No. 839,984. PATENTED JAN. 1, 1907

W. H. BRISTOL.

THERMO ELECTRIC GENERATOR.

APPLICATION FILED DEC. 2, 1905.

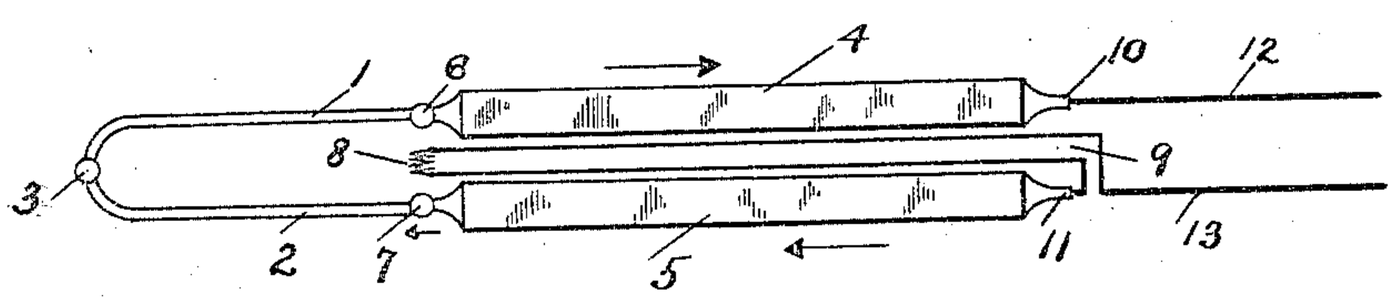

Fig. 1.

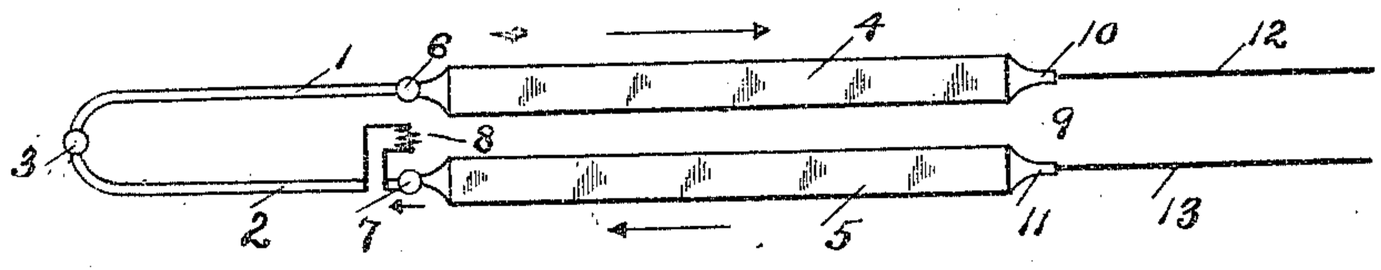

Fig. 2.

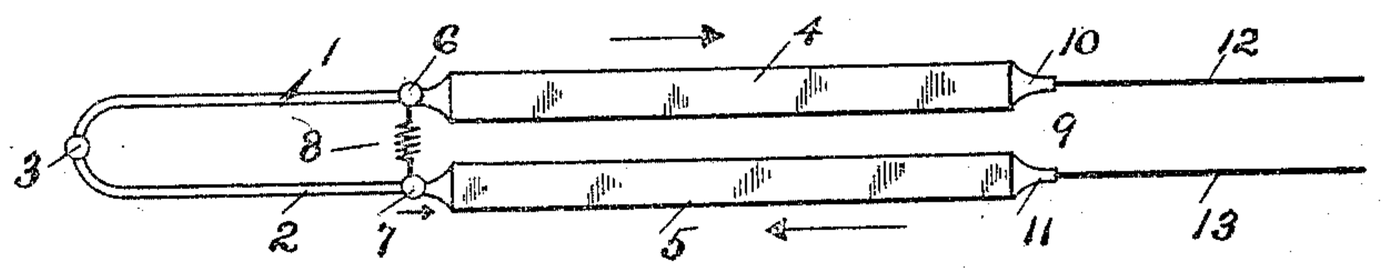

Fig. 3.

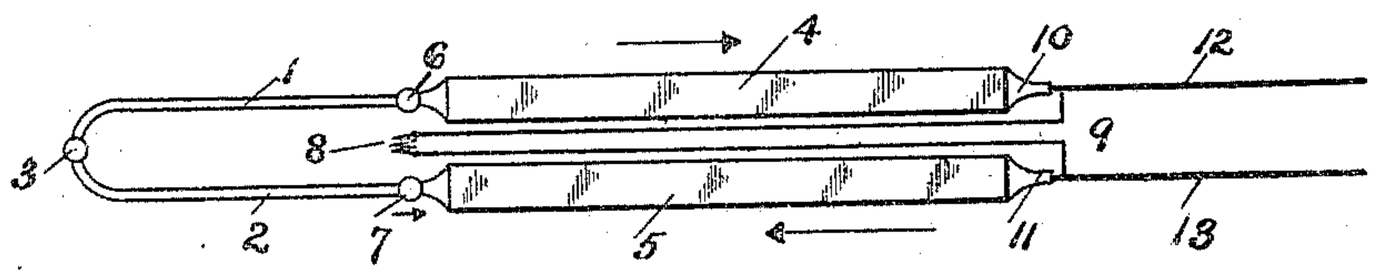

Fig. 4.

Witnesses
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UNITED STATES PATENT OFFICE.

WILLIAM H. BRISTOL, OF NEW YORK, N. Y.

THERMO-ELECTRIC GENERATOR.

No. 838,984. Specification of Letters Patent. Patented Jan. 1, 1907.

Application filed December 2, 1905. Serial No. 290,017.

To all whom it may concern:

Be it known that I, WILLIAM H. BRISTOL, a citizen of the United States, and a resident of New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Thermo-Electric Generators, of which the following is a specification.

My invention has reference to improvements in thermo-electric generators adapted for use in pyrometers, and relates particularly to improvements on the generator disclosed in my prior patent, No. 764,177, of July 5, 1904.

It has for its object to compensate for the effects of changes of temperature at the junction of the cheaper elements with the more expensive ones.

For this purpose my invention consists, essentially, of a thermo-electric generator comprising elements of high fusing-points forming a couple, elements of lower fusing-points connected to the elements of said couple, and means adapted to compensate for the effect of variations of temperature at said junctions.

Heretofore it has been proposed to join two elements adapted to withstand extremely high temperature with conductors less capable of resisting high temperature, but of greater conducting and less expensive material, and to maintain said conductors at their junctions at a comparatively low temperature by means of a protective insulation surrounded by a water-jacket or by so selecting the material or arranging the junctions of said conductors so that the effects of the temperature variations upon the junctions will be neutralized. The former method is somewhat cumbersome and impracticable and the latter difficult of realization, because of the amount of experimental work involved in the search for the combination of metals which will perfectly accomplish the desired results.

According to my present invention I approximate the generator disclosed in my prior patent, No. 764,177, and then complete the neutralization of the effects of temperature variations upon the junction by providing suitable compensating means so arranged with respect to the generator that the temperature variations at the junctions will not affect the generator as a whole.

The nature of my invention will be best understood in connection with the accompanying drawings, in which—

Figures 1 to 4 are plan views of my improved thermo-electric generator, showing the various ways of arranging the compensating means.

Similar numerals of reference designate corresponding parts throughout the several views.

Referring now to the drawings, 1 and 2 designate the elements of a thermo-electric couple joined together at 3 in the usual manner. This couple is composed of metals or alloys having high fusing-points and capable of resisting extremely high temperatures without rapid deterioration—such, for example, as platinum and an alloy of platinum and ten per cent. of rhodium. It is well known that these materials are possessed of comparatively high resistance and are very expensive. To reduce the cost and the resistance of the generator as a whole, I make use of the elements 4 and 5 of a material or materials which are comparatively inexpensive substances—for example, iron, steel, nickel, or alloys thereof—and which have a lower fusing-point than the said expensive elements. Owing to the inexpensiveness of the elements 4 and 5, they may therefore be made of such proportions that they will offer but little resistance to the passage of the current and their resistance be inappreciably affected by temperature variations.

The elements 4 and 5 are so far removed from the fire end 3 of the couple that they do not receive the full heat, but only radiated or conducted heat, and are therefore not subject to injury from the intense heat to which the expensive elements are subjected, the junctions being at the points 6 and 7.

In view of the fact that different metals or metals and alloys meet at the junctions 6 and 7 secondary couples are formed, whose combined effect is to produce a current opposing or increasing the current developed by the thermo-electric generator. As indicated by the arrows in Figs. 1 and 2, the combined effect of the secondary currents is to increase the current produced by the thermo-electric generator, while in Figs. 3 and 4 the combined effect of the secondary current is shown to oppose the current of the generator. To compensate for the secondary effect at the junctions 6 and 7, I provide a suitable resistance 8, either in series with or in par-

allel with said generator and located in close proximity to the said junctions. By these means I am enabled to compensate for or neutralize the effects due to the temperature variations upon the junctions 6 and 7. For example, as shown in Figs. 1 and 2, the tendency of the secondary effects is to increase the total effect of the generator with an increase of temperature at the junctions 6 and 7. To obviate this, I place the resistance 8 with positive resistance coefficient in series with one of the elements 4 and 5 or the elements 1 and 2, thereby affecting the generator as a whole. Being located in close proximity to the junctions 6 and 7, this resistance will be increased with an increase of temperature and is so calculated as to cut down the effect of the generator as a whole in the same proportion as the combined secondary effects of the junction or secondary couples would increase it. I thus maintain a correct development of current by the generator as a whole, depending solely upon the difference in temperature between the fire end 3 and the cold end 9.

The elements 4 and 5 are an active part of the generator as a whole, having its fire end at 3 and its cold end at 9, and any thermo-electric effect is dependent solely upon differences of temperature between these two points, variations of temperature intermediate of these points having no effect upon the generator.

As shown in Figs. 3 and 4, the tendency of the combined secondary thermo-electric effects is to oppose or decrease the thermo-electric effect of the generator with increase of temperature at the junctions 6 and 7. I therefore place the resistance 8 of positive resistance coefficient in parallel with the generator as a whole, as shown in Figs. 3 and 4. Then as the temperature increases at the junctions 6 and 7 this resistance will also increase and will short-circuit less of the current developed by the generator, thereby increasing the effect of the generator as a whole. The resistance 8 is so calculated as to increase the active effect of the generator in the same proportion as the combined secondary effects of the junction or secondary couples would decrease it, thereby maintaining a correct current for the generator as a whole, irrespective of the temperature variations at positions intermediate of its fire end 3 and cold end 9.

It is obvious that I may employ resistances having negative temperature coefficients and arrange them accordingly; but I prefer to use a resistance having a positive temperature coefficient.

The generator is provided with terminals 10 and 11 and leads 12 and 13, which are adapted to be connected to the usual indicating or recording devices to indicate or record the thermo-electric effect of said generator.

What I claim as new, and desire to secure by United States Letters Patent, is—

1. A thermo-electric generator comprising: primary elements of high fusing-points forming a couple; secondary elements of lower fusing-points connected thereto and forming secondary couples intermediate of the hot and cold ends of said generator; and means independent of said elements adapted to compensate for the effects of said secondary couples.

2. A thermo-electric generator comprising: primary elements of platinum and an alloy of platinum with ten per cent. of rhodium, forming a couple; secondary elements of nickel-steel alloy and of iron, respectively connected thereto and forming secondary couples intermediate of the hot and cold end of said generator; and means independent of said elements adapted to compensate for the effects of said secondary couples.

3. A thermo-electric generator comprising: primary elements of high fusing-points forming a couple; secondary elements of lower fusing-points connected thereto and forming secondary couples intermediate of the hot and cold end of said generator; and a resistance located in close proximity to the junctions of said secondary elements with the said primary elements, and adapted to compensate for the effects of said secondary couples.

4. A thermo-electric generator comprising; primary elements of platinum and an alloy of platinum with ten per cent. rhodium, forming a couple; secondary elements of nickel-steel alloy and of iron, respectively connected thereto and forming secondary couples intermediate of the hot and cold end of said generator; and a resistance located in close proximity to the junctions of said secondary elements with the said primary elements, and adapted to compensate for the effects of the said primary couples.

5. A thermo-electric generator comprising: elements of high fusing-points forming a couple; secondary elements of lower fusing-points connected thereto and forming secondary couples intermediate of the hot and cold end of said generator; and a resistance located in series with said generator and in close proximity to the junctions of said secondary elements with said primary elements, and adapted to compensate for the effects of said secondary couples.

6. A thermo-electric generator comprising: primary elements of platinum and an alloy of platinum with ten per cent. rhodium, forming a couple; secondary elements of nickel-steel alloy and of iron, respectively connected thereto and forming secondary couples intermediate of the hot and cold end

of said generator; and a resistance located in series with said generator and in close proximity to the junctions of said secondary elements with said primary elements, and adapted to compensate for the effects of said secondary couples.

Signed at New York city, in the county of New York and State of New York, this 29th day of November, A. D. 1905.

WILLIAM H. BRISTOL.

Witnesses:

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SALLYE O. YUDIZKY.