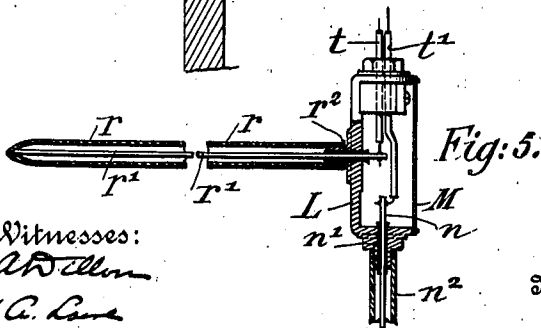
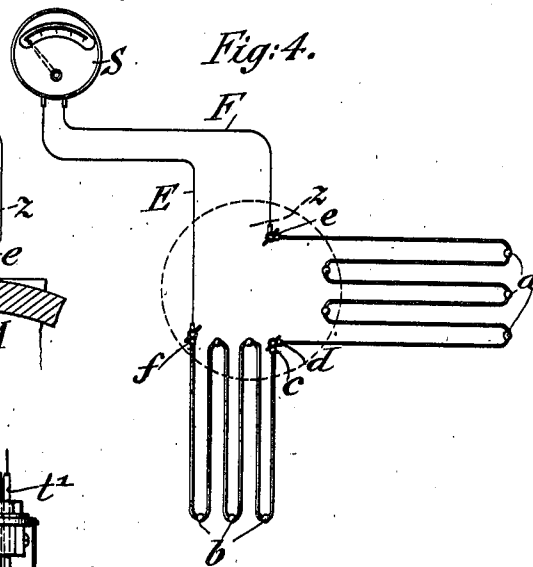
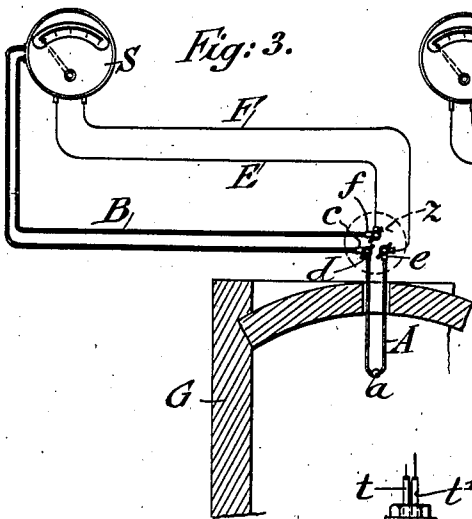
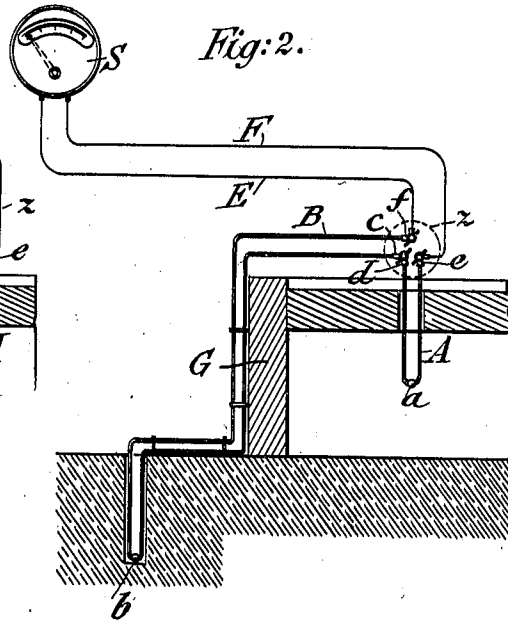
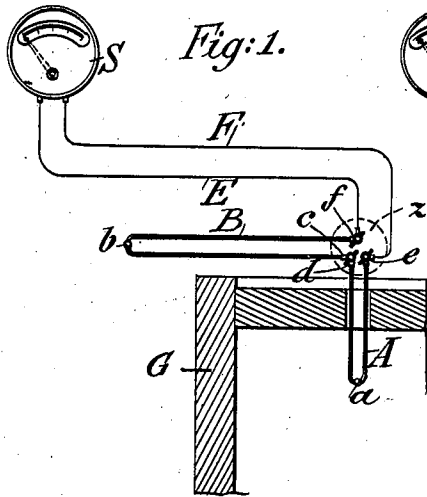


C. H. WILSON.
THERMO ELECTRIC PYROMETER.
APPLICATION FILED SEPT. 11, 1912.

1,103,640.

Patented July 14, 1914.



Witnesses:
M. A. Dillon
H. C. Lane

Inventor
Charles H. Wilson
By his Attorneys
Loebel & Loebel

UNITED STATES PATENT OFFICE.

CHARLES H. WILSON, OF MOUNT VERNON, NEW YORK.

THERMO-ELECTRIC PYROMETER.

1,103,640.

Specification of Letters Patent.

Patented July 14, 1914.

Application filed September 11, 1912. Serial No. 719,799.

To all whom it may concern:

Be it known that I, CHARLES H. WILSON, a citizen of the United States of America, and a resident of the city of Mount Vernon, county of Westchester, and State of New York, have invented certain new and useful Improvements in Thermo-Electric Pyrometers, of which the following is a specification.

10 This invention relates to improvements in thermo-electric pyrometers.

The object of my invention is to provide means for increasing the accuracy of the reading and for decreasing the cost of the device.

15 It has hitherto been proposed to use extension-pieces of metallic composition similar or dissimilar to the elements of the thermo-couple and having approximately the same electromotive force within limits, as a means of making the thermo-couple itself short, and thereby reducing original or renewal cost, but one of the objections to that method is that the extension-pieces must be of different construction from the other elements of the thermo-couple, the most notable difference being that the elements of the couple are ordinarily welded together, while the elements of the extension-pieces or leads must be insulated from each other throughout their length even at their terminals, though, of course, they are ultimately brought in series by electrical connection through the thermo-couple and through the instrument. By my invention it will generally be possible to use two ordinary thermo-couples of the same type and interchangeable, one being employed for use in the furnace and the other as the compensator couple.

20 There was heretofore employed a secondary thermo-couple of the same material as the primary couple, which was of rare metal, connected in opposition thereto, but the compensator couple so used was only for the purpose of making it convenient to employ a detachable water-cooled device to the cold end of the primary couple, as it is not convenient to inclose the two cold junctions of the primary couple in a water-jacket because the leads would then have to be connected and disconnected within the water-jacket. Compensator couples connected in series with the primary couple have also heretofore been employed. But when a compensator couple is connected in

series, the compensator couple, the primary couple and the leads cannot have all of their connections to each other made at a point of uniform temperature, as for instance in one connection box, for when the compensator couple is connected in series it must have that one of its ends, where its own elements are joined to each other, at or near the temperature of the cold ends of the primary couple. Consequently if the compensator couple had its other junctions also at the temperature of the cold ends of the primary couple, as would occur if all were within one connection box, the compensator couple would have its hot and its cold junctions all at the same temperature and it would create no electromotive force and accomplish no compensation. But these devices had the disadvantage of giving inaccurate readings, owing to their susceptibility to the fluctuation in the temperature of the cold ends of the primary couple and in the necessity of requiring means for keeping those ends at uniform and substantially constant temperature. Or, on the other hand, such devices had the disadvantage of requiring compensation means composed of expensive metals, whereby the readings were to a certain extent corrected.

My invention consists in arranging a secondary couple of inexpensive metal with a primary couple, by connecting the secondary couple in opposition to the primary couple, all of the junctions of said couples with each other, and the leads, being maintained at substantially uniform but not necessarily constant temperature, whereby the readings are rendered independent of the fluctuations of the temperature of the zone including said junctions, and whereby the secondary couple is enabled to be located at any point distant from the source of heat being measured, and is not required to have a temperature relative to or the same as the cold ends of the primary couple.

The invention more specifically consists in connecting a thermo-couple of some rare and noble metals, such as, for instance, platinum and an alloy of platinum and rhodium, or of the base metals, such as, for instance, iron and an alloy of copper and nickel, in opposition or opposed potential (the opposite of connection in series) with another thermo-couple of base metals or their alloys, and having all the junctions in a "zone" of uniform temperature.

In the accompanying drawings, Figure 1 shows a pyrometer embodying my invention, and comprising a primary couple, a secondary or compensator couple, leads and a measuring instrument, the parts being indicated conventionally, Fig. 2 shows a pyrometer embodying my invention with the secondary couple carried to earth, Fig. 3 shows such a pyrometer with the secondary couple carried to the measuring instrument, Fig. 4 shows a pyrometer embodying the invention and comprising compound primary and secondary couples connected to leads and a measuring instrument, and Fig. 5 is a section through a junction-box and the connected elements of the pyrometer as practically constructed.

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

The primary couple is shown at A, *a* being what is generally known as the hot junction, *d* and *e* being what are generally known as cold junctions. The elements *ad* and *ae* are dissimilar in composition, and may be of noble or base metals or their alloys. The secondary or compensator couple B has *b* as a junction analogous to *a*, while *c* and *f* are junctions analogous to *d* and *e*. The elements *bc* and *bf* are of dissimilar material, composed of base metals or any of their alloys. Junctions *c* and *d* may be in direct contact or in contact through some short piece of electrically conducting material. Junctions *e* and *f* are connected by ordinary copper or aluminum leads E and F to the measuring instrument at S. The primary couple A and secondary couple B when made of similar materials have the element *ad* of the primary couple and the element *bc* of the secondary couple of the same material and the element *ae* of the primary couple and the element *bf* of the secondary couple both of the same material, which however is different from the material in *ad* and *bc*; which is the reason for the specification that the thermo-couples are to be connected in opposition (the opposite of in series). When the elements of the primary couple are one or both of different material from the elements composing the secondary couple, the elements composing the secondary couple will be selected from such materials, as for the same change of temperature, within limits, will result in approximately the same thermo-electric effect, or, in other words, the secondary couple and the primary couple have approximately the same thermo-electric force. The primary and secondary couples are then connected so that the current generated in the secondary couple tends to flow in the same direction relative to the direction of the current generated in the primary couple as if the elements of the secondary couple were

made of the same materials as the elements of the primary couple. The junctions *e*, *d*, *c* and *f*, are arranged within a small compass or otherwise located so as to maintain them within a zone of approximately uniform but not necessarily constant temperature so that calibrations may be made and readings taken on the assumption that all four of those junctions will be at the same temperature. This is conveniently done by including them all within a single connection-box, and as I shall have occasion to refer to the temperature of the zone of approximately uniform temperature around these several junctions, I shall hereafter refer to such temperatures as that of the zone indicated by a dotted circle *z* encompassing the several junctions *e*, *d*, *c* and *f*. The temperature of the zone may, as reckoned on any temperature scale, be between the temperatures of the junctions *a* and *b* and when this is the case and when the two elements of the primary couple A have their direction of polarity such that the current generated in the primary couple flows from *e* to *a* to *d*, then the current generated in the secondary or compensator couple B will tend to flow from *c* to *b* to *f*, which is in the same electrical direction, as would of course follow from the fact that the couples are connected in opposition and have the analogous junctions *a* and *b*, one higher and one lower than the uniform temperature of their other junctions which are all within the zone. The temperature of the zone *z* may be lower than that of either the junction *a* or the junction *b* and then when the current in the primary couple flows from *e* to *a* to *d* the current generated in the secondary or compensator couple tends to flow from *f* to *b* to *c* in opposition to the current generated in the primary couple as must naturally result from the two couples connected in opposition and with their analogous junctions *a* and *b*, both heated above the temperature of the zone. The effect of this compensator couple is such that if the temperatures of junctions *a* and *b* remain constant and the temperature of the zone drops, increasing the difference in temperature between the zone and *a* which results in increasing the electromotive force generated in a couple A, the current generated in the couple B will tend to neutralize the additional electromotive force generated in the primary couple and this will be accomplished either by the generation of an increased counter electromotive force in the compensator couple, when the currents generated in the primary and compensator couples act in opposite directions, or by a reduction of the electromotive force generated in the compensator couple when that current flows in the same direction as the current generated in the primary couple.

The result is that the readings obtained on the measuring instrument are independent of the temperature of the zone. Those readings are not independent of the temperature of the junction *a* within the furnace or other structure *G*, and it is not desired that they should be for it is desired that they actually show the temperature of the junction *a* and all its changes. Likewise the readings on the measuring instrument are not independent of the temperature of the junction *b*, but the thermo-couple *B* is made long enough to have the junction at a point where it will not be substantially influenced by the temperatures being measured and preferably long enough to reach a point where the temperatures are approximately constant. In some cases it suffices to have the junction *b* where it will take up the room temperature as in Fig. 1, or the same may be extended to a point of approximately constant temperature underground as in Fig. 2, or to a point within the measuring instrument as in Fig. 3.

Inasmuch as fluctuations in temperature of the junction *b* have an undesirable effect in disturbing the readings, I use when placing the junction *b* within the measuring instrument, and for especially accurate work, some automatic device for accelerating or retarding the motion of the indicating hand as a further compensation and wish to make clear that my invention relates to extending the junction *b* to the measuring instrument even though a further compensator in the instrument is employed, although my invention does not relate to the use of such a compensator *per se* in the instrument as such compensators are already employed in the thermo-electric pyrometers.

The connections between the leads and the four elements of the couples within the zone *z* may be made by soldering or any convenient quick and detachable connectors.

While in Fig. 1 I have illustrated the couples as being made up each of two wires, one wire for each element, or any other approved construction of thermo-couple, as for instance, the one shown in Fig. 5, in which a tube replaces one of the wires, may be employed. In Fig. 5 is shown a couple of this type in which *M* indicates a tube of size sufficient to receive the wire *n*, the tube being tapered at one end where it connects with and supports the wire, the junction of the tube and wire at the apex of the cone constituting the thermo-electric junction.

Inasmuch as it is frequently advantageous when measuring low temperatures to use several thermo-couples connected in series, all of the couples having their hot junctions in the same zone of temperature being measured and their cold junctions in a zone outside of the furnace, all of which is done for the purpose of building up the electromotive

force which is directly multiplied by the number of couples so connected in series, a plurality of couples may be used, constituting one compound primary couple analogous of the single primary couple shown in the drawing and a plurality of couples constituting a compensator couple analogous to the single compensator couple shown in the drawing. The method of junction and arrangement of compound couples is shown in Fig. 4.

By connecting the couples in opposition I mean the reverse of connection in series. Thermo-couples are said to be connected in series when a metal or alloy, constituting the first element of a couple, being electropositive to the second element of the couple and connected to that second element at one end of the couple, is, at the other end of the couple, connected to an element of the second couple, to which element of the second couple it is also electropositive, the remaining element of the second couple being electropositive to the first-mentioned element of the second couple, resulting in every alternate element being of the same thermo-electric order of polarity. Inasmuch as the direction of the current generated in the thermo-couple depends on which end of the couple is hotter than the other end, it is evident that reversing the temperatures of the two will result in current flowing in the opposite direction. Inasmuch as the junctions *a* and *b* and the zone *z* may, any of them, be hotter or cooler than any one other, or both others, my reference to connecting the couples in opposition relates to connection in such manner than under the same conditions the element *ea* is electropositive to the element *da* when under those conditions the element *fb* is electro-positive to the element *cb*. In other words, if junctions *a* and *b* were both hotter or both colder than the zone the currents generated in the two couples would oppose each other.

In Fig. 5 is shown a junction-box comprising a base-portion *L* with a cover *M*, which cover is frictionally secured detachably to the base. Through one side of the box one element *n* passes, and is insulated from the other element *n*² by a collar *n*¹. The elements pass downwardly, being broken away in the drawing and act in the same manner as the primary couple *A* shown in Fig. 1. The other couple corresponds to the couple *B* shown in Fig. 1, and has one element *r* secured to the base-portion *L* and the other element *r*¹ within the element *r* and passing through an insulating collar *r*² and into the junction-box. The element *r* and the element *n*² are electrically connected by means of the base *L*. The element *r*¹ is connected with a lead *t* which connects with the measuring instrument (not shown in Fig. 5) and the element *n* is connected by

a lead π with the other terminal of the instrument.

Each couple may be of similar construction, namely an outer tube with a pointed end, and an inner rod-like element electrically connected with the tube at its outer pointed end and insulated from the other end of the same.

I claim:

10 1. In a thermo-electric pyrometer, a primary thermo-couple, ordinary conducting low resistance leads coöperating therewith, a current measuring device connected therewith, a compensator couple connected in opposition to the primary couple, the elements of said compensator couple being dissimilar in composition to the elements of the primary couple, and having an electromotive force approximately the same as the electromotive force of the primary couple within the limits of temperatures occurring at the point of connection between the primary and compensator couples and means for maintaining the junctions of the couples with each other and with their leads at substantially equal and uniform temperature, said compensator couple having its active end located beyond the influence of said means.

2. In a thermo-electric pyrometer, a primary thermo-couple, ordinary conducting low resistance leads coöperating therewith, a current measuring device connected therewith, a compensator couple connected in opposition to the primary couple, the elements of said compensator couple being dissimilar in composition to the elements of the primary couple, and having an electromotive force approximately the same as the electromotive force of the primary couple within the limits of temperatures occurring at the point of connection between the primary and secondary or compensator couples; said compensator couple and the primary couple being each of

compound form composed of a plurality of couples connected in series and means for maintaining the junctions of the couples with each other and with their leads at substantially equal and uniform temperature, each of said compensator couples having its active end located beyond the influence of said means.

3. A thermo-electric pyrometer, comprising a primary couple, a secondary couple connected in opposition thereto, and means for maintaining the junctions of the couples with each other and with their leads at substantially equal and uniform temperature, said secondary couple having its active end located beyond the influence of said means.

4. A thermo-electric pyrometer, comprising a primary couple, a secondary couple connected in opposition thereto, means for maintaining the junctions of the couples with each other and with their leads at substantially equal and uniform temperature, the secondary couple having its active end located beyond the influence of said means, and means for maintaining the active junction of the secondary couple at a constant temperature.

5. A thermo-electric pyrometer, comprising a primary couple, a secondary couple connected in opposition thereto, and a junction-box assembling the junctions of the couples and the leads connected therewith for maintaining the junctions at substantially equal and uniform temperature, the active end of said secondary couple being located outside said junction-box.

In testimony, that I claim the foregoing as my invention, I have signed my name in presence of two subscribing witnesses.

CHARLES H. WILSON.

Witnesses:

C. M. NICHOLSON,
ERNESTINE H. LIMA.