is detected and remain in undisturbed contact a finite time after each contact, a primary electric circuit including the coil of an electromagnetic relay and which circuit is closed and said coil energized by the coming together of said parts as each degree day occurs, a register for registering each degree day as it occurs, means connected with and adapted to operate said register, an electric operating circuit including switch contacts associated with the primary circuit electromagnetic relay and connected therewith for actuating the register operating means and which operating circuit is energized by the primary circuit through the electromagnetic relay therein, a normally open holding circuit including a normally open switch, and a cam operable by the register operating means for closing the holding circuit normally open switch and which switch closing is effected during the finite period of time that the parts are in contact for maintaining said register operating means operating circuit complete only for a sufficient time and independently of whether the said parts are in contact to permit each detected degree day to be properly registered by the register.

12. In a device of the class described, the combination of a degree-day detector for detecting degree days during a definite period of time, comprising a rotatable member having a surface movable through a definite path of rotation during said definite period of time, contact means having spaced contact portions distributed over the surface of said rotatable member along the path of rotation of said member, the number of said contact portions per given length of path of rotation of the rotatable member varying progressively transversely of the direction of rotation of the rotatable member, a temperature controlled and movable member having a contact cooperating with said rotatable member contact portions, said temperature controlled and movable member contact being adapted for individual contact association with the rotatable member contact portions by movement of said movable member transversely of said path of rotation, a register for registering and accumulating the number of contacts between the rotatable member contact portions and the temperature controlled and movable member contact occurring while the rotatable member is moving through its path of rotation, means for actuating the register, means including the rotatable member contact portions and the temperature controlled and movable member contact operating the register actuating means upon initial contact of said temperature controlled and movable member contact and a rotatable member contact portion and operable during the duration of contact of said contacts, and additional means operable by the last mentioned means for continuing the operation of the register actuating means only for a sufficient time and independently of whether the said contacts are in contact to permit each detected degree day to be properly registered by the register.

13. In a device of the class described, the combination of a degree-day detector for detecting degree days during a definite period of time, comprising a rotatable member having a surface movable through a definite path of rotation during said definite period of time, contact means having spaced contact portions distributed over the surface of said rotatable member along the path of rotation of said member, the number of said contact portions per given length of path of rotation of the rotatable member varying progressively transversely of the direction of rotation of the rotatable member, a temperature controlled and movable member having a contact cooperating with said rotatable member contact portions, said temperature controlled and movable member contact being adapted for individual contact association with the rotatable member contact portions by movement of said movable member transversely of said patch of rotation, a register for registering and accumulating the number of contacts between the rotatable member contact portions and the temperature controlled and movable member contact occurring while the rotatable member is moving through its path of rotation, an electric motor connected with and for actuating the register, a normally open electric circuit including the rotatable member contact portions and the temperature controlled and movable member contact closed by and upon contact of one of said rotatable member contact portions and the temperature controlled and movable member contact operating and maintaining said operation of the motor for the time interval that a contact portion of said rotatable member and the temperature controlled and movable member contact are in contact, and additional means operable by the register motor during the operation thereof by the aforesaid electric circuit for continuing the operation of the motor only for a sufficient time and independently of whether the said contacts are in contact to permit each detected degree day to be properly registered by said register.

14. In a device of the class described, the combination of a degree-day detector for detecting degree days during a definite period of time, comprising a rotatable member having a surface movable through a definite path of rotation

during said definite priod of time, contact means having spaced contact portions distributed over the surface of said rotatable member along the path of rotation of said member, the number of said contact portions per given length of path of rotation of the rotatable member varying progressively transversely of the direction of rotation of the rotatable member, a temperature controlled and movable member having a contact cooperating with said rotatable member contact portions, said temperature controlled and movable member contact being adapted for individual contact association with the rotatable member contact portions by movement of said movable member transversely of said path of rotation, a register for registering and accumulating the number of contacts between the rotatable member contact portions and the temperature controlled and movable member contact occurring while the rotatable member is moving through its path of rotation, an electric motor connected with and for actuating the register, a normally open electric circuit including the rotatable member contact portions and the temperature controlled and movable member contact closed by and upon contact of one of said rotatable member contact portions and the temperature controlled and movable member contact operating and maintaining said operation of the motor for the time interval that a contact portion of said rotatable member and the temperature controlled and movable member contact are in contact, and a normally open holding circuit closed by the motor and connected therewith for maintaining the operation of the said motor only for a sufficient time and independently of whether the said contacts are in contact to permit each detected degree day to be properly registered by said register.

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