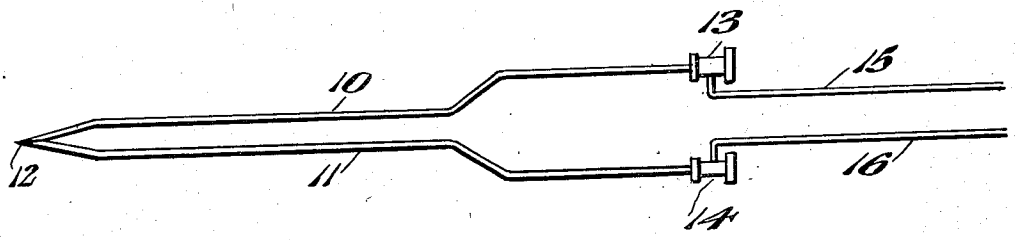
Nov. 17, 1925.

1,561,593

R. P. BROWN

THERMOELECTRIC COUPLE

Filed Sept. 5, 1923



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UNITED STATES PATENT OFFICE.

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THERMOELECTRIC COUPLE.

Application filed September 5, 1923. Serial No. 661,041.

To all whom it may concern:

Be it known that I, RICHARD P. BROWN, a citizen of the United States, and a resident of Philadelphia, county of Philadelphia, State of Pennsylvania, have invented certain new and useful Improvements in Thermoelectric Couples, of which the following is a specification.

Some of the objects of the present invention are to provide an improved thermo-electric couple; to provide a thermo-couple having an extension portion of low heat resisting materials combined with a primary portion of relatively high heat resisting materials; to provide extension leads for a thermo-couple whereby the cold junction of the couple is most accurately transferred to the measuring instrument, or to a point where the temperature of the cold junction can be maintained constant; to provide a thermo-couple extension whereby a specific electro-motive force is generated at a given temperature; to provide a thermo-couple extension, one element of which is formed of an alloy of nickel, copper and manganese; and to provide other improvements as will hereinafter appear.

The drawing is a graphic representation of a thermo-couple embodying the present invention.

Referring to the drawing, one embodiment of the present invention in thermo-couple extensions is shown as a part of a compound thermo-couple, having primary elements respectively 10 and 11, joined in the usual manner at 12, and having their respective free ends joined at 13 and 14 to extension leads 15 and 16. The element 10 in the present construction is the positive element of the couple and is formed of a nickel-aluminum alloy, and the element 11 is the negative element and is formed of an alloy of nickel and chromium, though it will be understood that the positive element of a couple is the element from which the electric current flows to the other or negative element when the junction of the couple is heated. Thus, the nickel-chromium wire is to be connected to the plus or positive side of the measuring instrument, while the nickel-aluminum wire is to be connected to the negative side of the measuring instrument. These two alloys are widely used as primary elements of a thermo-couple because they have a comparatively high heat resistance, a high electro-motive force, and produce an electro-motive force temperature curve with an absence of critical points. A primary thermo-couple as so constructed is known to the trade as a chromel-alumel thermo-couple, and has been selected as the preferred type of primary for use with the extensions of the present invention, though it will be understood the invention is not limited to this particular primary.

For the purpose of extending the cold junction of the thermo-couple to a distant point, such as a measuring instrument, or a location where the temperature of the cold junction can be maintained constant, the positive element 10 is connected to an extension element wire 15, formed of an alloy of nickel, copper and manganese, such alloy being generally known as constantan. The proportions of the alloy are nickel, approximately 45 per cent; copper, approximately 53 per cent; and manganese, from ¼ per cent to 1 per cent. The negative element 11, formed of nickel and chromium, is connected to a wire 16 of copper of the purity of the ordinary commercial copper wire. The materials of these extensions 15 and 16 have considerably less heat resistance than do the primary elements of the couple, but have the advantage of low resistance and are less expensive than the wires forming the primary thermo-couple.

While in the foregoing the percentage of manganese has been stated as varying from one-quarter of one per cent to one per cent, very desirable and satisfactory results have been obtained when the manganese content is one-half of one per cent, and this or as near thereto as possible is the preferred ratio. It has been found that the percentage of manganese added to the copper and nickel has a very material effect on the E, M. F. generated by a thermo-couple formed of constantan wire combined with a copper wire. For example, a thermo-couple formed of constantan wire approximately 54 per cent, nickel approximately 45 per cent and manganese ¼ of 1 per cent, the other side of the thermo-couple being copper, with hot junction at 1500° F., cold junction zero F., will give a certain E. M. F.; and if the copper and nickel in the constantan wire are maintained in the same pro-

portions, and the manganese is increased to ½ of one per cent, the copper wire remaining the same, a change in E. M. F. equivalent to 150° F. will occur. Since a change in the manganese content from ¼ of 1 per cent to ½ of one per cent causes a change of approximately 10 per cent at 1500° F. and this percentage is approximately the same at 150° F., (the temperature to which the cold end of a primary thermo-couple may frequently be subjected), it is very important that in the manufacture of thermo-couple wire, one wire being commercially pure copper and the other being an alloy of copper, nickel and manganese, that the manganese content be accurately controlled. It will thus be evident that control of the manganese content of the alloy is of the greatest importance in obtaining accurate results and by test and experiment a percentage of one-half of one per cent manganese has been found to give highly satisfactory results. If the manganese varies too greatly from this percentage, accurate results cannot be secured in extending the cold junction from the thermo-couple to a distance by means of extension leads of copper combined with a copper-nickel-manganese alloy. The small percentage of impurities, such as iron, silicon and carbon remaining in the constantan wire in its finished state are negligible and have no effect upon the functioning of the extension wires.

Although only a single form is shown in which this invention may be embodied, it is to be understood that the invention is not limited to any specific construction, but might be applied in various forms without departing from the spirit of the invention or the scope of the appended claims.

Having thus described my invention, I claim:

1. A thermo-electric couple comprising in combination a primary couple and two extension elements thereto, one of said elements being formed of an alloy containing approximately 54% of copper, approximately 45% of nickel and from .25% to 1% of manganese.

2. A thermo-electric couple comprising in combination a primary couple and extension elements connected thereto, one of said elements being formed of an alloy containing approximately 54% of copper, approximately 45% of nickel and approximately one-half of one per cent of manganese.

3. A thermo-electric couple comprising a primary couple having one element formed of nickel and chromium alloy and the other element formed of a nickel and aluminum alloy, an extension formed of pure copper connected to the nickel-chromium element, and a second extension formed of an alloy containing approximately 54% of copper, approximately 45% of nickel and from .25% to 1% of manganese connected to said nickel-aluminum element.

Signed at Philadelphia, county of Philadelphia, State of Pennsylvania, this 26 day of July, 1923.

RICHARD P. BROWN.