

- [54] COINAGE MATERIAL
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- [58] Field of Search..... 29/194, 196.3, 196.6, 29/183.5, 198

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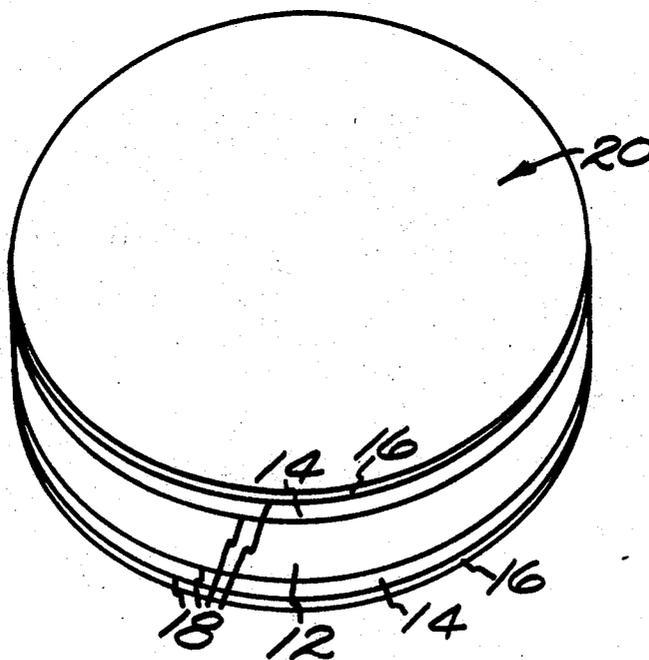
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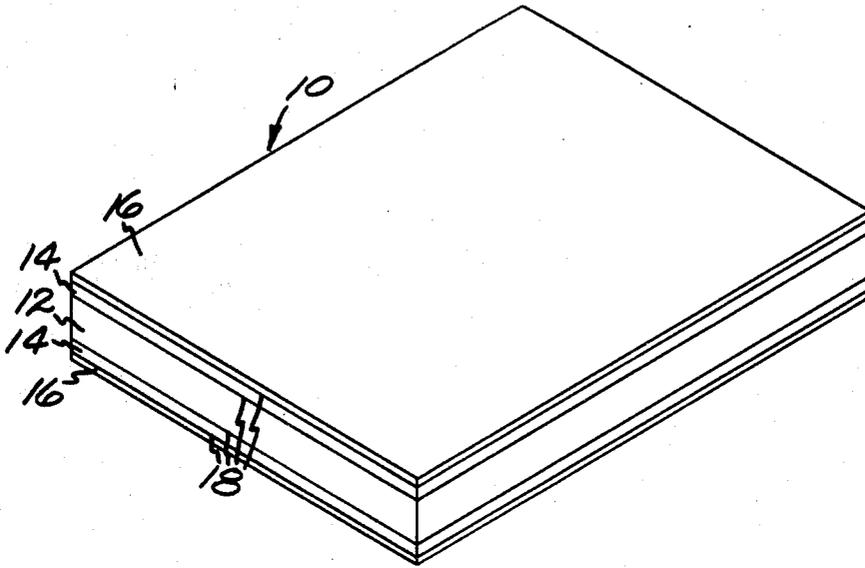
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[57] **ABSTRACT**

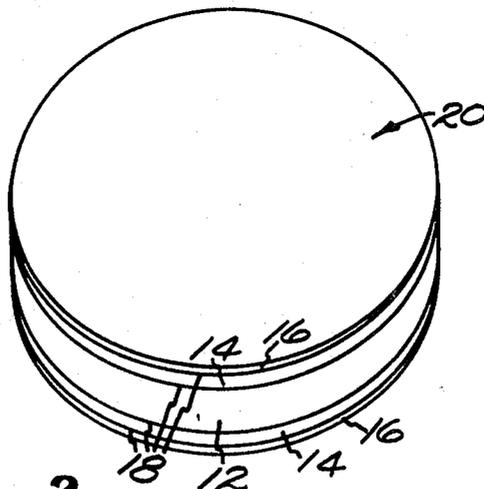
A low-cost material for making coins is shown to comprise a core layer of low carbon steel, a relatively thin layer of nickel silver metallurgically bonded to each side of the core layer, and a relatively very thin layer of nickel metallurgically bonded to the outer surface of each of the layers of nickel silver material. These materials cooperate to provide a composite coinage material having desirable coinage properties including pleasing surface color, good ring, excellent mintability, good corrosion-resistance and low-cost. The layers of relatively low-cost nickel silver, being of comparable color to nickel, permit use of very thin outer layers of the more expensive nickel without risk of exposing the steel core material on the minted surfaces of coins after coinage wear. In addition, the nickel silver galvanically protects the edge of the steel core layer to reduce the occurrence of rust staining at the edges of the coins.

6 Claims, 2 Drawing Figures





*Fig. 1.*



*Fig. 2.*

## COINAGE MATERIAL

A coinage material commonly used in the developing countries to minimize coinage material costs consists of nickel-clad, low carbon steel. This material has a pleasing surface color, good ring, and excellent mintability. These known coins usually employ nickel cladding layers having a thickness comprising at least about 5 percent of the total thickness of the composite coinage material to assure that the steel core material is not exposed on the nickel coin surfaces as the coins become worn during use. The use of such thicknesses of the nickel material represents a significant part of the cost of the coinage material. This known coinage material is objectionable in one respect in that the material is subject to a significant amount of corrosion along the exposed edge of the steel core of the coinage material, this corrosion causing darkening of the edge of the coin and tending to cause rust staining of fabric containers for the coins.

It is an object of this invention to provide a novel and improved coinage material; to provide such a material which is useful in making coins having a pleasing surface color, good ring and excellent mintability; to provide such a coinage material which is characterized by very low-cost; and to provide such a coinage material which displays improved resistance to rust staining at the edge of the core of the material.

Other objects, advantages and details of this invention appear in the following detailed description of preferred embodiments of the invention, the detailed description referring to the drawings in which:

FIG. 1 is a perspective view of a preferred embodiment of the coinage material provided by this invention; and

FIG. 2 is a perspective view of a coin made from the material shown in FIG. 1.

Referring to the drawings, 10 in FIG. 1 indicates the novel and improved composite coinage material of this invention which is shown to include a core layer 12 of mild or low carbon steel, a layer 14 of nickel silver material disposed on each side of the steel core layer 12, and a layer 16 of nickel disposed on the outer surface of each of the layers 14 of nickel silver material. As shown, each of the metal layers in the composite material 10 is metallurgically bonded to adjacent layers of metal in the coinage material, the bond between the layers extending substantially throughout the interfaces 18 between the metal layers.

In accordance with this invention, the core layer 12 of the composite material 10 embodies any conventional mild or low carbon steel, the specific material being selected primarily with regard to low-cost. For example, any of the steel materials sold under the designations SAE 1006 to SAE 1020 Low Carbon Steel are preferably used in forming the core layers of the composite, these materials having nominal compositions, by weight, as indicated below in Table I:

TABLE I

SAE No.	Carbon	Manganese	Phos. (Max.)	Silicon (Max.)	Iron
1006	0.08 max.	0.25-0.40	0.040	0.050	Bal.
1008	0.10 max.	0.25-0.50	0.040	0.050	Bal.
1010	0.08-0.13	0.30-0.60	0.040	0.050	Bal.
1012	0.10-0.15	0.30-0.60	0.040	0.050	Bal.
1016	0.13-0.18	0.60-0.90	0.040	0.050	Bal.
1018	0.15-0.20	0.60-0.90	0.040	0.050	Bal.
1020	0.18-0.23	0.30-0.60	0.040	0.050	Bal.

These steel materials are widely available at low-cost and are characterized by good working properties so that the steel materials are readily bonded to the other metal materials in the coinage composite, so that the coinage composite is readily rolled to a desired gauge by any conventional means, and so that blanking and minting of coins from the composite material 10 is easily accomplished. The thickness of the core layer 12 of the composite preferably falls in the range from about 60 to 94 percent of the total thickness of the composite material. Typically, for example, the core layer 12 is formed of SAE 1010 Low Carbon Steel and has a thickness of 0.04150 inches in a composite material having a total thickness of 0.05000 inches, the core layer thus comprising about 82.5 percent of the total thickness of the coinage material. As will be understood, the core layer 12 provides the desired volume, heft or weight, and strength in the coinage material 10.

In accordance with this invention, the layers 14 of the coinage material 10 embody any conventional nickel silver material. Nickel silver is a silver-white alloy principally embodying copper, nickel and zinc. For example, the nickel silver materials commonly designated 65-18 Nickel Silver, 55-18 Nickel Silver, 65-12 Nickel Silver (German Silver) and 65-10 Nickel Silver are preferably used in forming the intermediate layers 14 of the composite coinage material 10, these nickel silver materials having nominal compositions, by weight, as indicated below in Table II;

TABLE II

	Copper	Nickel	Zinc
65-18 Nickel Silver	65%	18%	17%
55-18 Nickel Silver	55%	18%	27%
65-12 Nickel Silver	65%	12%	23%
65-10 Nickel Silver	65%	10%	25%

These materials, because of their relatively high copper and zinc contents are significantly less expensive than pure nickel. However, the nickel silver materials display a white color quite similar to that of nickel. Most important, the high zinc contents of these materials make the materials significantly more anodic in the galvanic series of metals and alloys than either mild or low carbon steels or pure nickel metal. Thus, when the nickel silver layers 14 are utilized in the coinage material 10, together with the steel core layer 12 and the outer nickel layers 16, the nickel silver layers tend to corrode in preference to either of the steel or nickel materials, thereby to galvanically protect the edge of the steel core layer in the composite. However, the product of corrosion of the nickel silver material merely tends to dull the surface of the edges of the nickel silver layers in the composite so that such corrosion does not tend to darken the edge of the coin material or to cause red rust staining of the material. For this purpose, the nickel silver material embodied in the layers 14 preferably has a nominal content of at least 15 percent zinc by weight. Because of the color similarity to nickel, the presence of the nickel silver layers in the composite 10 creates the color effect of a substantially greater thickness of the outer cladding metal along the edge of the composite material 10. Each of the nickel silver layers 14 preferably has a thickness comprising from about 2 to 19 percent of the total thickness of the composite coinage material 10. Typically, for example, where the core layer 12 is formed of SAE 1010 steel having a thickness of about 0.04150 inches, each of the

nickel silver layers 14 is formed of the 65-12 Nickel Silver alloy and has a thickness of about 0.00200 inches comprising about 4.25 percent of the total thickness of a composite material 10 having a total thickness of about 0.05000 inches.

In accordance with this invention, the outer layers 16 of the composite material 10 are preferably formed of pure or substantially pure nickel metal. This metal material displays the pleasing white color which is usually associated with coinage material and which has received wide public acceptance in such coinage materials. The nickel metal is readily minted and receives a sharp imprint during conventional minting processes. Nickel is also readily bonded to nickel silver materials by conventional roll-bonding processes and the like. However, while nickel metal is preferred for use in the layers 16 of the composite 10, these outer metal layers could also be formed of various conventional cupronickel alloys and the like where the metal embodied in the outer layers 16 has acceptable mintability, has a pleasing white color generally corresponding to the nickel silver material used in the composite, and is less anodic in the galvanic series of metals and alloys than the nickel silver material which is utilized. That is, the outer metal layers could be formed of copper-nickel alloys containing from 15 to 70 percent nickel by weight and the balance copper. Preferably, the outer layers 16 of the composite material 10 have a thickness in the range from about 1 to 5 percent of the total thickness of the composite. Typically, for example, where the core layer 12 is formed of SAE 1010 Steel having a thickness of about 0.04150 inches and where the intermediate layers 14 are formed of German Silver having a thickness of about 0.00200 inches, the layers 16 are preferably formed of commercially pure nickel having a thickness of about 0.00225 inches comprising about 4.5 percent of the total thickness of the composite material which has a total thickness of about 0.05000 inches. Where the nickel layers 16 are quite thin having a thickness corresponding to as little as about 1 percent of the total thickness of the composite material — a thickness as small as 0.0005 inches for example, — complete integrity of the nickel surface of the coinage material is readily achieved while significantly reducing the cost of the composite material. The nickel silver layers 14 of the composite then provide assurance that, if the thin nickel cladding of the material should wear through during use of the material in a coin, the steel core layer of the coin will not be exposed on the minted coin surface.

The layers of metal in the composite 10 preferably have a solid-phase metallurgical bond therebetween, this bond extending throughout the interfaces 18 between the metal layers. Preferably, for example, such metallurgical bonds are formed in the cold roll bonding processes and the like described in U.S. Pat. Nos. 2,691,815 or 2,753,623. However, the metal layers of the composite can also be metallurgically bonded together by hot roll bonding processes or the like within the scope of this invention.

This coinage material 10 is uniquely adapted for use in making low-cost coins, tokens or the like 20 shown in FIG. 2 which particularly meet the needs of the developing nations. The coinage material has a pleasing color on the minted surfaces thereof and has a pleasing color extending through a significant portion of the thickness of the material as the coin is viewed from its

edge. The composite material has a good coinage ring and is readily minted by conventional minting processes. The material is characterized by low-cost and displays little tendency to darken along the edges or to permit rust staining at the edges of the material during use of the material in coinage. After rolling to desired gauge, when the materials embodied in the composite are in work-hardened condition, coins 20 are readily blanked from the coinage material 10. The coin blanks are then adapted to be annealed in conventional annealing processes to anneal all three layer materials in the coin blank to facilitate subsequent minting of the coin surfaces.

It should be understood that although particular embodiments of the coins and coinage materials provided by this invention have been described by way of illustration, this invention includes all modifications and equivalents of the disclosed embodiments falling within the scope of the appended claims.

I claim:

1. A composite metal laminate material useful in making coins comprising a core layer of mild steel having a thickness in the range from about 60 to 94 percent of the total thickness of said composite material providing said composite material with selected strength, weight and volume at low cost, a layer of nickel silver having a composition, consisting essentially of by weight, of from about 55 to 65 percent copper, from about 10 to 18 percent nickel and from about 17 to 27 percent zinc metallurgically bonded to each side of said steel layer, each of said nickel silver layers having a thickness in the range from about 2 to 19 percent of the total thickness of said composite material providing galvanic corrosion protection for the edge of said steel core layer and providing a significant part of the edge of said composite material with a white color, and an outer layer of metal selected from the group consisting of nickel and of cupronickel alloys consisting essentially of from about 15 to 70 percent nickel by weight and the balance copper metallurgically bonded to each of said nickel silver layers, each of said outer layers having a thickness in the range from about 1 to 5 percent of the total thickness of said composite material providing the outer surfaces of said composite material with good mintability and providing the outer surfaces and a significant part of the edge of said composite material with a white color.

2. A composite metal laminate material as set forth in claim 1 wherein said steel layer embodies a steel material selected from the group consisting of a steel material having a composition, by weight, of 0.08 percent (max.) carbon, 0.25 to 0.40 percent manganese, 0.040 percent (max.) phosphorous, 0.050 percent (max.) silicon, and the balance iron, a steel material having a composition, by weight, of 0.10 percent (max.) carbon, 0.25-0.50 percent manganese, 0.040 percent (max.) phosphorous, 0.050 percent (max.) silicon, and the balance iron, a steel material having a composition, by weight, of 0.08-0.13 percent carbon, 0.30-0.60 percent manganese, 0.040 percent (max.) phosphorous, 0.050 percent (max.) silicon, and the balance iron, a steel material having a composition, by weight, of 0.10-0.15 percent carbon, 0.30-0.60 percent manganese, 0.040 percent (max.) phosphorous, 0.050 percent (max.) silicon, and the balance iron, a steel material having a composition, by weight, of 0.13-0.18 percent carbon, 0.60-0.90 percent manganese, 0.040 per-

cent (max.) phosphorous, 0.050 percent (max.) silicon, and the balance iron, a steel material having a composition, by weight, of 0.15-0.20 percent carbon, 0.60-0.90 percent manganese, 0.040 percent (max.) phosphorous, 0.050 percent (max.) silicon, and the balance iron, and a steel material having a composition, by weight, of 0.18-0.23 percent carbon, 0.30-0.60 percent manganese, 0.040 percent (max.) phosphorous, 0.050 percent (max.) silicon, and the balance iron, and wherein each of said nickel silver layers embodies a nickel silver material selected from the group consisting of a nickel silver material having a composition, by weight, of 65 percent copper, 18 percent nickel and 17 percent zinc, a nickel silver material having a composition, by weight, of 55 percent copper, 18 percent nickel and 27 percent zinc, a nickel silver material having a composition, by weight, of 65 percent copper, 12 percent nickel and 23 percent zinc, and a nickel silver material having a composition, by weight, of 65 percent copper, 10 percent nickel, and 25 percent zinc.

3. A composite metal laminate material as set forth in claim 2 wherein said core layer has a thickness of about 0.04150 inches and is formed of a steel material having a composition, by weight, of 0.08-0.13 percent carbon, 0.30-0.60 percent manganese, 0.040 percent (max.) phosphorous, 0.050 percent (max.) silicon, and the balance iron, wherein each of said nickel silver layers has a thickness of about 0.00200 inches and has a composition, by weight, of 65 percent copper, 12 percent nickel, and 23 percent zinc, and wherein each of said outer metal layers has a thickness of about 0.00225 inches and is formed of nickel.

4. A coin formed of a composite metal laminate material comprising a core layer of mild steel having a thickness in the range from about 60 to 94 percent of the total thickness of said composite material providing said composite material with selected strength, weight and volume at low cost, a layer of nickel silver consisting essentially of, by weight, from about 55 to 65 percent copper, from about 10 to 18 percent nickel and from about 17 to 27 percent zinc metallurgically bonded to each side of said steel layer, each of said nickel silver layers having a thickness in the range from about 2 to 19 percent of the total thickness of said composite material providing galvanic corrosion protection for the edge of said steel core layer and providing a significant part of the edge of said composite material with a white color, and an outer layer of metal selected from the group consisting of nickel and of cupronickel alloys consisting essentially of from about 15 to 70 percent nickel and the balance copper metallurgically bonded to each of said nickel silver layers, each of said outer layers having a thickness in the range from about 1 to 5 percent of the total thickness of said composite material providing the outer surfaces of said composite material with good mintability and providing the outer

surfaces and a significant part of the edge of said composite material with a white color.

5. A coin as set forth in claim 4 wherein said steel layer embodies a steel material selected from the group consisting of a steel material consisting essentially of, by weight, of 0.08 percent (max.) carbon, 0.25 to 0.40 percent manganese, 0.040 percent (max.) phosphorous, 0.050 percent (max.) silicon, and the balance iron, a steel material consisting essentially of, by weight, of 0.10 percent (max.) carbon, 0.25-0.50 percent manganese, 0.040 percent (max.) phosphorous, 0.050 percent (max.) silicon, and the balance iron, a steel material consisting essentially of, by weight of 0.08-0.13 percent carbon, 0.30-0.60 percent manganese, 0.040 percent (max.) phosphorous, 0.050 percent (max.) silicon, and the balance iron, a steel material consisting essentially of, by weight, of 0.10-0.15 percent carbon, 0.30-0.60 percent manganese, 0.040 percent (max.) phosphorous, 0.050 percent (max.) silicon, and the balance iron, a steel material consisting essentially of, by weight, of 0.13-0.18 percent carbon, 0.60-0.90 percent manganese, 0.040 percent (max.) phosphorous, 0.050 percent (max.) silicon, and the balance iron, a steel material consisting essentially of, by weight, of 0.15-0.20 percent carbon, 0.60-0.90 percent manganese, 0.040 percent (max.) phosphorous, 0.050 percent (max.) silicon, and the balance iron, and a steel material consisting essentially of, by weight, of 0.18-0.23 percent carbon, 0.30-0.60 percent manganese, 0.040 percent (max.) phosphorous, 0.050 percent (max.) silicon, and the balance iron, and wherein each of said nickel silver layers embodies a nickel silver material selected from the group consisting of a nickel silver material consisting essentially of, by weight, of 65 percent copper, 18 percent nickel and 17 percent zinc, a nickel silver material consisting essentially of, by weight, of 55 percent copper, 18 percent nickel and 27 percent zinc, a nickel silver material consisting essentially of, by weight, of 65 percent copper, 12 percent nickel and 23 percent zinc, and a nickel silver material consisting essentially of, by weight, of 65 percent copper, 10 percent nickel and 25 percent zinc.

6. A coin as set forth in claim 5 wherein said core layer has a thickness of about 0.04150 inches and is formed of a steel material consisting essentially of, by weight, of 0.08-0.13 percent carbon, 0.30-0.60 percent manganese, 0.040 percent (max.) phosphorous, 0.050 percent (max.) silicon, and the balance iron, wherein each of said nickel silver layers has a thickness of about 0.00200 inches and consists essentially of, by weight, of 65 percent copper, 12 percent nickel, and 23 percent zinc, and wherein each of said outer metal layers has a thickness of about 0.00225 inches and is formed of nickel.

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