July 7, 1970 C. B. GWYN, JR 3,519,543

PROCESS FOR ELECTROLYTICALLY CLEANING AND POLISHING ELECTRICAL CONTACTS

Filed Oct. 27, 1967

FIG. 1.

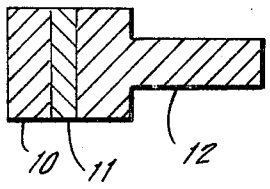


FIG. 2.

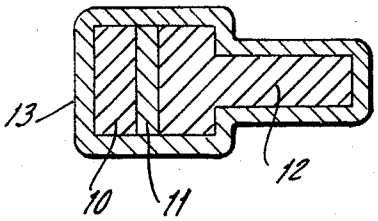


FIG. 3.

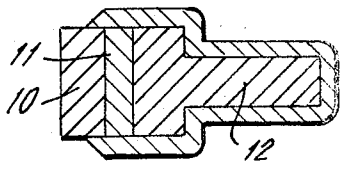
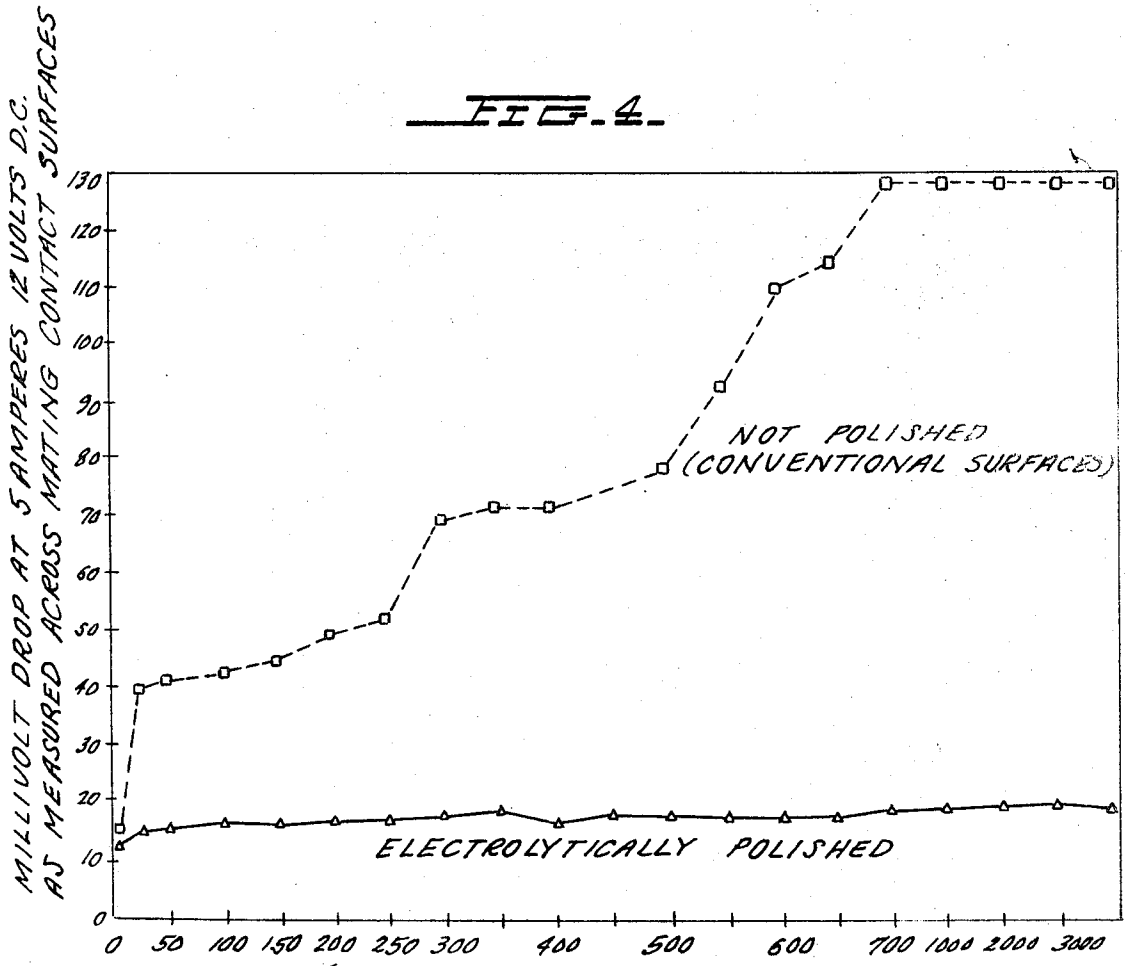


FIG. 4.



INVENTOR.
CHILDRESS B. GWYN, JR.

BY

OSTROLENK, FABER, GERB & SOFFEN

ATTORNEYS

United States Patent Office 3,519,543 Patented July 7, 1970

3,519,543

PROCESS FOR ELECTROLYTICALLY CLEANING AND POLISHING ELECTRICAL CONTACTS

Childress B. Gwyn, Jr., Wethersfield, Conn., assignor to Talon, Inc., Meadville, Pa., a corporation of Pennsylvania

Filed Oct. 27, 1967, Ser. No. 678,590
Int. Cl. C23b 3/06
U.S. Cl. 204—140.5 4 Claims

ABSTRACT OF THE DISCLOSURE

Process for cleaning and polishing contacts of molybdenum, tungsten and alloys thereof by nickel plating the contacts after brazing them to ferrous supports and then electrolytically deplating the contacts.

This invention relates to electrical contacts, and more particularly relates to a novel process for electrolytically polishing contact surfaces of tungsten, molybdenum and binary alloys of the two.

Contacts of refractory metals such as tungsten, molybdenum and alloys thereof are well known. Their use is limited, due to a rise in contact resistance after extended periods of time whether the contacts are on the shelf or in duty.

Some of the causes of this increased resistance are:

(a) Contamination of contact surface during brazing of contacts to their support body,

(b) The presence of cutting mediums such as carborundum or silicon carbide from the cutting disks used to cut the refractory metal stock,

(c) The presence of impurities in the contact surfaces picked up during tumbling operations used for polishing and burr removal,

(d) The effects of high humidity, particularly on tungsten,

(e) Electrolytic, or battery action due to the connection of dissimilar metal combinations such as tungsten brazed to a steel backing member which causes "brown surfacing"; a form of tungsten oxide or other surface composition change which blocks current flow.

It is known that some of these effects, in the case of tungsten faced contacts, could be controlled by electrolytically polishing the contacts. Thus, U.S. Pat. 1,958,338 teaches a polishing arrangement for tungsten in which the contact is placed in an electrolytic solution and D-C current is passed through the contact. While this type treatment improved the shelf life of tungsten faced contacts, it could not be used with molybdenum or tungsten-molybdenum alloys.

In accordance with the present invention, a novel electrolytic treatment is provided for polishing tungsten, molybdenum or tungsten-molybdenum binary alloys which substantially improves both shelf life of the contacts and the life of the contacts in operation. In particular, and in accordance with the invention, the refractory contact material is first brazed to a suitable ferrous backing or support. Thereafter, a plurality of such elements are immersed in a nickel plating solution (of the Watts-type) and the elements are made negative to cause nickel plating of each of the elements. After this plate has reached a certain thickness, the polarity of the system is reversed and the nickel plating begins to deplate. However, it was found that the nickel plate covering the refractory contact surface deplates much faster than the plating on the braze region and the ferrous support so that the refractory contact surface is exposed while the remaining portion of the assembly is still plated. The polishing effect of this deplating process has been found

to apply equally to tungsten, molybdenum and alloys thereof with equal efficiency and with a substantial improvement in shelf life, and with a substantial and lasting elimination of the localized battery effect formerly obtained between the dissimilar metals of the assembly.

Accordingly, a primary object of this invention is to improve the quality of refractory-type contacts.

Another object of this invention is to improve the shelf life and decrease the effect of localized battery action between dissimilar metals in the contact.

A further object of this invention is to provide a novel process for polishing electrical contacts which applies equally to tungsten, molybdenum and tungsten-molybdenum binary alloys.

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

FIG. 1 is a cross-section view of a contact brazed to a ferrous metal support.

FIG. 2 is a cross-section view similar to FIG. 1 after the formation of a nickel plate thereon.

FIG. 3 is a cross-section of FIG. 2 after the deplating portion of the process.

FIG. 4 shows a comparison of the voltage drop across pairs of contacts polished and not polished according to the invention.

Referring first to FIG. 1, refractory contact surface members such as member **10** of tungsten, molybdenum or tungsten-molybdenum binary alloys are prepared in a conventional manner as by cutting the disks from rods, and tumbling or burnishing the disk **10** to a desired degree of surface finish. Disks **10** can have a diameter of ⅛" and a thickness of 1/32". Thereafter, the finished disks are brazed, as by copper brazing **11** to a steel or other ferrous backing member such as rivet **12** by brazing in a neutral or reducing atmosphere.

A nickel plating operation is then used which could plate only the ferrous backing member **12**, but preferably coats the entire assembly, shown as coating **13** in FIG. 2. This complete coating extends across the copper braze **11** and has been found to reduce or completely eliminate the battery action formerly found between the refractory working material **10** and the ferrous backing **12**.

The electroplating is carried out using a conventional solution such as a water solution of the Watts-type and could be formulated as follows:

Nickel sulfate ($NiSO_4 \cdot 6H_2O$) 10 ounces per gallon of water.

Nickel chloride ($NiCl_2 \cdot 6H_2O$) 45 ounces per gallon of water.

Boric acid (H_3BO_3) 5 ounces per gallon of water.

The pH of the solution is 2.8 to 4.5, and is held at a temperature of 110° F. to 160° F.

In using this solution, a given number of elements assembled as in FIG. 1 are supported within a plastic revolving barrel filled with the solution, and are electrically connected to the negative (cathode) side of a suitable D-C voltage source of from 6 to 14 volts. An electrolytic current current density of about 75 amperes is then passed through the solution for from 1 to 25 minutes until a desired nickel plate thickness is developed on the subassemblies, which is not critical.

With the parts still immersed in the plating solution, the potentials are then reversed, with the plated parts made anodic and a deplating process begins. The solution is then again agitated as by rotation of the containing barrel.

During this deplating process, it was found that the nickel plate over the refractory contact surface deplates at a much faster rate than the plate on the copper braze

11 or ferrous backing 12. Thus, the undesired nickel plate over the contact working surface is quickly removed (as shown in FIG. 3) and is subsequently exposed to an electrolytic polishing action in which the surface appearance changes from a typically dull, somewhat roughened, surface to a very smooth surface having a mirror-bright appearance.

In the case of tungsten copper brazed to a ferrous backing and exposed to high humidity conditions, the working surface of the tungsten tends to turn a dull grey, blue, yellow, or combination of these colors within three to ten days, which indicate the presence of various forms of tungsten oxides, nitrides and the like. This effect is not observed in tungsten contacts polished in accordance with the invention, even after a three-year period. Thus, shelf life of contacts formed in accordance with the invention is substantially improved.

The efficacy of this electrolytic treatment is further shown by measurements of the contact surface resistance rise obtained when, in highly humid ambient atmospheres, two normally open and, therefore, exposed tungsten contact surfaces in standard commercial relays are periodically closed under a normal pressure of 30 grams. FIG. 4 shows the surface resistance drop measured across the mating faces of such contacts as compared to unpolished contacts. It has been determined that a millivolt drop in excess of 100 m.v. results in erratic service and/or failure to complete a circuit. The curves of FIG. 4 show that the resistance drop across the electrolytically polished mating surfaces seldom reached a maximum of 25 m.v. over a period of two or more years, whereas the millivolt drop across the contacts not electrolytically polished rapidly increased to or exceeded 100 m.v.

Similar results are obtained with molybdenum and molybdenum-tungsten alloy contacts.

It should be noted that a molybdenum or a binary molybdenum tungsten contact working surface may be readily electrolytically polished by the present invention, whereas heretofore an electrolytically polished surface has been difficult, if not impossible, to obtain on molybdenum and binary molybdenum-tungsten surfaces.

Although this invention has been described with respect to its preferred embodiment, it should be understood that many variations and modifications will now be obvious to those skilled in the art, and it is preferred, therefore, that the scope of the invention be 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. The method of manufacture of an electrical contact having a refractory metal contact surface comprising the steps of

(a) securing a refractory contact element to a ferrous backing member;

(b) nickel plating the exposed surface of said refractory contact and adjacent areas of said ferrous backing member with a continuous nickel plate;

(c) and thereafter electrolytically deplating said nickel plating until at least a portion of said surface of said refractory contact is exposed and has a polished exposed surface.

2. The method of claim 1 in which said refractory contact element is secured to said ferrous backing member by copper brazing; said nickel plating extending across the brazed connection.

3. The method of claim 1 wherein said refractory contact is of a material selected from the group consisting of tungsten, molybdenum and binary alloys thereof.

4. The method of making an electrical contact comprising the steps of

(a) cutting contact elements selected from the group consisting of molybdenum, tungsten and alloys thereof from a supply source;

(b) initially smoothing and deburring said contact elements;

(c) copper brazing said contact elements to a ferrous support member;

(d) inserting said element and support member in an electrolytic solution which includes nickel ions, and nickel plating said element and support member with a nickel plate to a given thickness;

(e) reversing the polarity of the electrolytic solution to deplate at least one surface of said element and until said at least one surface has a polished appearance.

References Cited

UNITED STATES PATENTS

2,349,356	5/1944	La Motte	204—140.5
2,382,865	8/1945	Dittmar	148—4
2,564,823	8/1951	Wallace	204—228
3,287,238	11/1966	Latawiec et al.	204—140.5
3,314,869	4/1967	Dobbin et al.	204—140.5

JOHN H. MACK, Primary Examiner

A. C. PRESCOTT, Assistant Examiner

U.S. Cl. X.R.

204—141, 143

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,519,543 Dated July 7, 1970

Inventor(s) Childress B. Gwyn, Jr.

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

The Assignment should read--

assignor, by mesne assignments, to Textron Inc., Providence, R.I., a corporation of Delaware

SIGNED AND SEALED

OCT 27 1970

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents

USCOMM-DC 60376-P69
U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334