Aug. 4, 1936. C. B. GWYN, JR 2,049,771

METHOD OF MAKING SILVER CONTACTS

Filed Feb. 6, 1935

Fig. 1

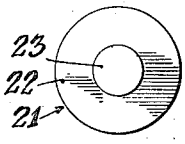


Fig. 3



Fig. 5

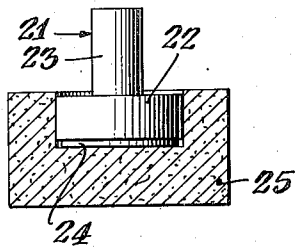


Fig. 6

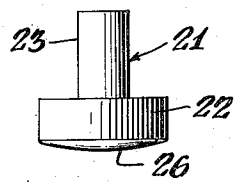


Fig. 2

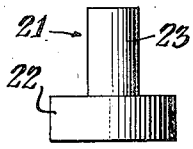


Fig. 4

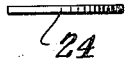


Fig. 9

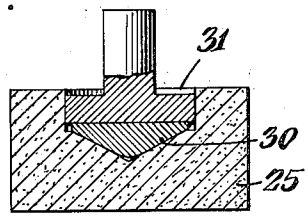


Fig. 7

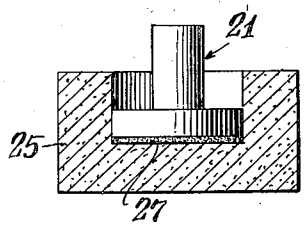


Fig. 8

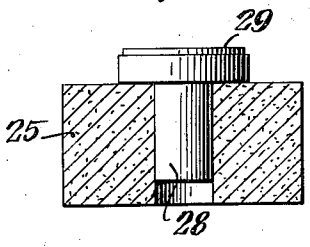


Fig. 10

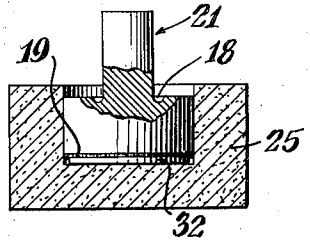


Fig. 12

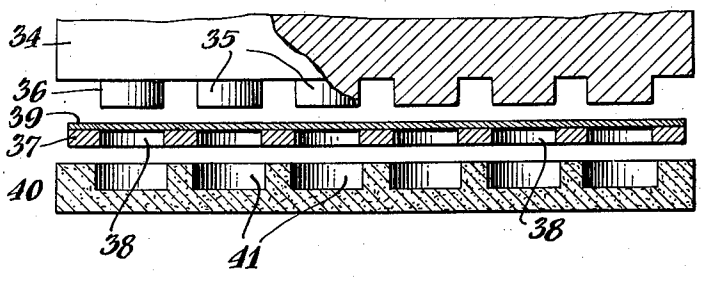


Fig. 11

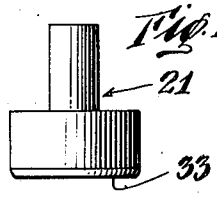
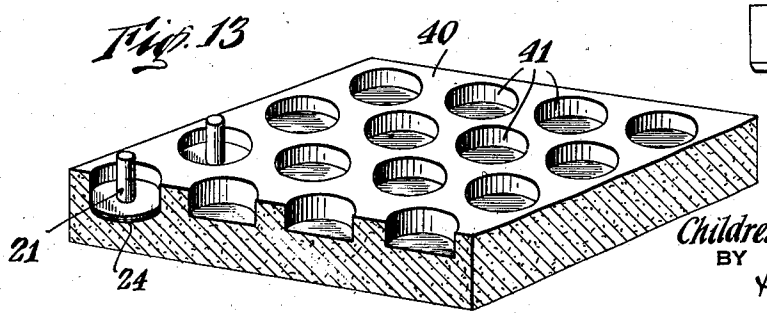


Fig. 13



INVENTOR
Childress B. Gwyn Jr.
BY
ATTORNEY

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UNITED STATES PATENT OFFICE

2,049,771

METHOD OF MAKING SILVER CONTACTS

Childress B. Gwyn, Jr., Indianapolis, Ind., assignor, by mesne assignments, to P. R. Mallory & Co., Inc., Indianapolis, Ind., a corporation of Delaware

Application February 6, 1935, Serial No. 5,210

12 Claims. (Cl. 29—155.55)

This invention relates to electrical contacts of silver and methods of fabrication thereof.

This application is a continuation in part of my co-pending application Serial Number 756,733 filed December 10, 1934.

An object of the invention is the provision of an electrical make and break contact assembly having a working face of silver composition and a backing or support of relatively hard and inexpensive material, and which due to its unique construction will function more efficiently than silver contacts of the prior art.

A further object is to provide a silver contact assembly of higher mechanical strength and durability than heretofore available.

A still further object is to produce a contact assembly of superior operating characteristics at normal and elevated temperatures.

Another object is to produce a silver contact member at a substantially lower cost than has heretofore been possible by reducing the amount of expensive materials required for a satisfactory contact assembly.

An additional object is to produce silver contacts or contact assemblies in quantities with an economy of labor and with resulting uniformity of product.

Other objects will be apparent from the disclosure and drawing together with the appended claims.

The present invention comprehends the provision of a contact element of silver composition fused to a metal backing. Preferably this is accomplished by utilizing a support or rivet blank of some hard base metal such as steel, which may or may not be first plated with a flashing of nickel, copper or silver, placing a quantity of silver or suitable silver composition on or against the support, and heating the assembly in a suitable atmosphere such as hydrogen, until the silver or silver composition flows and fuses itself to the support.

According to present practice, most electrical make and break contacts of silver are made by fabricating not only the contact working face, but also the entire contact body, including the shank, of silver. From the standpoint of continued efficient operation, such contacts are not altogether satisfactory. The silver shank support, being rather soft, does not provide the strong hard backing desirable for frequent make and break operations. Furthermore, the silver, being relatively weak, is not too well adapted to form a strong and durable mechanical attachment to the member or device to which it is connected. Since under certain operating conditions, the contacts become quite hot, the difference in expansion between the silver and connected parts, causes the entire contact body to loosen and has often resulted in loose "stacks" with consequent erratic operation. The loss of adjustment which results from this latter condition or from distortion of the soft metal backing, causes inefficient and unreliable service.

The above disadvantages are overcome by the present invention, which provides a structure in which for the most part only the working face is of silver and which has a hard strong durable support integral with the silver facing, thus allowing the locating and attaching of the contact assembly in an electrical circuit in such manner as to insure dependable and efficient operation over long periods of time without necessity of adjustment. Furthermore, by the employment of an inexpensive material, such as steel, for the greater part of the contact body, the cost of the contact is materially reduced.

The invention accordingly comprises the features of construction, combination of elements, arrangements of parts, and methods of manufacture referred to above or which will be further brought out and exemplified in the disclosure hereinafter set forth, including the illustrations in the drawing, the scope of the invention being indicated in the appended claims.

For a fuller understanding of the nature and objects of the invention as well as for specific fulfillment thereof, reference should be had to the following detailed description taken in connection with the accompanying drawing, in which:

Figure 1 is a plan view of a rivet blank for use in forming the contact assembly;

Figure 2 is a side view of the rivet blank shown in Figure 1;

Figure 3 is a top view of a disc of contact metal;

Figure 4 is a side view of the disc shown in Figure 3;

Figure 5 is a sectional elevation of the rivet blank and contact disc assembled in a receptacle preparatory to uniting said rivet and disc by heat treatment;

Figure 6 is a side view of a completed contact element;

Figure 7 is a sectional elevation of the rivet blank and contact material assembled in a suitable receptacle for heat treatment according to a modified form of the invention;

Figure 8 is a sectional elevation of a rivet

blank and contact disc assembled in a receptacle preparatory to uniting by heat treatment;

Figure 9 is a sectional elevation of a completed contact element of modified form and the receptacle used in forming the same;

Figure 10 is a sectional elevation of parts assembled for the formation of a contact element according to a still further modified form of the invention;

Figure 11 is a side view of a contact element formed according to the method illustrated in Figure 10;

Figure 12 is a sectional elevation showing parts arranged for the simultaneous production of a plurality of contact elements; and

Figure 13 is a perspective view of a multiple receptacle containing contact assemblies preparatory to the heating treatment.

Like reference characters indicate like parts in the several figures of the drawing.

While a preferred embodiment of the invention will be described herein, it is contemplated that considerable variations may be made in the method of procedure and the construction of parts without departing from the spirit of the invention.

Referring to the drawing, the rivet blank 21 illustrated in Figures 1 and 2 is preferably formed of a base metal having the mechanical characteristics necessary to form a mechanically strong and durable assembly when secured to backing members to form part of electrical apparatus. The rivet blank may be made of steel, for example, by upsetting, cold heading, or by other methods of fabrication, well known in the art, to form a head 22 and shank 23 of desired diameter and length. The steel rivets are preferably plated with a thin film or flashing of copper from 0.0001" to 0.0005" thick. A wide variety of other base metals having a melting point higher than the desired facing, may of course be had, instead of the steel.

The contact metal may be prepared for assembly in a variety of ways, such as forming it into a disc 24 as shown in Figures 3 and 4. The disc is preferably slightly less in diameter than the rivet head and may be formed by punching, heading or otherwise forming the disc from a measured amount of silver.

The rivet blank 21 and contact disc 24 are assembled in a suitable receptacle 25 as illustrated in Figure 5, prior to uniting. Receptacle 25 may preferably be formed of a material which does not unite or adhere to the contact metal when it is in a molten or solid state, such as carbon, graphite, or other suitable refractory material.

The receptacle containing the contact parts assembled in a suitable manner as shown, with the contact metal placed against the face of the rivet desired to be coated, is placed in a heating chamber and heated, the temperature being raised high enough for a sufficient period of time for the contact metal to fuse onto or partly alloy with the rivet member. If an iron or steel rivet is used and the contact metal is silver a temperature of 985° C. for approximately two minutes is satisfactory to allow the capillary attraction between the melted silver and iron to cause a "wetting" or uniting of the two materials. While it is possible to carry on the heating without any special precautions as to the type of atmosphere used, it is preferred that the atmosphere in the heating chamber shall be neutral or reducing in nature, or that the heating shall be done in a vacuum. A hydrogen atmosphere is very satisfactory.

Upon cooling, the contact parts will be found to have united to form a contact element, such as illustrated in Figure 6. The contact metal, due to its capillary attraction for the base metal backing member and its own tendency to "ball up" or form a spherical or hemi-spherical shape, will produce a rounded surface 26 on the contact element when it cools and solidifies.

According to a modified form of the invention, the contact metal, such as silver, instead of being preformed in the shape of a disc for uniting with the rivet blank, may be used in the form of powder or shavings 27, which are placed in the bottom of receptacle 25 as shown in Figure 7. The rivet blank 21 is placed over these as shown in this figure and the heat treatment applied as previously described.

Figure 8 illustrates an alternate method of forming the contact assembly. Carbon receptacle 25 houses rivet blank 28 upon the head of which is placed silver disc 29. When this assembly is heated, the silver melts, unites with the steel and forms a convex shaped contact face similar to that shown in Figure 6.

When a rounded face is desired, such as that illustrated in Figure 6, the operation is carried out as previously described. If, however, it is desired to produce contact faces of special shapes, such as oval, pointed, square, etc., the receptacle 25 may be suitably recessed to produce the shapes desired. In Figure 9, for example, a method of forming a pointed contact is illustrated, this figure showing the receptacle 25 containing the contact assembled after the heating operation. It will be noted that the contact surface 30 has assumed a somewhat pointed form due to the shape of recess 31 in receptacle 25.

To produce a flat face contact or a contact with a very slight radius, I find it desirable to apply a nickel flash or plating to the rivet, the thickness of the plating being from 0.0001" to 0.0005", the thinnest plating being preferred. The capillary action of nickel is so much greater than that of copper or silver that complete silver coverage may be secured with a disc as low as 50% of the diameter of the rivet head. When a nickel plating is employed, it is desirable to have a recess in the back of the blank around the shank such as shown in Figure 10, in which carbon receptacle 25 houses nickel plated steel rivet blank 21 which rests upon silver disc 32. The nickel plating, about 0.0002" is shown in exaggerated form at 19. When heated in the manner hereinabove described, the silver will be found to have spread evenly over the rivet face to form a substantially flat contact surface 33 as shown in Figure 11. The recess 18 in the blank prevents the silver from flowing down the side of the shank. This is not required when flashings of copper or silver are employed as the capillary action with these metals tends to draw the facing on the contacts into a natural radius.

Another advantage derived from the use of nickel is that thinner flat silver facings can be produced. The nickel may be sprayed on the surface of the rivet instead of plating, in which case the wetting action takes place only on the head of the rivet and the recess is unnecessary.

The above described method of producing contact elements lends itself extremely well to automatic or semi-automatic operation and to simultaneous production of a large number of elements. This may be carried out as illustrated

in Figure 12, for example. In this figure is illustrated a punch press member 34, having punching projections 35, shown more clearly at 36. A punching plate 37, having holes 38, registering with projections 35, is located immediately below the punching member 34. A sheet 39 of contact facing material, such as silver or silver alloy suitable for contact material, such as coin silver, etc., rests upon the upper surface of plate 37. Immediately below plate 37 is a boat or other suitable receptacle 40 provided with a corresponding plurality of recesses 41 located immediately below said holes 38. In the punching operation, member 34 moves downward a sufficient distance to cause projections 35 to punch the contact discs from the plate 39, made of contact metal. The discs thus produced are forced through holes 38 in plate 37 by the projections 35 and fall into the recesses 41 provided in the receptacle 40, located immediately below each of said holes. The diameters of recesses 41 are preferably only slightly larger than that of the punched discs.

Boat, or receptacle 40, is formed of a suitable refractory material, such as carbon or graphite. After the contact discs 24 have been punched into the recesses 41, the rivet blanks 21 are inserted on top of these discs. This may conveniently be done by merely placing a number of rivet blanks upon the upper surface of boat 40 and shaking the boat in such a manner that the rivet blanks will fall into the holes. Due to their rivet shape, it is found that the rivet blanks will readily fall into the holes with the desired orientation without further precautions being taken. The boat 40, containing the contact assemblies ready for insertion into the heating chamber is shown in perspective in Figure 13, parts being cut away to better illustrate the relationship of the contact parts.

If desired, union of the contact material with the rivet blank may be aided and the appearance of the completed contact element may be improved by applying a light plating of silver to the entire rivet blank 21 before formation of the silver facing on the rivet head. When this is done, the copper or nickel plating is omitted.

The nickel, copper, or silver plating which is applied to the rivet blanks prevents oxidation and also increases the capillary action of the silver so that a uniform bonding action is obtained. Where unplated blanks are employed, I have found that it is usually necessary to utilize a silver disc or powder which covers the entire face of the contact in order to obtain complete coverage; by using a plating, the disc size can be as much as 25% smaller in diameter than the face of the finished contact and still provide complete coverage. Furthermore, the shape of the silver disc is not of importance as long as the required amount of silver is available.

The platings or flashings which I employ are not to be confused with brazing discs which have been employed in uniting dissimilar metals. In the present invention, the plating is used merely as a method of controlling the mechanical flow of the silver facings. It also overcomes deleterious effects of wet hydrogen or other reducing or inert gases. In the prior art, where contact facings of tungsten or other refractory metal discs have been applied to steel backings, copper or silver brazing discs have been inserted therebetween to produce a definite bonding between two comparatively non-melting elements, whereas in the contact assemblies of my invention, the contact face material is essentially one which will melt and flow at a lower temperature than the base metal backings. The plating, in the instant case, is for convenience and is not a necessity, as under proper production control, it may, if necessary, be eliminated.

The present invention makes possible the production of contact elements at a greatly reduced cost, both by making it possible for the shank of the contact rivet to be made of a cheaper material and also by reducing the thickness of silver required in the rivet head. As an example of this, it has previously been necessary for manufacturing and mechanical reasons to make the head of a certain type of rivet from silver .025" thick or greater. According to the present invention, a contact having sufficiently long life may be made with a silver facing .010" in thickness or less, with equally satisfactory results.

The difficulty experienced in the past of providing contact elements which will provide satisfactory operation under high temperature conditions has been entirely overcome by the present invention. Since the rivet blank may be made of the same material or of material having substantially the same expansion characteristics as the backing member to which it is to be attached, no loosening or erratic operation will be obtained. Likewise, much higher mechanical strength will be obtained in the resulting structure and no loosening after long operation will take place.

The improved qualities inherent in the contact of this invention may be said to be derived from the fact that the silver face is completely united and fused with its support. This is brought about by the flowing or melting of the silver to the support, as distinguished, for example, from welding or soldering where junction is effected at a plurality of points. It appears that the contact and the method of producing it are inseparable. The present invention provides for automatic or semi-automatic fabrication of the contact elements and it has the advantage of low cost from a manufacturing standpoint. Other advantages will be readily apparent from the preceding description of the invention.

The term "silver" or "silver composition" as used herein includes pure silver as well as compositions of silver with other metals, where the product is suitable for use as a silver contact and where it has a melting point sufficiently low to be adapted for use in the contact and method of this invention.

The term "fused" means joining of the face of the contact and its support by the melting and flowing of the silver.

While the present invention as to its objects and advantages has been carefully described herein as carried out in a specific embodiment thereof, I do not desire to be limited thereby but intend to cover the invention broadly within the spirit and scope of the appended claims.

What is claimed is:

1. The method of forming an electrical make and break contact element which comprises providing an individual base metal support with a silver contact face by fusion of a quantity of silver to a liquid molten condition and allowing it to cool and solidify in contact with said base metal support.

2. The method of forming an individual electrical make and break contact which comprises placing a quantity of silver against a relatively higher melting point metal support and heating the assembled metals in a reducing atmosphere

above the melting point of silver so as to cause said silver to fuse to said support.

3. The method of forming an individual electrical make and break contact which comprises applying a thin plating of one of the metals nickel, silver and copper to a hard metal support, placing a quantity of silver composition against said support and heating said support and silver composition above the melting point of said silver composition so as to effect a fusion of the latter.

4. The method of forming an individual electrical make and break contact which comprises applying a thin plating of one of the metals nickel, silver and copper to a steel support, placing a quantity of silver composition against said support and heating said support and silver composition above the melting point of said silver composition so as to effect a fusion thereof.

5. The method of forming an electrical make and break contact which comprises placing a quantity of silver in the bottom of a recess in a refractory receptacle, placing a hard metal contact backing blank upon said silver in said recess and heating the assembled metals to fuse said silver to said blank.

6. The method of forming an electrical make and break contact which comprises placing a quantity of silver in a recess having approximately the desired shape of the face of the completed contact, placing a hard metal blank against said silver, and heating said assembly to fuse the silver to the blank and to cause its face to assume the desired shape.

7. The method of forming an electrical contact member which comprises placing a quantity of silver against one face of an individual contact backing blank so as to cover less than the whole of said face, heating the thus assembled parts sufficiently to allow said silver to melt and flow over said entire face of said backing blank, and then cooling the assembly below the temperature at which said silver will flow.

8. The method of forming an electric contact member which comprises placing a quantity of silver against a circular face of a backing member so as to cover only a portion of said face, heating the thus assembled parts sufficiently to allow said silver to melt and flow over said face to the circular edge thereof, and then cooling the assembly below the temperature at which said silver will flow.

9. The method of forming an electrical contact member which comprises applying to an individual steel backing blank a flashing of a metal having a higher capillary attraction for molten silver than the capillary attraction of steel for molten silver, placing a quantity of silver against a face of said blank having said flashing thereon, heating the assembled parts sufficiently to allow said silver to melt and flow over said face to substantially cover said face, and then cooling the assembly below the temperature at which the silver will flow.

10. The method of forming an electrical make-and-break contact which comprises placing a quantity of silver against a ferrous metal support and heating the assembled metals above the melting point of silver so as to cause said silver to fuse to said support.

11. The method of forming an individual electrical make-and-break contact which comprises placing a quantity of silver against an individual steel backing and heating the assembled metals above the melting point of the silver so as to cause said silver to fuse to said backing.

12. The method of forming an electrical make-and-break contact element which comprises providing an individual steel backing with a silver contact face by fusion of a quantity of silver to a liquid molten condition and allowing it to cool and solidify in contact with said steel backing.

CHILDRESS B. GWYN, JR.