METHOD FOR MANUFACTURING ELECTRICAL CONTACT ELEMENTS

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ABSTRACT OF THE DISCLOSURE

A method for manufacturing composite electrical contact elements wherein spheres of precious metal such as silver are fed one at a time to a welding station where they are brought into contact with the free end of a base metal wire and are there welded; the base metal wire thereafter being cut to sever the welded piece from the continuous length of base metal wire. Subsequently the welded article is formed as by forging or the like into its final shape.

This invention relates to the art of electrical contact elements and more particularly to an improved method and means for manufacturing bimetallic electrical contact elements from a continuous supply of the contact and base materials.

Although the principles of the present invention are broadly applicable to the production of a variety of tipped or headed members, the present invention is particularly adapted for use in the manufacture of electrical contact elements and hence it has been so illustrated and will be so described.

Those familiar with the art of bimetallic electrical contact elements will know that such articles are generally manufactured by welding two separate pieces together. One of the pieces is generally a relatively inexpensive conducting metal forming a base support and the other a small contact metal such as silver or platinum. The composite is then formed to a described shape. In view of the size, configuration and tolerances required, accurate positioning of the contact tip with respect to its base support is difficult particularly where relatively small contact tips are applied to base supports of thin stock. Additionally, the proper mass of contact material for the contact tip is generally difficult to predetermine and the desired final shapes hard to attain on automatic production equipment.

It is with the above considerations in mind, that the present means have been evolved, means including both method and apparatus for manufacturing bimetallic electrical contact elements permitting continuous production of relatively small contacts of desired shape in a simple economic fashion.

It is accordingly among the primary objects of this invention to provide a novel method for producing contact elements or the like on a continuous production basis.

A further object of the invention is to provide improved methods and means for producing electrical contact elements wherein the desired positioning of the material of the contact tips is subject to ready control.

A still further object of the invention is to provide a method and means of producing electrical contact elements on an automatic basis.

It is also an object of the present invention to provide such a process of manufacture that will result in the elimination of wasted raw material and to further decrease cost of manufacturing by a reduction in the required operations to produce the finished article.

These and other objects of the invention which will become hereafter apparent are achieved by providing a supply of the contact material or tips in a predetermined form, for example, spheres or balls of silver or other material of desired electrical properties contained in an automatic feeding device such as a hopper having an opening large enough to permit movement of a desired contact tip to a position adjacent the free end of an elongate length of base material such as steel or the like. Appropriate transfer means are employed for effecting transfer of the contact tip from the hopper to the base material. Subsequently a welding circuit is established through a support for the contact tip, a contact tip and the wire, to permanently join the free end of the wire to the contact tip. The welder itself may include a switch which may be automatically or manually operated. When the switch is closed electric current passes through the circuit to thus weld the wire to the spherical contact tip. Thereafter the wire is automatically cut to separate the wire segment with the contact tip welded thereon from the remainder of the wire. This separated segment is then formed with a contoured head in the shape of the desired finished composite contact element. The new free end of the wire is then joined to the next spherical contact tip to continuously duplicate the operation.

A feature of the invention resides in the arrangement of the automatic feed for supplying one contact tip at a time, and transporting said contact tip on a transferring mechanism for engagement with the free end of the wire forming the contact body. In this manner the wire may be fed from a continuous spool or some other supply which avoids the difficult problem of continuously feeding individual segments of the body of the contact element made of the base material and then positioning them to properly engage the contact tip for welding. In accordance with the present invention the wire is cut subsequent to the welding operation in which the components of the electrical element have been joined and this facilitates an easier gripping of the contact element for movement through the various forming stages until the desired contoured form is obtained.

Another feature of the invention resides in the use of spherical balls of contact material which may readily be controlled as to size and readily fed for welding to the contact body.

The specific details of a preferred embodiment of the invention, and their mode of functioning will be particularly pointed out in clear, concise and exact terms in conjunction with the accompanying drawings wherein:

FIG. 1 is a side elevation view which illustrates the means for transporting contact tips from a supply source to a work station;

FIG. 2 is a schematic detail view which illustrates the welding of the contact tip to the body of the contacting element;

FIGS. 4, 5 and 6 illustrate the contacting element in successive forming operations to obtain the desired tip or head configuration.

Referring now more particularly to the drawings, like numerals in the various figures will be employed to designate like parts.

As illustrated in FIG. 6 the completed contact element 10 is seen to comprise a body 12 and a head 14, the latter divided into a body head section 16 formed integral with the body 12 and an outer head section or contact tip 17 welded to the body head section 16. Although the body is described as being of a base metal such as steel, any one of a large variety of conductive materials may be employed, it being preferred to utilize an inexpensive material. The contact tip 17 is, however, selected from a class of highly conductive metals such as silver or the like.
Referring to FIG. 1 a supply of contact tips 17 are contained within an automatic feeding means such as a gravity feed hopper 20 which is capable of continuously releasing the contact tips of a defined mass and of suitable material, as for example, silver and having a configuration such as the shape of a ball or sphere which lends itself to being easily transferred to a work station 25. The feed hopper 21 has at its lower end a funnel 21 having a downwardly inclined conical wall 22. Within the hopper a quantity of contact tips 17 is contained which pass through a tubular section 23 having a vertical passageway 24 of a diameter large enough to accommodate one contact tip at a time passing therethrough to establish a column of contact tips therein.

One contact tip 17 at a time is positioned on work supporting means, which may be in the form of a support block 28, having a work receiving recess or seat 29 on its horizontal upper surface 30. Transfer of the tip 17 to the seat 29 is effected by means of a transferring mechanism 35 of any conventional design and which may consist of a motor 34 having a reciprocable shaft 37 coupled to a transfer arm 38 provided with contact tip receiving means in the form of an aperture 39 extending in a plane normal to the movement of the transfer arm 38 and adapted for vertical alignment with the passageway 24. The receiving aperture 39 has a diameter slightly in excess of the contact tip 17 to permit its free passage therethrough and into the seat 29 of the support block when the transfer arm 38 is moved from the illustrated solid line position shown in FIG. 1 to the position illustrated by the phantom lines in FIG. 1. As illustratively shown, the bottom surface 40 of the transfer arm 38 is slidably mounted on the upper surface 32 of slide way 31.

If desired, the support block 28 may be traversed in a horizontal plane from the position shown in FIG. 1 to a position wherein the recess 29 is in vertical alignment with the passageway 24 of the feeding means 20 for receiving a contact tip 17 directly from the feeding means 20.

Extension 41 on transfer arm 38 is provided to guide and control the movement of the contact tip 17 and terminates at one end at the aperture 39 and at its opposite end at the leading edge 42 of the transfer arm 38. The distance between the parallel spaced horizontal surfaces 30 and 32, and depth of recess 28 are preferably dimensioned to slightly exceed the diameter of the contact tip 17. In this manner the contact tip 17 will be automatically released from the transfer arm 17 when the latter reaches the position illustrated by the phantom lines in FIG. 1, since the bottom surface 40 will clear the contact tip 17 when it is seated in the recess 29.

Referring to FIG. 2 it will be seen that at the work station 25 the free end 46 of a wire 45 is brought into engagement with the contact tip 17 along an axis which passes substantially through the center thereof. The wire 45 may be in the shape of a rod of an extended length to permit continuous manufacturing. The wire 45 may be of an electrically conductive material such as steel or some other relatively inexpensive metallic material. The welding operation is preferably of the type known as resistance welding and may be carried out by means of any suitable welding machine or mechanism. As illustrated in FIG. 2 the electric current from a source 50 is coupled by lead 51 to the work support 28 and the lead 52 is coupled to the wire 45 so as to form a circuit through the work support 28, contact tip 17 and wire 45.

As illustrated in FIG. 3 cutting means 55 are provided in the form of a blade 56 mounted in a support 57 and powered by any conventional means to effect cutting of a discrete length of the wire 45 to provide the body 12 of desired length from a continuous length of body material. Clamping means 60 is provided to engage the body 12 and support it in position for the continuing operations to be performed on the contact element 10 during the continuous manufacturing operation. It is appreciated that the work station 25 may be fixed in that the operations may take place at one location or that the various operations may occur at different work stations to which the contact element 10 is transported for each operation. With the completion of the cutting operation illustrated by FIG. 4 the body 12 of the wire 45 is available for engaging another contact tip which is transferred to the work support 28 by means of the transferring mechanism 35 for welding.

The contact element 10 is then processed through one or more forming operations in any conventional manner until the desired contour is attained. As illustrated in FIGS. 5, 6 and a series of three forming steps are illustrated to shape the contact element 10 of FIG. 3 into the final shape of FIG. 6. As seen in FIG. 4, forming means 62 in the form of a contoured die member 63 powered in any conventional manner shapes a portion of the body 12, formerly the free end on the wire 45, into the body head section 16, and the spherical tip 17 is simultaneously formed into desired shape with a weld plane 18 between the body head 16 and tip 17 as illustrated in FIG. 5. In FIG. 5 the head 14 is shown further shaped having a lower contact surface 15 and a body head surface 19 in parallel spaced relationship to each other. In FIG. 6 the finally formed contact element 10 is shown having a body section 12 merging into the head section 16 with an abrupt change in cross section from one diameter in the body to another in the head surface 19, the latter being at substantially right angle to the axis of the body. The body head 16 and the spherical contact tip 17 has been illustrated as being partially cylindrical in shape terminating in a hemispherical contact surface 18.

OPERATION

The aforesaid contact element 10 may be formed of a variety of materials and is not limited for use as an element for the transmission of electrical energy. The means herein disclosed may be utilized in jobs of a large variety of situations where it is desired to provide an element having an enlarged head or tie integrally joined to a base. In operation on a continuous production line the automatic feeding means 21 is supplied with a quantity of spherical contact tips 17 that move downwardly into a transfer mechanism 35 that move downwardly into a transfer mechanism 35 designed to reciprocate in a horizontal plane as indicated by the double headed arrow 43 between a normal position as illustrated in FIG. 1 where in a contact tip 17 is received in the aperture 39 and therein transported until the position illustrated by the phantom lines in FIG. 1 is attained and in that position the spherical contact tip 17 falls into the recess 29 in the work support 28. The movement of the transfer arm 38 may be synchronized by the motor drive 36 so that upon release of the contact tip 17 the cycle of receiving and transporting an additional contact tip is timed with the completion of the welding cycle.

As illustrated in FIG. 2, the work station 25 the free end 46 of the wire 45 engages the contact tip 17 and is welded thereto by the flow of current from power source 50 which passes through the work support 28, contact tip 17 and wire 45. Thereafter the wire is cut by cutting means 55 to separate the welded wire segment which forms the body 12 and contact tip 17 from the remainder of the wire. Clamping means 60 preferably engages the body 12 prior to the cutting operation, and supports the contact element 10 during the subsequent forming operations by forming means 62.

The completed contact element illustrated in FIG. 6 produced by the method hereinafter described comprises a body 12 and a head 14 formed from a portion of said body and the contact tip 17. The welded or fused zone 18 is shown as being substantially at a plane midway between the contact face 15 and the surface 19 which is the transition area in which a portion of the body 12 is formed as part of the contact head. Although the head has been illustrated as being partially cylindrical in shape it is appreciated that the desired configuration imparted
to the contact head may vary in size, shape, etc. including the fact that the contact tip might constitute the entire head as well.

The above disclosure has been given by way of illustration and exemplification, and not by way of limitation, and it is desired to protect all embodiments of the herein disclosed inventive concept within the scope of the appended claims.

What is claimed is:

1. A method of manufacturing contact elements, said method comprising the steps of:
   (A) providing a supply of spherical contact tips,
   (B) transferring a contact tip from the supply to a work station and depositing said contact tip in a restraining means at said work station,
   (C) positioning the traverse free end surface of an elongate length of material of the type desired for formation of the body of said element in engagement with the contact tip at said working station,
   (D) welding the contact tip to the traverse free end surface of the elongate material,
   (E) cutting off a discrete length of the elongate material to leave remaining a contact element consisting of a body and head portion, and
   (F) repeating the above steps with another contact tip.

2. A method as in claim 1 including the step of forming the contact element to a desired configuration.

3. A method as in claim 1 in which said transferring step is performed by:
   feeding a contact tip from the supply into a transferring mechanism adapted to releasably retain the contact tip therein, moving said transferring mechanism to the work station, and releasing the contact tip from said transferring mechanism.

4. A method as in claim 1 wherein the contact tip is transferred to the work station and deposited in a cavitied restraining means at said work station.

5. A method as in claim 4 in which the step of depositing the contact tip is accomplished by seating the tip on an electrically conductive support restraining means.

6. A method as in claim 4 in which the step of welding the contact tip to the work is accomplished by passing an electric current through said support, contact tip and at least the end portion of the elongate length of material in contact with the tip.

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