Oct. 27, 1964 R. R. WITHERSPOON 3,154,660

ARC-RESISTANT ELECTRICAL CONTACT HAVING A CADMIUM-COPPER, ALLOY SURFACE

Filed March 26, 1962

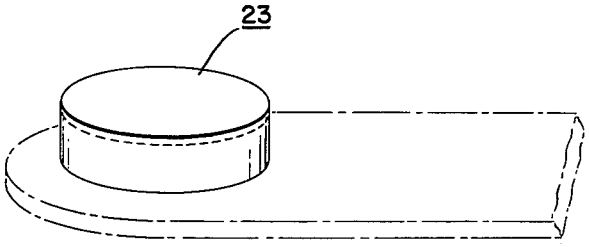


Fig. 3

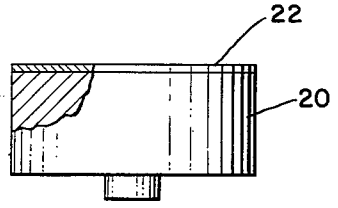


Fig. 1

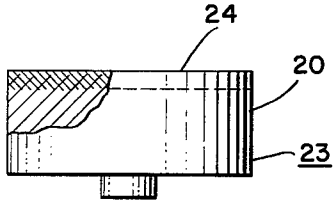


Fig. 2

INVENTOR.
Romeo R. Witherspoon
BY
His Attorney

United States Patent Office

3,154,660

Patented Oct. 27, 1964

3,154,660

ARC-RESISTANT ELECTRICAL CONTACT HAVING A CADMIUM-COPPER, ALLOY SURFACE

Romeo R. Witherspoon, Anderson, Ind., assignor to General Motors Corporation, Detroit, Mich., a corporation of Delaware

Filed Mar. 26, 1962, Ser. No. 182,497
2 Claims. (Cl. 200—166)

This invention relates to electrical contacts and is particularly concerned with contacts and method for making said contacts wherein an alloy material is provided adjacent the working surface only of the contact which resists welding due to arcing. This application is a division of Serial No. 182,497 filed March 26, 1962.

It is, therefore, the main object of this invention to provide a contact and method for making the same which is resistant to welding due to arcing conditions and wherein the contact may be produced economically.

A further object of the invention is to provide a contact and method for making the same wherein the contact is made from copper and has a working surface comprising a copper-cadmium alloy which is resistant to welding.

In carrying out the above object it is a further object of the invention to produce the copper-cadmium alloy adjacent the working surface only of contact through diffusion processes.

Further objects and advantages will be apparent, reference being had to the accompanying drawings, wherein FIG. 1 is a cross section of a copper contact showing a cadmium layer adjacent one surface only thereof for illustration purposes wherein the thickness of the layer is greatly exaggerated also for illustration purposes.

FIG. 2 is a cross section of the same contact after diffusion of the cadmium layer into the copper and FIG. 3 is a view in perspective of a typical application of the contact mounted on a contact arm.

In certain applications, for example in passenger car switches and the like, copper contacts are frequently used because of the ease of manufacture and relatively low cost thereof. These contacts have a tendency to weld together when small arcs are produced which nullify their other desirable characteristics. It has been found that a contact formed from a copper-cadmium alloy wherein the cadmium is in quantities of about 1% by weight of the contact, resists this welding effect and produces a highly satisfactory contact which has a long life under the conditions of its environment. Contacts of this character are relatively expensive when compared to copper contacts due to the inclusion of the cadmium therein and, therefore, when used in the required numbers in passenger car applications, increase the overall cost of the electrical system.

I have found that contacts may be formed that have all of the desirable characteristics of the copper-cadmium alloy contacts and which may be produced quite reasonably, in fact, at only slightly more than the cost of pure copper contacts. This obviously is a great economic saving and in no way reduces the desirable characteristics found in the higher cost copper-cadmium alloy contacts.

Specifically, I have found that by producing the desired copper-cadmium alloy adjacent the working surface only of the copper contact, that all the desirable characteristics of the copper-cadmium alloy contact may be preserved. This surface alloy is very thin and may extend for a depth of from about .0005" to .03" with from .0005" to .015" from the surface of the contact being preferred.

I have found that such a copper-cadmium alloy surface may be produced by several procedures. One, and possibly the cheapest, method of producing this type of

contact, is to electroplate the surface of the copper contact with cadmium. This plated surface copper contact is then heated to cause diffusion of the cadmium into the copper to the desired depth. Control of the percentage of the cadmium may be obtained through the thickness of the cadmium layer and the temperature and the time of heating.

Similar contacts can be produced by laminating cadmium foil with the copper or by merely placing cadmium foil in intimate contact with the copper contact. Also, cadmium powder may be briquetted onto the surface of a copper contact in the desired thickness, etc. Any of these expedients fall within the scope of my invention. For obvious reasons the electroplating method is the easiest to handle and will be described in detail.

Referring to the drawings, FIG. 1 shows a cross section of a copper blank and slug **20** with a cadmium plate **22** in place on the surface. The thickness of the plate **22** is greatly exaggerated in order to properly illustrate the invention.

In FIG. 2 the cadmium plate **22** has been diffused into the copper blank **20** to form a contact **23** having a copper-cadmium layer **24** integral therewith. I have discovered that in order to obtain approximately a 1% cadmium alloy that the plating thickness should be about .0001" of cadmium. If any losses are caused by volatilization of the cadmium during diffusion, a slightly heavier plate should be applied. In all instances the thickness of the plate is best arrived at by trial in view of the diffusion procedures subsequently utilized to obtain the desired result. In this connection, after the plating **22** has been applied to the copper blank **20**, the assembly is heated to cause diffusion of the cadmium into the copper. The period of heating will vary with the temperature and in accordance with the depth of diffusion and percentage of cadmium desired in the copper-cadmium alloy stratum. In general, if a .0001" electro-plate of cadmium is applied and is diffused to a depth of about .01" it will produce a copper alloy in this portion of the contact which will have about 1% cadmium therein. In most instances copper-cadmium alloys where cadmium ranges between .5% to 2% are useful with about 1% by weight being preferred.

The temperature of the heating step may vary, for example, the blank with the cadmium thereon may be heated below the melting point of cadmium to cause diffusion. In this instance, temperatures from about 500–575 F. may be used with complete satisfaction. On the other hand, if faster diffusion is desired this temperature may go upwards to about 900 F. which is well above the melting point of cadmium. It is obvious that as the temperature goes up the period of heating will be reduced. However, as the temperature goes up caution must be exercised to prevent excessive loss of cadmium due to vaporization thereof. In all instances the time of heating is best arrived at by trial to obtain the desired depth of diffusion and percentage of cadmium in the copper-cadmium alloy.

During the heating of the contacts, an inert atmosphere should be used. In this connection, reducing atmospheres are preferred although they are not always necessary. Cracked ammonia, dehumidified, incompletely burned natural gas, hydrogen or other well-known reducing atmospheres are all satisfactory.

It is understood that the invention may be practiced to obtain any desired depth of penetration of the cadmium and to obtain varying percentages of cadmium in the copper-cadmium alloy layer as is desired and the procedures to accomplish these ends will be obvious to those skilled in the art in view of the disclosure herein.

While the embodiments of the present invention as herein disclosed, constitute preferred forms, it is to be understood that other forms might be adopted.

What is claimed is as follows:

1. An electrical contact for use in an application where arcing normally occurs comprising; a solid copper contact having a copper-cadmium surface layer integrally formed therewith, said layer including diffused cadmium in percentages of from .5% to 2% by weight of the copper and extending within the contact to a depth of from .0005" to .03", the remainder of the contact being substantially pure copper.

2. An electrical contact for use in an application where arcing normally occurs comprising; a solid copper contact having a copper-cadmium surface layer integrally formed therewith, said layer including diffused cadmium in percentages of about 1% by weight and extending within the contact to a depth of about .01", the remainder of the contact being substantially copper.

References Cited in the file of this patent

UNITED STATES PATENTS

1,395,269	Gebauer	Nov. 1, 1921
1,820,699	Hartman	Aug. 25, 1931
2,216,510	Burns	Oct. 1, 1940
2,360,522	Shobert et al.	Oct. 17 1944
2,425,053	Swinehart	Aug. 5, 1947
2,730,594	Page	Jan. 10, 1956
2,770,700	Holm et al.	Nov. 13, 1956
3,026,603	Zysk et al.	Mar. 27, 1962