

June 21, 1949.

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COMPOSITE METAL

2,474,038

Filed March 3, 1945

2 Sheets-Sheet 1

FIG. 1.



FIG. 2.



FIG. 3.

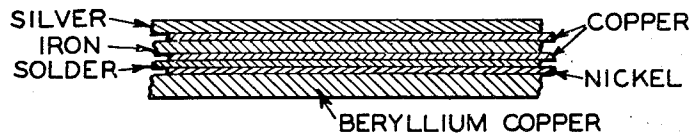
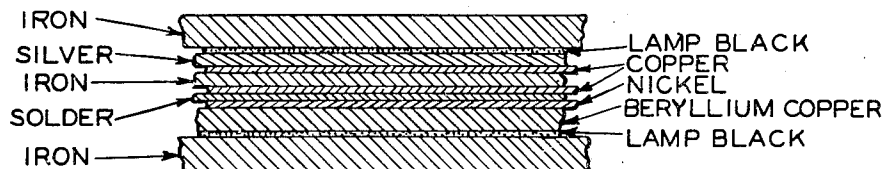


FIG. 4.



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FIG. 5.

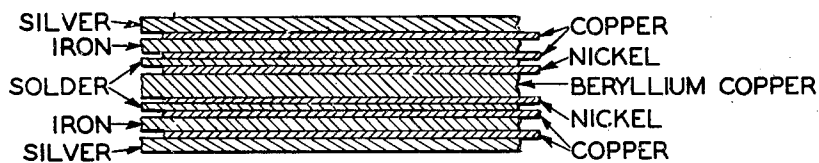
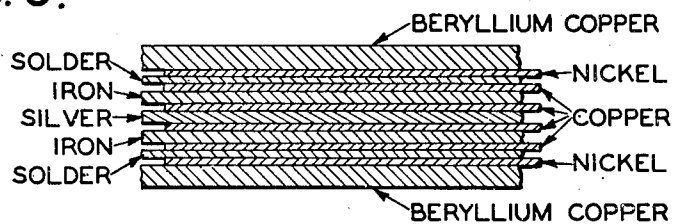


FIG. 6.



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UNITED STATES PATENT OFFICE

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COMPOSITE METAL

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5 Claims. (Cl. 29—196.3)

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This invention relates to composite metals and more particularly to composite metals having a precious metal surface and a beryllium-copper base.

Among the objects of this invention are the provision of a composite metal having a precious metal surface and a beryllium-copper base; and the provision of a composite metal of the class indicated which may be solution annealed without blistering so that the composite metal may be easily formed, and yet may be subsequently treated to spring temper it. Other objects will be in part apparent and in part pointed out hereinafter.

The invention accordingly comprises the elements and combinations of elements, steps and sequence of steps, features of construction and manipulation, and arrangements of parts which will be exemplified in the structures and methods hereinafter described, and the scope of the application of which will be indicated in the following claims.

In the accompanying drawings, in which are illustrated several of various possible embodiments of the invention,

Fig. 1 is a fragmentary section through an intermediate for the production of the composite metal of the present invention;

Fig. 2 is a fragmentary section through another intermediate;

Fig. 3 is a fragmentary section through the finished composite metal prior to bonding;

Fig. 4 is a fragmentary section showing the composite metal ready for bonding;

Fig. 5 is a fragmentary section through an alternative embodiment of the finished composite metal prior to bonding; and,

Fig. 6 is a fragmentary section through still another embodiment.

Similar reference characters indicate corresponding parts throughout the several views of the drawings.

Beryllium-copper alloy has been used as a base for a plate of silver, gold or other precious metals. However, such composite metals could not be solution annealed because when such a treatment was attempted the composite metal blistered and the precious metal layer peeled.

Precious metal plates on a beryllium-copper base have been utilized in the past but these have been in the cold-roll-hardened state. A cold rolled beryllium-copper is not as hard or springy as one which is first solution annealed and then tempered. Such cold rolled plated beryllium-copper composite metal was accepted heretofore

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since it was the only alternative available to a blistering and peeling composite metal.

According to the present invention a beryllium-copper alloy base metal and a precious metal surface layer are combined to form a composite metal which may be solution annealed, and which therefore may be tempered to a desired hardness and springiness. In the composite metal of the present invention the beryllium-copper alloy base and the precious metal surface layer are bonded together through a separating layer of a relatively infusible metal such as iron. By relatively infusible is meant a metal which will fuse with, or bond to, the adjacent metals only on a "skin" layer, so that the silver is separated from the beryllium-copper with a finite unalloyed layer of this blocking or separating metal, and further characterized by having a melting point several hundred degrees higher than the solution-quench temperature. An iron intermediate layer is the preferred type. It is first coated with a layer of what may be termed an anti-oxidant metal, that is, one which protects the separating metal from oxidation. Suitable anti-oxidant metals are copper and nickel. The surface of the beryllium-copper base is likewise protected by such an anti-oxidant metal.

Referring now to the drawings,

Fig. 1 illustrates a beryllium-copper base which has been coated with a protecting layer of nickel. This coating may be applied in any desired manner, as by dipping, electroplating, spraying, etc. The nickel coating protects the beryllium-copper surface from oxidation.

Fig. 2 illustrates an intermediate layer of iron which is coated on both sides by a protecting layer of copper. This copper layer may be applied in any desired fashion, as by dipping, electroplating, spraying or the like. The copper layer not only protects the surface of the iron from oxidation, but aids in bonding together the beryllium-copper base and a precious metal surface layer.

Fig. 3 illustrates, with the layers in their relative positions, the composite metal ready for bonding. It will be noted that a surface layer of silver and a beryllium-copper base are joined together through a layer of copper, a layer of iron, a second layer of copper, a layer of solder and a layer of nickel.

Fig. 4 illustrates a means for bonding the layers together. The entire assembly is sandwiched between two sheets of iron which have been coated on the contacting sides with layers of lamp black. The two sheet iron layers are held in position by clamps (not shown) which also serve to retain the

layers of the composite metal in juxtaposition. The assembly is then heated at 1580° F., taken out of the oven and the clamps tightened. This bonds together the layers of the composite metal to form the desired product.

The resulting composite metal ingot has a beryllium-copper base and a precious metal surface layer. It may be solution annealed without danger of the layers separating or blistering, and may be formed as desired by rolling operations, etc. For example, it may be rolled to a desired final thickness with as many anneals in between rolling operations as are necessary, and after a final solution anneal may be sold either in the soft form or heat treated to a spring temper as preferred.

Fig. 5 illustrates an alternative embodiment of the composite metal in which a beryllium-copper base is plated on both sides with a precious metal. In this instance the beryllium-copper base is initially plated on both sides with a protecting layer of nickel, and two intermediate layers and two precious metal layers are utilized, one on each side of the beryllium-copper base.

Fig. 6 illustrates a still further embodiment in which two beryllium-copper base layers form the outer surfaces of the composite metal while a silver layer forms the central layer. This embodiment is formed in the same way as the Fig. 5 embodiment, that is, a sandwich is formed utilizing two intermediate layers, only in this instance the order of the components is reversed from that of the Fig. 5 embodiment. The Fig. 6 embodiment is of value for purposes such as where increased conductivity of the mass is desired and yet it is desired to retain the hardening quality of the whole mass.

The solder layer is of the customary type for the purpose and, if desired, a flux may be also used. The coating layers of anti-oxidant metal need only be of sufficient thickness to prevent the formation of oxides on the beryllium-copper where it is to be bonded, and to prevent the formation of oxides on the separating metal layer. The coating may be put on electrolytically to a desired thickness or may be put on by lamination, by dipping, etc., and then rolled down to the requisite thickness of a few ten-thousandths of an inch.

As specific examples of the formation of the composite metal of the present invention, the following are given:

Example 1

A sheet of pure silver, at least .010" thick, is used as the precious metal layer. It may be thicker if preferred and may be as thick as the beryllium-copper on which it is to be plated. In the present example the pure silver is .035" thick. A beryllium-copper layer .750" thick and consisting of an alloy containing 2.25% beryllium by weight and the remainder copper, is electroplated with pure nickel to a thickness of approximately .00025". A sheet of iron .010" thick and consisting of low carbon iron is electroplated with pure copper to a thickness of approximately .00025". The elements are now assembled with the silver on top, next the plated iron, next a layer of solder and then the final layer of the plated beryllium-copper. A flux need not be used. On top of the silver is placed a sheet of 1/8" iron covered with lamp black. A similar sheet is placed outside the beryllium-copper. The lamp black provides a reducing atmosphere and also prevents the silver and the beryllium-copper from sticking to the

iron. The assembly is then clamped to hold the whole pack together and heated at 1580° F. for a predetermined time depending upon its volume, e. g. a 3" wide by 14" long ingot would take about 35 minutes. The assembly is then taken out of the oven, the clamps tightened before cooling, and the whole then permitted to cool.

The resulting ingot of a silver plated beryllium-copper base is then ready for desired forming operations, which may include solution annealing.

Example 2

An ingot is formed as described in Example 1 except that the beryllium-copper base is plated on both sides with nickel, and two sheets of copper plated iron and two sheets of silver are utilized. The elements are assembled with a layer of silver on top, next a layer of the plated iron, next a layer of solder, next the plated beryllium-copper, next a layer of solder, next the other layer of the plated iron and then the other layer of silver. The assembly is then bonded as described in Example 1.

The resulting ingot of beryllium-copper plated on both sides with silver is then ready for desired forming operations which may include solution annealing.

Example 3

A composite metal having a central layer of silver and a beryllium-copper layer on each side is formed as follows:

Two beryllium-copper layers .120" thick and consisting of an alloy containing 2.25% beryllium by weight and the remainder copper are electroplated with pure nickel to a thickness of approximately .00025". The elements are now assembled with a silver layer .140" thick in the center, next the plated iron on each side of the silver layer, next a layer of solder approximately .003" thick outside each of the plated iron layers and then outside of each solder layer the final layer of the plated beryllium-copper. The sandwich assembly is then bonded in the way described in Example 1.

The resulting ingot of a silver cored beryllium-copper is then ready for desired forming operations which may include solution annealing.

The solder used in the foregoing examples is of the usual type, as for example, a solder consisting of approximately 30% silver and 70% copper.

Attention is directed to my copending application, Serial No. 666,442, filed May 1, 1946.

In view of the above, it will be seen that the several objects of the invention are achieved and other advantageous results attained.

As many changes could be made in the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense.

I claim:

1. A composite metal comprising a precious metal layer, a base layer of beryllium-copper, an intermediate layer of iron, a protecting metal layer on said base layer, and a protecting metal layer on said iron layer, said layers being bonded together.

2. A composite laminated metal comprising a beryllium-copper base layer, a first anti-oxidant protective metal layer bonded to said base layer, a solder layer bonded to said first protective layer, a second anti-oxidant protective metal layer

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bonded to said solder layer, a separating iron layer bonded to said second protective layer, a third anti-oxidant protective metal layer bonded to said separating layer, and a precious metal bonded to said third protective layer.

3. A composite laminated metal comprising a layer of a metal selected from the group consisting of gold and silver, a base layer of beryllium-copper, an intermediate layer of iron, a layer of nickel on said base layer, and a layer of copper on said intermediate layer, said layers being bonded together.

4. A composite laminated metal comprising a layer of gold, a base layer of beryllium-copper, an intermediate layer of iron, a layer of nickel on said base layer, and a layer of copper on said intermediate layer, said layers being bonded together.

5. A composite laminated metal comprising a layer of silver, a base layer of beryllium-copper, an intermediate layer of iron, a layer of nickel on said base layer, and a layer of copper on said intermediate layer, said layers being bonded together.

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