April 13, 1971 C. B. GWYN, JR 3,574,570

COMPOSITE CONTACT STRUCTURE FOR CONNECTION TO AN ALUMINUM SUPPORT

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FIG. 1.

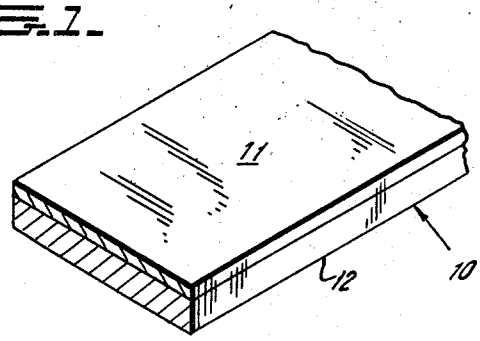


FIG. 2.

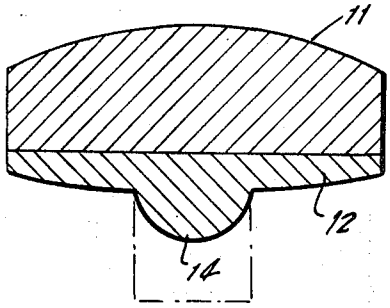


FIG. 3.

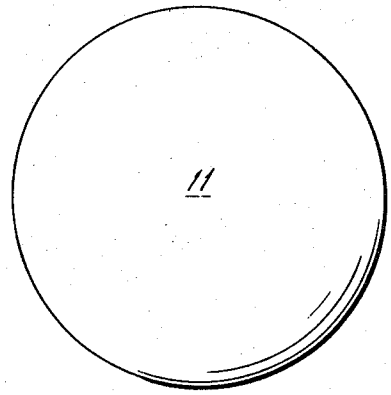


FIG. 4.

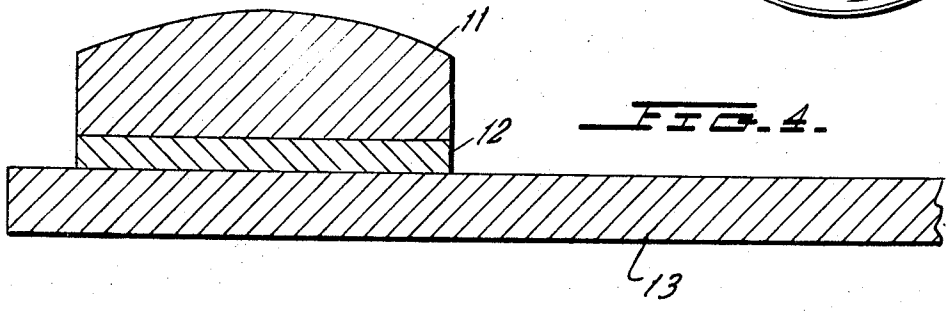
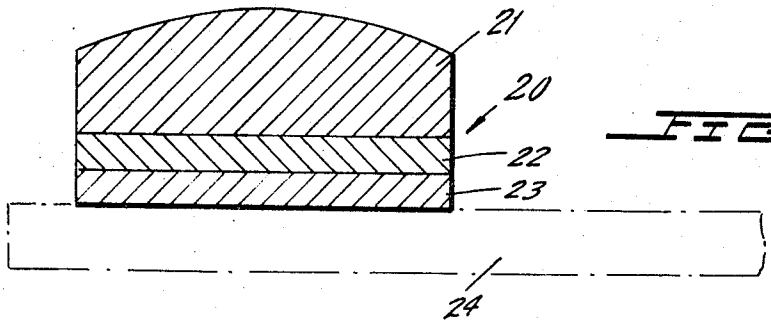


FIG. 5.



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COMPOSITE CONTACT STRUCTURE FOR CONNECTION TO AN ALUMINUM SUPPORT

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U.S. Cl. 29—197.5 3 Claims

ABSTRACT OF THE DISCLOSURE

A composite contact structure for connection to an aluminum support where the contact structure has a working face material which is bonded on its rear surface to an aluminum or aluminum-silver alloy body material suitable for connection to an aluminum support by conventiional techniques such as brazing, welding, staking, and the like.

This invention relates to composite electrical contacts, and more particularly relates to an electrical contact which can be secured to an aluminum support by conventional connection techniques.

The use of aluminum support members for electrical contact assemblies is very limited due to a general inability to properly and permanently attach usual contact materials to the aluminum support. Where aluminum supports have been used, the supports are generally clad with materials such as copper, silver, stainless steel, and the like, so that the contact elements can be secured to the aluminum support with standard commercially available techniques, such as brazing, welding, staking, etc. The cladding of the support structure in this manner, however, is undesirable because of the expense involved. Moreover, even where the support has been clad for the reception of a contact material, it has been difficult to obtain uniform results in the securement of the contact material to the support.

In accordance with the present invention, a novel composite contact is formed which includes the usual contact working surface where, however, the back of the working surface is secured to an aluminum or aluminum-alloy body portion. The composite contact itself will then be easily connectable to an aluminum support by conventional techniques such as brazing, welding, and the like, which can permanently and efficiently connect aluminum or aluminum-alloy bodies to one another.

The invention may be applied to various types of contact facing materials. For example, the contact facing material may be a refractory material selected from the group consisting of tungsten, molybdenum, mixtures of tungsten and molybdenum, binary alloys of tungsten and molybdenum, tungsten-carbide, molybdneum-carbide, and mixtures of such materials. These refractory materials are then infused with non-refractory materials selected from the group consisting of silver, copper, silver-copper mixtures and silver-cadmium mixtures in an amount of up to 60% by weight of the refractory metal body. Contact facing materials of this type are well known.

In accordance with the invention, the rear surface of these materials has secured thereto an aluminum body or a silver-aluminum body secured thereto. This securement may be obtained by puddling or flowing the aluminum or silver-aluminum alloy over the contact working face material in a suitable time-temperature cycle. Good results have been obtained particularly when using a refractory contact material composed of a silver-tungsten alloy and a backing material of an aluminum-silver alloy containing about 11.5% by weight of silver.

The two bodies were placed together and then heated in a neutral atmosphere to a temperature of about 1850° F. for about 10 minutes. A permanent attachment was formed between the refractory contact material and the silver-aluminum alloy backing where the silver-aluminum alloy backing was easily attached to aluminum support members trrough conventional welding or brazing, or the like.

Moreover, it was found that the so-called "battery" or electrolytic action often found to take place between aluminum and a body member material differing in the electromotive potential series did not take place apparently because of the silver content in the silver-aluminum alloy body.

It has also been found that this battery action is either entirely eliminated or further substantially decreased when a brazing alloy containing a major percent of cadmium is used between the silver-rich aluminum surface and the aluminum support member when the composite body is being brazed to the aluminum member. The effect of the cadmium has been found to be improved with regard to decreasing the battery action where the silver content in the silver-aluminum alloy is less than 10% by weight.

It has also been found that good results can be obtained where the backing material of the composite contact is substantially pure aluminum used in combination with a silver-rich surface of the contact working face material.

It has also been found that an aluminum or aluminum-silver alloy backing body can be connected to other types of contact materials such as the ductile contact materials which are of silver, copper, silver-copper mixtures, cadmium, cadmium-oxide and silver-cadmium mixtures where these materials are to be connected to either aluminum, iron or nickel support members. In these arrangements, the contact facing material is initially fused to a suitable substrate such as iron, and the aluminum or silver-aluminum alloy is thereafter fused to the rear surface of the iron substrate. The contact is then suitably coined in any desired manner so that it may be connected to an aluminum support at the aluminum or silver-alumimum body surface.

Accordingly, a primary object of this invention is to produce a surface as an integral part of a contact body which promotes and permits the permanent attachment of the contact body to an aluminum support member.

Another object of this invention is to provide a contact structure which can be economically and uniformly connected to aluminum support bodies.

These and other objects of this invention will become apparent from the following description taken in connection with the drawings in which:

FIG. 1 shows a strip of composite material constructed in accordance with the invention and from which suitable contact shapes may be punched.

FIG. 2 shows a typical contact element constructed in accordance with the present invention and punched from the sheet of FIG. 1.

FIG. 3 is a top view of FIG. 2.

FIG. 4 shows the contact of FIGS. 2 and 3 connected to an aluminum support structure.

FIG. 5 shows a second embodiment of the invention in which a non-refractory contact having an aluminum or aluminum-silver alloy backing is connected to an aluminum support structure.

Referring first to FIG. 1, there is illustrated therein an elongated sheet **10** having an upper refractory layer **11** and a lower layer **12** composed of aluminum or a silver-aluminum alloy. Sheets **11** and **12** may have any desired thickness, depending upon the contact structure which is ultimately to be formed. The refractory material **11** may be a material selected from the group consisting of tungsten, molybdenum, mixtures of tungsten and molybdenum,

binary alloys of tungsten and molybdenum, tungsten-carbide, molybdenum-carbide and mixtures of such materials where the refractory is infiltrated with silver in accordance with the techniques disclosed in my copending application Ser. No. 455,439, filed May 13, 1965, entitled Method for Making Refractory Metal Contacts Having Integral Welding Surfaces Thereon. Layer **12** may consist of pure aluminum or a silver-aluminum alloy having a silver content of about 11.5% by weight.

The two layers **11** and **12** are suitably cleaned, and then placed atop one another within a suitable furnace. For example, the two layers may be placed upon a ceramic or carbon plate and heated in a neutral or reducing atmosphere such as hydrogen or NH_3 at a temperature of about 1850° F. for about ten minutes. In this process, the silver-aluminum layer **12** faces upwardly and will puddle or flow, thereby to form a permanent attachment to the refractory layer **11**. Thereafter, composite contact elements having the shape illustrated in FIGS. 2 and 3 are stamped from the sheet in a usual stamping operation.

It will be apparent that instead of using elongated sheets **11** and **12** which are secured to one another in a single heating operation, other contact shapes could be used. For example, the aluminum or silver-aluminum alloy body **12** could have the initial shape of a rivet, with the individual rivets secured to the refractory contact element **11** in a heating cycle similar to that described above.

In the embodiment of the invention illustrated in FIGS. 2 and 3, it will be apparent that the aluminum or silver-aluminum body **12** can be easily connected to an aluminum support structure. For example, FIG. 4 shows the contact of FIGS. 2 and 3 as connected to an alumiunm support body **13** by a pressure connection which deforms extension **14** of the contact of FIG. 2 and causes a good connection between the contacts and the aluminum support **13**. Other suitable connection techniques can be used which are well known for the connection of aluminum to aluminum or aluminum alloys to aluminum such as conventional welding or brazing techniques, and the like.

Where brazing is used, it has been found useful to use cadmium in the brazing material since this somewhat decreases the so-called "battery action" between the aluminum support **13** and the contact, especially where relatively less than 10% by weight of silver is used in the backing **12**. Where backing **12** is of aluminum or contains more than about 10% silver, there is very little battery action even in the absence of the use of cadmium in the brazing alloy when securing the contact to the aluminum support **13**.

The invention described in FIGS. 1 to 4 shows the use of an aluminum or aluminum-alloyed backing for a refractory metal contact.

FIG. 5 illustrates the present invention in combination with a non-refractory contact element. Thus, in FIG. 5, a composite contact element **20** consists of a non-refractory working face portion **21** which may be silver, copper, silver-copper mixtures and alloys, cadmium, silver-cadmium mixtures and alloys, and the like. When using this type arrangement, an iron or nickel substrate material **22** is fused or otherwise secured to the working face material **21**. Thereafter, the aluminum or silver-aluminum body portion **23** is secured to the intermediate substrate portion **22** in any suitable puddling operation, or the like, so that the composite contact **20** may now be connected to an aluminum support by any of the conventional techniques for connecting aluminum or aluminum-alloys to

aluminum supports. Thus, in FIG. 5, the aluminum backing **23** may be directly connected to the alumiunm support **24** as by brazing, welding or staking.

Again, it has been found useful to include cadmium in the brazing alloy in order to decrease battery action which may occur where the aluminum backing **23** includes silver less than about 10% by weight.

Although this invention has been described with respect to particular embodiments, it should be understood that many variations and modifications will now be obvious to those skilled in the art, and, therefore, the scope of this invention is limited not by the specific disclosure herein, but only by the appended claims.

The embodiments of the invention in which an exclusive privilege or property is claimed are defined as follows:

1. In combination: a composite electrical contact and an aluminum support therefor; said composite electrical contact comprising a first body portion terminating in a contact working surface and a second body portion terminating in a support-connection backing surface; said first and second body portions connected to one another; said first body portion being selected from the group consisting of

(a) a refractory material selected from the group consisting of tungsten, molybdenum, mixtures of tungsten and molybdenum, binary alloys of tungsten and molybdenum, tungsten-carbide, molybdenum-carbide, and mixtures of such materials, and

(b) a non-refractory material selected from the group consisting of silver, copper, cadmium, silver-copper mixtures and silver-cadmium mixtures.

said second body portion consisting of a silver-aluminum alloy having up to about 11.5% silver by weight;

and said support connection backing surface directly connected to said aluminum support without the need for substantial cladding thereof.

2. The combination as set forth in claim **1** wherein said support-connection surface is connected to said aluminum support by brazing with a brazing compound; said brazing compound including cadmium therein.

3. The combination set forth in claim **1** wherein said combination also includes a third body portion interposed between said first and second body portions; said third body portion consisting of a material selected from the group consisting of iron, nickel and nickel-copper alloys; said first body portion being of a non-refractory material selected from the group consisting of silver, copper, cadmium, silver-copper mixtures and alloys and silver-cadmium mixtures and alloys.

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U.S. Cl. X.R.

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