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3,300,840 1/1967 Marshall et al. 29/573
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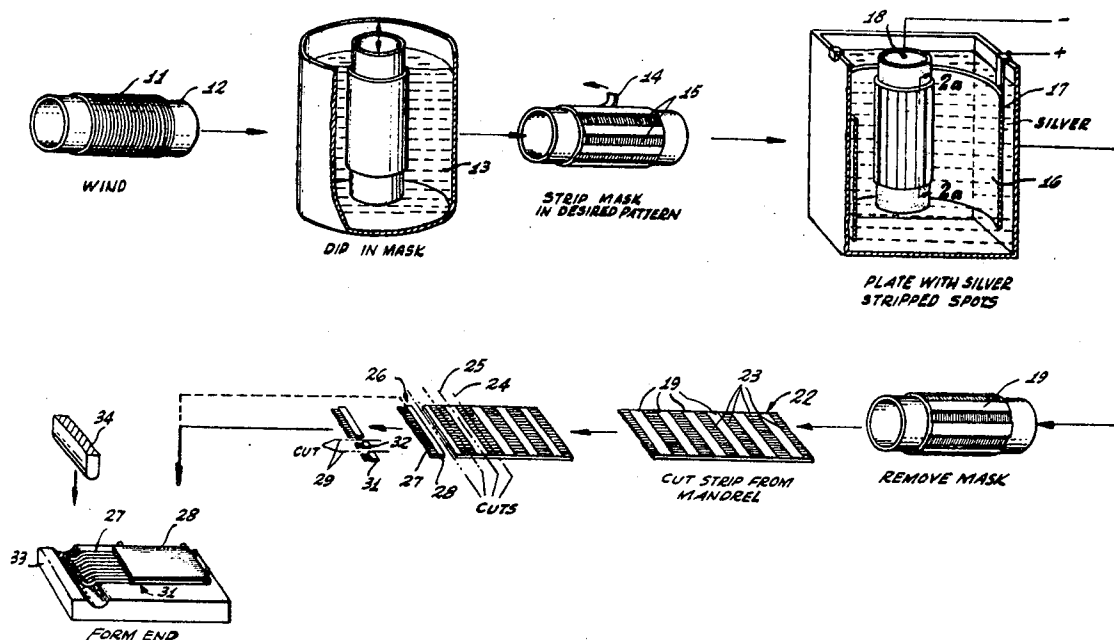
[54] **METHOD AND BLANK FOR MAKING
POTENTIOMETER CONTACT SPRINGS**
4 Claims, 7 Drawing Figs.

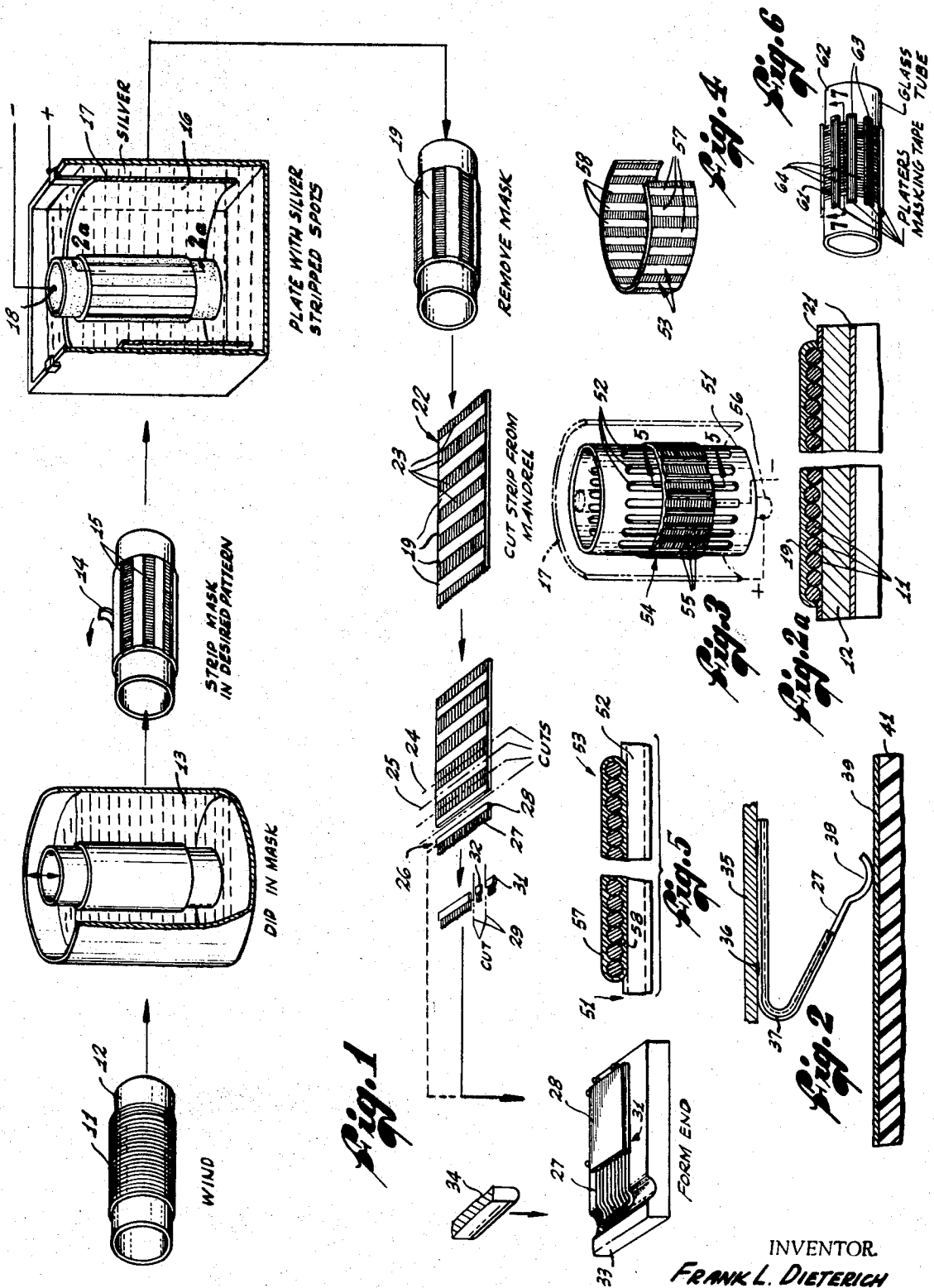
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[56] **References Cited**
UNITED STATES PATENTS

2,760,036	8/1956	Raymer	29/630(E)X
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ABSTRACT: A method of manufacturing miniature potentiometer contact springs by winding a substantial length coil of a single layer of fine, heat-treatable precious metal alloy wire on a generally cylindrical form, masking spaced strips longitudinally of the wire coil, silver plating the wire coil between the masked strips, removing the strips and cutting the strip-plated wire band from the mandrel as a sheet, cutting the wire sheet in the middle of the plated and unplated strips to produce control strip blanks having short free wires at one end and joined plated wires at the other end. The free ends of the wires in the blank are then formed into radiused points of contact, and the blank heat-treated to develop hardness, wear resistance and spring characteristics in the wire fingers. This blank may itself form an article of commerce with the customer (or the original manufacturer) slicing the strip blank into the desired contact widths, forming the plating bonded portion, if desired, and attaching it to a support. The wire may be wound on a solid mandrel and the coil plated only on its outer surface or on a slotted mandrel and the coil plated on both inside and outside surfaces at the slots.





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METHOD AND BLANK FOR MAKING POTENTIOMETER CONTACT SPRINGS

BACKGROUND OF THE INVENTION

1. This invention is directed to the method of making multiple contact point contact springs for miniature potentiometers in which contact fingers engage a resistance surface under pressure and are slidably movable therealong to effect electrical contact therewith at the points of contact finger engagement.

2. Potentiometer contact springs have long been made from thin sheets or strips of heat-treatable metal alloy, with the contact slotted or slit to provide a plurality of fingers to ensure full contact and engagement with the resistance surface. In miniature potentiometers, the contact becomes very small and it is difficult to slit it into the small finger width and also to provide the slot widths without increasing the overall width of the contact. Punching of the slits in a die has become impractical because of the narrowness of the slits and fingers and the very short life of dies which will produce such narrow slits and contact fingers. Narrow slits can be produced with electron beam cutting but this requires an extremely costly machine which must be operated in a vacuum and involves other production difficulties.

It has, therefore, been proposed to produce multifinger contact springs of small size by using small, round or rectangular wires which are placed parallel to each other and joined together at one end, with their free ends forming the multiple contact fingers. Such multiple wire contacts are shown in the U.S. Pats. to Raymer No. 2,760,036 and Lewis et al. No. 3,328,707.

The method employed by Raymer is described in his specification in columns 8 and 9 under the central heading "C. Manufacture of wiper brush." Raymer winds his wire upon a carbon rod and plates the entire wire coil with copper. He then removes the plated band from the rod and coats the portion of the plating which is to remain intact with an acid-resisting material and then removes the copper from the remainder of the wire by nitric acid. Thereafter the contacting end is formed and the contact mounted. The Raymer process is subject to several disadvantages including the limiting of his contact wires to platinum because of the acid treatment, the fact that he can plate on only one side of the wire coil, and must plate the entire circumference of the coil. His method is considerably more complex, expensive and time consuming than that of the present invention.

In the Lewis et al. patent, the contact wire springs are handled individually and are individually mounted in clips or clamps in which they are welded and soldered. In view of the small size of the individual wiper wires, such manipulation is extremely difficult and time consuming and is not suited to high production output.

SUMMARY OF THE INVENTION

According to the present invention, the contact spring is made from a heat-treatable precious metal alloy wire which is plated only adjacent its attachment end, leaving free multiple wire fingers which are to make contact contact with the potentiometer resistance surface. The wire is wound on a solid or slotted mandrel and is masked so that the plating metal, such as silver, will be deposited only in spaced strips running longitudinally of the wire coil and deposited on the outside of the coil in the case of the solid mandrel and on both sides of the coil in the case of the slotted mandrel. The mask is removed from the coil and the coil from the mandrel in the form of a sheet which is then cut transversely of the wires at the center portions of both the plated and unplated strips, thereby resulting in long contact strip blanks of short wires bonded at one end and free at the other. The free ends of the wires may then (or after individual contacts are cut off) be formed to radiused points of contacts and heat-treated in conventional manner at a temperature and for a time to develop hardness, wear re-

sistance and spring characteristics. Where the forming and heat-treating are performed on the contact strip blank, it may form an article of commerce with the customer slicing the strip into the individual contact widths desired. In either case, the individual contacts are formed at their plated portions, if desired, and assembled to a support.

While the adhesion of the plated silver and the cohesive strength of the silver deposit are normally ample for contact purposes, if greater strength is desired it may be secured after plating by welding or fusing the plated silver to the wire by percussion or resistance welding, welding torch, use of an electron beam or laser, or other welding and fusing methods.

The process according to the present invention lends itself to high production automation procedures and is superior in economy and in the performance of the contact spring product. It never requires handling of anything smaller than the finished contact and enables the securing of contacts of any desired width from a standard contact strip. It is flexible in providing the performance and physical requirements of desired contact design.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a progressive, perspective view showing the steps in the process of forming potentiometer contact springs according to the present invention;

FIG. 2 is a view partly in section and partly in side elevation showing the contact mounted in a potentiometer in engagement with a resistance surface;

FIG. 2a is a partial longitudinal sectional view on the line 2a-2a of FIG. 1 showing the plating deposited on the outside of the wire coil while wrapped on a mandrel;

FIG. 3 is a perspective view showing the manner of plating on both sides of the wire coil;

FIG. 4 is a perspective view of the wire band secured from the plating method of FIG. 3;

FIG. 5 is a partial longitudinal sectional view on the line 5-5 of FIG. 3; and

FIG. 6 is a perspective view of a modified mandrel, wire coil and masking prior to plating.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Reference is first made to the process of forming a potentiometer contact spring according to the present invention as illustrated in FIGS. 1, 2 and 2a, in which a bare wire coil 11 is wound spirally in immediate turn-by-turn contact upon a conducting tube mandrel 12, for example of stainless steel. The wire may be of any desired size and composition, an example being a heat-treatable alloy of 30 percent gold, 30 percent platinum and 20 percent silver with the remainder copper and zinc. While the size of the wire will depend upon the performance and physical requirements of the finished contact, an example in a miniaturized potentiometer would be wire of a diameter of 0.002 inch—0.005 inch. The wire-wound tube is then dipped in a nonconducting rubber or plastic base platers' masking solution 13 to completely cover the tube and wire and the resulting mask 21 is thoroughly dried and strips 14 removed longitudinally of the coil to leave circumferentially spaced bare strips 15 on the wire coil on which silver plating will be deposited.

The resulting strip, coil and mandrel are placed in a plating bath 16 surrounded by a cylindrical anode 17 of silver which is connected to the positive terminal of a direct current voltage source. The negative terminal of the direct current source is connected at 18 through the mask directly to the tube 12 so that contact is made through the tube to the wire coil 11. Silver is then deposited on the wire coil in strips 19 to any desired thickness, for example, 0.002 inch—0.005 inch, as shown in FIG. 2a.

The plated wire coil and the tube mandrel are then removed from the bath 16 and the mask removed by mechanical peeling. The wire coil is then cut longitudinally, for example in the middle of a nonplated strip 23 and is removed from the man-

drel and straightened to form the sheet 22 having spaced strips of silver plating 19 with strips 23 of unbonded wire therebetween. The band or sheet 22 is then sheared into strips by cuts 24 through the middle of the unbonded strips 23 and cuts 25 through the middle of the plated strips 19. This results in a plurality of individual contact strip blanks 26 having free unbonded wires 27 at one edge and bonding plating 28 at the other edge.

At this point alternate procedures may be followed in which either the strip blank is formed and heat-treated while intact to produce an article of commerce where the customer will slice the blank at lines 29 into individual contact widths or the strip blanks are immediately cut along lines 29 to form individual contacts 31 and 32 of any desired width and the forming of the free ends of the wires 27 and their heat treatment performed on the individual contacts. For either case, the forming of the wire fingers into radius points of contact is indicated in the dies 33 and 34, which operation should be done before heat-treating the contact fingers in conventional manner at a temperature and for a time to develop hardness, wear resistance and spring characteristics. Any forming of the plated portion of the contact may be done after heat-treating, if desired, because the silver prevents any springback from changing the set of the form. The finished contact may be spot welded at 36 to a support 35 as shown in FIG. 2 where the contact wires 27 have radius ends 38 contacting a potentiometer resistance surface 39 on a ceramic substrate 41. The springfingers 27 engage the surface 39 under pressure and are slidable thereacross by the support 35 in conventional manner.

A modified process which plates the wire coil and contacts on both sides is illustrated in FIGS. 3-5. Here a cylindrical mandrel 51 is provided with a plurality of longitudinally extending, circumferentially spaced slots 52 therethrough and the mandrel 51, which may again be of stainless steel, is dipped in the masking solution and dried prior to the winding of the wire coil thereon. The width of the slots 52 after masking is the desired width of the plated band 53. A wire coil 54 is then wound round the cylindrical mandrel 51 and the masking solution is painted on the wire coil to cover only the area of the bridges of the slotted cylinder as at 55.

The masked coil and mandrel are then placed in a plating bath, as at 16, with an outer cylindrical anode, the same as 17 in the description of the FIG. 1 illustrated process, and also with an axial silver rod anode 56, the anodes 17 and 56 being connected together to the positive side of a direct current voltage source and the wire coil 54 itself being connected directly to the negative side of the direct current source. Plating then occurs on the outside of the wire coil between the masking strips 55 and on the inside of the masking coil through the slots 56 to provide plating, as shown in FIG. 5, at 57 on the outside and at 58 on the inside of the wire coil. The platings 57 and 58 are each of the order of 0.001 inch-0.002 inch of silver.

After plating, the mask on the wire coil is peeled off and the coil cut through the middle of an unplated wire strip and removed from the cylindrical mandrel, as shown in FIG. 4, whereupon the band is developed into a sheet as indicated at 22 in FIG. 1 and the remaining operations carried out as described in the process illustrated in FIG. 1. The mask is desired beneath the wire coil 54 with the slotted mandrel 51 to provide a resilient surface on which the wire is wound to prevent creeping of the plating up the wire from the slot area.

A further modification of the process is illustrated in FIG. 6 wherein the wire coil 61 is wound on a nonconducting tube mandrel 62, of glass or the like, and is masked by means of strips 63 of platers' masking tape which are adhered to the outside surface of the coil in longitudinally extending strips circumferentially spaced to provide bare wire strips 64 therebetween to which the silver plating is applied in a plating bath as illustrated in FIG. 1. In this arrangement, the overall masking step is avoided as is the stripping of the mask from the

coil where plating is desired. The coil itself will be connected to the negative terminal of the DC voltage source and anode 17 to the positive side as in the plating bath 16. After plating, the masking tape strips 63 are readily peeled off and the band cut from the mandrel and developed into the sheet 22 and processed as previously described.

While certain preferred embodiments of the process of this invention have been specifically described and the steps therein illustrated, it is understood that the invention is not limited thereto as many variations will be apparent to those skilled in the art and the invention is to be given its broadest interpretations within the terms of the following claims.

I claim:

1. The method of forming a spring contact including the steps of:

winding a single layer coil of wire on a form;
applying nonconducting mask to said coil except for longitudinally extending, circumferentially spaced bare strips thereof;

plating continuous strips of high-conductivity metal on said bare strips of said coil;

removing the mask from said coil;

cutting said coil longitudinally and removing it from the form in the form of the sheet;

cutting said sheet on lines bisecting both said plated and unplated strips to form contact strip blanks comprising a plurality of side-by-side wire fingers free at one end and joined at the other end in a continuous bonded strip by said plating;

and further the steps in a desired order of

forming the free ends of said wire fingers to provide radius points of contacts thereon;

heat-treating said fingers to provide spring characteristics therefor; and

slicing said strip blank parallel to said wire fingers into individual contacts of the desired width.

2. The method defined in claim 1 including:

forming the plated portion of said individual contact to the desired shape and mounting said plated portion to a support.

3. The method defined in claim 1 in which said form is provided with slots therethrough exposing the interior surface of the coil thereat:

applying the mask to the exterior surface of the coil at the bridging portions of the form only so as to expose both sides of the coil at longitudinally extending, circumferentially spaced strips; and

plating said coil with a highly conductive metal both interiorly and exteriorly of said coil so as to provide continuous plated strips on both the inside and outsides of the coil extending longitudinally of the coil and spaced circumferentially thereof.

4. A method of forming a spring contact including the steps of:

forming a single layer coil of bare conductive wire;

plating adjacent inner and outer strips of said coil in the form of continuous longitudinally extending, circumferentially spaced plated strips of conducting metal separated by unplated longitudinally extending interior and exterior strips of said coil;

cutting said coil on lines bisecting both the plated and unplated strips thereof to form contact strip blanks comprising a plurality of side-by-side wire fingers free at one end and joined at the other end by a continuous plated strip on both sides of the wire; and

the further steps in a desired order of forming the free ends of said wire fingers to provide radius points of contact thereat, cutting said strip blanks parallel to said wire fingers into individual contacts of the desired width, and heat-treating the wire fingers to provide spring characteristics thereto.