(No Model.)

# J. E. WHITE

## CIRCUIT CLOSING THERMOMETER.

No. 347,851. Patented Aug. 24, 1886.

Fig. 1.

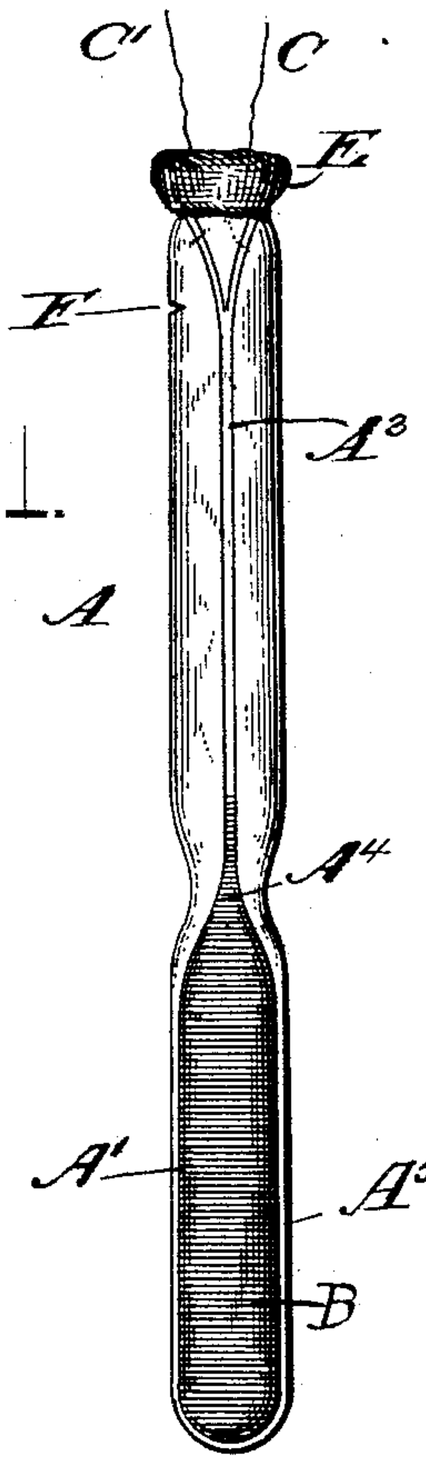



Fig. 3.

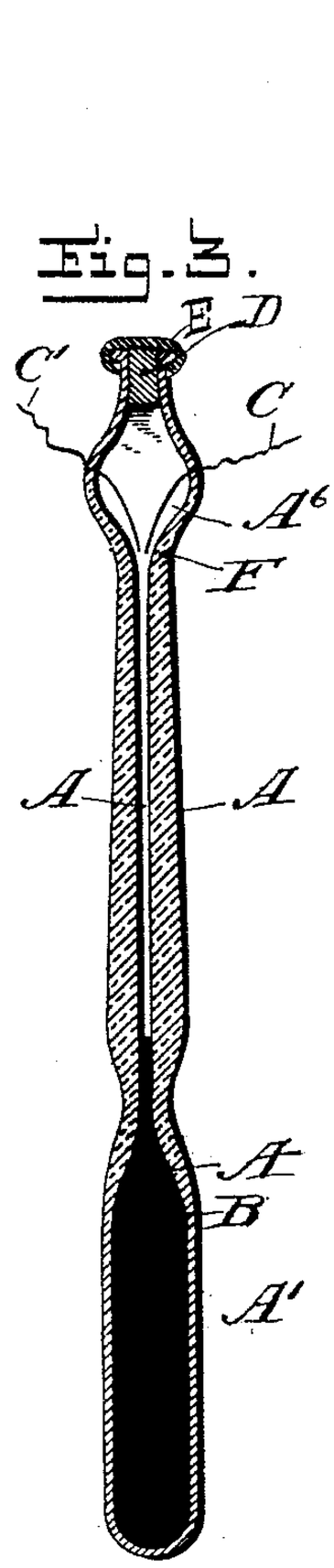



Fig. 2.

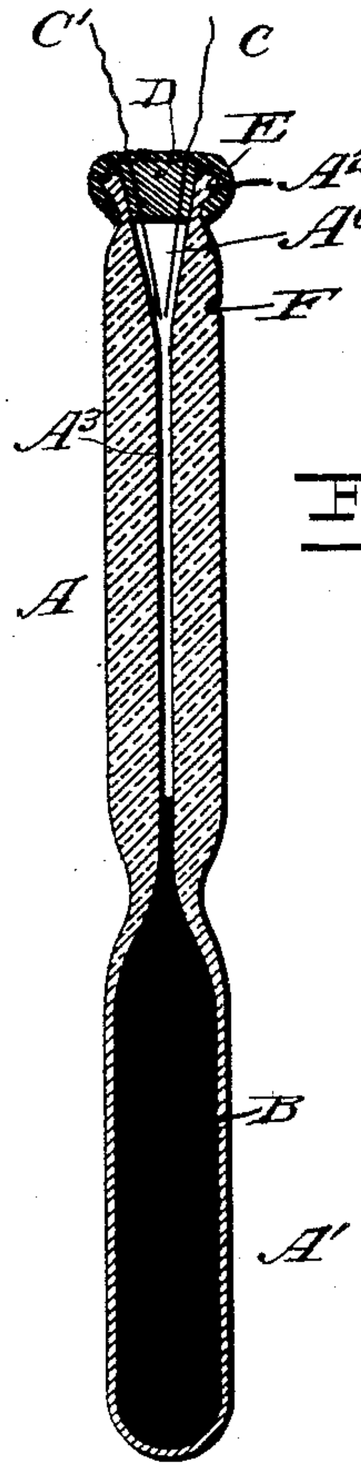
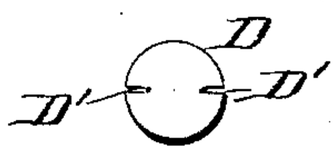



Fig. 4.

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# UNITED STATES PATENT OFFICE.

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## CIRCUIT-CLOSING THERMOMETER.

SPECIFICATION forming part of Letters Patent No. 347,851, dated August 24, 1886.

Application filed November 11, 1885. Serial No 182,472. (No model.)

*To all whom it may concern:*

Be it known that I, JOHN E. WHITE, a citizen of the United States, residing at Syracuse, in the county of Onondaga and State of New York, have invented certain new and useful Improvements in Thermostats, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention has relation to thermostats, and has special reference to that class of the same which comprise a thermometric tube provided with a body of mercury and with the terminals of an electric-circuit, which, normally, are arranged separate from each other, and which are thrown into electrical connection with each other by the contact therewith of a portion of the mercury within the tube, the closing of said connection—that is, the completion of the circuit—being caused by an increase of the temperature of the mercury.

The object of the invention is to produce a thermostat of the class mentioned which shall be sensitive, reliable, and accurate in its operation, and which shall be of such construction that no corrosion or other disadvantageous action of the mercury upon the wires of the circuit can occur by reason of the contact therewith of the mercury when not in the act of closing the circuit.

Other objects and advantages of my invention will appear in the following description, and the novel features thereof will be particularly pointed out in the claims.

Referring to the drawings, Figure 1 is a front elevation, and Fig. 2 a central vertical section, of a thermostat constructed in accordance with my invention. Fig. 3 is a like section of a modification, and Fig. 4 is a detail in plan.

Like letters indicate like parts in all the figures of the drawings.

A represents a tube of glass terminating at one end in an elongated bulb, A′, and at the opposite end in an exterior annular lip, $A^2$. At the lower end of the straight portion $A^3$ of the bore of the tube said bore is gradually expanded, preferably in a symmetrical cone-shaped manner, as at $A^4$, to form the chamber $A^5$ for the mercury B. This chamber is expanded laterally, so that the walls thereof are comparatively thin, in order that the mercury contained therein may be largely exposed and sensitive to changes in temperature. The upper end of the bore $A^3$ of the tube is expanded into the form of an inverted cone, $A^6$. The terminals C C′—one being positive and the other negative—of an electric-circuit are arranged within the cone $A^6$, and, preferably, they may rest upon the inner surface of said cone and project toward each other, though not in contact at the apex of the cone.

For the purpose of a clear illustration of the arrangement of the terminals they are shown as separated from and not in contact with the inner surface of the cone, but when arranged in contact with said surface they are supported and are less liable to be brought into contact with each other by sudden jars or otherwise than when arranged independently of said surface, as shown.

By reason of the extremely slight diameter of the terminals C C′, which are preferably of platinum, the insertion of the same within the cone and in due relation to each other, is facilitated by passing them inwardly along the inner surface of the cone; but, as before stated, for the purpose of illustration, they are not shown in such position.

To maintain the terminals in a desired position, I may fill a portion of the cone $A^6$ with any desired device, material, or cement, the terminals passing therethrough; or, I may first insert a cork, D, through which the terminals pass, and I may or may not facilitate the insertion of the terminals through the cork by forming slits D′ in opposite sides thereof and then forcing the cork into the open end of the tube, thus closing it hermetically. Such closure of the tube may be further secured by the application of any desired cement or plastic E, which, to give further security, may be extended over, so as to embrace, cover, and include the lip $A^2$ of the tube; or, as is customary in the construction of electrical glass appliances, the terminals may be inclosed or embedded in the glass of the tube itself by melting the same and compressing it into a desired form.

A further modification is illustrated in Fig. 3, wherein the terminals C C′ are passed directly through the walls of the upper cone of

the tube, the same being extended to form a mouth, which, in this instance, is closed by any suitable plug and cement. This form is also fully adapted to the method of hermetically sealing the upper end of the tube by fusing the glass and compressing it for that purpose.

F indicates the grade-mark of the thermostat. Heretofore mercurial thermostats have been constructed with one terminal of the circuit arranged at the lower end of the tube, passing through the glass thereof, and into the body of the mercury therein, and the other terminal has been inserted above the mercury, either directly into the bore of the tube or through the walls thereof into said bore. This construction is accompanied with the constant action of the mercury upon the terminal immersed therein, which in time corrodes the terminal following the metal thereof into and possibly through the aperture in the tube through which it is passed, thereby producing in thermostats which have been for a long time in use a leakage of the mercury therefrom, whereby a greater degree of heat than that originally required to cause the mercury to expand a sufficient distance to close the circuit is demanded. Furthermore, this construction subjects the glass, at the point of the entrance of the terminal, to expansion and contraction by reason of the changes of temperature to which it is subjected, and in this manner the glass either becomes cracked or a leak is formed and a loss of mercury results, whereby the instrument is rendered imperfect and unreliable, as well as, in time, inoperative.

Now, by experiment, the quantity of mercury, the size and length of the bore, and the position of the ends of the terminals in the cone may be regulated, so that a predetermined degree of heat is rendered essential to produce the desired operation of the mercury. For example, the tube A, with a quantity of mercury therein, is subjected to a heat of 120°, when the mercury will rise in the tube up to the point F, where an indicating-mark is placed on the tube, as shown. The terminals are inserted in the cork so that they will reach below the point F. The cork is firmly seated, and each of the terminals is drawn upwardly until they coincide with the mark F, when they are sealed in that position. I thus produce a thermostat which requires 120° of heat to operate it. By connecting the terminals of one or of a series of such thermostats, arranged at suitable places within several compartments of a building with an electrical conductor suitably arranged in said building and connected with an alarm, a rise of temperature in any of said compartments to 120° will cause said alarm to be sounded. In this manner the thermostat is applied for detecting the presence of fire or other abnormal heat. This capability of indicating a rise of temperature renders the thermostat capable of use in many arts. For example, they may be used in detecting a rise of temperature in cellars or other store-rooms for beer, where it is desired to maintain a uniform temperature, which, rising to a point to sound the alarm, can be regulated at once by the person in charge of the same. They may also be applied to bearings of machinery, to indicate the heating of the journals or boxes of the same, and for indicating changes of temperature in the bodies of persons under medical treatment and otherwise.

I am aware that attempts have been made to utilize the expansion of mercury to close electrical circuits in thermostats, wherein both the terminals have been conducted into the open mouth of a vessel having mercury therein, but in such cases the body of mercury has been disproportionate to the object in view, in that an excessive degree of heat was required to expand the same without diminution of the area of its upper surface to cause it to come into contact with and connect the terminals. In my improvement I may employ a relatively-large body of mercury, but by the cone $A^4$, I restrict to a marked degree the area of its upper surface to that of the relatively-slight diameter of the bore $A^3$, whereby not only a less degree of heat is required to cause the mercury to ascend a desired distance, but greater sensitivenes as well as greater accuracy is secured in the operation of the thermostat as a whole. Furthermore, in passing the terminals freely in the open end of the tube, as heretofore, the action of the air, and in manufacturing establishments, the action of gases and other chemical properties commingled with the air oxidizes and otherwise renders impure the mercury, so that by hermetically sealing the upper end of the tube I obviate this disadvantage. I do not, however, broadly claim hermetically sealing the terminals in position, as this has been heretofore done.

I am also aware that an S-shaped mercury-tube, something after the nature of a plumber's trap, has been employed, in which the bore at the upper portion has been enlarged to make room for the terminals; but the mercury also was to a material extent contained in said enlargement of the bore, which construction would require an undue variation in temperature to raise the mercury to the terminals, while in my invention the upper surface of the mercury is normally (that is, at a degree of temperature below that at which it is desired to close the circuit) within the reduced bore, and the terminals only are in the enlarged chamber or bore, thus requiring the raising, by change of temperature, of a relative extremely small quantity of mercury to effect a closing of the circuit; and, furthermore, it is not essential in any degree to the accomplishment of this result that the upper enlarged chamber of the bore should be in the form of an inverted cone, as any enlargement which will give room for the terminals will suffice. I may also duplicate the circuit and terminals, if desired—that is, have four or more, instead of two.

I have demonstrated by actual experiment

and use the accuracy and sensitiveness of the thermostat herein shown, and I attribute the same to the peculiar form, proportion, and construction hereinbefore described.

Having described my invention, what I claim is—

1. A thermostat comprising a tube having a central bore terminating below in a mercury-bulb and above in an enlarged chamber in which are arranged out of contact with each other the terminals of an electrical conductor, the upper surface of the mercury reaching normally a point below said enlarged chamber, substantially as specified.

2. A thermostat comprising a tube, the lower end of the bore of which is expanded to form a bulb, and the upper end of which is gradually expanded to form an inverted cone, in combination with terminals hermetically arranged separately in the upper cone, from which the mercury is separated by a reduced bore of the tube, substantially as specified.

3. A thermostat comprising a tube, the bore of which is expanded to form a bulb, a grade-mark at a point on the tube to which the mercury therein rises at a certain temperature, and terminals arranged in the upper end of the tube and projected to said point, substantially as specified.

4. The combination of the tube A, having the bore $A^3$, the cone shape symmetrical enlargement thereof $A^4$, the mercury-bulb $A^5$, and the inverted cone $A^6$, with the terminals C C′, arranged within said cone $A^6$, and means for hermetically sealing said terminals in the tube, the mercury being separated by the reduced bore from the enlargement $A^4$, substantially as specified.

In testimony whereof I affix my signature in presence of two witnesses.

JOHN E. WHITE.

Witnesses:
E. B. STOCKING,
WM. S. DUVALL.