# United States Patent

[11] 3,571,546


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[21] Appl. No. **785,325**
[22] Filed **Dec. 19, 1968**
[45] Patented **Mar. 23, 1971**
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[54] **CONTACT MEMBER**
**16 Claims, 8 Drawing Figs.**


[52] **U.S. Cl.** ..... **200/166,** 29/630
[51] **Int. Cl.** ..... **H01h 1/02**
[50] **Field of Search** ..... 200/166 (C); 29/622, 630, 630 (C)



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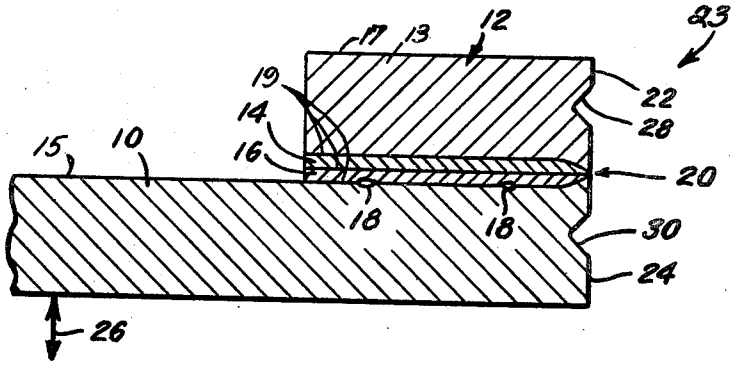
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**ABSTRACT:** An electrical contact member including an electrical contact and a contact support which are secured together by welding, soldering or the like to form an interface between the contact and support. The contact member is mechanically reinforced along the edge of this interface between the contact and support to retard separation of the contact and support at the interface edge during use of the contact member.

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SHEET 1 OF 2

PRIOR ART

Fig. 1.

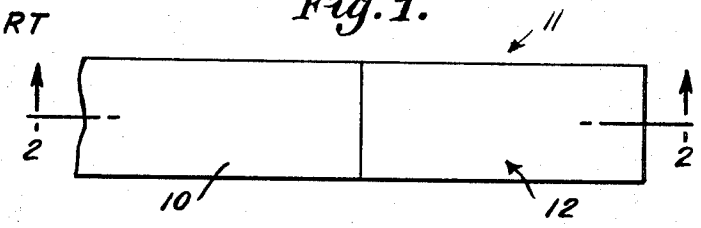



Fig. 2.

PRIOR ART

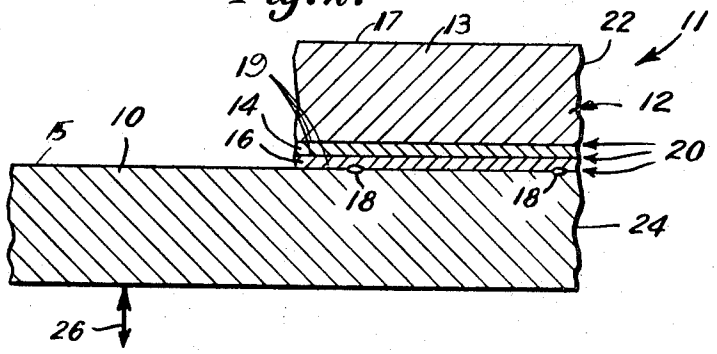



Fig. 3.

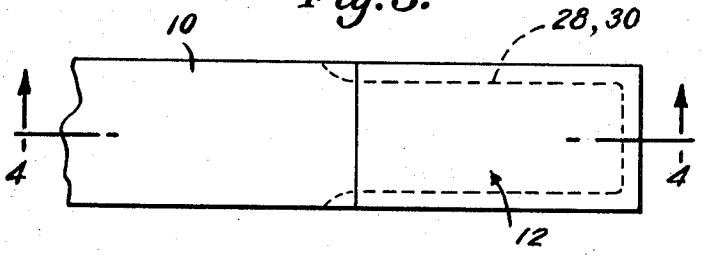
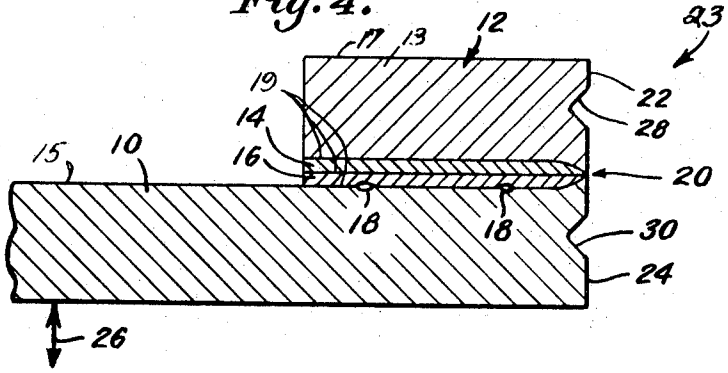



Fig. 4.




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Fig. 5.

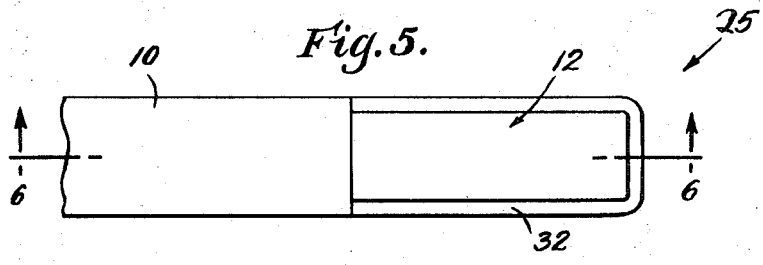



Fig. 6.

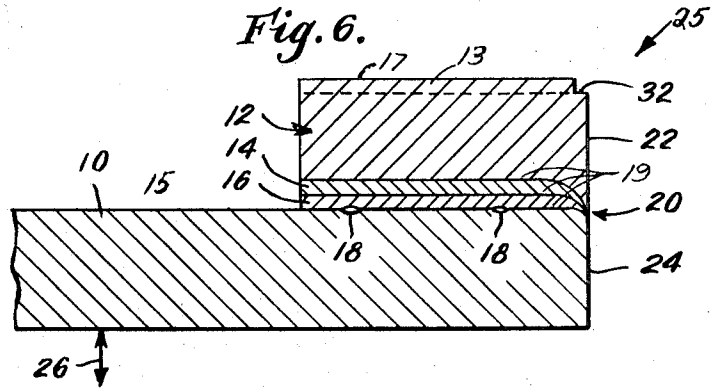



Fig. 7.

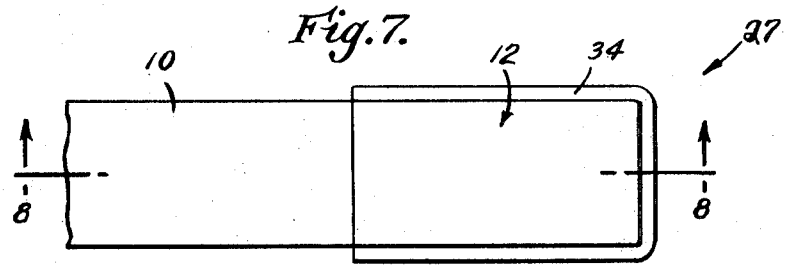
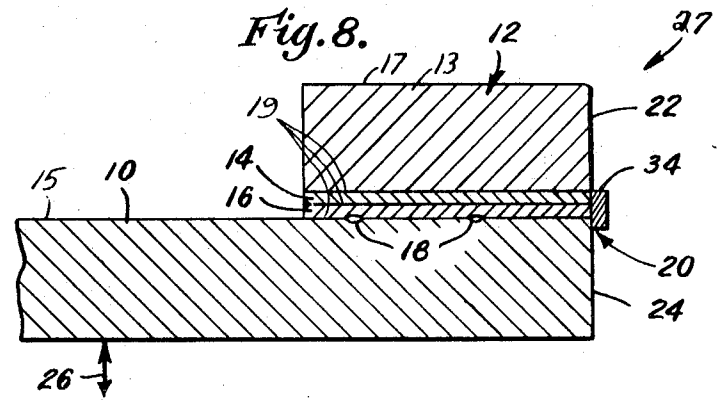



Fig. 8.




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# CONTACT MEMBER

When electrical contact members are made in conventional manner, electrical contacts are secured to support members by soldering or welding or the like so that an interface is formed between the contact and support. When these contact members are used in various electrical devices such as circuit breakers, line starters and the like, particularly where the contact members are required to carry heavy currents, there is a tendency for the member contacts to curl up or draw away from the contact supports during use. That is, the contacts tend to separate from the contact supports along the edges of the interfaces between the contacts and supports. This contact curling or separation has been the cause of early failure of the electrical devices and has substantially reduced the reliability of many such devices which have had to carry heavy currents.

It is an object of this invention to provide novel and improved contact members; to provide such contact members which are adapted to carry heavy current loads; to provide such contact members which display longer service life; and to provide such contact members which are characterized by improved reliability in use.

Briefly described, the novel and improved contact members of this invention each comprise an electrical contact of any conventional type which is secured to any conventional contact support by welding, soldering or the like, to form an interface between the contact and support. Preferably, the contact is secured to a surface of the support adjacent to and edge of the support surface so that a surface of the contact is disposed generally parallel to the support surface to be readily contacted by other contact means and so that the edge of the interface between the contact and support is disposed on a lateral portion of the contact member. The contact member is then mechanically reinforced along said lateral portion at the location of the interface edge for retarding separation of the contact and support at the interface edge during use of the contact member. In one embodiment of this invention, a metal reinforcing member is welded, soldered or otherwise secured to both the contact and the contact support along the interface edge for reinforcing the contact member at the location of the interface edge. Preferably, however, the contact, the support, or both the contact and the support are deformed adjacent to the edge of the interface between the contact and support for establishing compressive stresses in the contact and/or support material at either side of the interface edge.

Other objects, advantages and details of the novel and improved contact members of this invention appear in the following detailed description of preferred embodiments of the invention, the detailed description referring to the drawings in which:

FIG. 1 is a partial plan view of a contact member known in the prior art;

FIG. 2 is a section view along line 2–2 of FIG. 1;

FIG. 3 is a partial plan view similar to FIG. 1 illustrating a preferred embodiment of the contact member of this invention;

FIG. 4 is a section view along line 4–4 of FIG. 3;

FIG. 5 is a partial plan view similar to FIG. 1 illustrating an alternate embodiment of the contact member of this invention;

FIG. 6 is a section view along line 6–6 of FIG. 5;

FIG. 7 is a partial plan view similar to FIG. 1 illustrating another alternate embodiment of the contact member of this invention; and

FIG. 8 is a section view along line 8–8 of FIG. 7.

Referring to the drawings, 11 in FIG. 1 illustrates a typical contact member known in the prior art which is shown to include a contact arm element or support 10 formed of copper, steel, or other electrically conductive metallic material of suitable strength. The contact support may be stiff or resilient as desired. An electrical contact 12 is secured to this contact support in any conventional manner. For example, the contact 12 may be formed of a layer of silver-cadmium-oxide material 13 such as is described in U.S. Pat. application Ser. No. 607,034 filed Jan. 3, 1967 in the name of T. Santala et al.



which application is assigned to the assignee of the present invention. Preferably this layer 13 is metallurgically bonded to a layer 14 of fine silver of the like along one surface of the layer 13 to facilitate soldering of the contact. As is well known, the silver-cadmium-oxide material of the layer 13 is especially adapted to make and break low-resistance electrical contact with other, mating contact means (not shown) with minimum pitting or arc erosion of the contact layer and with minimum welding or sticking of the contact to its mating contact. The contact 12 is secured to a surface 15 of the contact support 10 adjacent to an edge of the support surface by means of a solder or braze layer 16 for disposing a surface 17 of the contact 12 generally parallel to the support surface 15 to be conveniently contacted by any suitable mating contact means and for disposing interfaces 19 between the contact layers, between the contact and solder layers, and between the solder layer and the contact support 10 so that edges 20 of these interfaces are located along one or more lateral portions of the contact member 11. Any conventional silver or copper solder or the like may be used in the solder layer 16. When a contact is secured to a contact support in this manner, there is some tendency to leave bubbles or voids 18 along one or more of the interfaces 19, which bubbles or voids reduce the effectiveness of the bonds with which the contact layer 13 is secured to the support 10. As will be understood, when a contact comprising only a single layer of silver-cadmium-oxide is secured to a contact support by welding in another typical prior art contact member construction, only a single interface 19 is formed between the contact and the contact support. As will also be understood, conventional means for cutting, punching out or forming the contact 12 and contact support 10 tends to leave lateral surfaces 22 and 24 of the contact and support in somewhat roughened condition as illustrated in FIG. 2.

When a typical contact member as described above is utilized in a circuit breaker, line starter or other electromechanical device, and particularly where the contact member is required to carry a heavy current load, there is a tendency for the contact 12 to curl up or draw away from the contact support after a limited number of make and break cycles of the electromechanical device. That is, the contact tends to separate from the support along the edges 20 of the interfaces 19, this separation being due in part to the differences in thermal expansion and contraction of the contact member materials during use, to the partial welding or sticking of the contact materials at the contact surface 17 to a mating contact means during breaking of electrical contact with such mating contact means, to occasional mechanical misalignment between the edges of the contact and contact support, and to other more subtle causes. A roughened edge of the contact or support at the lateral portion of the contact member also occasionally forms a stress concentration point resulting in cracking of the contact or support followed by partial curling up of the end of the contact member.

In a preferred embodiment of the contact member of this invention as is illustrated in FIGS. 3 and 4, the contact member 23 embodies an electrically conductive, stiff or resilient, metal contact arm element or support 10 to which an electrical contact 12 is secured by welding, soldering, brazing or the like in conventional manner. For example, where the contact 12 embodies a layer of silver-cadmium-oxide material 13 metallurgically bonded to a layer 14 of fine silver or the like, the contact is secured to the contact support by means of a layer of silver, copper or other suitable solder 16. In this arrangement, the silver-cadmium-oxide material layer 13 of the contact 12 is secured to the contact support by bonds formed at the interfaces 19. In accordance with this embodiment of this invention, the edges of 20 of the interfaces 19 are therefore disposed along lateral portions of the contact member 23 and these lateral portions of the contact member are compressively deformed or grooved as at 28 and 30 respectively after cooling of the solder layer for establishing compressive stresses in the contact and support materials at either side of the interface edges 20. Preferably as shown in FIG. 4, the deformation

of the contact and/or contact support is sufficient to reduce the thicknesses of the fine silver layer 14 and of the solder layer 16 to a minimum at the location of the interface edges. The thicknesses of the fine silver and solder layers may be substantially reduced so that edges 20 of the interfaces 19 are merged as illustrated in FIG. 4, or, more commonly, may be reduced to the point where the fine silver layer is very thin and the solder layer is substantially reduced from its original thickness at the edge 20 of the interfaces 19. It should be understood that, although the contact and support may be compressively grooved to approximately equal extents as shown in FIG. 4 so that the fine silver and solder layers are compressed together equally from each direction, either the contact along or the support alone may be compressively grooved. Alternately, the contact may be compressively grooved at 28 to a greater extent than is the contact support at 30 so that the contact material is wiped down over the edge of the contact support at the location of the edge or edges 20 of the interfaces 19. As will be understood, the contact and support may be compressively grooved or deformed as shown by pressing a groove-forming tool or roller having a complementary shape along the lateral portion of the contact member 23. Preferably, as illustrated in FIG. 4, the surfaces 22 and 24 are also compressed and smoothed by whatever means are used for forming the compressive grooves 28 and 30, thereby to remove stress concentration points in the support, and particularly in the contact. That is, smoothing of the surfaces 22 and 24 removes roughened portions of the support and contact surfaces which might form stress concentration points and might tend to cause cracking of the contact or support. Although the lateral portions of the contact member 23 may be provided with uniform compressive grooves as shown in FIG. 4, the lateral portions of the contact member may also be compressively grooved at random locations along the interface edge 20 as by knurling or the like within the scope of this invention.

In the contact member 23, as illustrated in FIGS. 3 and 4, the noted compressive stresses are established in the contact and support materials along either of the interface edge or edges 20 formed between the contact and support, thereby to retard any tendency of the contact and support to separate from each other at the location of the interface edge during use of the contact member. That is, when the contact member materials are subjected to thermal expansion and contraction during use of the contact member, these compressive stresses resist any tendency for the contact to curl up or draw away from the support at the location of the interface edges. Further, the compressive deformation of the lateral portions of the contact member tends to force any bubbles or voids 18 away from the edges of the interfaces 19, thereby further retarding any tendency of the contact support to separate at this location. The application of the described compressive deformation also tends to correct misalignment of contact and support such as would cause any tendency of the contact and support to separate. Further, by smoothing the lateral surfaces of the contact member components, risk of cracking of the contact or support is substantially eliminated. As will be understood, this mechanical reinforcing of the contact member by establishment of compressive stresses within the contact and support at the location of the interface edge or edges 20 is easily and inexpensively accomplished but provides the contact member with the ability to carry heavy currents without curling of the contact and increases the service life and reliability of the contact member in heavy current applications.

In an alternate embodiment of this invention as illustrated in FIGS. 5 and 6, the lateral portions of the contact member 25 are mechanically reinforced by coining or compressively indenting the surface 17 of the contact 12 along an edge of the contact surface 17, thereby to establish compressive stresses within the contact and support materials at the location of the edge or edges 20 of the interfaces between the contact and support materials. That is, the edge of the contact surface 17 is compressively indented as shown at 32 FIGS. 5 and 6, preferably with sufficient force to reduce the thicknesses of the fine silver layer 14 and the solder layer 16 at the interface edges 20 and to deform the contact and support for wiping some of the contact materials down to or over the edge of the support element as illustrated in FIG. 6. Preferably the surfaces 22 and 24 of the contact and support are also smooth by any conventional compressive means. For example, the contact member is easily and inexpensively provided with the compressive indentation 32 and is easily smoothed at the surfaces 22 and 24 by forcing the contact end of the member 25 into a mold or die having suitably shaped steps which cause formation of the compressive indentation 32. This embodiment of this invention achieves substantially all of the advantages previously described with reference to the contact member 23 and is very economically manufactured.

In another alternate embodiment of this invention as illustrated in FIGS. 7 and 8, the lateral portions of the contact member 27 are mechanically reinforced by the addition of a metal reinforcing member 34 which is welded, soldered or otherwise secured to both the contact and the contact support at the location of the interface edge or edges 20. For example, where the contact and support have a configuration illustrated in FIGS. 7 and 8, the metal member 34 is preferably formed of steel or copper or the like in a U-shape as shown and is welded to the contact and support along the lateral portions of the contact member to cover the interface edges 20. In the contact member 27, separation of the contact and support at the interface edges 20 is also achieved, this embodiment of the invention having substantially all of the advantages of the contact members 23 and 25 previously described.

As will be understood, this invention includes contact members in which the contact is welded directly to the contact support so that only a single interface is formed between the contact and support provided that the contact member is mechanically reinforced to retard separation of the contact and support at the location of this single interface edge during use of the contact member. The contact member of this invention also incorporates contacts formed of any suitable contact materials including solid copper contact materials and the like within the scope of this invention. It should be understood that although particular embodiments of this invention have been described by way of illustration, this invention includes all modifications and equivalents thereof which fall within the scope of the appended claims.

I claim:

1. A contact member comprising a contact support and contact means secured to said support throughout the interface between said contact means and support, at least one of said contact member components having portions adjacent an edge of said interface compressively stressed reinforcing said contact members to retard separation of said contact means from said support at said interface edge during use of said contact member.

2. A contact member comprising an electrically conductive metallic arm and an electrical contact secured in electrically conductive relation to a surface of said arm forming an interface between said contact and arm, said contact secured to said arm surface adjacent an edge of said arm surface disposing a contact surface in generally parallel relation to said arm surface and disposing an edge of said interface between said contact and arm at a lateral portion of said contact member, at least one of said contact member components being deformed at said lateral portion of said contact member establishing compressive stresses in said contact member at said edge of said interface reinforcing said contact member to retard separation of said contact from said arm at said edge of said interface during use of said contact member.

3. A contact member as set forth in claim 2 wherein a surface portion of said contact at said lateral portion of said contact member is smooth and compressively stressed adjacent said interfacial edge.

4. A contact member as set forth in claim 2 wherein said contact surface which is generally parallel to said arm surface

is compressively indented at an edge of said contact surface extending along said lateral portion of said contact member establishing compressive stresses in said contact at said edge of said interface.

5. A contact member as set forth in claim 2 wherein said contact is compressively grooved at said lateral portion of said contact member adjacent said edge of said interface establishing compressive stresses in said contact at said edge of said interface.

6. A contact member as set forth in claim 2 wherein said arm is compressively grooved at said lateral portion of said contact member adjacent said edge of said interface establishing compressive stresses in said arm at said edge of said interface.

7. A contact member as set forth in claim 2 wherein said contact and arm are compressively grooved at said lateral portion of said contact member adjacent to said edge of said interface establishing compressive stresses in said contact and arm at said edge of said interface.

8. A contact member as set forth in claim 7 wherein said lateral portion of said contact member is knurled forming a plurality of deformed and compressively stressed portions of said contact and arm at said edge of said interface.

9. A contact member comprising an electrically conductive metallic arm, an electrical contact embodying a layer of silver-cadmium-oxide material metallurgically bonded to a layer of silver, said contact soldered to a surface of said arm by means of a layer of solder adherent to said silver layer of said contact forming an interface between said contact and arm, said contact soldered to said arm surface adjacent an edge of said arm surface disposing a contact surface in generally parallel relation to said arm surface and disposing said edge of said interface between said contact and arm at a lateral portion of said contact member, at least one of said contact member components deformed at said lateral portion of said contact member establishing compressive stresses in said member at said edge of said interface reinforcing said contact member to retard separation of said contact from said arm at said edge of said interface during use of said contact member, said silver layer of said contact and said solder layer reduced in thickness by said deformation at said edge of said interface.

10. A contact member as set forth in claim 9 wherein a surface portion of said contact at said lateral portion of said contact member is smooth and compressively stressed adjacent said edge of said interface.

11. A contact member as set forth in claim 9 wherein said contact surface which is generally parallel to said arm surface is compressively indented at an edge of said contact surface extending along said lateral portion of said contact member establishing compressive stresses in said contact at said edge of said interface.

12. A contact member as set forth in claim 9 wherein said contact is compressively grooved at said lateral portion of said contact member adjacent said edge of said interface establishing compressive stresses in said contact at said edge of said interface.

13. A contact member as set forth in claim 9 wherein said arm is compressively grooved at said lateral portion of said contact member adjacent said edge of said interface establishing compressive stresses in said arm at said edge of said interface.

14. A contact member as set forth in claim 9 wherein said contact and arm are compressively grooved at said lateral portion of said contact member adjacent said edge of said interface establishing compressive stresses in said contact and arm at said edge of said interface.

15. A contact member comprising contact arm, a contact secured to a surface of said arm adjacent an edge of said arm surface disposing a surface of said contact in generally parallel relation to said arm surface and disposing an edge of an interface between said contact and arm at a lateral portion of said contact member, and a reinforcing member secured to said contact and arm along at least a portion of said edge of said interface retarding separation of said contact from said arm at said edge of said interface during use of said contact member.

16. A contact member as set forth in claim 15 wherein said contact comprises a layer of silver-cadmium-oxide material metallurgically bonded to a layer of silver, said contact secured to said arm surface by means of a layer of solder adhered to said silver layer of said contact, said reinforcing member formed of metal.