

Sept. 13, 1955

C. E. OHLHEISER

2,717,957

SNOW, ICE AND SLEET SENSING DEVICE

Filed May 3, 1951

2 Sheets-Sheet 1

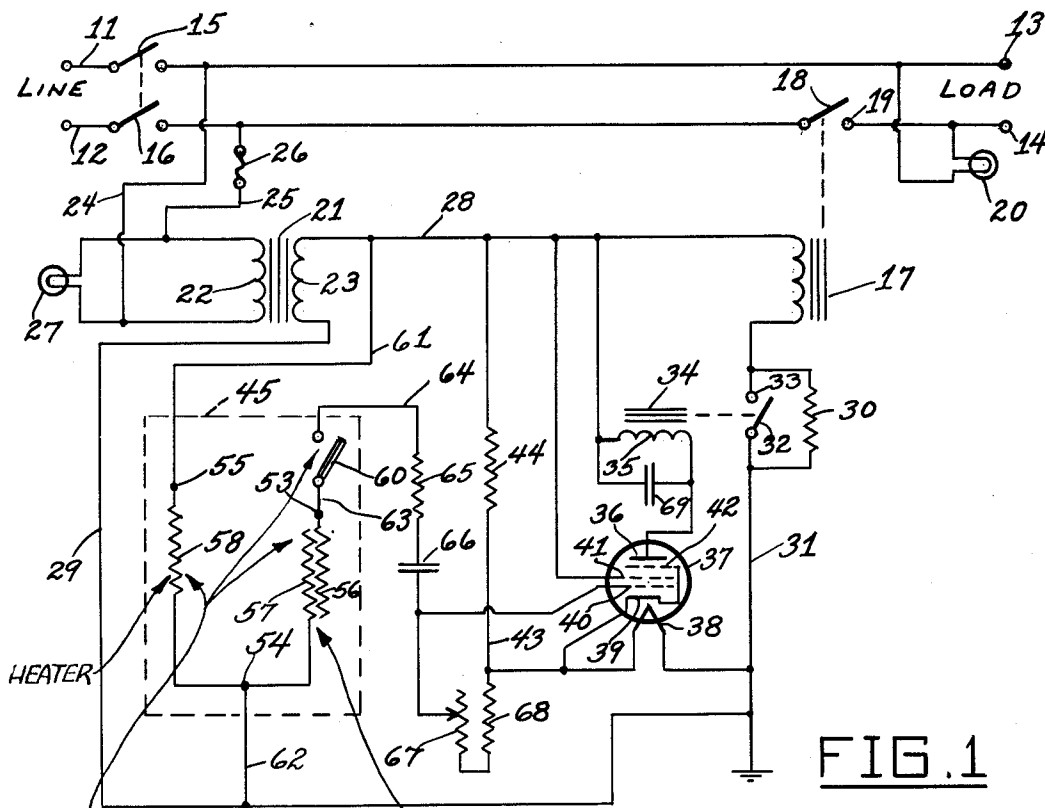


FIG. 1

IN THERMAL
RELATIONSHIP

MOISTURE
SENSING
ELEMENT

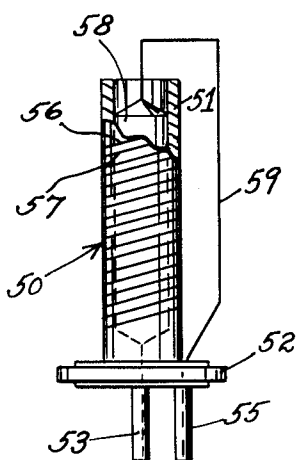


FIG. 2

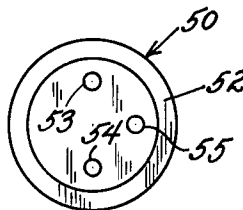


FIG. 3

INVENTOR.
CARLTON E. OHLHEISER
BY *Herman Z. Gordon*
ATTORNEY

Sept. 13, 1955

C. E. OHLHEISER

2,717,957

SNOW, ICE AND SLEET SENSING DEVICE

Filed May 3, 1951

2 Sheets-Sheet 2

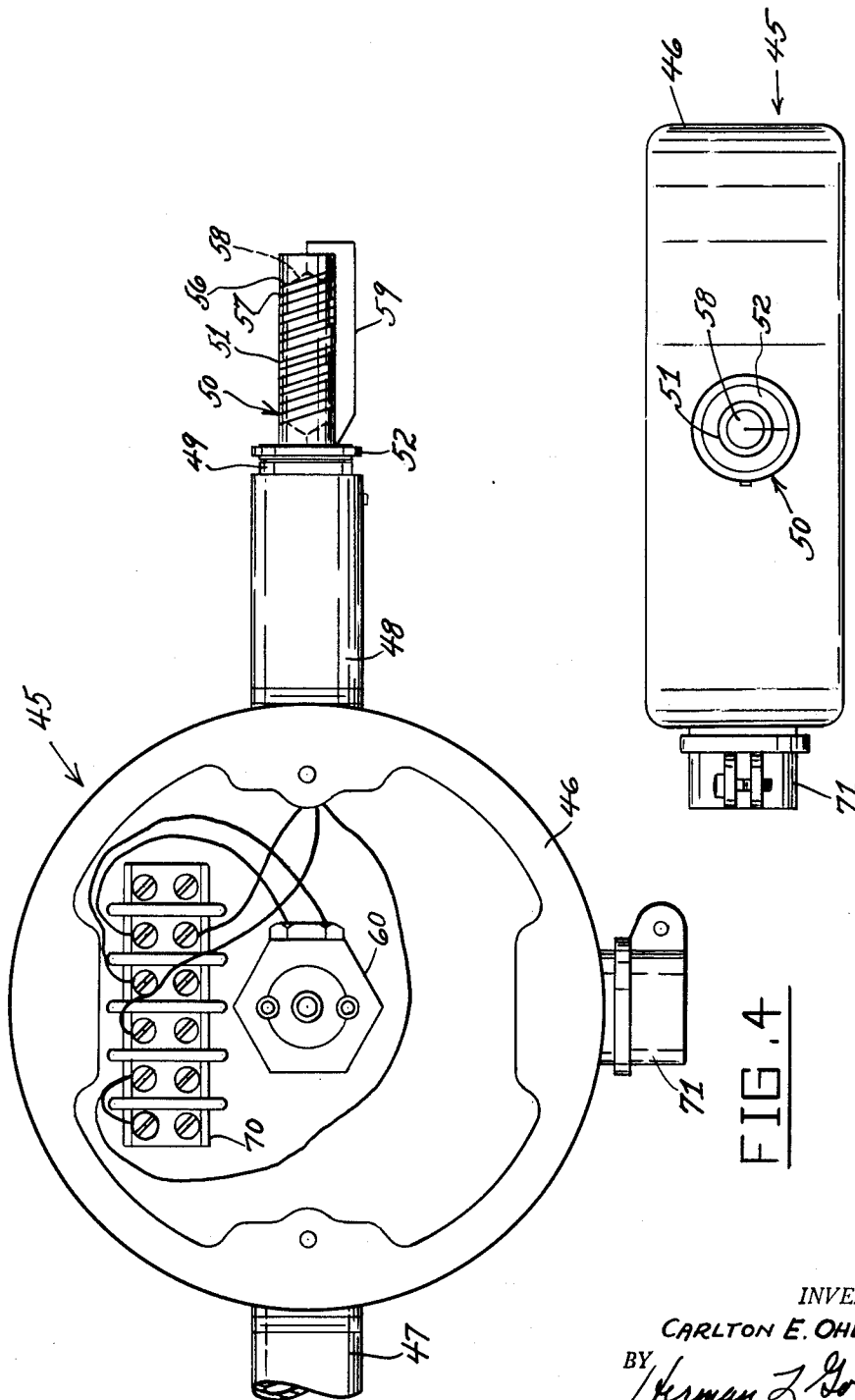


FIG. 4

FIG. 5

INVENTOR.

CARLTON E. OHLHEISER

BY *Kerman Z Gordon*

ATTORNEY

1

2,717,957

SNOW, ICE, AND SLEET SENSING DEVICE

Carlton E. Ohlheiser, Silver Spring, Md., assignor to American Instrument Company, Inc., Silver Spring, Md.

Application May 3, 1951, Serial No. 224,431

4 Claims. (Cl. 250—27)

This invention relates to snow, ice and sleet sensing devices, and more particularly to an apparatus for detecting the presence of snow, ice or sleet on an exposed structure, such as an antenna, and for controlling a heater or other similar device provided to remove the accumulated snow, ice or sleet from said structure.

A main object of the invention is to provide a novel and improved snow, ice and sleet sensing apparatus for controlling heating equipment associated with antennas or similar exposed structures, said apparatus being simple in construction, involving relatively few parts, being reliable in operation, and being easy to install.

A further object of the invention is to provide an improved snow, ice and sleet sensing apparatus for controlling heating equipment associated with radio antennas and similar exposed structures, said apparatus being inexpensive to manufacture, being rugged in construction, and having high sensitivity.

A still further object of the invention is to provide an improved snow, ice and sleet sensing apparatus for detecting the accumulation of snow, ice or sleet on an exposed structure, such as a radio antenna, and for controlling electrical heating equipment designed to remove said accumulation, said apparatus being arranged to function under all weather conditions, requiring a minimum amount of supervisory attention, and being completely automatic in operation.

Further objects and advantages of the invention will become apparent from the following description and claims, and from the accompanying drawings, wherein:

Figure 1 is a wiring diagram of an improved snow, ice and sleet sensing apparatus constructed in accordance with the present invention.

Figure 2 is an elevational view, partly in cross-section, of a moisture-sensing element employed in the apparatus of Figure 1.

Figure 3 is a bottom view of the moisture-sensing element of Figure 2.

Figure 4 is a plan view of a housing employed as a support for the moisture-sensing element and to contain the thermostat and terminal strip of the apparatus of Figure 1, the moisture-sensing element being shown in place thereon.

Figure 5 is a side elevational view of the housing of Figure 4, the moisture-sensing element being shown in end view.

Referring to the drawings, Figure 1 shows a wiring diagram of a control circuit for controlling the energization of standard antenna heating equipment from supply lines designated at 11 and 12. The heating equipment is connected to the terminals 13 and 14. Designated at 15 and 16 are the poles of a manually operated double-pole control switch connected in the respective lines 11 and 12. Designated at 17 is a normally open solenoid switch whose contacts 18 and 19 are connected in the line 12 between switch pole 16 and load terminal 14, as shown. Connected across the load terminals 13 and 14 is an indi-

2

cating lamp 20, which becomes energized simultaneously with the antenna heating equipment.

Designated at 21 is an isolation transformer having a primary winding 22 and a secondary winding 23. The terminals of primary 22 are connected to the line wires 11 and 12 by respective conductors 24 and 25, the conductor 25 including a fuse 26. Connected across the primary terminals is an indicator lamp 27 which becomes energized when line voltage is applied to primary 22.

One terminal of secondary winding 23 is connected by a wire 28 to one terminal of the solenoid 17. The remaining terminal of secondary 23 is connected to ground by a wire 29. The remaining terminal of solenoid 17 is connected to ground through a resistor 30 and a wire 31, as shown. Resistor 30 has a relatively high value of resistance. Connected across resistor 30 are the contacts 32 and 33 of a relay 34, said contacts being closed when relay 34 is deenergized but being held open when a substantial value of current flows through the relay winding, shown at 35.

Relay winding 35 is connected between wire 28 and the plate 36 of a vacuum tube 37. Tube 37 has a filament 38, a cathode 39, a control grid 40, a screen grid 41 and a suppressor grid 42. Said tube may be a conventional tube, such as a tube of the 50L6 type. Screen grid 41 is connected to wire 28, and the suppressor grid 42 is internally connected to cathode 39.

One terminal of filament 38 is grounded. The other terminal of said filament is connected through a wire 43 and a filament resistor 44 to the wire 28. Cathode 39 is connected to wire 43, as shown.

Designated at 45 is a temperature and moisture sensing unit adapted to be mounted adjacent the antenna or other structure to be protected against the accumulation of snow, ice or sleet. As shown in Figures 4 and 5, the unit 45 comprises a circular metal housing 46 provided at one side thereof with a tubular supporting arm 47 adapted to be secured in any suitable manner to the mast of the antenna, or to any other portion thereof adjacent the elements to be protected. Secured in the opposite side of the housing 46 is a tubular conduit 48. Secured in the end of conduit 48 is a socket 49 in which is mounted the exposed, pronged moisture sensing element 50. Element 50 comprises a tubular coil form 51 of insulating material, secured to a circular base 52. Secured to base 52 are the respective prongs 53, 54 and 55. Wound on coil form 51 are the spaced bifilar conductors 56 and 57, connected respectively to the prongs 53 and 54. Secured inside the coil form 51 is a heating resistor 58. One terminal of resistor 58 is connected to prong 54. The other terminal of said resistor is connected to prong 55 by a wire 59 extending outside of and spaced from the surface of coil form 51, as shown in Figure 2.

Mounted centrally in housing 46 is a thermostat switch 60 of conventional construction. Thermostat 60 is arranged to open its contacts when the ambient temperature is just above freezing, as, for example, at a temperature of 34 degrees Fahrenheit. At temperatures lower than this value the thermostat contacts are closed.

The prong 55 is connected through socket 49 and a wire 61 to the wire 28. Prong 54 is connected through said socket and a wire 62 to ground. Prong 53 is connected through the socket and a wire 63 to one terminal of thermostat 60. The other terminal of the thermostat is connected through a wire 64, a resistor 65, and a condenser 66 to the control grid 40 of tube 37. Connected in series between grid 40 and cathode 39 are the variable resistor 67 and the fixed resistor 68.

It will be noted that grid 40 will be substantially at the same potential as cathode 39 when either thermostat 60 is open or when the windings 56 and 57 are electrically insulated from each other, i. e., when moisture is

not present on the moisture sensing element 50. Under these conditions, a substantial value of rectified current flows through the plate circuit of tube 37 and energizes relay 34. A filter condenser 69 is connected across the terminals of the winding 35 of relay 34 to smooth said rectified current. The contacts 32—33 of relay 34 are therefore held open, as shown in Figure 1, and solenoid switch 17 is deenergized.

When considerable moisture is present in the atmosphere, the windings 56 and 57 will be bridged by a path having relatively low resistance when said moisture is deposited on the exposed sensing element 50. However, the mere bridging of windings 56 and 57 by moisture will produce no result in the circuit unless the ambient temperature is below a predetermined value, for example, a value near freezing temperature, such as 34 degrees Fahrenheit. The presence of a low ambient temperature causes thermostat 60 to close its contacts. When windings 56 and 57 are bridged by moisture and the contacts of thermostat 60 are closed, grid 40 is connected to ground through condenser 66, resistor 65, wire 64, thermostat 60, the bridged windings 56 and 57, and wire 62. Since cathode 39 is at a potential above ground potential during the periods when tube 37 is conducting, by a value equal to the filament voltage, the grid potential drops to a value substantially lower than the cathode potential, determined by the setting of variable resistor 67. Thus, when the windings 56, 57 are bridged and the contacts of thermostat 60 are closed, the grid potential may drop to a value sufficiently below cathode potential to bias tube 37 beyond cut-off, or to substantially reduce the flow of plate current through said tube, causing relay 34 to become deenergized. Therefore, contacts 32—33 close, shunting resistor 30 and causing solenoid switch 17 to become energized. Contacts 18 and 19 close and cause the antenna heating equipment to become energized.

It will be understood that heating resistor 58 is continuously energized and maintains moisture sensing element 50 at a sufficiently high temperature to melt snow, ice or sleet which may be deposited on the element. The circuit will therefore detect moisture in the form of snow, ice or sleet on the structure with which the apparatus is employed, by the simultaneous closure of the contacts of thermostat 60 and the bridging of windings 56 and 57 by the melted snow, ice or sleet.

As above explained, the box 45 is mounted on an exposed portion of the structure to be protected. A suitable terminal strip 70 is provided in the box to facilitate the connection of the various elements of the unit 45, and a conventional B-X connector 71 is provided in the wall of said box to receive an armored cable employed for the external connections of said unit. The box is provided with a suitable removable metal cover, not shown.

In a typical embodiment of the invention, the following values for the various components were employed:

Resistor 58	10,000 ohms, 1 watt.
Resistor 65	100,000 ohms.
Condenser 66	0.1 mfd., 400 volts.
Variable resistor 67	0-5 megohms.
Resistor 68	20,000 ohms.
Resistor 44	500 ohms, 20 watts.
Resistor 30	3,500 ohms.
Condenser 69	8 mfd., 250 volts.
Tube 37	50L6 GT.
Thermostat 60	Catalogue No. 4-246A, manufactured by the American Instrument Co., Inc., Silver Spring, Md.
Transformer 21	115 volt, 1:1 ratio.

While a specific embodiment of a snow, ice and sleet sensing device has been disclosed in the foregoing description, it will be understood that various modifications with-

in the spirit of the invention may occur to those skilled in the art. Therefore it is intended that no limitations be placed on the invention except as defined by the scope of the appended claims.

What is claimed is:

1. A sensing device of the character described comprising a source of current having a high potential terminal and a low potential terminal, a vacuum tube having a plate, a control grid and a cathode, a current-responsive device connected between said plate and said high potential terminal, a moisture-responsive element and temperature-responsive switch means connected in series between said grid and said low potential terminal, said element being of the type having substantially open-circuit resistance when dry and low resistance when wet, and said temperature-responsive switch means being arranged to close below a predetermined value of ambient temperature and to open above said value, an impedance connected between said grid and cathode, impedance means connected across said high potential and low potential terminals, heating means disposed adjacent said moisture-responsive element in heat-transmitting relation thereto, and means connecting said cathode to said impedance means at an intermediate point on said impedance means, whereby no current flows through said impedance and said grid is substantially at the same potential as said cathode when either the moisture-responsive element is dry or the ambient temperature is above said value, and whereby current flows through said impedance and said grid is at a reduced potential relative to the cathode when the moisture-responsive element is wet and the ambient temperature is below said value.

2. A sensing device of the character described comprising a source of current having a high potential terminal and a low potential terminal, a vacuum tube having a plate, a control grid and a cathode, a current-responsive device connected between said plate and said high potential terminal, a moisture-responsive element and temperature-responsive switch means connected in series between said grid and said low potential terminal, said element being of the type having substantially open-circuit resistance when dry and low resistance when wet, and said temperature-responsive switch means being arranged to close below a predetermined value of ambient temperature and to open above said value, an impedance connected between said grid and cathode, impedance means connected across said high potential and low potential terminals, an electric heater disposed adjacent said moisture-responsive element in heat-transmitting relation thereto and connected to said source of current, and means connecting said cathode to said impedance means at an intermediate point on said impedance means, whereby no current flows through said impedance and said grid is substantially at the same potential as said cathode when either the moisture-responsive element is dry or the ambient temperature is above said value, and whereby current flows through said impedance and said grid is at a reduced potential relative to the cathode when the moisture-responsive element is wet and the ambient temperature is below said value.

3. In a sensing device of the character described a source of current, a load impedance, a moisture-responsive element, a temperature-responsive switch element, a heater disposed adjacent said moisture-responsive element in heat-transmitting relation thereto, means connecting said heater to said source of current, and circuit means connecting said load impedance to said source of current through said moisture-responsive element and said temperature-responsive switch element, said moisture-responsive element being of the type having high resistance when dry and low resistance when wet, and said temperature-responsive switch element being arranged to open above a predetermined value of ambient temperature and to close below said value.

4. In a sensing device of the character described, a

5

moisture-responsive element, a thermostat, and a load impedance connected in series, said element being of the type having high resistance when dry and low resistance when wet, a heater disposed adjacent said element in heat-transmitting relation thereto, and an energizing means connected to said heater.

References Cited in the file of this patent

UNITED STATES PATENTS

2,269,019 Hall ----- Jan. 6, 1942 10 2,295,570

2,329,423

2,357,371

2,358,406

2,375,456

2,468,791

2,490,965

2,553,060

2,564,597

2,611,643

6

Dunmore ----- Sept. 15, 1942
 Steghart ----- Sept. 14, 1943
 Wolfner ----- Sept. 5, 1944
 Lichtgarn ----- Sept. 19, 1944
 Wolfner ----- May 8, 1945
 Thomson ----- May 3, 1949
 Huck ----- Dec. 13, 1949
 Miner ----- May 15, 1951
 Dahline ----- Aug. 14, 1951
 Higgins ----- Sept. 23, 1952