No. 119,543. Patented Oct. 3, 1871.

Fig: 1.

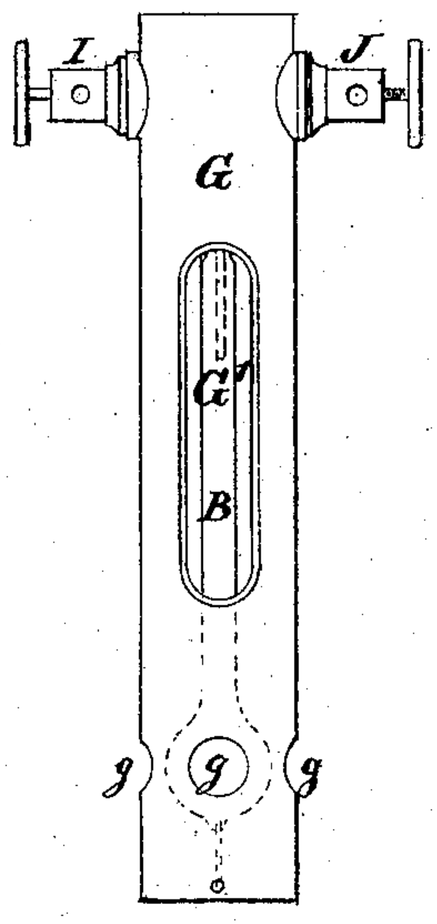
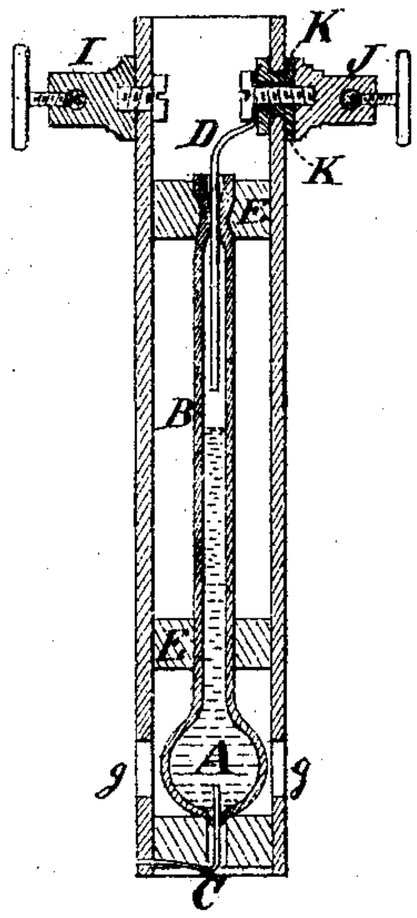


Fig: 2.



A. M. Sternberg

Manufacture of Thermometers for Electro Magnetic Regulation of Temperature.

Fig: 3.

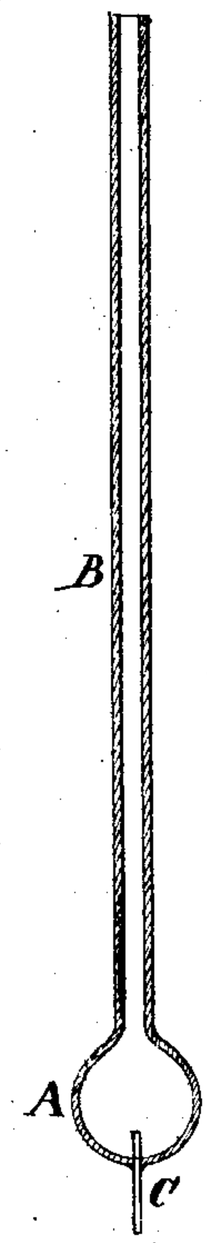


Fig: 4.

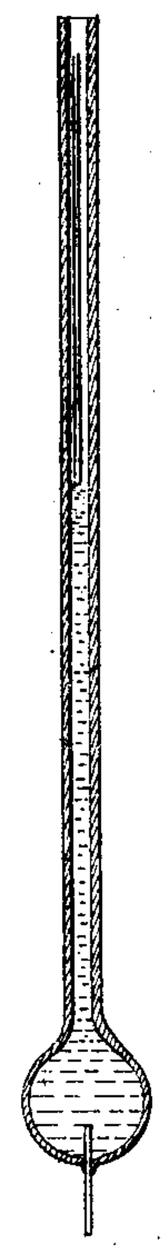


Fig: 5.

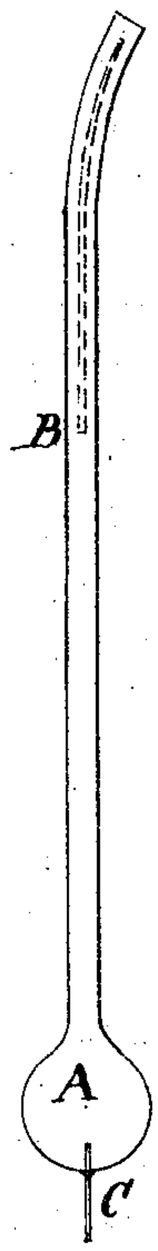


Fig: 6.

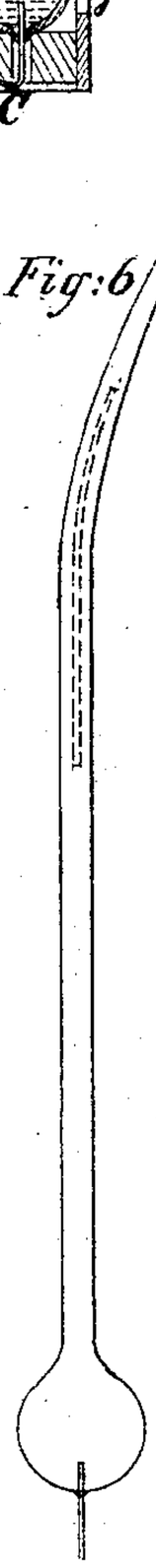


Fig: 7.

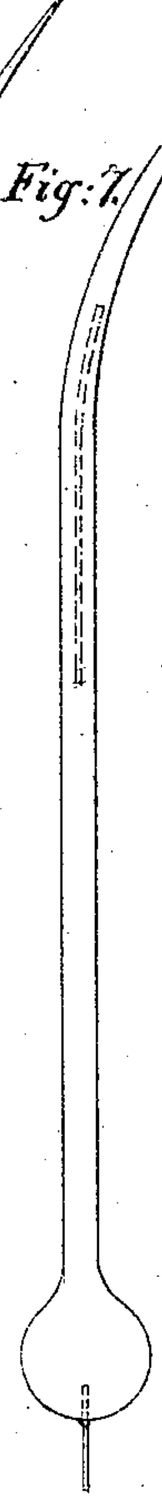


Fig: 8.

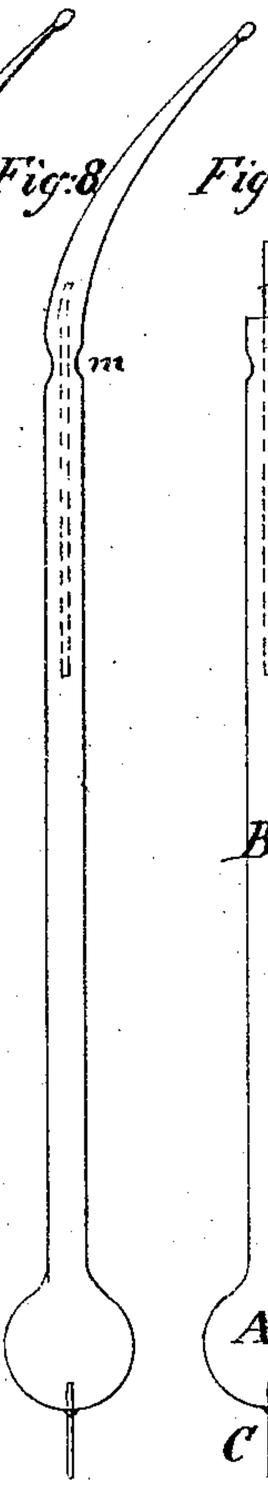
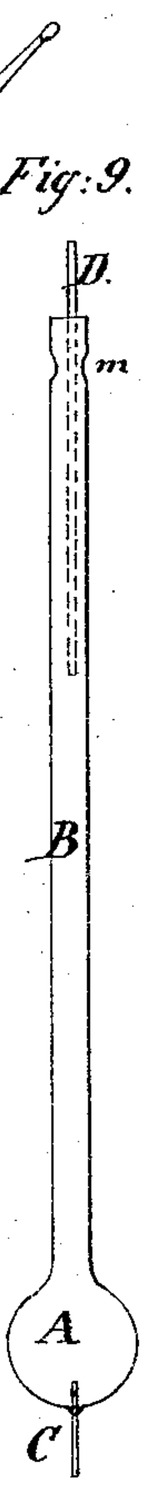


Fig: 9.



Witnesses:

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J. A. Burfleet

Inventor:

Geo. M. Sternberg

by his attorney

J. A. Stetson

UNITED STATES PATENT OFFICE.

GEORGE M. STERNBERG, OF NEW YORK, N. Y.

IMPROVEMENT IN THE MANUFACTURE OF ELECTRIC THERMOMETERS.

Specification forming part of Letters Patent No. 119,543, dated October 3, 1871.

To all whom it may concern:

Be it known that I, GEORGE M. STERNBERG, of New York city, in the State of New York, have invented certain new and useful Improvements in the Manufacture of Thermometers for Electro-Magnetic Regulation of Temperature.

My invention is intended to be used in all situations where it is desired that an electric circuit shall be made and broken by raising and lowering the temperature.

The invention described in my patent dated March 1, 1870, requires thermometers having a wire or analogous connection to the base of the mercury column, and another wire or analogous connection mounted in the upper portion of the tube with its lower end at the point corresponding to the temperature at which the circuit is to be closed and broken. It is easy to fix the wire at the base of the column, because this may be done before the mercury is introduced; but fixing the wire in the upper end has involved serious difficulties.

I will describe the filling of ordinary thermometers with great brevity. The interior of the glass tube, everywhere small, is drawn at the upper end to a very fine thread, and the open end on being plunged into the mercury draws in the mercury slowly when the bulb has been heated and allowed to cool. After the bulb and the tube have been filled by repeated operations of this kind the temperature of the mercury in the bulb is raised. The expansion of the mercury causes it to be ejected slowly and in a very fine stream through the minute aperture at the top. When the flow has nearly stopped the blow-pipe flame is applied to the minute orifice and the glass is fused together and hermetically sealed. The success of the operation is due to the smallness of the aperture. When a wire is introduced the aperture must be much larger, and it is difficult or practically impossible to apply the same system in sealing the upper end of a glass tube with a wire in it. The annular space around the wire is so much larger than the fine aperture ordinarily treated that the mercury interferes with the joining of the glass, and repeated attempts result in repeated failures to close the opening successfully, with an entire exclusion of air. My invention overcomes the difficulty by very simple and certain means.

I will proceed to describe what I consider the best means of carrying out the invention.

The accompanying drawing forms a part of this specification.

Figure 1 is a front view, and Fig. 2 is a section of the complete instrument. The remaining figures show the stages of the manufacture after the lower conductor has been sealed in place. Fig. 3 is the tube empty; Fig. 4, the same filled and with the upper conductor introduced; Fig. 5, the tube bent to hold the conductor temporarily; Fig. 6, the same with the upper end drawn out; Fig. 7, the same after the mercury has been heated; and the tube entirely filled, and the top melted and sealed; Fig. 8, the same after the second sealing around the conductor; and Fig. 9, the same after the tube has been straightened and the superfluous glass at the top broken off.

Similar letters of reference indicate corresponding parts in all the figures.

A is the bulb, and B the stem of a glass thermometer formed in the ordinary or any approved proportions at and near the bulb, but the stem B is made longer than will be finally required. A conductor-wire, C, being introduced by any suitable means in the bulb, or in a chamber communicating with the bulb, forms a connection for one pole of the battery. To form a connection for the other pole I introduce a length of wire, preferably iron or platina, and push it down until its lower end is at or a little below the point corresponding to the temperature where the connection is to be made and broken. This wire must be of so little length that its upper end shall be entirely within the glass tube B. In order to maintain it in its place I soften the tube B by heat and bend it as indicated. By this means the elasticity of the wire D is made available to hold it in its place with considerable force. The mercury being introduced into the interior of A and B in the ordinary manner, I soften the upper end of the tube B and draw it out so as to reduce the bore to the fineness ordinarily obtained at this point; and now, having applied heat to the bulb, the mercury is swollen so as to fill the entire bore and be ejected through the fine orifice at the upper end, and in this condition the tube is sealed at the upper end by the application of the blow-pipe, the operation being in every respect analogous to that of closing the upper end of the ordinary thermometer. Now, having thus hermetically sealed the upper end, the thermometer is allowed to cool down to the ordinary temperature, in which condition

the mercury sinks and leaves the upper part of the tube empty. Now the blow-pipe flame is applied opposite the middle or other point in the wire D. The glass on melting around the wire D finds now no mercury between itself and the wire, and there is no obstacle to its fusing directly together and adhering to the wire. This result ensues invariably. It is aided by the pressure of the external atmosphere, there being a vacuum on the interior and a full pressure on the exterior of the tube, and also by the tendency of melted or partially-melted glass to agglomerate or draw together, sometimes known as the cohesive attraction of fluids. In any case where there is a reluctance of the glass to thus fuse tightly around the wire, the result is encouraged by a twisting or other movement of the glass by the fingers. So soon as the result is effected the difficult portion of the operation is over. Next the tube is straightened, and having allowed the glass at the point *m* to become sufficiently cool, the glass above is broken off and the projecting end of the wire D is exposed and ready to be joined by soldering or screw-cap, or otherwise, to any suitable conductor. I have devised means for adjusting the position of the conductor D after the thermometer is otherwise finished. By this means a very great degree of nicety in the point of connection can be attained. To effect this, I first push down the wire D to a point a little below—say, the sixteenth of an inch below—the position which I assume it is to finally keep and effect the double sealing, as above described. I afterward raise the temperature of the mercury at leisure, preferably raising the temperature of a large number at once, and raising it very slowly in a suitable bath until the mercury stands at exactly the point which it is desired to maintain, and I now mark on the exterior of the tube and allow it to cool again. Next, I heat the point *m*, but to a less degree than is required for absolute fusion. This temperature should be sufficient to soften but not to melt the glass, and in this condition of the glass I carefully and delicately pull on the conductor D, moving it slightly through the softened glass and partially extending the glass until the lower end of the conductor D is exactly opposite the mark. Now, on allowing it to cool, the thermometer is complete, and it may be used with some success without any casing. I prefer, however, to incase it in the manner shown in Figs. 1 and 2, in which G is a tube of brass having openings *g* around its base, and a large long opening, G′, in its front side. I and J are mountings, provided with binding-screws, by which connections are made to the wires of a battery, not represented. The connection I is in full electric contact with the case G, which latter is put in connection at the bottom with the wire C. The other mounting, J, is insulated from the tube G by a mass of hard rubber, K. It is in communication only with the wire D, which extends upward from the top of the thermometer, as represented. The thermometer is held properly in the tube G by means of pieces of cork E E. This casing protects the thermometer from injury in being roughly handled, and affords a very suitable casing to be immersed in fluids. Its weight may be suspended by the wires which connect it with the battery, or by any other suitable means.

I claim as my invention—

1. The thermometer A B, having the wire D hermetically sealed therein and projecting at the top, substantially as and for the purposes herein set forth.

2. The within-described method of hermetically sealing the thermometer-tube B around the conductor D, the same consisting in first drawing the tube B to form a fine aperture above the wire and sealing it there in the ordinary manner, and afterward sealing it again at a point opposite the wire after the mercury has cooled and withdrawn, as specified.

3. The within-described method of adjustin the position of the conductor in a hermetically-sealed thermometer by softening the glass by heat, and drawing the conductor or both the conductor and the glass, as herein specified.

4. The hermetically-sealed magnetic thermometer herein described, mounted within the perforated casing G, suspended on lugs I J, one of which is insulated from the casing G and connected directly to one of the wires as specified.

In testimony whereof I have hereunto set my name in the presence of two subscribing witnesses.

GEO. M. STERNBERG.

Witnesses:
C. C. LIVINGS,
J. A. SURFLEET.