

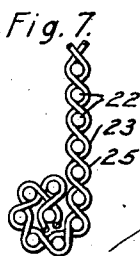
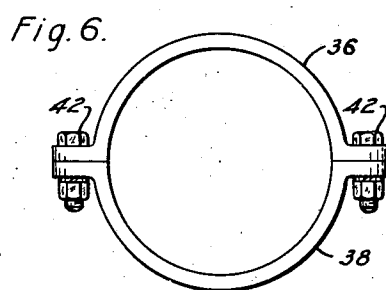
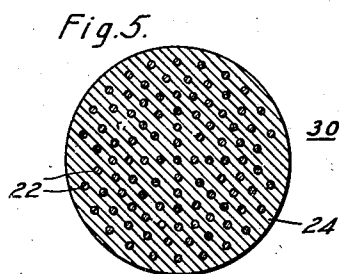
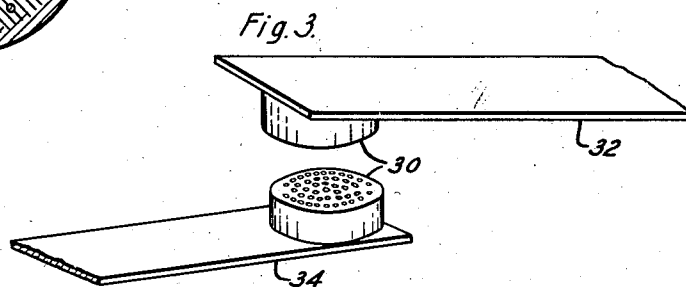
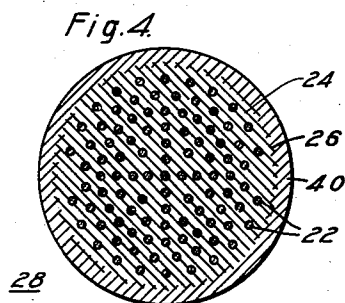
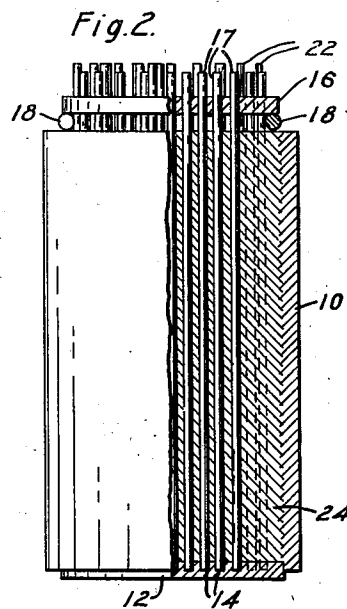
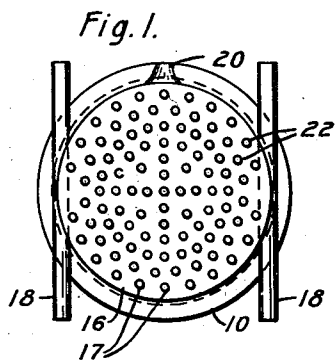
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WITNESSES:

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3 Claims. (Cl. 200—166)

This invention relates to electrical conductors, and more particularly electrical contact members and process for making the same.

Contact members for electrical circuit making and breaking devices should have low electrical resistance, low contact drop, resistance to sticking and wear resistance. Good conducting metals such, for example, as copper and silver have relatively low melting points and poor wear resistance, and are not entirely satisfactory as contact members for continuous usage. Refractory metals which have satisfactory resistance to wear and sticking are generally poor conductors having a high contact drop and high electrical resistance.

Heretofore contacts have been made by sintering a mixture of powdered refractory metal with a good conducting metal. Such sintered combinations have not resulted in the expected advantageous contact members. This is believed due to the fact that the continuity of the electrical path through the good conducting member has been broken in numerous places by the particles of poor conducting refractory metal.

The object of this invention is to provide for combining refractory metals with good conducting metals to form contact members.

Other objects of the invention will, in part be obvious, and will, in part, appear hereinafter.

The invention accordingly comprises the several steps and the relation of one or more of such steps with respect to each other and the article possessing the features, properties and the relation of elements which are exemplified in the following detailed disclosure and the scope of the application of which will be indicated in the claims.

For a fuller understanding of the nature and objects of the invention reference should be had to the following detailed description taken in connection with the accompanying drawing in which:

Figure 1 is a top plan view of a mold;

Fig. 2 is a side elevational view, partly in section, of a mold and an element formed therein, in accordance with the teachings of this invention;

Fig. 3 is a view in perspective of a pair of contact members;

Fig. 4 is a cross-sectional view of a circumferentially reinforced contact;

Fig. 5 is a cross-sectional view of a contact;

Fig. 6 is a top plan view of a split mold, and

Fig. 7 is an enlarged end view of a modified form of refractory metal spacing.

It is the purpose of the invention to embed refractory metals having good wear resistance and good resistance to sticking within a main base member of a good electrical conducting metal. It is a purpose of the invention to so locate the refractory metal within the contact member so as not to interrupt the continuity of the electrical path through the good conducting metal.

The refractory metals which have been found to provide excellent wear resistance and resistance to sticking are the metals tungsten and molybdenum, particularly in wire or rod form. The members are preferably of an elongated shape with any general cross section. A further characteristic which will be desirable in the refractory members is the property of being wetted by molten good conducting metal and with a good bond being formed on solidification. Accordingly, other refractory metals having these general properties may be employed as the equivalents of the refractory metals specifically set forth.

The main body of the contact members is composed of a good conducting metal such, for example, as copper and silver. The properties which are desirable for the main body metals are good electrical conductivity and low contact drop. Copper and silver base alloys, while they may not have as good conducting characteristics as pure silver or copper, may be suitable for application in contact members, and it is contemplated to make use of them in this invention.

The copper and silver will not form a good alloy with tungsten and molybdenum since these metals do not form solid solutions. Thus, it is not possible to alloy the good conducting metal with a refractory metal to secure a combination of their desirable properties. It is accordingly necessary to mechanically intermingle selected shapes of each of these groups of metals and by proper casting or other uniting treatment, form a unitary contact member body.

In order to secure the combined advantages of the good conducting metals, copper or silver, and the refractory metals, tungsten or molybdenum, it is proposed to make electrical contact members embodying elements of the refractory metal in a parallel relation relative to the direction of current flow and extending substantially entirely through a cast bonding base member composed of good conducting metal. In this way the continuity of the electrical path through the good conducting metal is not interrupted by the refractory metal.

For one method of manufacturing the contact member according to the invention, reference is made to Figs. 1 and 2 of the drawing. In Fig. 2 a circular shell 10 constituting a mold in which to cast the good conducting metal is closed at its bottom by a circular blank cap 12 fitting tightly therein. The blank cap 12 has arranged therein a series of indentations 14 for properly spacing the refractory metal wires or rods 22.

In order to use the blank cap 12 more than once, it may be advisable to coat it with a thin layer of graphite, aluminum oxide, or other refractory mineral which will prevent adherence thereto of the cast metal. The shell 10 may likewise be treated with a graphite or aluminum oxide to permit of easy withdrawal of the cast contact body.

At the top of the mold 10 is placed a second cap 16, preferably of a size smaller than the mold 10, having a series of perforations 17 corresponding to the indentations 14 in the lower cap 12. Preferably the upper cap 16 is elevated somewhat above the shell 10 by means of rods or spacing members 18. The gap effected by the use of members 18 provides for escape of gases and for casting of the copper.

In Fig. 1 a casting lip or trough 20 in the shell 10 is shown. However other means may be provided for introducing the molten metal into mold 10.

It may be desirable to assemble the refractory rods and the caps 12 and 16 together before introduction into the mold shell 10. In such a case the two caps 12 and 16 may be superimposed with the perforations 17 and indentations 14 matching. The refractory metal wires or rods 22 may be inserted through the perforations into the indentations 14. If the upper cap 16 is of a size slightly smaller than the internal diameter of the shell 10, the assembly may be introduced from the bottom of shell 10 and the upper cap 16 may be lifted up by some suitable means such as a small wire (not shown) attached thereto to a position where rods 18 may be introduced to prevent its falling down. The cap 12 may be then forced tightly into the bottom portion of shell 10 to provide a leak-tight joint.

In some instances it may be advisable to preheat the assembly 10, 12, 22 and 16 in order to effect the best casting of the good conducting metal therein. Since the member 10 may be several feet in length, preheating the mold will aid in forming a uniform casting.

Preheating to a temperature somewhat below the melting temperature of the copper or silver will be sufficient to ensure a uniform and homogeneous casting about the refractory rods 22.

A ladle of molten copper or silver or their good conducting alloys may be conveyed to the mold 10 and the molten metal poured by lip means 20 into the preheated assembly. The molten metal 24 will flow to the bottom of the mold above blank cap 12 and the level of the molten metal will rise until the top of shell 10 has been reached. Gradual cooling, preferably from the bottom of the mold adjacent the cap 12, will ensure a sound casting in the mold 10.

After the entire casting has been solidified, the upper cap 16 may be withdrawn from the upper ends of the rods 22, the bars 18 removed and the lower cap 12 may be forced off. If the shell 10 has had its interior surface coated with some refractory mineral such as graphite or aluminum oxide, it will be relatively easy to withdraw the casting therefrom. The cast body may be cut

by means of an abrasive wheel into contact members of predetermined length. The cutting is intended to be in a direction perpendicular to the refractory members 22.

Fig. 5 is a top plan view of one of the contact members 30 after being cut off from a casting. The contact member 30 comprises a main body member 24 of a substantially unitary structure having embedded therein a plurality of refractory metal rods 22 extending substantially entirely therethrough. The face visible in Fig. 5 is the face which will be subjected to impact with another similar contact member during the making and breaking of electrical circuits.

Referring to Fig. 3, there is illustrated a pair of opposed contact members 30 similar to the Fig. 5 construction mounted by means of silver brazing or other suitable welding technique upon a pair of contact arms 32 and 34. Suitable circuit breaker mechanism may be arranged to provide for the separation and contact of the opposed contact members 30 by actuating one or the other of arms 32, 34.

In some instances it may be desirable to reinforce the contact member of Fig. 5 to restrain possible mushrooming of the contact under heavy and repeated circuit making contact. In Fig. 4 the external shell 40 of the contact member 28 is made of some metal having considerable tensile strength such, for example, as beryllium copper, with moderate conducting properties. Other metals, depending on the requirements, may be employed for this shell 40.

In producing the reinforced contact member, the shell 40 of suitable metal is used as the mold 10 in Figs. 1 and 2. In making this embodiment, the refractory mineral employed in Fig. 2 on the interior of the shell member 10 will be dispensed with in order that the cast metal may integrally bond, as shown at 26, throughout the entire length and with the inner surface of the shell 40. Thus a unitary, well-bonded contact member resistant to mushrooming will be provided.

The molten good conducting metal bonds well with the refractory metals, tungsten and molybdenum, and in the separate contact members formed from the cast body of Fig. 2 or having the reinforced structure described hereinbefore, will exhibit a solid well-bonded contact unit. Under impact it is found that with the refractory metal members disposed as described and extending through the contact member to the backing member or contact arm that the resulting stress will be well distributed in the entire contact member. It is believed that such contact members will exhibit well matched faces whereby the current will be uniformly spread over the entire face of the contact and will not be concentrated in small areas. Moreover the small current in refractory rods 22 will easily enter the good conductor main body in which they are bonded.

The shell mold of Fig. 2 may be constructed according to the arrangement of Fig. 6 for ease in separating the cast body from the mold where the contact members are to be formed without the circumferential reinforcing ring or shell. The mold illustrated in Fig. 6 comprises two identical halves 36 and 38 united by bolting means 42. The mold of Fig. 6 will be easier to manipulate than the solid cylinder 10 in Fig. 2.

In order to dispense with the necessity for manually locating refractory rods in indentations 14 of blank cap 12 and the perforations 17 of cap 16, other means for spacing the refractory rods may be employed. For example, the modi-

fication of Fig. 7 may be resorted to in some instances. In Fig. 7 the refractory members 22 are woven into a sort of fabric by means of spaced apart wool wires 23, 25. For example, the wires 23 and 25 may be spaced an inch or more from each other along the length of the refractory metal members 22. The refractory metal fabric made in this way may be rolled up on itself as shown on the lower part of Fig. 7 until a column of refractory material sufficient for use in the mold 10 of Fig. 2 has been obtained. The wires 23 and 25 will provide adequate spacing between refractory rods so that molten copper or silver may penetrate and bond the mass as a whole. Obviously the wires 23 and 25 are selected for size according to the spacing desired between the consecutive refractory wires 22. In any event the refractory members constitute a minor proportion of the whole cross section of a contact member.

Since certain changes in carrying out the above process and certain modifications in the article which embody the invention may be made without departing from its scope, it is intended that all matter contained in the above description or shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense. Therefore, I desire that my invention be interpreted as broadly as possible and that it be limited only by what is expressly set forth in the following claims.

I claim as my invention:

1. An electrical contact member having a contact surface, comprising in combination, a unitary conducting base member comprising the major cross-section of material in a plane parallel to the contact surface, the conducting base member being of a metal selected from the group of copper, silver and their alloys, heat and impact resisting refractory metal members selected from the group of tungsten and molybdenum embedded in and bonded to the conducting base member, the refractory metal members being separated

from each other and extending substantially entirely through the conducting base member in a direction perpendicular to the contact surface, and an external shell extending about and bonded to the base member substantially perpendicularly to the contact surface to restrain mushrooming of the contact.

2. An electrical contact member having a contact surface, comprising in combination, a unitary conducting base member comprising the major cross-section of material in a plane parallel to the contact surface, the conducting base member being of a metal selected from the group of copper, silver and their alloys, heat and impact resisting refractory metal wires selected from the group of tungsten and molybdenum embedded in and bonded to the conducting base member, the refractory metal wires being separated from each other and extending substantially entirely through the conducting base member in a direction perpendicular to the contact surface, and an external shell extending about and bonded to the base member substantially perpendicularly to the contact surface to restrain mushrooming of the contact.

3. An electrical contact member having a contact face, comprising, in combination, a unitary base of good conducting metal forming the major cross-section of material in a plane parallel to the contact face, and substantially parallel heat and impact resisting refractory metal members embedded in and bonded to the good conducting base metal, the parallel refractory metal members being substantially uniformly separated from one another by wool wires, the separated, parallel refractory metal members extending lengthwise entirely through the conducting base metal perpendicular to the contact surface, and an external shell extending around and bonded to the base metal to restrain mushrooming of the contact.

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