Jan. 16, 1945. A. G. RUSSELL 2,367,314

ELECTROLYTIC METHOD OF COATING LOCALIZED AREAS OF ARTICLES

Filed June 24, 1941

FIG. 1

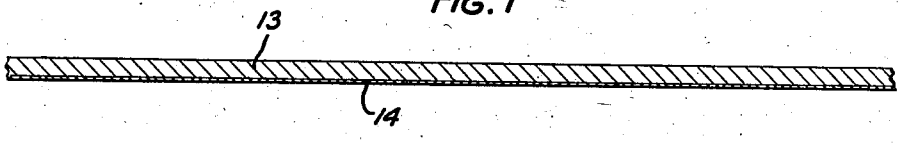


FIG. 2

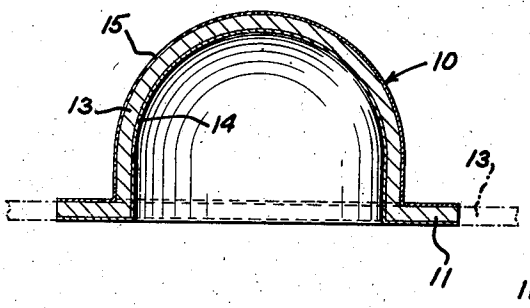


FIG. 3

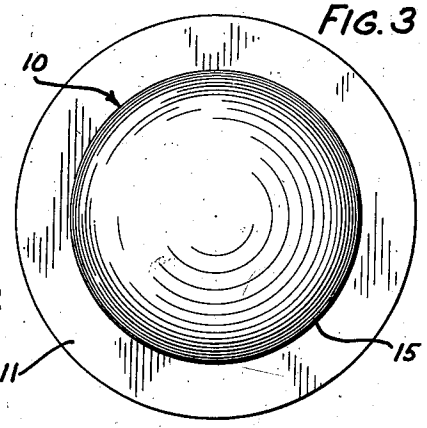


FIG. 4

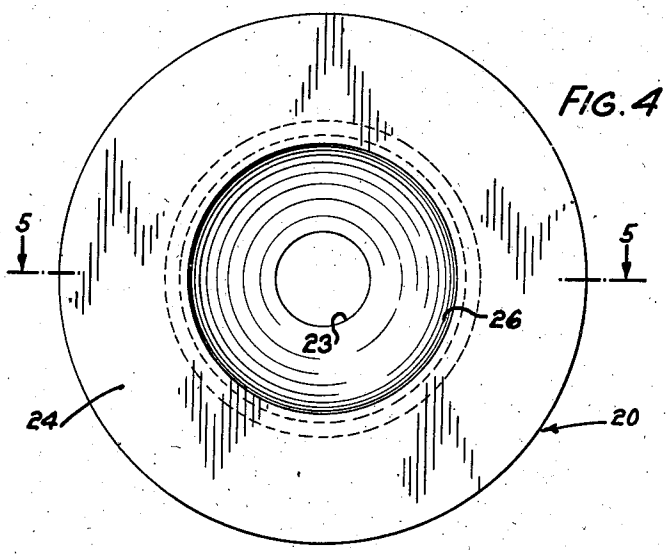
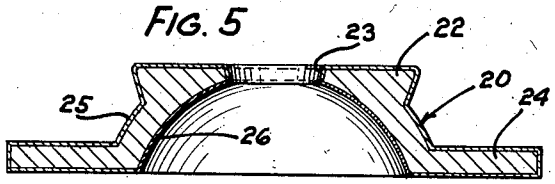


FIG. 5



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ELECTROLYTIC METHOD OF COATING LOCALIZED AREAS OF ARTICLES

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6 Claims. (Cl. 204—15)

This invention relates to the manufacture of coated articles, and more particularly to methods for making articles having a coating of metal on a selected portion of the article surface.

In certain types of electrical apparatus, such as communication equipment, shaped members are often employed to make electrical contact with other portions of the apparatus and in many instances satisfactory performance of the apparatus necessitates that these contact members receive and transmit current without appreciable losses or distortion. For example, in certain telephone transmitters, cup-shaped electrodes are used to provide the necessary electrical connections with the carbon particles therein and satisfactory operation of the transmitter depends in a large measure upon the contact efficiency of these electrodes. In order to provide the needed operating and service characteristics, it is often desirable to use gold or some other noble metal as a contact material on these electrodes and due to the very high cost of these noble metals, it is important to restrict their use to the portions of the electrode surface which are actually in contact with the carbon.

In some cases, these electrodes have been formed from strip material or turned from rod stock and the formed parts have then been gold plated in special racks which were constructed to concentrate the gold deposit on the contact areas as much as possible. This former method has produced satisfactory electrodes but in the manufacture of certain electrode types, which are very small and fragile, particularly careful handling in the racking operation has been necessary with the result that the racking expense has been undesirably high. Also, it is difficult in a rack of this type to provide shielding means that will produce a sharp line of demarcation between the plated and non-plated areas and it is usually necessary to make allowances for extending the gold deposit beyond the actual contacting surface of the electrode in order to insure formation of a satisfactory deposit over the entire critical area, with a consequent excess utilization of gold.

An object of this invention is the provision of improved methods for producing a continuous and uniform deposit of noble metal on an accurately restricted portion of an article surface.

In accordance with one embodiment of the invention, the above and other objects of the invention are accomplished in the manufacture of telephone transmitter electrodes by providing one face of a continuous brass or other copper base alloy strip with a coating of nickel, forming the coated strip into an electrode having a coating of nickel on one surface and exposed brass or other copper alloy on the other, and finally gold plating the electrodes in a conventional barrel plater wherein the electrodes are immersed loosely in an electrolyte. By use of a combination of electrolyte composition, temperature and current density, a uniform and continuous film of gold is produced over the exposed brass area without the formation of any gold deposit on the nickel surface.

A more complete understanding of the invention may be had from the following detailed description of the invention taken in conjunction with the appended drawing, in which

Fig. 1 is a sectional view of a faced metal strip utilized in producing transmitter electrodes in accordance with one embodiment of the invention;

Fig. 2 is a sectional view of an electrode illustrating the manner in which the electrode is formed from the strip shown in Fig. 1;

Fig. 3 is a plan view of the electrode shown in Fig. 2;

Fig. 4 is a plan view of an electrode made in accordance with an alternative embodiment of the invention to that illustrated in Figs. 1, 2 and 3; and

Fig. 5 is a sectional view of the electrode shown in Fig. 4, taken on the lines 5—5 of Fig. 4.

The electrode 10 shown in Figs. 2 and 3 has a cup or dome-shaped body portion, which is a hemisphere, and a narrow and continuous peripheral flange 11 extending from the base of the dome-shaped body. When this electrode is assembled in a transmitter, the outer surface of the dome-shaped body is in contact with the carbon particles and it is therefore desirable to coat all of this surface uniformly with gold.

In producing an electrode of this type, a strip 13 of brass, bronze, or other copper-base alloy, is first suitably cleaned, for example, in a caustic solution. One type of alloy used for this purpose contains 35% zinc and the balance copper but other alloys containing predominantly copper are also suitable. The cleaned alloy strip is next provided with a thin and uniform facing of nickel 14, preferably by electroplating in an aqueous solution of nickel sulphate, sodium chloride and boric acid.

In this plating operation only one face and the edges of the strip are provided with the nickel coating. In nickel-plating thin strip material, it is convenient to wrap the strip spirally around a plating rack having a surface of soft rubber which closely engages the under-surface of the strip and to support the rack and strip in the nickel-plating bath. In this manner, access of the plating solution to the under-surface of the strip in contact with the rack, and the formation of a coating thereon, is prevented. In another method, suitable for coating either thin or thick strip material, the strip is conducted through the plating bath in contact with a partially immersed cylindrical roller faced with soft rubber. This roller should be sufficiently large

in diameter so that one face of the strip can be held in close contact with the roller facing by tension applied to the strip during complete passage of the strip through the plating bath, thereby excluding plating solution and metal deposit from the engaged face of the strip. Only a very thin facing of nickel is required on the strip and it is not necessary for the nickel layer to be uniform in thickness. Therefore, the plating action is continued only long enough to produce a continuous nickel film on the strip face.

In the next operation, the nickel-faced strip is formed by conventional means into the electrode shape, as shown in Figs. 2 and 3, with the nickel coating on the inside surface of the dome or cup and the brass surface on the outside of the dome.

The formed electrode is next gold plated and this operation can be performed without the use of racks or other special supports in a barrel plater of the conventional type. The usual barrel plater comprises a chamber which contains an electrolyte, a movable mesh basket in the chamber for supporting the articles to be plated in the electrolyte, and plating electrodes which are suitably connected in a power circuit. In one type of barrel plater that is satisfactory for this purpose, the mesh basket, made of insulating material, is cylindrical in form and is supported on a rotatable shaft. The anodes are positioned in the electrolyte outside of the bsket and a plurality of cathode contacts are mounted inside the basket in positions where they will engage the articles as the basket rotates. The basket is partially immersed in the electrolyte and the articles in the basket are completely immersed in the electrolyte. During rotation of the basket, the cathode contacts engage the submerged articles and apply the plating current thereto.

Since the articles are supported loosely in the basket, current is transmitted from article to article by contact and the current density varies in the course of the plating operation in accordance with the number of articles that are receiving current, either directly from the cathode contacts or through article to article contact, at any one time. It has been discovered that despite this inevitable variation in current density, a satisfactory gold coating **15** can be applied on the brass area and the deposit of gold on the nickel avoided. This is accomplished with a combination of electrolyte compositions, electrolyte temperature and current density values.

The following electrolyte composition is preferred:

	Ounces per gallon of water
Sodium gold cyanide	1.5
Potassium cyanide	6.0
Potassium hydroxide	.50

When this particular composition is employed, the electrolyte is maintained at a temperature of approximately 120° F. during the plating operation.

Some deviation from the above listed specific constituent proportions is permissible and the following ranges can be used, particularly if accompanying adjustments are made in other process factors:

	Ounces per gallon of water
Sodium gold cyanide	.75 to 2.5
Potassium cyanide	3.0 to 8.0
Potassium hydroxide	.20 to .70

In using these solutions, the solution temperature is maintained between 105° F. and 135° F. and, in general, best results are obtained if the higher temperatures are employed with the more concentrated solutions.

Sodium and potassium compounds are employed preferably in the combinations shown in the above table in making up these solutions but, in some instances, a sodium compound can be substituted for a potassium compound or a potassium compound for a sodium compound in chemically equivalent proportions.

As stated above, the current density varies during the plating operation in accordance with the total number of articles or electrodes connected in the plating circuit at any one time. The number of electrodes placed in the basket, the quantity of solution in the container, the spacing of the cathode contacts, and the rotational speed of the basket are coordinated to minimize this current density variation but it cannot be completely eliminated. However, it is possible to segregate the gold deposit to the brass or copper alloy area by maintaining the average current density, based on the combined areas of all the electrodes in the basket, within certain limits. This average current density should be maintained between .2 and .6 ampere per square foot of article surface and preferably established at .4 ampere per square foot of electrode surface. This average value is based on the total area of all the electrodes in process. The current density will exceed the average values at some stage of the process but under the described conditions the maximum values do not reach a harmful intensity or duration.

The completed electrodes have a continuous film of gold **15** over the entire exposed brass area and the gold film terminates abruptly at the lines of demarcation between the nickel-coated and the exposed brass or copper alloy areas.

Another type of transmitter electrode which is produced by an alternative method within the scope of the invention is shown in Figs. 4 and 5. This electrode **20**, which is of substantially heavier construction than the electrode shown in Fig. 3, has a dome-shaped or cup-shaped body **22** with a circular opening **23** in its central portion and an extensive peripheral flange **24** around the dome-shaped body. When an electrode of this type is mounted in a telephone transmitter, the flange serves as a mounting and the inner, or concave, surface of the dome is in contact with the carbon particles.

In producing this type of electrode, a shape is initially produced from brass or other copper alloy sheet by means of conventional forming dies or turned from rod stock on a screw machine or the like. The same copper base alloy compositions used for the small electrodes **10** are suitable for this heavier electrode **20** also.

In the forming or turning operation all portions of the electrode, with the exception of the concave or inner surface of the dome, are formed accurately to the final dimensions, with allowances for coatings to be applied subsequently. The concave portion of the dome is formed oversize, or with a shorter radius than that finally required, so that excess base or alloy material is provided at this portion of the body.

The shaped articles are then nickel-plated by a conventional process, to provide a thin and continuous coating or layer of nickel **25** over the entire article surface.

Next, a machining operation is applied to the inner or concave face of the dome to increase the radius of this configuration. In this operation, which can be performed on a lathe or screw ma-

chine, the nickel coating and a layer of the underlying brass or other copper alloy base material are removed from that portion of the electrode. At the conclusion of this machining operation, all portions of the article have a coating of nickel except the inside surface of the dome, where the brass or other base material is exposed.

The machined electrode is then gold plated in a barrel plater to apply a gold coating 26 on the inner surface of the dome. In this operation, the same combination of electrolyte composition, solution temperature and average current density used for plating the small electrode, as above described, are employed.

The completed electrodes, of both types, have a continuous coating of gold which has excellent electrical properties and is accurately restricted to those portions of the electrode surfaces which are actually in contact with the carbon particles when the electrodes are assembled in a transmitter. The gold coating is very uniform in thickness, which obviates the necessity for heavy plating to assure complete minimum coverage and results in further economies in the use of gold. In the processing operations, racking is not required and the electrodes can be processed in quantities with minimum handling and without special equipment.

It will be apparent that modifications of the invention embodiment specifically described herein can be made to adapt the invention to various articles and conditions and it is to be understood that the invention is limited only by the scope of the appended claims.

What is claimed is:

1. In a method for making an article having different portions of its surface coated with different metals, the steps of forming the article from a copper base alloy, producing a nickel coating on only a portion of the article surface, immersing a quantity of the formed articles loosely in an aqueous electrolyte comprising from .75 to 2.5 ounces of sodium gold cyanide, 3 to 8 ounces of potassium cyanide and .20 to .70 ounce of potassium hydroxide per gallon of water, and plating the articles in said electrolyte at an average current density ranging from .2 to .6 ampere per square foot of article surface while maintaining the electrolyte at a temperature between 105° F. and 135° F. to cause the deposit of a gold film on the alloy surface without causing the deposit of gold on the nickel surface.

2. In a method for making a cup-shaped article having different portions of its surface coated with different metals, the steps of electrodepositing a layer of nickel on one face of a copper alloy strip, forming the strip into a cup-shaped article having the nickel coating on one surface of the cup and exposed alloy on the other surface of the cup, immersing a quantity of the formed articles loosely in an aqueous electrolyte comprising from .75 to 2.5 ounces of sodium gold cyanide, 3 to 8 ounces of potassium cyanide and .20 to .70 ounce of potassium hydroxide per gallon of water, and plating the articles in said electrolyte at an average current density ranging from .2 to .6 ampere per square foot of article surface while maintaining the temperature of the electrolyte between 105° F. and 135° F. to cause the deposit of a continuous gold film on the alloy surface without causing the deposit of any gold on the nickel surface.

3. In a method of making an article having different portions of its surface coated with different metals, the steps of forming the article from a copper base alloy, coating a selected portion of the article surface with a layer of nickel, immersing a quantity of the formed articles loosely in an aqueous electrolyte comprising about 1.5 ounces of sodium gold cyanide, 6 ounces of potassium cyanide and .50 ounce of potassium hydroxide per gallon of water, and plating the articles in said electrolyte at an average current density around .4 ampere per square foot of article surface while maintaining the electrolyte at a temperature of about 120° F. to cause the deposit of a uniform gold film on the alloy surface without causing the deposit of any gold on the nickel surface.

4. In a method of making a cup-shaped transmitter electrode, the steps of forming a cup-shaped electrode from a copper base alloy, electrodepositing a layer of nickel on the entire surface of the electrode, removing the nickel layer from only one surface of the cup portion of the electrode, immersing a quantity of the electrodes loosely in an aqueous electrolyte comprising from .75 to 2.5 ounces of sodium gold cyanide, 3 to 8 ounces of potassium cyanide and .20 to .70 ounce of potassium hydroxide per gallon of water, and plating the electrodes in said electrolyte at an average current density ranging from .2 to .6 ampere per square foot of article surface while maintaining the temperature of the electrolyte between 105° F. and 135° F. to cause the deposit of a continuous gold film on the surface of the cup surface from which the nickel layer was removed without causing the deposit of any gold on the nickel remaining on the remaining portions of the electrode.

5. In a method for making a cup-shaped transmitter electrode, the steps of forming a copper base alloy into a body having the general shape desired in the completed electrode and excess material on the concave surface of the cup portion, electrodepositing a layer of nickel on the entire surface of said body, machining the nickel coated body to remove the nickel layer and the excess alloy from the concave surface of the cup portion, immersing a quantity of the machined bodies loosely in an aqueous electrolyte comprising from .75 to 2.5 ounces of sodium gold cyanide, 3 to 8 ounces of potassium cyanide and .20 to .70 ounce of potassium hydroxide per gallon of water, and plating the bodies in said electrolyte at an average current density ranging from .2 to .6 ampere per square foot of body surface while maintaining the temperature of the electrolyte between 105° F. and 135° F. to cause the deposit of a continuous gold film on the concave surface of the cup without causing the deposit of any gold on any other portion of the body.

6. A method of making an article having different portions of its surface coated with different metals comprising providing a nickel coating on a selected portion of a copper base alloy article, immersing the article in an electrolyte comprising an aqueous solution of .75 to 2.5 ounces of sodium gold cyanide, 3.0 to 8.0 ounces of potassium cyanide, and .20 to .70 ounce of potassium hydroxide per gallon of water, maintaining the electrolyte at a temperature of substantially 105° F. to 135° F., and passing an electric current at a current density ranging from .2 to .6 ampere per square foot of surface through the article to apply a gold coating to the article only in the portion in which it is free of nickel.

ALEXANDER G. RUSSELL.