April 18, 1933. E. KAMMERER 1,904,241

COMPOUND METAL STOCK

Filed Aug. 3, 1929

Fig. 1.

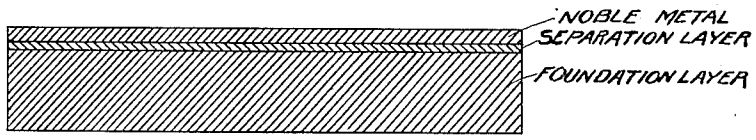



Fig. 2.

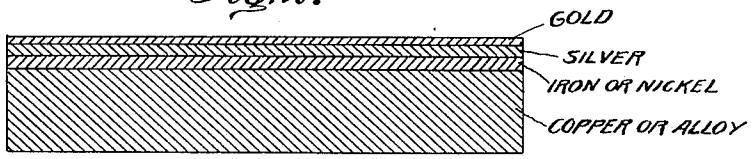
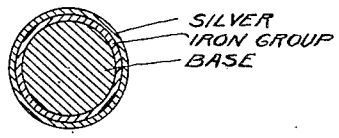



Fig. 3.




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# UNITED STATES PATENT OFFICE

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## COMPOUND METAL STOCK

Application filed August 3, 1929, Serial No. 383,271, and in Germany December 31, 1926.

The present invention relates to compound metal stock having many of the useful properties of noble metals such as gold or silver, and free from certain objections to metal stocks heretofore used extensively, consisting of a base layer or foundation layer of copper or copper alloys such as brass, bronze, and the like, carrying a layer or coating of noble metal.

The invention is based upon my discovery that such old devices can be very substantially improved by interposing a layer of a metal or alloy which does not, during the normal high temperature treatments, substantially diffuse into either the noble metal or the foundation metal or alloy, and for this purpose nickel and iron give very satisfactory results. Other metals which can be used as this separating or insulating layer are chromium, cobalt, manganese, and alloys of these metals with each other or with iron or nickel. When iron is used either alone or in the form of alloys, it is preferably relatively poor in carbon.

For reasons of economy it will be understood that the foundation layer is usually much thicker than the other layers, and preferably the foundation layer constitutes a major fraction of the entire thickness of the compound metal stock.

The layer of noble metal is, for reasons of economy, ordinarily made rather thin, and the separation layer can likewise be rather thin, and it is only necessary to have enough of this separation layer to prevent diffusion of the noble metal into the foundation layer, and to prevent diffusion of the foundation metal into the noble metal layer, during the heat treating processes. The separation layer should, as above indicated, be composed of a metal which does not alloy with either of the adjacent metals, or at any event does not have any considerable tendency to alloy therewith.

The compound metal stock can be made up in the form of plates or sheets, or in the form of rods or wire, or in the form of tubes having a noble metal on the interior or exterior or both, and in the case of plates also a noble metal layer may be applied on one or both sides of the foundation layer, a separation layer always being used to separate the noble metal layer or layers from the foundation layer.

If silver is the noble metal to be employed, the above iron group metals will very well withstand the action of silver even at quite high temperatures, but in the case of gold as the noble metal, they do not completely withstand the action of the gold at high temperatures. In other words gold has some tendency to alloy with iron or nickel, and in cases where gold is to be used as the finish layer, I preferably interpose a layer of silver between the gold and the iron or nickel.

The annexed drawing, forming a part of this specification, illustrates several forms of the invention. In said drawing Figure 1 is a section of metal stock made in accordance with the invention, in the form of a plate.

Figure 2 shows a modification in which the top layer may be gold, the second layer silver, the third layer iron or nickel, and the fourth or bottom layer is the foundation layer, say of copper or copper alloys.

In the great majority of cases the foundation layer will be copper or an alloy in which copper is the predominating element. The foundation layer will have a melting point at least as high as the melting point of silver, or preferably substantially higher than the melting point of silver.

The preferred foundation layers are brass, bronze and German silver.

The two principal uses of compound metal stock made in accordance with the present invention are jewelry and chemical apparatus. The invention however is of course not restricted to these two uses.

For the manufacture of metal stock for use in the manufacture of jewelry the foundation or base layer can be any of those above referred to. I prefer to employ nickel as the separation layer, or alloys of nickel for example nickel containing a little copper and zinc, nickel-iron alloys, Monel metal, and numerous other nickel-copper alloys. Nickel and nickel alloys are preferable to iron or iron alloys as the separation layer, in stock

of this kind, on account of the greater ease in rolling, and freedom from rusting.

The noble metal preferably in contact with the nickel layer is silver, and if gold is desired, it is preferable to interpose a layer of silver as indicated in Fig. 2 of the drawing.

The thickness of the several layers can vary between wide limits. As an example, I refer to Figure 1, and assuming the top layer to be silver, the intermediate layer to be nickel or iron or their alloys, and the foundation layer to be copper, brass or bronze, the thicknesses of the several layers can be as follows—silver, 0.5 to 1 millimeter, separation layer 0.10 millimeter and foundation layer or base 2 to 10 millimeters, or any other desired thickness. These dimensions refer to the final rolled stock. They are usually much thicker before the rolling.

Referring to Figure 2, the gold layer may be for example 0.5 millimeter, or even substantially less than this if desired. The silver layer might be .5 to 1 millimeter and the separation layer, iron or nickel, might be 0.2 or 0.3 millimeters, the foundation being of any desired thickness, say 3 to 10 millimeters or more. In all cases however it is preferred that the foundation layer constitute the major part of the thickness of the entire stock, this layer of course being the cheapest of the several constituents.

What has been said above in regard to gold, silver and the like, should of course be understood as applying not only to pure gold, pure silver and the like, but also to these metals when they contain the usual diluents or alloying constituents, whether for the purpose merely of cheapening or for the purpose also of hardening or producing other desirable properties such as color, or workability or specific gravity.

In using gold as the top layer, I preferably do not have this in contact with nickel as a separating layer for the reason that nickel and gold will be found to have a substantial tendency to alloy with each other, and although these do not alloy so readily as copper and gold, yet they possess a far greater alloying tendency than for example nickel and silver. I have above referred to the use of an interposed layer of silver, between the gold and the separation layer.

For making apparatus for use in the chemical industries, it is usually necessary to make the foundation layer of copper or copper alloys, this being particularly the case when the exterior of the vessel or receptacle is to be in contact with heating gases such as flue gases and the like, since only copper and its alloys will be found to withstand such treatment.

As above referred to the noble metal may consist of silver, and if gold should be chosen, I preferably also employ the layer of silver between this and the separation layer. The separation layer may consist of iron or nickel or alloys of these, as above indicated.

The compound metal stocks or articles made therefrom, for the purposes above enumerated, as well as for numerous other purposes for which the same might be useful, ordinarily have to withstand considerable heat treatment. For instance it is usual to anneal devices made from such compound metal stock, at temperatures from about 600° C. up to 800° C. Frequently in the operation of soldering, the articles may be heated up to 560° C. or even up to about 800° C., or some intermediate temperature. Articles of the kind referred to frequently have to be welded, which may necessitate heating the compound metal stock up to 900 or 1000° C., and the articles of course should be capable of withstanding such temperatures. The details of the welding process are given in my prior application 241,954. In the manufacture of jewelry, temperatures of about 600° C. up to 900° C. may frequently be encountered in the enameling operations.

It will be understood that even at these high temperatures there is no substantial amount of alloying of the metal of the separation layer with the noble metal or with the metal of the foundation layer, and of course the noble metal cannot alloy with the foundation layer because they are completely separated by the separation layer.

As the preferred method of producing the compound metal stock, the following is given, merely for the purpose of illustration and not as confining the invention thereto.

The metal sheets to form the several different layers are each separately made, preferably with very smooth surfaces. The three or more separate sheets are first assembled, then placed in a heating furnace and heated sufficiently to cause the same to adhere upon pressure, after which they are subjected to high pressure, say a pressure of several hundred atmospheres. The stock can then be allowed to cool and can be rolled down to the desired thickness. It will be understood however that any one or more of the successive layers can be deposited upon the foundation layer, by electrolysis and the material then annealed. It is also possible to apply the separation layer and the silver layer (and also the gold layer if employed) by the Schoop process or by welding or by squirting or by any other suitable process, and the pressing process above referred to is given only by way of example.

The subject matter of the present application is in large part continued from my copending application Serial No. 241,954, filed Dec. 22, 1927.

I claim:—

1. A rolled compound metal stock having a layer of an iron-group metal intermediate other adjacent layers respectively of copper-

containing metal foundation and silver, to substantially prevent inter-diffusion of such copper-containing metal and silver, when heating the said stock up to enameling and annealing and soldering temperatures, the copper-containing metal constituting a major part of the entire stock, the layer of iron-group metal being resistant to alloying with gold and silver.

2. A rolled compound metal stock containing a plurality of layers, including at least one layer of precious metal, and a foundation layer of copper-containing metal, both the said layers being wholly in contact with a layer intermediate said precious metal layer and said foundation layer, composed of metal of the herein described group consisting of nickel, iron, cobalt, chromium and manganese, which will substantially prevent inter-diffusion of said precious metal and copper-containing metal with each other and will prevent interdiffusion of said intermediate layer metal with said precious metal, during heating up to temperatures suitable for annealing, said copper-containing metal constituting a major fraction of the entire thickness of said stock, such compound metal stock being free from any layer in contact with such precious metal layer which would be readily alloyable therewith.

3. A rolled compound metal stock suitable for making jewelry, composed of at least four layers, in the order stated, namely, a gold layer, a silver layer, a layer of metal of the iron group and a foundation layer, such layers being firmly joined together, and such silver layer being free from any contact with metal more easily alloyable therewith than is gold.

4. A rolled compound metal stock suitable for making jewelry, comprising a silver layer, a foundation metal layer which normally would readily alloy with silver, at enameling temperatures, and an interposed separation layer of nickel-containing metal free from constituents capable of readily alloying with silver, said foundation layer forming a major fraction of the thickness of the stock.

5. A rolled compound metal stock suitable for making jewelry, comprising a silver layer, a foundation metal layer which normally would readily alloy with silver at enameling temperatures, and an interposed separation layer of nickel-containing metal free from metals easily alloying with silver, said foundation layer having a melting point higher than that of silver.

6. A rolled compound metal stock suitable for making jewelry, comprising a silver layer, a foundation metal layer which normally would readily alloy with silver at enameling temperatures, and an interposed separation layer of nickel-containing metal free from copper, said foundation layer containing copper as a substantial constituent, the first two of said layers being directly connected to each other, and the last two layers being directly connected to each other.

7. A rolled compound metal stock suitable for manufacture of acid-resistant chemical apparatus comprising a metal base of metal which would normally be easily alloyable with silver, a layer of a metal not readily alloyable with silver even during welding operations at a high temperature, such last named layer being composed of a metal selected from the herein described group consisting of nickel, chromium, cobalt, manganese and iron which is low in carbon, a layer of silver directly connected to such last mentioned layer, and a substantial layer of gold carried directly upon said silver layer, such compound metal stock being butt-weldable without any substantial alloying of adjacent layers.

In testimony whereof I affix my signature.

ERWIN KAMMERER.