

UNITED STATES PATENT OFFICE.

ALBRECHT HEIL, OF FRANKFORT-ON-THE-MAIN, GERMANY, ASSIGNOR TO
THE FIRM OF A. WOLF, JR., & CO., OF FRANKFORT-ON-THE-MAIN,
GERMANY.

METHOD OF UNITING THE TWO COMPONENTS OF A THERMO-ELECTRIC COUPLE.

SPECIFICATION forming part of Letters Patent No. 781,338, dated January 31, 1905.

Application filed October 31, 1904. Serial No. 230,791.

To all whom it may concern:

Be it known that I, ALBRECHT HEIL, a subject of the German Emperor, and a resident of Frankfort-on-the-Main, Germany, have invented certain new and useful Improvements in Methods of Uniting the Two Components of Thermo-Electric Couples, of which the following is a specification.

As is well known, the two components of a thermo-electric couple are made of two different metals or alloys and united in their contact-face by soldering. This manner of uniting the two parts, however, presents disadvantages which prevent the thermo-electric battery formed of such couples from attaining a high useful effect. When using a soft solder, it is obviously not possible to bring the components of the thermo-electric couple above a temperature near the melting-point of the solder, and as this point is very low it is impossible to obtain a reasonably high useful effect of the thermo-electric battery with the aid of high temperatures in such thermo-electric couples. A hot solder could also not be used for the reason that its melting-point is above that of the antimony or the antimony alloy of which the one component of the couple is usually made. It is also not possible to unite the two parts by mechanical compression by reason of the brittleness of the antimony or antimony alloy, which is nearly equal to that of glass, and also by reason of the difference in the coefficients of expansion of the two components. The brittle antimony alloy is not capable of sustaining a great pressure. Owing to the difference in the expansion of the two components, the great heat during the working of the thermo-electric battery would within a short time cause the formation of a layer of oxid between the two components, which layer of oxid would reduce the useful effect of the battery quite considerably. The formation of the layer or film of oxid could also not be avoided by casting the antimony alloy around the stubborn component made of metal more difficult to fuse, for during the casting a considerable layer of oxid would be in any

case formed between the two metals or alloys and render the union inadequate.

My invention relates to a new method of uniting the two components of a thermo-electric couple made, respectively, of antimony or antimony alloy and the so-called "constantan" (hereinafter to be referred to) or any other metal or alloy difficult of fusion, whereby the two components are united intimately and in a reliable manner, so that for a thermo-electric battery formed of such couples the highest possible useful effect can be secured.

I have discovered that when the stubborn metal or alloy is heated up to nearly a red heat and when a piece of antimony or antimony alloy is strongly rubbed on the hot stubborn metal or alloy particles of the antimony or antimony alloy will not only melt and unite with the stubborn metal or alloy, but also reduce any oxid during the rubbing operation, so that no film or layer of oxid can be produced in any way between the stubborn metal or alloy and the lining of antimony or antimony alloy.

The new method therefore consists in bringing the end or the whole of the component made of constantan or stubborn metal or alloy, as the case may be, up to about the melting-point of the antimony or antimony alloy and in rubbing a piece of antimony or antimony alloy strongly, uniformly, and completely on the end or contact-face of the first component until a uniform, complete, and adhering lining of the antimony or antimony alloy is formed thereon. This lining need not be very thick. It may have the thickness of a fracture of a millimeter; but care should be taken that this lining should completely cover the end or contact-face of the first part without leaving any defective spot. Then the first component so lined is again brought up to the same heat as before and pressed against the second component, when the liquid layer of antimony or antimony alloy on the first component will easily unite with the second component of the same material by melting up, and any film or layer of oxid that may have been formed on the second component will be removed by

pushing or squeezing out or otherwise. Thus the material of the second component forms itself the solder for uniting the two components, and it is evident that the union so formed
5 will be the best that can be procured at all, and the highest allowable potential difference will be obtained between the two components of the thermo-electric couple. Of course the second component may be brought up to a
10 convenient heat to facilitate its union with the first component during the soldering operation. The end or contact-face of the component of stubborn metal or alloy lined with the antimony or antimony alloy may also be sur-
15 rounded with molten antimony or antimony alloy, whereby the other component is not only formed, but also at the same time united with the former component. As the antimony or antimony alloy of the second component
20 will come into contact with the same metal or alloy on the first component, of course no film or layer of oxid will be formed on the contact-face.

The term "constantan" employed above
25 means usually an alloy of fifty per cent. copper and fifty per cent. nickel or an alloy of fifty-eight per cent. copper, forty-one per cent. nickel, and one per cent. manganese, or a similar alloy.

30 What I claim as my invention, and desire to secure by Letters Patent, is—

1. A method of uniting the two components of a thermo-electric couple made of a metal
35 or alloy difficult of fusion and of antimony or antimony alloy respectively, which consists

in first heating the stubborn component up to about the melting-point of the material of the second component, next rubbing strongly a piece of this material on the contact-face of the first component, until a uniform and com- 40 plete adhering lining of the antimony or antimony alloy without any film or layer of oxid is formed, afterward intimately uniting the two components by heat.

2. A method of uniting the two components 45 of a thermo-electric couple made of a metal or alloy difficult of fusion and of antimony or antimony alloy respectively, which consists in first heating the stubborn component up to about the melting-point of the material of the 50 second component, next rubbing a piece of this material on the contact-face of the first component strongly, uniformly and completely, until a uniform and complete adhering lining of the antimony or antimony alloy 55 without any film or layer of oxid is formed, afterward reheating the first component up to the same temperature and also the second component nearly so, then pressing both components in their contact-face on each other 60 while removing any film or layer of oxid that may have formed, whereby the two components are intimately united.

In testimony whereof I have signed my name to this specification in the presence of two sub- 65 scribing witnesses.

ALBRECHT HEIL.

Witnesses:

FRANZ HASSLACHER,

ERWIN DIPPEL.