METHOD OF MAKING AN ELECTRICAL CONTACT

Howard E. Spooner, Lincoln, R.I., assignor, by mesne assignments, to Engelhard Industries, Inc., Newark, N.J., a corporation of Delaware

Filed July 15, 1958, Ser. No. 748,761

7 Claims. (Cl. 29—155.55)

The present invention deals with electrical contact elements suitable for use in making and breaking electrical circuits and to methods for manufacturing such elements.

Hereinafter, electrical contacts for application with voltage regulators, relays, and the like, have been formed from base metal strips with precious metal inserts, inlays, or rivets which serve as the contact points. The precious metals have excellent current carrying capacities due to their low electrical resistance, and they are highly resistant to tarnish and electrical erosion, whereby electrical contacts formed from these metals have low contact surface resistance even with small contact pressures, and they are capable of maintaining low electrical resistance in service for long periods of operation.

In the manufacture of electrical contacts, the known methods include the solder flushing of a precious metal strip from which solder faced inserts and the like are blanked prior to incorporating the insert into a base metal strip which is subsequently subjected to contact forming operations. In the blanking of the inserts, there is considerable scrap produced, and this scrap necessitates costly refining to recover precious metal free of solder.

The present invention provides for improvements in the methods of making contacts.

It is an object of this invention to provide improved electrical contacts and to save precious metals in the manufacture thereof. It is another object of the present invention to provide a method for the manufacture of electrical contacts with a minimum of manufacturing operations. Other objects and advantages of this invention will become apparent from the description hereinafter following and the drawings forming a part hereof, in which:

Figure 1 is a top view of a base metal strip used in fabricating contacts embodying the invention,

Figure 2 is a top view of a perforated base metal strip,

Figure 3 is a side elevation of an individual insert plug greatly enlarged,

Figure 4 is an enlarged side elevation of a modified insert,

Figure 5 is a partly cross sectional and partly elevational view of the apparatus employed in manufacturing contact members according to the invention,

Figure 6 is a partial face view of a die shown in Figure 5,

Figure 7 is an enlarged section of a contact element blanked and formed from a composite strip,

Figure 8 is a partly cross sectional and partly elevational view of the composite strip of the apparatus of Figure 5.

Referring to the drawing, there is shown in Figure 1 a wide flat strip 10 formed of any suitable electrically conductive base metal, e.g. copper, nickel, and so forth, or alloys thereof, for example, brass, bronze, nickel-silver, etc. The strip 10, according to Figure 2, is formed by a punch press which punches out a series of bores or apertures 11, the shape, location, and number of the bores being dependent upon the shape and construction of the electrical contact element that is to be manufactured. The contact element which was chosen for illustration purposes has three precious metal contact points and there are three bores 11 punched in the strip 10 for each contact element to be inserted therein.

A series of locating or centering holes 12 is also punched in the strip 10 in a line parallel to an edge of the metal strip, the centering holes being spaced apart by a distance substantially equal to the length of strip needed to form one contact element.

In Figure 3 there is shown a flat laminated metal plug 13, the shape and size of which is such that it will press fit into a bore 11. The thickness of the plug 13 preferably approximates that of the metal strip 10. The plug 13 is punched out from a metal strip 14 (Figure 5) composed of metal or metals having a lower melting point than the metal of strip 10. The strip 14, as illustrated, is formed from a compound metal stock having a base or foundation a of an inexpensive metal, for example, copper, and a layer b of a precious metal as gold, silver, platinum, palladium, and alloys of these metals. The layer b may be electroplated on the surface of the foundation a, or the layers of metal may be integrally bonded together by direct weld with the application of heat and pressure, or by brazing methods, all of which is well known to those skilled in the art. Preferably, the strip 14 consists of precious metal, preferably silver or alloys thereof, e.g. coin silver, from which a disc 15, shown by Figure 4, is blanked.

The plug 13, shown in Figure 3 as a disc, is punched out from the metal strip 14, as illustrated by Figure 5, by passing the strip between a die 16 and punch 17, with the face a of the strip towards the die and its precious metal face b towards the punch. The die 16 is provided with a recess 18 around the rim of the die hole 19 shown in Figure 6.

With the strip 10 prepared as illustrated in Figure 2, the next step in the manufacture of the electric contacts of this invention comprises fixing the discs 13 into the bores 11. This may be accomplished by supporting the die 16 upon a base 21 and passing the flat strip 10 between the base and the die so that the discs 13 when punched from the strip 14 will pass through the die hole 19 and become seated in the bores 11 in the strip 10.

In order to maintain the strip in proper relative position so that the bores 11 are aligned with the die hole 19, the die 16 is provided in its bottom surface with the recess 22 of substantially the same depth and width as the strip 10 for carrying the strip. Figure 5 shows the punch 17 in a position after having punched out the disc 13 and before it has seated the disc into a bore 11. A guide plate 23 for the punch 17 is preferably mounted above the strip 14.

It is apparent that at this state the plug or insert members 13 are mechanically secured by press fitting in the apertures 11. Having thus mechanically seated the inserts in the apertures 11, the composite strip is passed through a critical bonding phase comprising continuously passing the composite strip through a preheating zone of a furnace or the like, whereby the strip is preheated to a temperature below the melting point of the insert 13 and preferably to a temperature approaching the melting point of the insert or just below the melting point of the insert, and continuously passing the said strip from said preheating zone through an insert melting zone, which is maintained at a temperature at or above the melting point of the insert for a period of time sufficient to provide only a molten skin or liquid surface on said insert and maintaining said inserts under said temperature, e.g. by controlling the speed of the strip through the melting zone until the surface tension of the liquid face is broken, whereby the said molten metal...
contacts the walls of the apertures 11 and forms an interfacial alloy of the metal of said base metal strip and the metal of said insert, and continuously passing said strip from said melting zone through a temperature zone having a temperature below the melting point of the insert. Since only the surface, or the face, of the inserts are in a molten condition, the insert is retained in the aperture, and upon cooling, results in a metal to metal bond between the insert and the base metal strip. After cooling, the bonded strip is subjected to the formation of a contact element therefrom, as hereinafter more particularly described.

Referring to Figure 8, I have found that the above-described method of inserting a contact plug 15 into a base metal strip may be further simplified in that the necessity for preforming holes or apertures 11 in a strip 10 can be eliminated. Instead of using a base metal strip 10 with perforations 11, as illustrated by Figure 1, or including only the centering holes 12, is positioned below the die 16, for example, in the recess 22. The plug or insert 15 is blanked or punched from a strip 15a as illustrated. As the punch 17 is advanced toward the strip 10 through die 16, the plug or insert 15 acts as an end of a punch and blanks a corresponding or similarly shaped portion out of the strip 10, leaving itself deposited in the opening formed in the strip 10 by the blanked portion 25 which is deposited in the depression 27 in the base 21, said deposition 27 preferably having a depth sufficient to leave the plug 15 as an insert in said strip 10 when the blank 24 contacts the bottom of the depression 27.

The finished contacts 25, shown by Figure 7, are formed from the assembled strip by a series of stamping, drawing, and cutting operations, the particular sequence of these operations being immaterial for the purposes of this invention so long as the projections 26 which serve as the contact points are drawn out with their precious metal surface on the apex or outer surface of the projection.

It is thus apparent that this invention provides a method for manufacturing an improved electrical contact having longer wearing properties and greater corrosion resistance than heretofore needed and permits of the most economical use of costly noble or precious metals or alloys of these metals, since only the very point of contact need be made from these metals.

Also, since no solder is employed in bonding the plugs 13 to strip 10, it is apparent that the scrap resulting from blanking operations may be recovered by ordinary melting procedure instead of costly refining, especially when the insert plugs are composed of precious metal, e.g., coin silver.

It is understood that this invention is not limited to the specific embodiments shown and described and that various deviations may be made therefrom without departing from the spirit and scope of the appended claims.

What is claimed is:

1. The method of making an electrical contact strip comprising a base metal strip including an insert member having a melting point lower than the base metal strip, said method comprising the steps of punching at least one insert member from a metal strip, press fitting said insert member into an aperture in the base metal strip, preheating the assembly of the strip containing the insert to a temperature below the melting point of the insert, continuously passing said preheated strip through a heating zone maintained at a temperature at least at the melting point of said insert, the duration of said continuous passage of said insert through said heating zone being limited to a time sufficient to form only a molten surface film of metal on said insert and until the surface tension of the molten film broken to form a metal to metal bond between the insert and base metal strip, continuously passing said assembly of the strip containing the insert from said heating zone through a temperature zone having a temperature below the melting point of said insert.

2. The method of making an electrical contact according to claim 1, comprising inserting said insert member into preformed holes in said metal strip.

3. The method of making an electrical contact according to claim 1, comprising punching said insert member from said metal strip and continuously advancing said insert member through a solid strip, whereby said insert displaces a correspondingly shaped section from said strip and is deposited into the aperture formed by the displaced section.

4. The method of making an electrical contact from a base metal strip including an insert member having a melting point lower than the base metal strip, said method comprising the steps of punching at least one insert member from a metal strip, press fitting said insert member into an aperture in the base metal strip, preheating the assembly of the strip containing the insert to a temperature below the melting point of the insert, continuously passing said preheated strip through a heating zone maintained at a temperature at least at the melting point of said insert, the duration of said continuous passage of said insert through said heating zone being limited to a time sufficient to form a molten surface film of metal on said insert and until the surface tension of the molten film is broken to form a metal to metal bond between the insert and base metal strip, continuously passing said assembly of the strip containing the insert from said heating zone through a temperature zone having a temperature below the melting point of said insert, stamming a contact member from said composite strip, said contact member including at least one insert.

5. The method of making an electrical contact according to claim 4, comprising forming a projection in said stamped contact member, the apex of said projection comprising said insert, whereby an electrical contact is formed having the insert as a contact point.

6. The method of making an electrical contact according to claim 4, wherein said insert is punched from a precious metal strip.

7. The method of making an electrical contact according to claim 4, wherein said insert is punched from a laminated strip comprising a precious metal layer and a base metal layer.

References Cited in the file of this patent

UNITED STATES PATENTS

2,226,944 Reeve ---------------- Dec. 31, 1940
2,261,412 Reeve ---------------- Nov. 4, 1941
2,373,861 Van Inwagen ------------- Apr. 17, 1945
2,392,917 Guinee --------------- Jan. 15, 1946
2,434,321 Kleiner et al. -------- Jan. 13, 1948
2,653,737 Spooner --------------- Jan. 20, 1953
2,708,249 Pryslak --------------- May 10, 1955
2,854,074 Frank et al. -------- Sept. 30, 1958

FOREIGN PATENTS

609,035 Great Britain --------- Sept. 24, 1948

OTHER REFERENCES