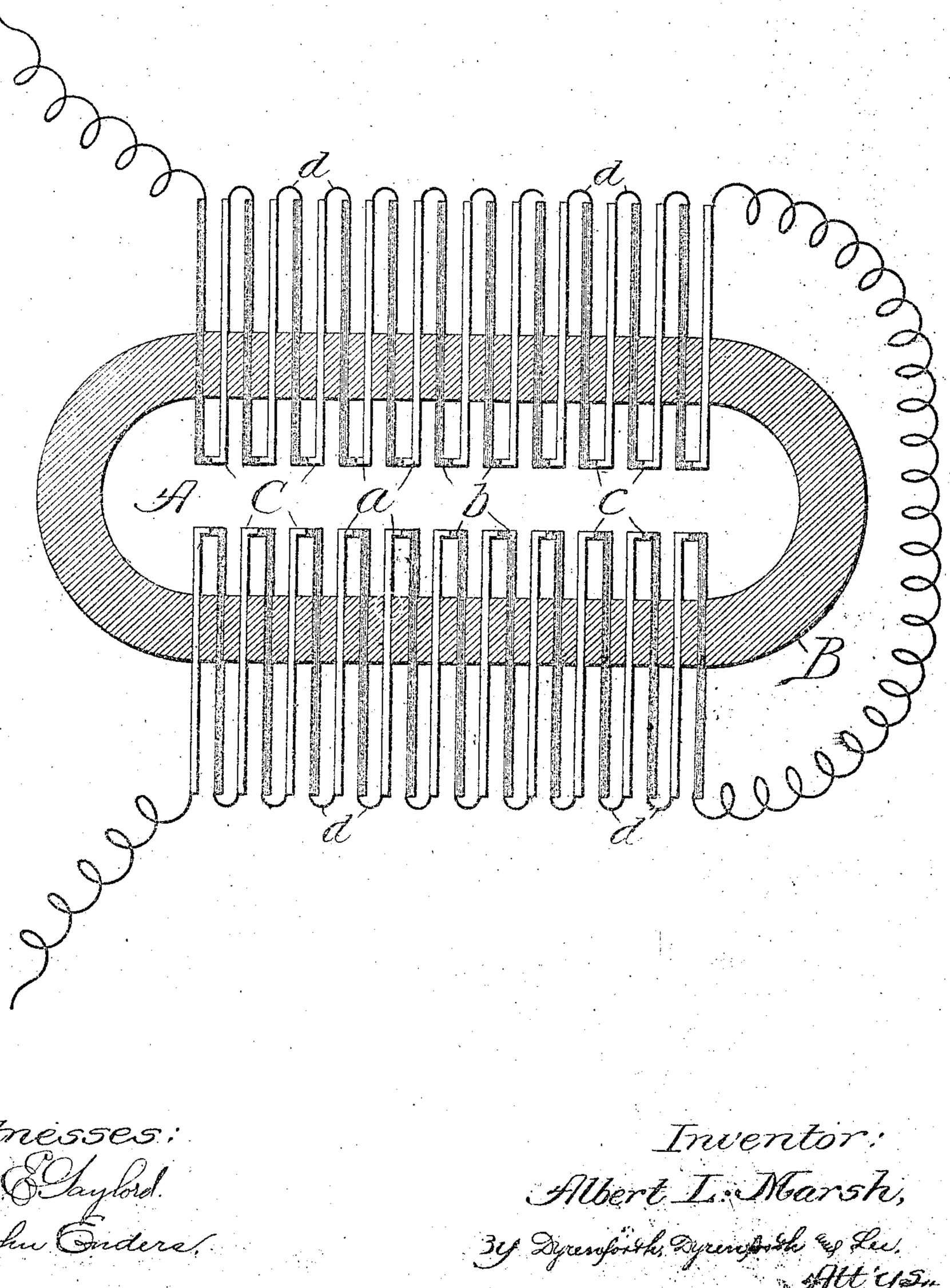
No. 781,289. PATENTED JAN. 31, 1905.

A. L. MARSH.

THERMO ELECTRIC ELEMENT.

APPLICATION FILED OCT. 18, 1904.



Witnesses:
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No. 781,289. Patented January 31, 1905.

UNITED STATES PATENT OFFICE.

ALBERT L. MARSH, OF LAKE BLUFF, ILLINOIS, ASSIGNOR TO WILLIAM A. SPINKS & COMPANY, OF CHICAGO, ILLINOIS, A FIRM.

THERMO-ELECTRIC ELEMENT.

SPECIFICATION forming part of Letters Patent No. 781,289, dated January 31, 1905.

Application filed October 18, 1904. Serial No. 228,943.

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 Thermo-Electric Element, 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 molybdenum, which has a very high melting-point, may, particularly when alloyed with nickel, be employed as a thermo-electric element electronegative 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, as well as comparatively great strength and durability. I have found that molybdenum may when alloyed with nickel be formed into a thermo-electric element strongly electronegative 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 without the drawbacks incident to said other couples.

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 much above 1,050° centigrade, the approximate fusing-point of pure copper. I form the negative element of an alloy of molybdenum (about fifteen per cent.) and nickel, (about eighty-five per cent.) Bars of the alloys named may be readily welded together at their ends to form thermo-electric couples.

The main advantages of a thermo-electric couple constructed of the elements described lie, first, in the great strength and durability of the couple; second, in the fact that as it may be subjected to heat of great intensity care in the matter of heat regulation is unnecessary; third, in the fact that the elements may be as thin as desired for rapid heat radiation at the ends farthest from their heated joints, and, fourth, in the 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 indicate 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 molybdenum-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 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. The outer end portions of the couples may be air-cooled, or they may be subjected to water-cooling or other artificial refrigeration.

I have obtained the best results by employing a molybdenum-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 molybdenum as an element in a theremo-electric couple.

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

1. A thermo-electric couple, one element of which is formed in whole or in part of molybdenum.

2. A thermo-electric couple, one element of which consists of an alloy of molybdenum and another metal.

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

4. A thermo-electric couple, one element of which consists of an alloy of molybdenum and nickel in substantially the proportions set forth.

5. A thermo-electric couple, one element of which consists of an alloy of molybdenum and nickel and the other element of an alloy of which nickel forms a part.

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

ALBERT L. MARSH.

In presence of—
WALTER N. WINBERG,
E. P. RICH.