No. 822,338. PATENTED JUNE 5, 1906.

E. BENNETT.

PYROMETER.

APPLICATION FILED OCT. 27, 1900.

Fig. 1.

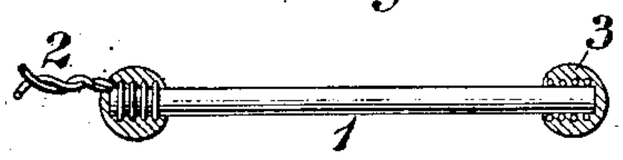


Fig. 2.

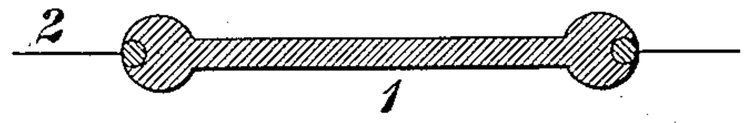


Fig. 3.

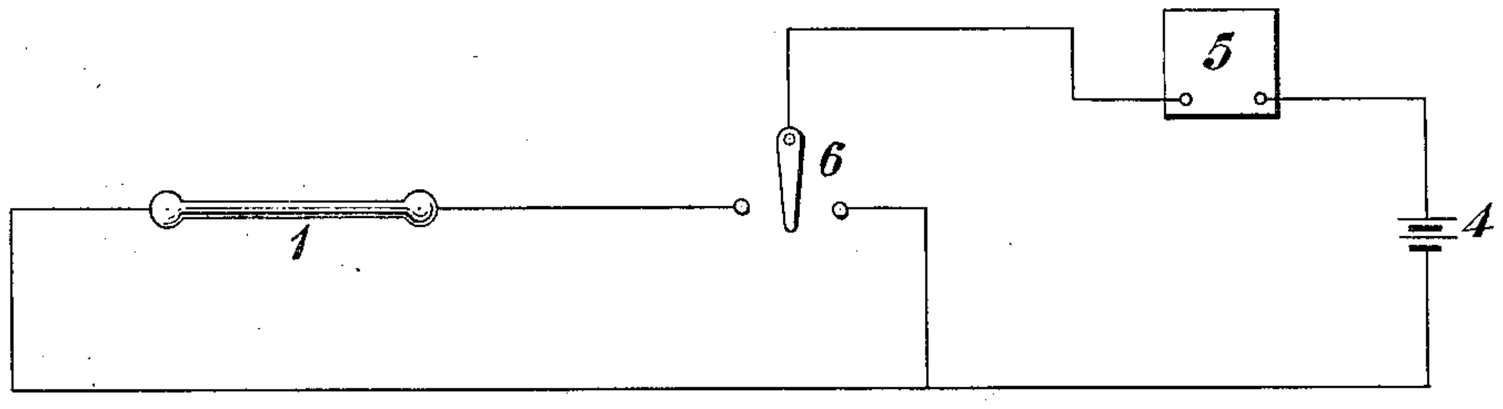


Fig. 4.

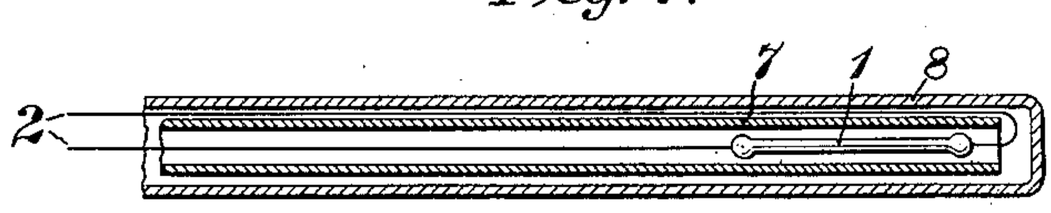


Fig. 5.

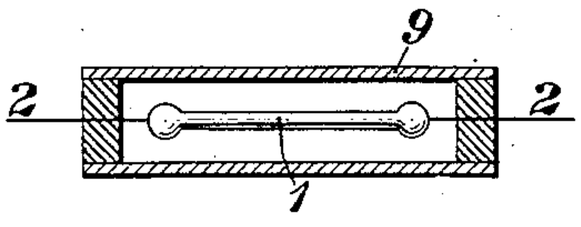


Fig. 6.

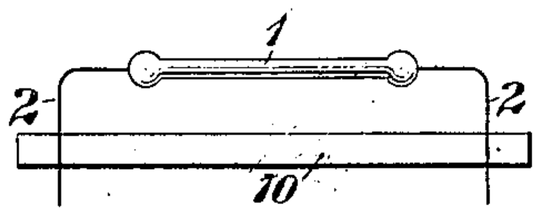
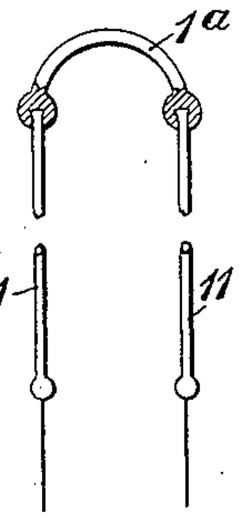


Fig. 7.



WITNESSES:

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UNITED STATES PATENT OFFICE.

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PYROMETER.

No. 822,338. Specification of Letters Patent. Patented June 5, 1906.

Application filed October 27, 1900. Serial No. 34,677.

To all whom it may concern:

Be it known that I, EDWARD BENNETT, a citizen of the United States, residing at Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented new and useful Improvements in Pyrometers, of which the following is a specification.

My invention relates to pyrometers; and it has for its object to provide a device of this character which shall be simple and inexpensive in construction and reliable in operation and which may be employed for accurately measuring higher temperatures than has been possible with devices of this general character heretofore employed.

My invention is primarily based upon the well-known fact that the ohmic resistance of all materials is a function of temperature; but my invention differs radically from those heretofore employed which have utilized this principle by reason of the material of which it is composed and its general characteristics of structure and the wide range of temperatures, the measurement of which it may be used to accurately determine.

In the drawings illustrating the invention, Figure 1 is a view, partially in side elevation and partially in section, of the resistance body or filament of the pyrometer, showing one means of attaching the terminal leads thereto. Fig. 2 is a sectional view of another form of the resistance-body, showing another means of attaching the terminal leads. Fig. 3 is a diagram of the circuits employed in the calibration of the resistance body or filament. Fig. 4 is a sectional view of one means of mounting and utilizing the filament, and Figs. 5 and 6 are respectively a sectional view and a side elevation of two other means of mounting the filament. Fig. 7 is a view, partially in elevation and partially in section, of a modified form of the invention.

The resistance body or filament 1 is composed of one or more of the refractory stable oxids—such, for example, as zirconia and yttria, which have negative temperature coefficients and are non-conductors at ordinary temperatures. The material of which the filament is to be composed is ground to a fine powder, and enough organic binder and water are added to make a stiff clay-like substance, which is forced under heavy pressure through a suitable die into the form of a long rod or string. After drying, the string is slowly heated to a high temperature in a furnace, thus burning out the organic binder and leaving a hard compact body. After the roasting is completed the string is provided with terminal leads, which are then connected to an electric circuit, and the string is heated to a conducting temperature by some external means if it be a non-conductor at ordinary temperatures. Sufficient current is then passed through it to keep it or maintain it in an incandescent condition for a considerable length of time, its temperature being raised and maintained to a point above the highest temperature to which it will ever be subjected when used as a pyrometer in order that the material may be thoroughly shrunk, and any changes which might take place gradually in use may be brought about in a short time, so that all subsequent heating and cooling will only subject the material to the same changes as those to which it has already been subjected.

After being subjected to the treatment just described the string is cut up into the required lengths, and each length is provided with terminal leads, usually of platinum wire 2. These lead-wires may be fastened to the ends of the filament or rod 1 in any suitable manner—as, for example, by winding them about the ends of the filament and applying a coating 3 of paste composed of like or similar material to that of the body of the filament and then baking the paste, so as to harden it and fasten the lead-wires securely in position.

Another method of attaching the lead-wires 2 is indicated in Fig. 2, this method being set forth in a patent granted to Marshall W. Hanks, June 26, 1900, No. 652,607.

The calibration of the filament may be effected by connecting it in the circuit, as indicated in Fig. 3, in which the source of current 4, here indicated as a battery, is employed in connection with a voltmeter 5 and a switch 6, the switch being provided with two stationary contact-terminals, so that the switch-arm may be first moved into position to determine the voltage of the source of the current and then into contact with the other terminal to place the filament 1 in circuit with the source of current and the voltmeter.

In Fig. 4 the filament is shown as inclosed within a tube 7, of suitable refractory material,

open at both ends, and the tube 7 is inclosed in a second tube 8, of refractory material, having one end closed. One of the lead-wires 2 projects out through the inner tube, and the other lead-wire projects out between the walls of the two tubes 7 and 8. This arrangement of apparatus is such as to effectually protect the filament from injury and also insure its proper subjection to the temperature that it is desired to measure.

In Fig. 5 I have shown the filament as mounted within a single tube 9, of refractory material, both ends of which are closed. In Fig. 6 the filament is supported upon a plate or strip 10 by means of the lead-wires 2.

In Fig. 7 the filament 1^a is shown as curved and as provided with leads 11, formed of a material—such, for example, as graphite—having low ohmic resistance, but having a melting-point above that of platinum, this construction being employed in cases where the temperatures to be measured lie above the melting-point of platinum.

The materials employed in making the pyrometer filaments may be varied largely to suit the convenience or wishes of the manufacturer, since there are many refractory stable oxids that are suitable for this purpose. The character of these filaments is such that temperatures much above the melting-point of metals may be accurately measured, and the range of such high temperature for which my invention is adapted is very large. The invention is therefore admirably adapted for commercial use where high temperatures are employed in kilns and furnaces, and the construction is simple and inexpensive and extremely compact, as well as durable and reliable in use.

I claim as my invention—

1. A pyrometer comprising an elongated resistance-body composed of one or more of the stable, refractory oxids and being a non-conductor of electricity, when cold, that has a negative temperature coefficient, relatively low resistance, refractory terminal conductors cemented tc the ends thereof, and a protecting device for said body.

2. A pyrometer comprising an elongated, cylindrical resistance-body composed of one or more of the stable, refractory oxids and being a non-conductor of electricity when cold and a conductor when hot, relatively low resistance, refractory terminal conductors cemented to its ends, and supporting and protecting means for said resistance-body.

3. A pyrometer comprising an elongated resistance-body that is composed of one or more of the stable, refractory oxids; that is a non-conductor of electricity when cold, relatively low resistance, refractory terminal leads cemented to its ends and a tube of refractory material inclosing and supporting said resistance-body.

4. A pyrometer comprising an elongated resistance-body that is composed of one or more of the stable, refractory oxids; that is a non-conductor of electricity when cold, relatively low resistance, refractory terminal leads cemented to its ends, a tube in which said body is located and a larger tube surrounding the first-named tube.

5. A pyrometer comprising two tubes of refractory material, the one within the other, and a resistance-body composed of one or more of the stable, refractory oxids of metals and having a negative temperature coefficient, and refractory, terminal leads which are respectively located within the inner tube and between the tubes.

6. A pyrometer comprising an elongated resistance-body of refractory material having a negative temperature coefficient and relatively low resistance, refractory terminal conductors cemented to its ends and two refractory tubes, the one within the other for protecting the refractory body and separating the terminal leads from each other.

In testimony whereof I have hereunto subscribed my name this 19th day of October, 1900.

EDWARD BENNETT.

Witnesses:

MURRAY C. BEEBE,

HUGH A. CROOKS.