

H. W. FISHER.
METHOD OF MAKING COMPOUND METAL ARTICLES.
APPLICATION FILED JUNE 16, 1909.

1,005,628.

Patented Oct. 10, 1911.

FIG. 1.

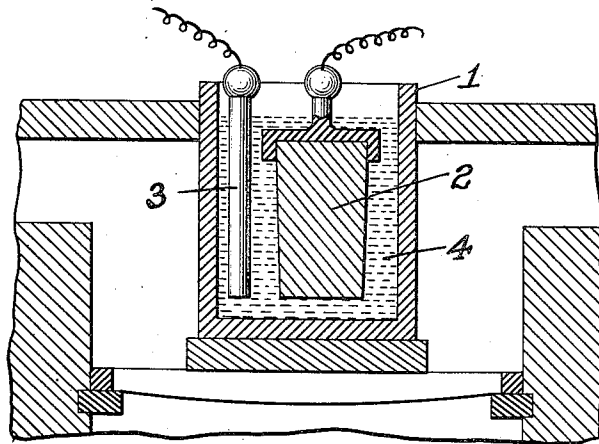


FIG. 2.

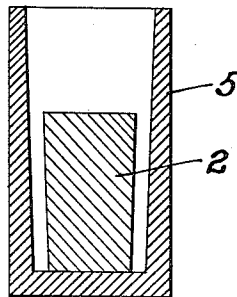
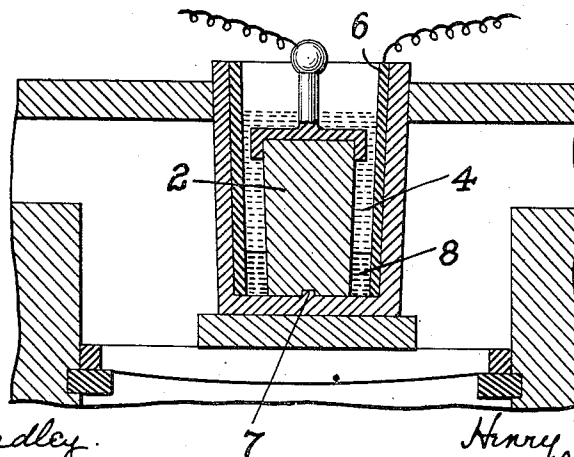


FIG. 3.



WITNESSES:

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METHOD OF MAKING COMPOUND METAL ARTICLES.

1,005,628.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, HENRY W. FISHER, residing at Pittsburgh, in the county of Allegheny and State of Pennsylvania, a citizen of the United States, have invented or discovered certain new and useful Improvements in Methods of Making Compound Metal Articles, of which improvement the following is a specification.

My invention relates to improvements in methods of uniting bodies of different metals to form compound articles, and the object of my improvement is to obtain in a commercially practicable operation a more intimate union of dissimilar metals than has heretofore been commonly accomplished.

While not limited in its nature to the treatment of any particular metals, nor to metals of any particular class or classes, my improvement finds immediate practical use in uniting copper and its alloys with iron in its various commercial modifications and alloys.

There is great demand for articles of iron and steel compounded with copper, for such articles combine the physical and chemical properties of both metals; and iron, the cheaper metal, provided with a surface of copper, may be made to serve in many ways, where the iron alone was, because of its properties, impracticable, and where copper alone, both because of its properties and because of its greater cost, also was impracticable. More particularly, I have found use for my improvement in the production of articles for use in electrical installations. Copper is largely used in such work, because of its high electrical conductivity; and iron has also a very extended use in electrical installations because of its tenacity and hardness, in some cases too because of its magnetic character, and in many cases because of its cheapness. The desirability of forming plates, wires, and other shapes with an iron body and a copper surface of greater or less depth, has long been recognized, and to this end it has been proposed to make the billets, rods, and blanks from which the particular articles are shaped from the two metals, united one upon the other, and then to reduce the compound blank to the shape and size desired. The difficulty heretofore has been to obtain such an intimate union of the iron core with the

copper surface that in the further treatment of the blank the components, when reduced, may maintain their proper relative dimensions, and that the ultimate product may be an adherent whole. Two distinct ways of uniting the two metals for such purposes have heretofore been proposed, and are to some extent practiced. One is to deposit electrolytically the body of the copper upon the body of iron, the other is to cast the body of copper upon the body of iron when properly placed within a mold. Neither of these two operations has been thoroughly satisfactory; the copper body applied by electrolysis has been to some extent of a porous or spongy character, a difficulty not wholly eradicated in subsequent treatment, and, moreover, the union of the deposit with the iron cathode has not been sufficiently intimate to adequately meet practical conditions. In the combining of the component metals by casting, there has been difficulty in failure to obtain intimate union of the two bodies.

My invention involves fundamentally the electrolytic method, but it is characterized by this feature, that, instead of being performed at or near atmospheric temperature, it is performed at a temperature as high as the melting point of copper. Under such circumstances, the deposit accumulates in molten condition, and the coating thus produced, instead of being porous, as is the case in the electrolytic operation at a low temperature, is compact and dense, as a coating cast from a body of molten metal. Furthermore, an electroplating so applied adheres more intimately to the cathode, thus producing a better result. In carrying out electrolysis at such elevated temperature (the melting point of copper is 1913° F.), it is necessary of course that the electrolyte be one which may be maintained in liquid state at that temperature. I do not limit myself to the broader aspect of my invention to an electrolyte of any specific material—other than that the whole should be capable of being maintained in liquid state at the melting point of copper—but I have found that borax is a substitute which will act as a solvent for copper salts, and will remain liquid at the desired temperature. I have found too that the alkaline chlorids, chlorid of sodium and chlorid of potassium,

may be employed for this purpose. I do not, however, consider them so good as borax, for at the desired temperature they tend to volatilize more rapidly than borax. Furthermore, I do not limit myself to any particular copper salt, but I have found cupric chlorid to be suitable for the contemplated purpose, and of course cupric fluorid may be employed in like manner. The essential thing is to employ the copper in a form soluble in the particular flux employed. In the use of cupric chlorid and other salts of copper, it will be found best to add such salt to the borax previously heated to or approximately to the temperature at which electrolysis is performed, immediately before electrolysis begins, this because of the tendency of such salt to volatilize at high temperature.

My method of procedure is exceedingly simple. I provide a suitable pot or cell, which will preferably be formed of highly refractory material, and place in it the borax and the copper salt, and bring the whole to the specified temperature, that is, the melting point of copper. I then introduce the body of iron upon which the copper is to be deposited. This body may be introduced in cold state. It forms the cathode and accordingly is in circuit with the anode. The anode may be a bar of graphite, or other suitable conductor, thrust into the body of the electrolyte, or it may be formed as the inner wall or part of the inner wall of the pot or cell. At such high temperature the refractory material of which such pots are ordinarily formed becomes itself conductive, and may serve as the anode, but preferably when the anode is to be integral with the wall of the pot or cell, I provide it with a lining of graphite.

It may be that the thin coating produced by electrolysis is of sufficient thickness, or it may be that a deeper coating is desired than can thus be conveniently or effectually built up. Ordinarily, after electrolysis has proceeded far enough to produce an initial coating, I stop the electrolytic action, and form by a distinct operation upon such copper-covered blank a second body of copper. The supplementary operation may be accomplished in various ways. The copper-plated blank may be taken from the cell in which the electrolysis has been performed, and placed within a suitable mold with a space between the coated surface and the mold wall, and into such mold cavity molten copper may be poured, as is usual in casting operations. In some cases I preferably have this mold cavity filled at the time when the pouring begins with a flux (as borax) in liquid condition, and in that case the molten copper will displace the liquid flux from the mold cavity. The presence of such a body of flux will effect a more

intimate union of the cast metal with the electro-plated surface of the iron body. Another alternative is to have a single vessel serve as the cell for electrolysis and the mold for casting. In such case, the anode will preferably, though not necessarily, be the inner wall of the cell, preferably faced with graphite, and the space between the iron body and the wall of the cell will be such as to afford a mold cavity of the desired width. In this case, when electrolysis shall have proceeded to the desired extent, molten copper will be teemed into the space between the article and the wall of the chamber, displacing the electrolyte. Instead of making this application of a second body of metal by casting, it may be made by electrolysis, carried on in the usual manner at or near atmospheric temperature. It will be understood that in any case the second supplemental body of metal cast or plated upon the coated blank need not be of the same metal as the initial coating, but will be of a metal or alloy, which will adhere to such coating by the operation employed to apply it. For example, the initial coating may be of pure copper, and the supplemental body may be of copper bronze.

While my invention will be understood from the foregoing description I have for the sake of greater clearness illustrated it in the accompanying drawings.

Figure 1 is a sectional view of a cell in which electrolysis is taking place. In this case, 1 represents the cell, 2 the body or core to be plated, 3 the anode, and 4 the electrolyte. It will be understood that the operation is progressing at the temperature at which copper melts.

Fig. 2 shows, in vertical section, a mold within which the iron body 2, previously electro-plated in a cell such as illustrated in Fig. 1, is placed, with the desired space between the body itself and the mold wall, and into this space molten copper is teemed, displacing, in my preferred arrangement, a body of molten flux, as borax.

Fig. 3 shows in vertical section a chamber serving both as an electrolysis cell and as a mold. In this case, the cell is preferably lined with graphite as indicated at 6, the graphite lining forming the anode in electrolysis. The body of metal 2 is suitably placed within the chamber, and to that end may be centered upon a centering pin, as 7. The initial part of the operation consists in the electro-plating of the body of iron 2, in the manner and at the elevated temperature already described, and the following operation consists in teeming molten copper into the space between the body 2 and the graphite wall 6; in this second operation, it will be understood that the electrolyte 4 is gradually displaced by a body of molten copper, 8. The further treatment consists, as will

readily be understood, in cooling, and, if desired, the reduction of the billet or blank to another size and form.

5 In the foregoing specification I have described my invention and shown its applicability in uniting metals without particular regard to the shape of the bodies to be united, further than to explain its applicability to the forming of compound ingots of
10 shapes commonly used in making sheets, rods, and like articles. Another application may properly be mentioned. That is to the application of a body of one metal to another body of metal in tubular form.
15 For example, a section of iron pipe may receive a copper coating either internally or externally by the operations above described; again, the space within a pipe may be entirely filled after the described manner, and
20 an iron pipe so filled with copper may be reduced to a wire. An iron sheathed copper wire so produced is of particular value in certain electrical installation. If the deposit is made on the inside of a tube, it will
25 be understood that the anode will be placed within the tubular space. Further, upon a blank of metal coated, by the hot electrolysis described, with another metal, a sleeve of the second metal, or of a metal or alloy
30 readily uniting with the electrolytic coating, may be applied, and the whole reduced by

rolling or other forging operation. If desired, a rod like body of metal may be thrust within a tube electro-plated internally by my improved method, and the whole reduced. 35

I claim as my invention:

1. The herein described method of forming and uniting the bodies of different metals which consists in electro-plating one
40 metal upon the other from an electrolyte maintained at a temperature as high as the melting point of the metal so deposited, submerging the electro-plated surface of the article so electro-plated in a bath of flux
45 and displacing such flux with a body of molten metal.

2. The herein described method of making compound metallic wire, which consists in electro-plating the interior of a metallic
50 tube with another metal at a temperature as great as the melting point of the metal so deposited, filling the space within the electro-plated tube with metal, and reducing the
55 blank so formed.

In testimony whereof, I have hereunto set my hand.

HENRY W. FISHER.

Witnesses:

CHARLES BARNETT,
FRIEDA E. WOLFF.