(No Model.)

F. H. PRENTISS & J. A. TILDEN.

ELECTRICAL THERMOSTAT.

No. 285,676. Patented Sept. 25, 1883.

Fig. 1.

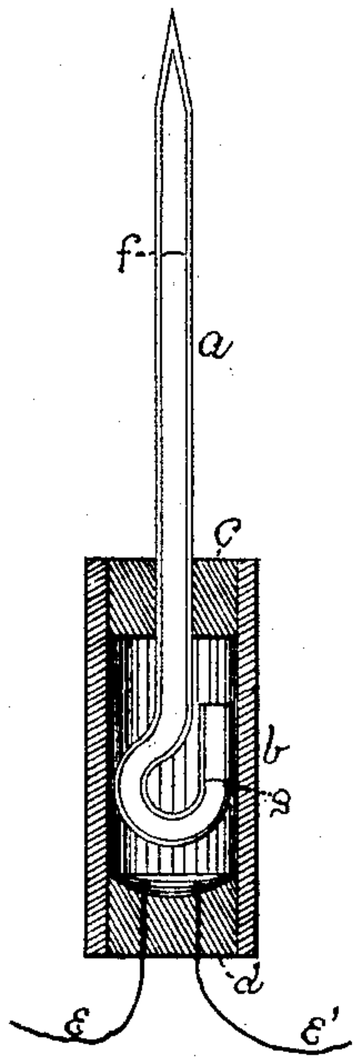
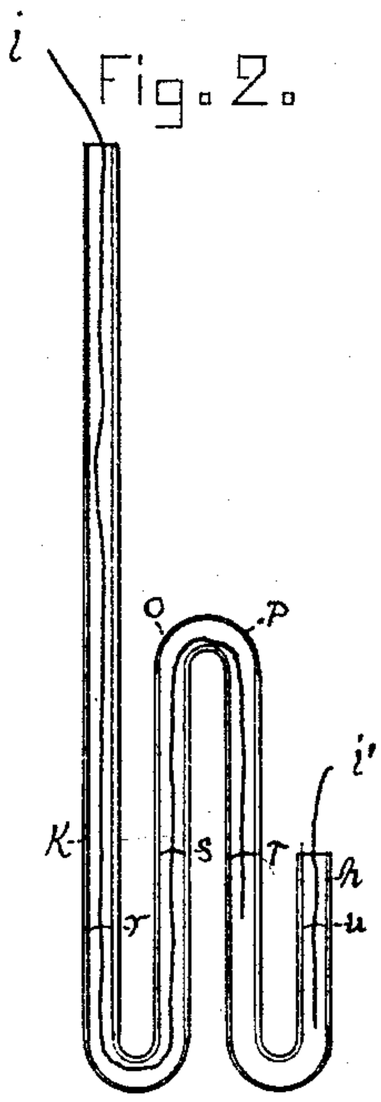


Fig. 2.



WITNESSES

N. C. Wilbur

Geo. Sheffield

INVENTORS

Frederick H. Prentiss.

James A. Tilden

UNITED STATES PATENT OFFICE.

FREDERICK H. PRENTISS, OF BOSTON, AND JAMES A. TILDEN, OF HYDE PARK, ASSIGNORS TO THE AUTOMATIC FIRE ALARM ASSOCIATION, OF BOSTON, MASSACHUSETTS.

ELECTRICAL THERMOSTAT.

SPECIFICATION forming part of Letters Patent No. 285,676, dated September 25, 1883.

Application filed December 7, 1882. (No model.)

To all whom it may concern:

Be it known that we, FREDERICK H. PRENTISS and JAMES A. TILDEN, citizens of the United States, residing, respectively, at Boston, in the county of Suffolk and State of Massachusetts, and at Hyde Park, in the county of Norfolk and State of Massachusetts, have invented a new and useful Electrical Thermostat, of which the following is a specification.

Our invention relates to improvements in electrical thermostats in which an electric circuit is made or broken by the movement of a movable electrical conductor, which conductor is moved at a predetermined temperature by the vaporization of a volatile liquid contained in a suitable reservoir, which temperature is determined by the properties of the saturated vapor of the volatile liquid used; and the objects of our invention are to make or break an electric circuit whenever the temperature of the atmosphere surrounding the thermostat reaches the degree at which the contained volatile liquid vaporizes. We attain these objects by a device, modifications of which are illustrated in the accompanying drawings, in which—

Figure 1 is a vertical section of an electrical thermostat embodying our invention as used on an open circuit. Fig. 2 is a vertical section of an electrical thermostat, also embodying our invention, as used on a closed circuit.

The tube *a* is shown filled with mercury between the points *f* and *g*. The upper end of the tube is sealed by fusing in a lamp or blow-pipe flame, and contains a volatile liquid, which completely fills the upper part of the tube above *f*. The receiver or holder *b* consists of a tube of glass or other suitable substance, the lower end of which is fitted with a rubber cork, *d*, or other non-conducting material, hollowed out, as shown, and through which pass two wires, E and E′. The tube A passes through a stopper, *c*, of cork, papier-maché, or other material, which fits (though not air-tight) the upper part of the receiver *b*.

The operation of the instrument is as follows: Upon the application of heat the expansion of the mercury and of the volatile liquid, as liquids, causes the mercury to rise above the point *g*, but not so much as to cause any of the mercury to be forced out of the tube *a* into the receiver *b;* and we do not claim any movement of the mercury produced by such expansion. When, however, upon the further application of heat, the boiling-point of the volatile liquid is reached and the formation of vapor ensues, the mercury will be forced out rapidly and instantly into the receiver *b*, and thus close the circuit by forming an electrical connection between the wires or electrodes E and E′. Thus, in case sulphuric ether were chosen as the volatile fluid, the boiling-point of which is about 98° Fahrenheit, the circuit would be closed at that temperature. Bisulphide of carbon, the boiling-point of which is about 118° Fahrenheit, would close the circuit at 118° Fahrenheit, and so, also, alcohol at 172° and water at 212°. Other temperatures may be readily obtained by the use of other liquids, among which are the long list of hydrocarbons.

Turning now to our second modification, (shown in Fig. 2,) the bent tube of glass is shown filled with mercury between the points *r* and *s* on one side and between the points *t* and *u* on the other side, while the volatile liquid completely fills the tube between the points *s* and *t*. The two electric wires *i* and *i′* are introduced, as shown, and terminate, respectively, *i* below the meniscus T and *i′* below the meniscus *u*, the mercury between *t* and *u* thus forming the electrical connection. The operation is as follows: When, upon the application of heat, the boiling-point of the volatile fluid is reached, the mercury is depressed in the two legs O and P and rises in the two legs K and N, and in consequence of the leg N being shorter than the leg K the mercury overflows from the leg N, exposing the end of the wire *i*, thus breaking the circuit.

Other forms can be used, both for open and closed circuits, besides these, and we do not confine ourselves to the special forms of the instrument shown in the drawings.

It will be seen from an inspection of the drawings that, since a very small quantity of volatile liquid (much less than here shown) is sufficient to drive out the mercury, no delicate proportionment of parts is necessary either of the liquids or the glass. It will also

be seen that the wires require no accurate adjustment.

We are aware that prior to our invention mercury and other liquids have been combined in electrical thermostats; but heretofore the circuit has been closed or broken by the expansion of the liquids as liquids alone, thereby requiring an apparatus of delicate and expensive construction with fine adjustment of electrodes, thus making the instrument quite too costly for general introduction, while in our instrument the temperature at which the circuit is opened or closed is determined solely by the volatile liquid employed, and the temperature at which the signal is given will be at the boiling-point of that liquid. Now, as the vapor is many times the volume of the liquid, it is evident from the very considerable movement of the mercury caused thereby that the size of the glass is immaterial, as is also to a great extent the distance of the electrodes, thus greatly simplifying and lessening the cost of construction.

To make the action of the thermostat clearer, and to show precisely the temperature at which the movement of the mercury would be caused by the conversion of the lighter liquid into vapor, we can take, for example, a thermostat as herein described in which the lighter fluid is water. Now, it is evident that the water would give off vapor at a temperature when the tension of the vapor would just balance external pressure. At the temperature of 212° Fahrenheit the tension of the saturated vapor of water is equal to 29.92 inches of mercury, and when the atmospheric pressure is also 29.92 inches the tension of the water-vapor is just equal to the atmospheric pressure, and the temperature 212° Fahrenheit is called the "boiling-point," the pressure 29.92 being the average height of barometer at sea-level. If reference be made to Fig. 1, it will be seen, in order that a vapor may form from the lighter liquid, the tension of the vapor must be equal to the difference between the atmospheric pressure (as indicated by barometer and expressed in inches of mercury) and the vertical distance *g f*. For example, if the height of barometer is 29.92 and the mercury column *g f* is 6.46 inches, the actual pressure is 29.92—6.46 or 23.46 inches. Now, the temperature at which the saturated vapor of water has a tension of 23.46 inches is 200° Fahrenheit, and consequently the temperature at which such a thermostat would act by converting its lighter liquid into vapor would be 200. By making the vertical distance *g f* 17.17 inches the action would begin at the temperature of 172° Fahrenheit. In the case of another liquid (not water) the action would be similar, and would follow the law of the relation between the temperature and the tension of the saturated vapor of the liquid used.

Having described our invention, what we claim, and desire to secure by Letters Patent, is—

1. In an electrical thermostat, the combination of mercury with a volatile liquid of different specific gravity, both contained in a suitable holder and relatively arranged substantially as described, whereby when said volatile liquid becomes a vapor by the application of heat the mercury is sufficiently displaced to close or break an electric circuit, as set forth.

2. An open-circuit electrical thermostat, composed of a glass tube closed at one end and open at the other, and containing mercury and a lighter volatile liquid, a holder for said tube, and two electrodes arranged to be electrically connected by mercury displaced from said tube, as set forth.

3. A combination of a reservoir containing a liquid which at a given pressure volatilizes at a given temperature, to be indicated by making or breaking an electric circuit, and also a mobile electrical conductor, said reservoir being sealed on the side intended to contain the volatile liquid, with two electrodes adapted to be electrically connected or disconnected by the movement of the mobile electrical conductor within the reservoir under the increasing tension of the vaporized volatile liquid, substantially as described.

FREDERICK H. PRENTISS.
JAMES A. TILDEN.

Witnesses:
JOHN C. HOADLEY,
EDWIN TILDEN.