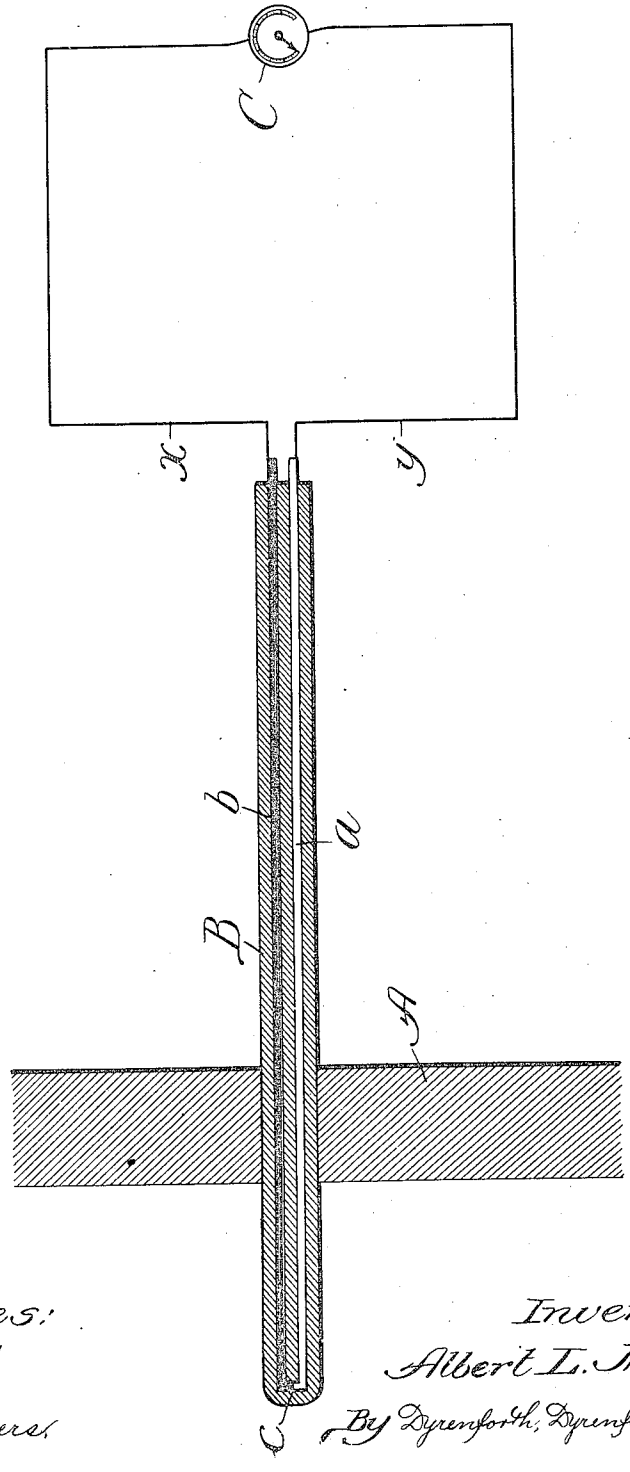
No. 786,577. PATENTED APR. 4, 1905.

A. L. MARSH.

THERMO ELECTRIC COUPLE.

APPLICATION FILED OCT. 18, 1904.



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No. 786,577. Patented April 4, 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 COUPLE.

SPECIFICATION forming part of Letters Patent No. 786,577, dated April 4, 1905.

Application filed October 18, 1904. Serial No. 228,945.

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 Couple, of which the following is a specification.

My object is to provide an improved, durable, and efficient thermo-electric couple having a particularly high melting-point for use as a thermo-electric generator, particularly, though not necessarily, for heat-measuring purposes.

I have discovered that cobalt is electropositive to certain other metals possessing very high melting-points and particularly to a certain group of such metals possessing metallurgical characteristics in common. I have also discovered that an element formed of cobalt possesses advantages for certain uses over any other metal of which I am aware, particularly when joined in a thermo-electric couple, as an electropositive element to an electronegative element, consisting of one of the metals of said group, especially when alloyed with nickel. By the term "positive element" is meant the element of a pair from which the electric current flows to the other or negative element through the junction of a pair which is subjected to heat. The metals referred to, which when alloyed, particularly with nickel, form elements electronegative to cobalt, are metals of what is termed the "chromium group" and embrace chromium, molybdenum, tungsten, and uranium. The chromium group referred to is defined in Watts's *Dictionary of Chemistry* and consists of the metallic elements of group VI, (indicated by the even-numbered series,) according to what is generally known as "Mendeléef's table," (see page 212, Remsen's *Chemistry*, 5th edition, Henry Holt & Co., New York, 1898.)

In carrying out my invention I prefer to form the negative element of the couple of one or another of the following alloys: first, chromium and nickel; second, molybdenum and nickel; third, tungsten and nickel; fourth, uranium and nickel. As uranium particularly is a very rare and expensive metal, I prefer to employ for the negative element an alloy of chromium and nickel, molybdenum and nickel, or tungsten and nickel, the first two said alloys being preferred. Any of the said alloys of nickel and a metal of the chromium group is electronegative to cobalt, and all of the said metals have a very high melting-point, greatly in excess, for example, of the melting-point of pure copper. A bar of either of the said alloys may be readily welded to a bar of cobalt to form a highly-refractory non-oxidizable durable and efficient couple which may be subjected without danger of injury to a concentrated flame of great intensity.

In a separate application filed by me June 4, 1904, Serial No. 211,125, I showed and described a thermo-electric couple consisting of a negative element formed of an alloy of nickel and one or more metals of the chromium group, and a positive element consisting of an alloy of copper and nickel. The nickel-copper alloy I consider more desirable for various reasons than cobalt as the positive element in thermo-electric batteries. For heat-measuring purposes, however, I believe that a positive element of cobalt possesses superior advantages as compared with a nickel-copper alloy.

In carrying out my invention the positive element may be chemically or commercially pure cobalt. The negative element may be formed of an alloy of chromium, ten per cent., and nickel, ninety per cent., or molybdenum, fifteen per cent., and nickel, eighty-five per cent., or tungsten, twenty per cent., and nickel, eighty per cent. Of course the proportions named may be varied without departing from the spirit of my invention.

In the accompanying drawing I have shown my invention applied to a pyrometer wherein the heat is measured by the force of the current generated by the application of the heat to the joint of a thermo-electric couple.

Referring to the drawing, A represents a furnace-wall. Extending through the wall is a tube B, of highly refractory material, containing a thermo-electric couple consisting of a positive element *a* of cobalt and a nega-

tive element *b*, consisting of an alloy of a metal of the chromium group and nickel in proportion as before stated. The elements are welded together at the joint *c*. The closed end of the tube B, with the joint *c*, extends into the furnace-chamber, while the outer end portion of the tube and couple extends to the outer side of the furnace, where it may be subjected as desired to air-cooling, water-cooling, or artificial refrigeration to maintain a difference of potential between the positive and negative elements in a manner well known. Conductor-wires *x y* may extend from the respective elements to a suitable galvanometer C, which may indicate the current, and thereby the heat to which the joint of the couple is being subjected.

The gist of my invention lies more especially in the discovery that commercially-pure cobalt may be employed as one of the elements of a thermo-electric couple; and my invention further consists in a thermo-electric couple one element of which consists in whole or in part of cobalt and the other in whole or in part of one of the metals of the chromium group.

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

1. A thermo-electric couple one element of which consists in whole of commercially-pure cobalt.

2. A thermo-electric couple, one element of which consists in whole or in part of cobalt and the other element of one of the metals of the chromium group.

3. A thermo-electric couple, one element of which consists in whole or in part of cobalt and the other element of an alloy containing one of the metals of the chromium group.

4. A thermo-electric couple, one element of which consists in whole or in part of cobalt and the other element of an alloy of nickel and one of the metals of the chromium group.

ALBERT L. MARSH.

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