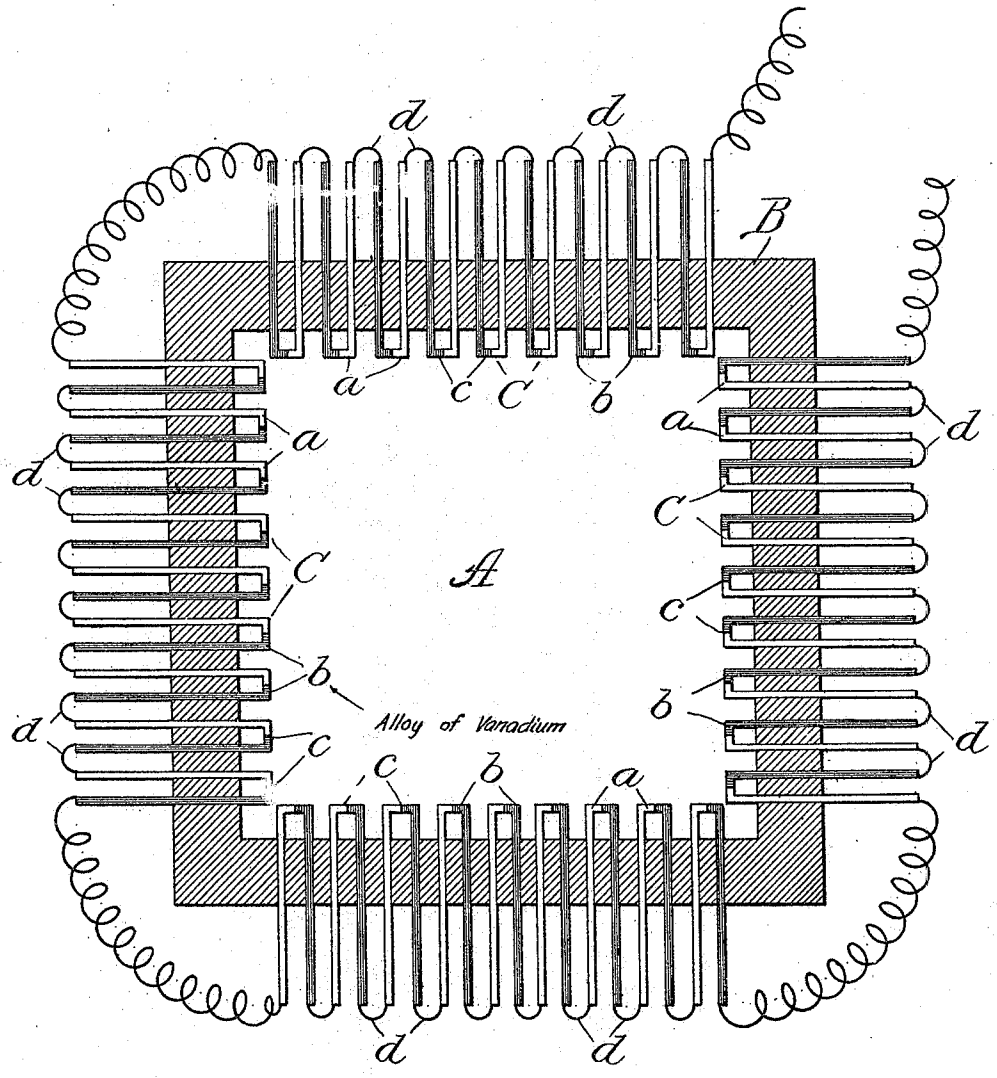
136-240

No. 874,780. PATENTED DEC. 24, 1907.

A. L. MARSH.

THERMO ELECTRIC ELEMENT.

APPLICATION FILED JAN. 17, 1907.



Witnesses:
Chas. S. Gaylord.
Chas. H. Burleigh.

Inventor:
Albert L. Marsh,
By Dyrenforth, Dyrenforth, Lee & Wiles,
Attys.

UNITED STATES PATENT OFFICE.

ALBERT L. MARSH, OF LAKE BLUFF, ILLINOIS, ASSIGNOR TO WM. A. SPINKS & CO., OF CHICAGO, ILLINOIS, A COPARTNERSHIP FIRM.

THERMO-ELECTRIC ELEMENT.

No. 874,780. Specification of Letters Patent. Patented Dec. 24, 1907.

Application filed January 17, 1907. Serial No. 352,689.

To all whom it may concern:

Be it known that I, ALBERT L. MARSH, a citizen of the United States, residing at Lake Bluff, in the county of Lake and State of Illinois, have invented a new and useful Improvement in Thermo-Electric Elements, of which the following is a specification.

My object is to provide an improved thermo-electric element which may be employed with another element to produce a thermo-electric couple having a particularly high melting-point.

I have discovered that the metal vanadium which has a very high melting-point, may either alone or, and, particularly, when alloyed with nickel, be employed as a thermo-electric element electro-negative to a nickel-copper element. Such a negative element renders it possible to construct thermo-electric couples of comparatively great efficiency which may be subjected at their junctions to intense heat without danger of injury. By the term "negative element" in this connection is meant the element of a pair to which the electric current flows from the other or positive element through the junction of the pair when subjected to heat at the said junction.

This invention is the result of experiments carried on with a view to discovering a readily-available metal having a melting-point exceeding, more especially, that of pure copper and which, either alone or when alloyed with other metal or metals, would be either electropositive or electronegative to another highly refractory metal or alloy with which it could be joined in a thermo-electric couple and possess the characteristics above set forth as my object and possess comparatively great strength and durability. I have found that vanadium may when alloyed with nickel be formed into a thermo-electric element strongly electro-negative to an element formed of an alloy of nickel and copper. Both the said negative and positive elements have melting-points much higher than that of pure copper and may be subjected without danger to intense heat, thereby establishing a difference of electric potential at least equal to any other practical couple of which I am aware.

In constructing a thermo-electric battery, for example, I prefer to provide the positive element of each couple of an alloy of nickel (about thirty-five per cent.) and copper, (about sixty-five per cent.) This element has a fusing-point above 1,050° centigrade, the approximate fusing-point of pure copper. I form the negative element of an alloy of vanadium (about ten per cent.) and nickel, (about ninety per cent.) Bars of the alloys named may be readily welded together at their ends to form thermo-electric couples.

The more important advantages which I have discovered a nickel-vanadium alloy for the negative element of a thermo-electric couple, to possess, are: Comparatively high electromotive force when used in conjunction with any positive element, such as pure nickel, or an alloy of nickel and copper, a nickel-vanadium alloy containing about ten per cent. of vanadium being negative to pure nickel, about .046 volts at 1000 °C., and to a nickel-copper element, about .078 volts at the same temperature; low specific resistance compared with an alloy of zinc and antimony, which is the negative element now mostly used, this alloy having a resistance of about 3.5 times that of an alloy of nickel and vanadium containing ten per cent. of vanadium; a melting-point high above that of pure copper; resistance to oxidation at temperatures much higher than those ordinarily used in thermo-piles; and great ductility, alloys containing less than fifteen per cent. of vanadium being capable of ready rolling or drawing, while the zinc-antimony alloy, referred to, is very brittle. Further advantages of my improved thermo-electric couple lie in its great strength and durability; in the fact that as it may be subjected to heat of great intensity care in the matter of heat-regulation is unnecessary; in the further fact that the elements may be as thin as desired for rapid heat-radiation at the ends farthest from their heated joints, and in the still further fact that the elements may be welded together to produce a joint equally heat-resistant with the body-portions of the elements.

In the accompanying drawing I show for purposes of illustration a thermopile of one desirable form in cross-section with thermo-electric couples connected in series to form an efficient thermo-electric generator.

A is a combustion-chamber surrounded by a wall B of highly-refractory material, such as fire-clay, asbestos, or the like.

C C indicates thermo-electric couples, each comprising a positive element in the form of

a strip *a* of the nickel-copper alloy mentioned and a negative element in the form of a strip *b* of the vanadium-nickel alloy mentioned. The elements of each couple are preferably electrically welded together to form a joint *c*, and they pass through the wall B to extend at their joints in the combustion-chamber A. The thermo-electric couples are connected in a common manner by means of strips *d*, which may be of copper, and the thermopile may have the usual terminals, one of which would be positive and the other negative. The couples C may be subjected in the chamber A, for example, to a direct blast of great intensity from a Bunsen burner. The couples will generate an electric current of an efficiency at least equal to that of which may be generated by the most efficient couples hitherto constructed and of which I am aware, and they may be subjected to a heat at their inner ends and a cooling action at their outer ends which maintains them at approximately the greatest efficiency for an indefinite time without affecting their durability to any material extent.

I have obtained the best results by employing a vanadium-nickel alloy in substantially the proportions named for the negative element and a nickel-copper alloy in substantially the proportions named for the positive element. My invention, however, is not in its broad sense to be limited by this statement, as the main point of my invention lies in the discovery of the use of vanadium as an element in a thermo-electric couple.

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

1. A thermo-electric couple, one element of which consists of an alloy of vanadium and another metal which when alloyed with vanadium forms an alloy which is electro-negative to nickel.

2. A thermo-electric couple, one element of which consists of an alloy of vanadium and nickel.

3. A thermo-electric couple, one element of which consists of an alloy of vanadium and nickel and the other element of an alloy of nickel and copper.

ALBERT L. MARSH.

In the presence of—
C. W. WASHBURNE,
WILLIAM M. COX.