No. 721,770. PATENTED MAR. 3, 1903.

A. ZELENY.

ELECTRIC THERMOMETER.

APPLICATION FILED JUNE 9, 1902.

NO MODEL.

Fig. 1.

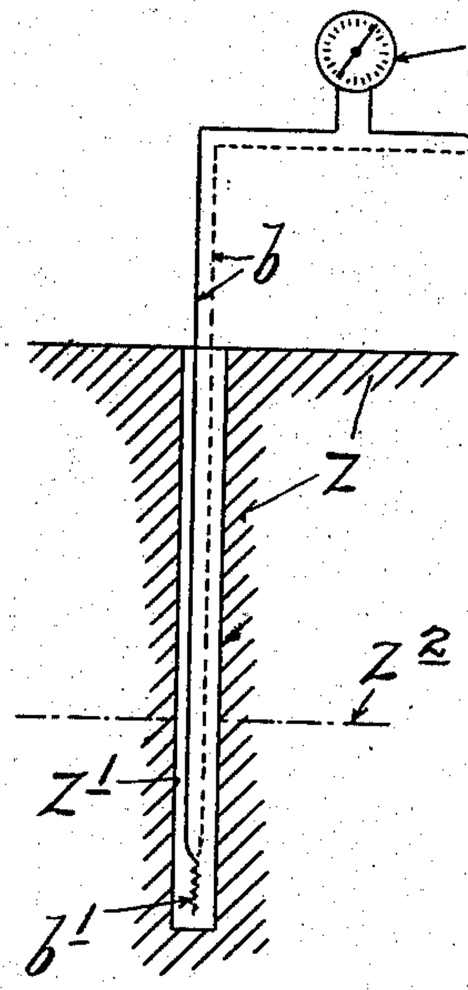


Fig. 2.

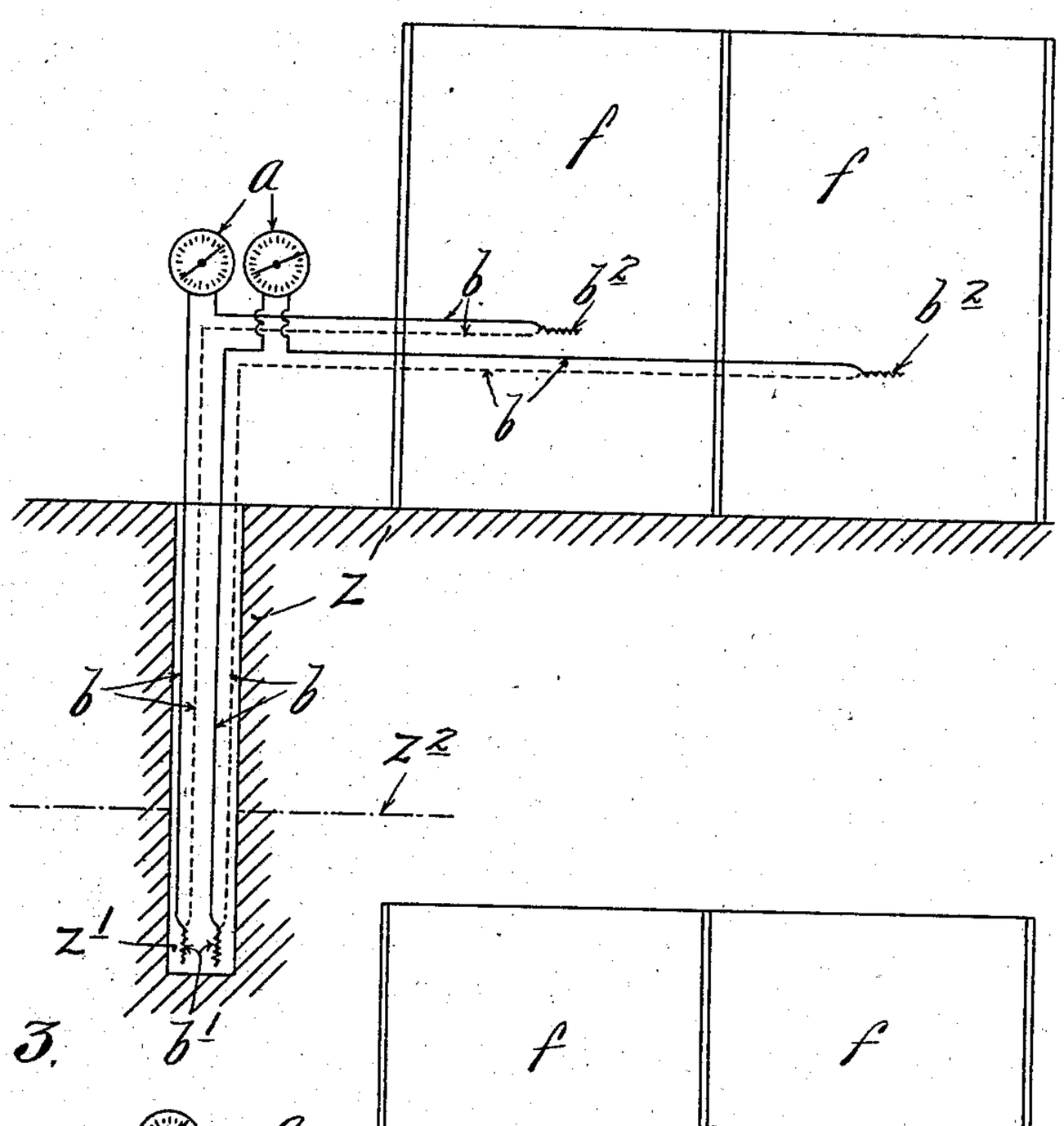


Fig. 4.

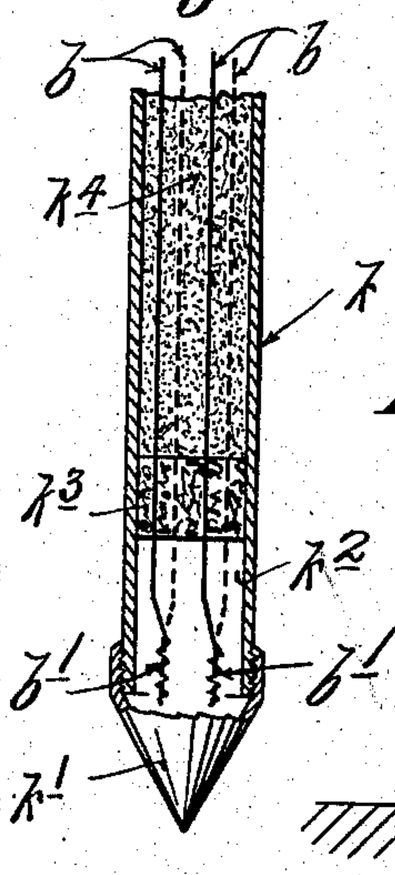
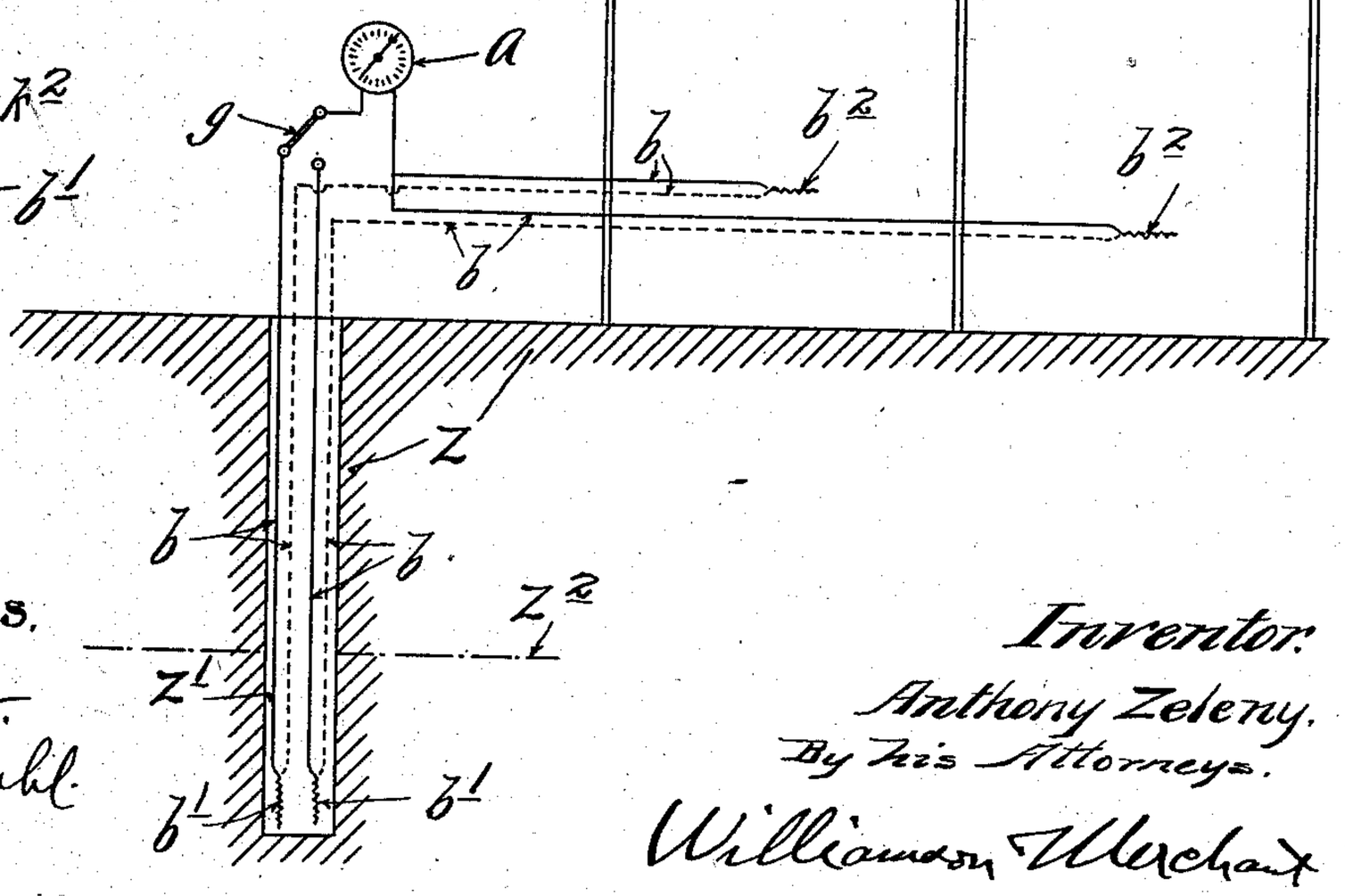


Fig. 3.



Witnesses.

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UNITED STATES PATENT OFFICE.

ANTHONY ZELENY, OF MINNEAPOLIS, MINNESOTA, ASSIGNOR OF ONE-HALF TO C. E. THAYER, OF MINNEAPOLIS, MINNESOTA.

ELECTRIC THERMOMETER.

SPECIFICATION forming part of Letters Patent No. 721,770, dated March 3, 1903.

Application filed June 9, 1902. Serial No. 110,744. (No model.)

To all whom it may concern:

Be it known that I, ANTHONY ZELENY, a citizen of the United States, residing at Minneapolis, in the county of Hennepin and State of Minnesota, have invented certain new and useful Improvements in Electric Thermometers; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My present invention has for its object to provide improved means for readily determining at a reading-station the temperature at a distant point or points, and relates generally to that class of devices disclosed and broadly claimed in my prior application, Serial No. 90,402, filed January 20, 1902, entitled "Multiplex electric thermometer."

The invention consists of the novel devices and combinations of devices hereinafter described, and defined in the claims.

The invention is illustrated in the accompanying drawings, wherein like characters indicate like parts throughout the several views.

Figures 1, 2, and 3 are views, partly in vertical section and partly in diagram, illustrating several forms of the thermo-electric thermometer designed in accordance with my invention; and Fig. 4 is a view in vertical section, taken centrally through an incasing pipe or tube, which tube is preferably used in connection with my improved thermo-electric thermometer.

In Figs. 1, 2, and 3 the character z indicates the earth, the character z' a well of small diameter bored into the earth to a point below the zone of changing temperature, the lower extremity of which zone is indicated by the dotted line marked z^2. The character a indicates a galvanometer or similar instrument of any suitable construction. The character b indicates leads constituting thermo-electric circuits. Each of these thermo-electric circuits comprises two thermo-electric junctions b' b^2. These thermo-electric circuits are preferably formed with one lead-wire of copper and the other of iron, which leads are twisted together at their ends and preferably soldered to form the thermo-electric junctions b' b^2. Of course other combinations of metal may be used to form the leads and thermo-electric junctions of the thermo-electric circuit or circuits. The thermo-electric junctions b' and b^2 of a given circuit are of course arranged to react against each other. The thermo-electric junctions b' in all three of the arrangements illustrated are located within the well z' below the zone of changing temperature of the earth. The junctions b' are in this way kept at a constant temperature, and hence are herein designated as the "constant-temperature thermo-electric junctions," or, for short, "constant-temperature junctions." The thermo-electric junctions b^2 are located at different points the temperature of which or of the surrounding space is to be determined. In the drawings, Figs. 2 and 3, said junctions b^2 are shown as located within different compartments f, which compartments may be assumed to be grain-bins. As is evident, the temperature of the junctions b^2 will vary with the temperature of the compartments f, and hence these junctions are herein designated as the "variable-temperature thermo-electric junctions," or, for short, "variable-temperature junctions." The galvanometers a are located at a suitable reading-station, which may be an office or any other desired place. The dials of these two galvanometers are preferably graduated in degrees of temperature; but in some cases they might be marked or otherwise provided with means whereby they would simply indicate certain limits of temperature. As already indicated, the galvanometer may be of any desired form, and, in fact, the expression "galvanometer" is herein used in a very broad sense to include any measuring instrument which is sensitive to an electric current or to a difference of potential.

In Fig. 1 a single thermo-electric circuit with a single galvanometer incorporated therein is illustrated. This is the simplest form of the device.

In Fig. 2 two thermo-electric circuits, each having incorporated therein a galvanometer, are illustrated. In this arrangement, however, the constant-temperature junctions of the several circuits are contained within the

same well or compartment and are located in the earth below the zone of changing temperature.

In Fig. 3 a common galvanometer a is by a switch g adapted to be connected into either of the thermo-electric circuits. In this construction the constant-temperature junctions b' are located in the same well below the zone of changing temperature of the earth. The expression "switch" is also herein used in a broad sense to cover all devices capable of use to open and close the circuits.

In a device of this character it is of great importance that one of the thermo-electric junctions of each circuit be kept at a constant temperature in order that the galvanometer may give the proper indication of temperature of the other thermo-electric junction. Where several thermo-electric circuits are employed with a common galvanometer, it is even of greater importance that the constant-temperature junctions of the several circuits be kept not only at constant temperatures, but at the same constant temperature. Otherwise stated, these conditions are necessary in order that the several variable-temperature junctions may for the same temperature always give the same deflection on the galvanometer. This condition is accomplished in a most satisfactory manner by placing the several constant-temperature junctions in the same compartment, which compartment is located in the earth below the zone of changing temperature. In this way all possibility of change in temperature of the constant-temperature junctions is avoided and all care, trouble, and expense of maintenance of this constant temperature is avoided.

To locate the constant-temperature junctions b' as above described, they are preferably placed within a metal pipe or tube k, which may be provided at its lower end with a conical point k', which makes driving of the pipe possible without digging a hole to form the well. The junctions b' are preferably located in an air-chamber k^2, left in the lower end of the pipe k below a plug k^3. Above the plug k^3 the pipe k is preferably filled with dry sand k^4 or other material which is a poor conductor of heat.

What I claim, and desire to secure by Letters Patent of the United States, is as follows:

1. The combination with a galvanometer, of a thermo-electric circuit having constant-temperature and variable-temperature thermo-electric junctions, the constant-temperature junction being located in the earth below the zone of changing temperature, and the variable-temperature junction being located at a point, the temperature of which is to be determined, substantially as described.

2. The combination with a galvanometer, of several thermo-electric circuits, each having constant-temperature and variable-temperature thermo-electric junctions, the constant-temperature junctions being contained in the same compartment and located in the earth below the zone of changing temperature, and the variable-temperature junctions being located at different points, the temperatures of which are to be determined, substantially as described.

3. The combination with a galvanometer and a switch constructed to connect the galvanometer with any one of a plurality of thermo-electric circuits, of said plurality of thermo-electric circuits having constant-temperature and variable-temperature thermo-electric junctions, the constant-temperature junctions being located in the earth below the zone of changing temperature, and the said variable-temperature junctions being located at different points, the temperatures of which are to be determined, substantially as described.

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

ANTHONY ZELENY.

Witnesses:
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F. D. MERCHANT.