

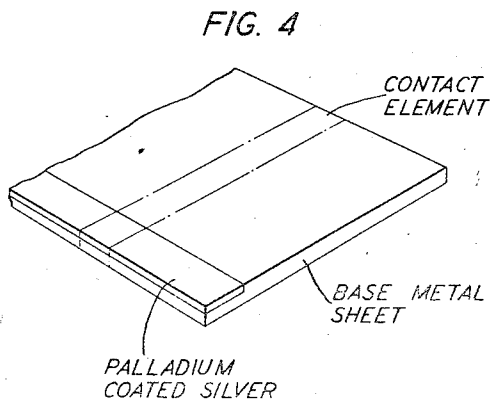
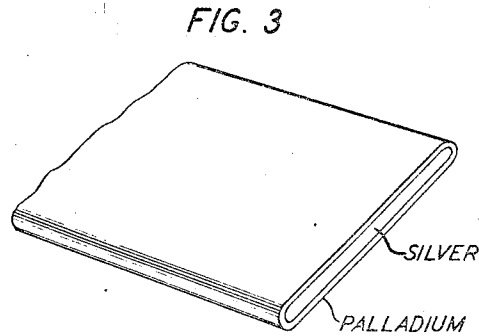
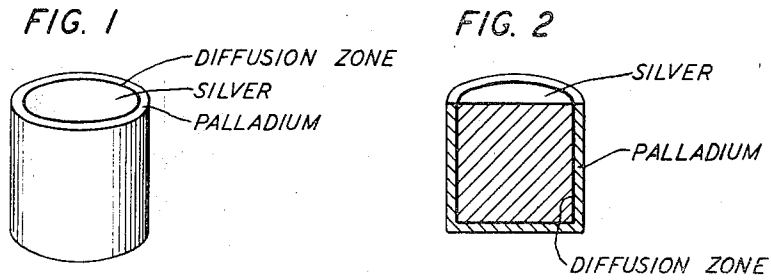
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DUPLEX METAL BODY

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DUPLEX METAL BODY

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8 Claims. (Cl. 200—166)

The present invention relates to duplex metal bodies and more particularly to silver-containing bodies which are provided with a durable, tarnish-resisting layer.

The present application is a continuation in part of the application of H. T. Reeve, Serial No. 237,195, filed October 27, 1938, which issued November 4, 1941 as United States Patent No. 2,261,412.

According to the present invention there is provided an essentially silver body which is economically surfaced with a tarnish-resistant layer which is also resistant to mechanical wear. Such silver bodies are useful for the formation of silver articles of all types but are particularly useful for the formation of electrical contact elements, especially those employed in telephone circuits.

The invention may best be described by reference to the accompanying drawing in which:

Fig. 1 shows a composite ingot made up of a thin cylindrical container of palladium or palladium alloy having an internal body of silver or silver alloy bonded thereto;

Fig. 2 shows a sectional view of the same ingot;

Fig. 3 shows a tape formed by rolling the ingot of Fig. 1 in such a manner that the tape contains an internal core of silver entirely surrounded by a thin layer of palladium;

Fig. 4 shows a metal sheet having an inlay of a tape such as that shown in Fig. 3; and

Fig. 5 shows a contact element punched from the sheet shown in Fig. 4.

The novel silver bodies of the present invention may be produced by providing a thin palladium shell as shown, for instance, in Fig. 1 and placing the required amount of silver in the recess of the shell. The silver may be added in granular or powdered form or in the form of a slug shaped to fit the container. The silver is then fused within the palladium shell by heating the shell and its contents to a temperature of about 970° C. to about 980° C. in an enclosed atmosphere of an inert gas or in a vacuum, preferably the latter. In place of fusing the silver within the palladium shell, it is also possible to heat the shell and the silver separately to the temperatures described above and then to pour the silver in the molten state into the shell.

The silver is maintained in a molten state within the palladium shell for a time sufficient to form the desired bond between the silver and the palladium in the final body. Although silver and palladium are mutually soluble in all proportions, some time is required for the fused silver to diffuse into the palladium shell at temperatures not

greatly above the melting point of silver. If a minimum amount of diffusion of the silver into the palladium is desired, in order to prevent contamination of the outer palladium surface, the bonding time is kept short and the palladium shell and its content may be cooled rapidly soon after the silver is fused within it. If a thicker diffusion zone of silver and palladium is desired, the fused silver may be maintained in contact with the palladium for a longer time or at a slightly higher temperature or both before cooling to solidification.

Figs. 1 and 2 are illustrative of the type of composite ingot which may be produced by this procedure. It is made up of an inner body of silver and an outer thin shell of palladium having a diffusion zone of silver and palladium between the two metals. The ingot produced as described above may be mechanically worked as by rolling, swaging, and drawing in the same manner as a body of a single metal.

If an ingot such as shown in Fig. 1 is rolled along its vertical axis, a tape such as shown in Fig. 3 may be produced. This tape consists of a core of silver surrounded by a thin layer of palladium-silver alloy and an outer thin layer of palladium. The thickness of the palladium layer is considerably exaggerated in the drawing for purposes of illustration. The tremendous increase in surface area when the ingot is rolled into the tape or other thin body causes the initially thin shell of palladium to be spread out into an even thinner layer. The amount of palladium on a given surface of such a tape may therefore be so small that the cost of such a tape is only slightly greater than that of a silver tape having no palladium coating. In such a tape or similar body the palladium at the outer surface may be substantially uncontaminated with silver even though the initial shell of palladium may have been no more than a few mils thick. However, a diffusion zone of silver and palladium will always be formed at the interface of the two metals, the thickness of the zone depending on the length of time during which the silver is maintained in the molten state in contact with the palladium.

In place of being rolled into a tape the composite body shown in Fig. 1 may be drawn into a wire consisting essentially of silver surrounded by a very thin layer of palladium. Similarly, various bodies of other shapes may be formed from such an ingot.

Due to the fact that the silver is coated with a very thin layer of palladium, the coated bodies

are essentially non-tarnishable silver bodies. In addition to the non-tarnishing properties imparted to the surface by the protective film of palladium, the surface is made more durable by the very hard layer of silver-palladium alloy in the bond just below the surface film of palladium. This alloy is much harder than either silver or palladium. If the softer palladium surface is worn away by mechanical wear, the underlying layer of palladium-silver alloy, which is also resistant to tarnishing and which is resistant to further mechanical wear, is exposed.

Articles made from such palladium-coated silver have a wide variety of uses. Superior contact elements may be stamped from a sheet or tape such as that shown in Fig. 3. Contact elements may also be prepared by inlaying a narrow thin tape of palladium-covered silver by any suitable means in a sheet of a suitable backing material such as brass or bronze as shown in Fig. 4. Contact elements such as shown in Fig. 5 may then be stamped from the duplex sheet, for instance, as shown by the broken lines in Fig. 4. The palladium-coated silver forms the contact surface in such a contact element.

The contact surface of palladium-coated silver has the advantage over ordinary silver contacts that there is no tendency for tarnishing of the surface to take place. As a result there is less danger of the development of a high contact resistance at the surface. If the softer palladium surface is worn away by mechanical wear at the point of contact the palladium-silver layer which is considerably more durable than either palladium or silver is exposed. This layer is also tarnish-resistant and offers a very satisfactory contact surface. In many telephone circuits, alloys of palladium and silver are superior as contacts to either of the constituents.

Not only silver itself but also silver alloys made up predominantly of silver may be protected in the manner described above. Thus electrical contacts may be made as described above using any suitable silver contact alloy such as a silver-tin alloy containing more than 90 per cent silver. Coins may be stamped from coin silver coated in the manner described. Similarly sterling silver articles may be formed from sterling silver covered with a thin layer of palladium.

Not only palladium itself but also suitable tarnish-resistant palladium alloys made up predominantly of palladium may be employed for forming the outside layer on the articles of the present invention. Alloys of palladium with silver up to 60 atomic per cent or with other noble metals or with suitable base metals, such as palladium-copper alloys may be employed.

As an example of the use of a palladium alloy for the purposes of the present invention a very satisfactory contact element for telephone circuits may be produced by forming a layer of a palladium-silver alloy-containing 60 atomic per

cent silver and 40 atomic per cent palladium on the surface of a silver body as described above. The coated body may be rolled into a tape .5 inch wide and .03 inch thick having a palladium alloy layer .0005 inch thick on each side. Such a tape may be joined to a base metal contact arm as shown in Figs. 4 and 5 and as described above. The contact surface so produced is very satisfactory from the standpoint of resistance to corrosion, tarnish and electrical erosion. The cost of the palladium incorporated into such a body is less than that of the silver, despite the tremendously greater price of palladium, because of the small amount necessary.

Although the invention has been described in terms of its specific embodiments, certain modifications and equivalents will be apparent to those skilled in the art and are intended to be included as part of the invention, which is to be limited only by the reasonable scope of the appended claims.

What is claimed is:

1. An electrical contact element comprising a base metal body faced with a body of silver having a relatively thin layer of palladium autogenously bonded to its contact surface, a diffusion zone of palladium-silver existing between the silver and the palladium layer.

2. An electrical contact element comprising a metal body of silver-containing metal having a relatively thin layer of palladium-containing metal autogenously bonded to its surface.

3. A body of predominantly silver metal having a relatively thin layer of predominantly palladium metal autogenously bonded to its surface, a diffusion zone containing silver and palladium existing between the silver-containing metal and the palladium-containing layer.

4. A body of silver having a relatively thin layer of palladium autogenously bonded to its surface.

5. A body of predominantly silver metal having a relatively thin layer of predominantly palladium metal autogenously bonded to its surface.

6. A tarnish-resistant durable silver body comprising a base of silver, a superimposed durable layer of silver-palladium alloy, and an outside thin tarnish-resisting layer of palladium, all of said layers forming a continuous metal body.

7. A tarnish-resisting durable silver body comprising a base made of metal containing predominantly silver, a superimposed durable layer containing silver and palladium and an outside thin tarnish-resisting layer of a metal containing predominantly palladium, all of said layers forming a continuous metal body.

8. An electrical contact element comprising a silver body having autogenously bonded to its surface a thin layer of a palladium-silver alloy containing not more than 60 atomic per cent of silver.

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