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Billmann

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[54] **PLUG CONNECTION CONTACT WITH HIGH SECURITY AGAINST BURNING OFF**

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[52] **U.S. Cl.** .....**339/111,** 339/262 R

[51] **Int. Cl.** **H01r 13/52**

[58] **Field of Search**.....339/262, 111, 258, 33, 273

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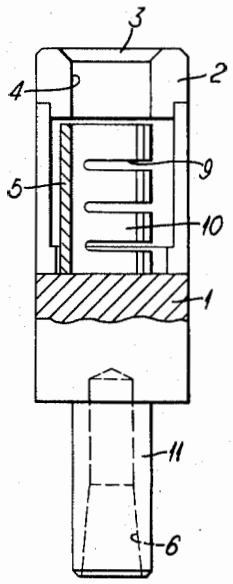
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[57] **ABSTRACT**

An electric connector for high circuit loads having an inner contact portion and an outer contact portion for the purposes of minimizing the arc encountered in switching high circuit loads. In an assembled position, a mating contact is electrically engaged by both the inner and the outer contact portions of the connector. When being removed from the connector, the mating contact disengages from the inner contact portion of the connector first, while maintaining electrical contact with the outer portion of the connector. As the mating contact element is further withdrawn, it disengages from the outer contact portion of the connector, and any arcing, occurring as a result of the discontinuity of low resistance contact, will occur between the mating contact element and the outer portion of the connector plug. The outer portion of the connector plug is composed of a material offering a high resistance to burning-off and is provided with an inwardly inclined surface at the entry portion of the connector to cause arcing to take place on such incline. The inner portion makes low resistance connection with the mating connector, and, by the action of the outer connector portion, is protected against the effects of arcing.

6 Claims, 2 Drawing Figures



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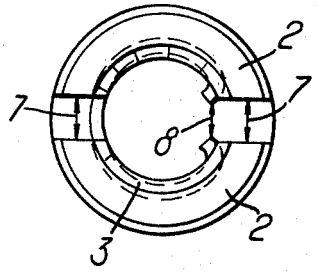


Fig. 1.

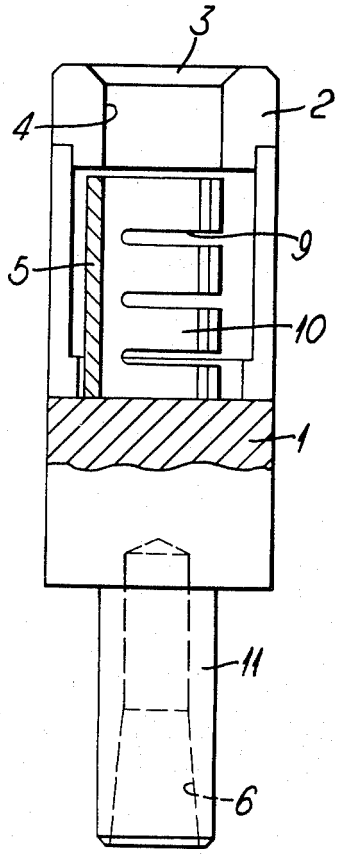


Fig. 2.

PLUG CONNECTION CONTACT WITH HIGH SECURITY AGAINST BURNING OFF

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to an electrical connection for high circuit loads. In particular, the invention relates to a new and improved electric connection which is constructed such that high current electrical arcing is prevented from destroying the electrical contact portion of the connector as a mating contact element is withdrawn breaking contact with the connector.

With plug connectors generally in use today, it has been found that separation of mating contact elements under load often cannot be carried out because the electrical arcs occurring as a result of the discontinuity of the electrical conducting path, cause a considerable wear of the material at the contact-making portion of the connectors. The burning of the contact and the damage effected thereby limit the utilization of such connectors and ultimately render such devices useless. Thus, the high transfer resistance occurring as the mating contact elements are separated bring about an undesirable electrical arc, the control of which has heretofore been either tolerated or eliminated by removing power from the equipment prior to disengagement of the electrical connectors.

2. Description of the Prior Art

Electrical connector manufacturers have made great strides in successfully improving the electrical contact between two mating contact elements to reduce the power losses normally encountered with such devices. However, it is well-known that the better electrical conductors are susceptible to what is termed "burning-off" as a result of electrical arcing to the contacts of such connectors. The "burning-off" has been described as the wearing away or damaging effect upon an electrical connector as a result of a high current carrying arc made with the connector. In order to eliminate such electrical arcing to extend the usable life of the connector, it has been necessary to either use harder electrical contact materials or to remove the electrical energy from the system while the connection is broken. Both of these solutions to the problem are highly undesirable, in that, in the first instance, contact materials of harder substances are generally the poorer electrical conductors of electricity, and in the second instance, it is often undesirable to remove power to an entire system for the mere purposes of permitting disconnection of only a portion thereof.

Accordingly, there has been a long need in the art for a connector which will provide both excellent electrical contact engagement with a mating connector element and which will reduce the effects of burning-off due to arcing.

SUMMARY OF THE INVENTION

Realizing the deficiencies of the prior art as enumerated above, the present invention provides an electrical connector which provides both excellent electrical engagement of mating contact, and additionally, provides a means by which electrical arcing is controlled to the extent that burning-off of the portion of the contact providing electrical connection is eliminated.

Accordingly, an object of the present invention is to provide an electrical contact element which, under high load, is not substantially affected by arcing occurring upon disconnection of mating contact elements.

A further object of the invention is to provide a connector of the type described above in which many circuit cycles of connecting and disconnecting can be accomplished without any substantial damage to the connector.

A further object of the invention is to provide a connector of the type described above which will withstand rough treatment over a period of long use.

Yet another and more specific object of the invention is to provide an electrical connector constructed of an inner portion and an outer portion, the inner portion providing good electrical contact with a mating contact element, and the outer portion providing a means for accepting a discharging electrical arc without substantial damage to such outer portion.

BRIEF DESCRIPTION OF THE DRAWING

Further features and advantages of the invention are apparent from the following description of an embodiment of the invention having reference to the drawing in which:

FIG. 1 is a top view of the connector in accordance with the present invention;

FIG. 2 is a side view of the connector in accordance with the invention, in which a portion has been removed to show the internal structure.

DESCRIPTION OF THE PREFERRED EMBODIMENT

With reference to FIGS. 1 and 2, the embodiment shown is in the form of a tubular plug connector in which a pin of the type known as a "taper-pin" can be inserted into the bottom receptacle 6 and a variety of known mating contact elements can be inserted into the connector from above, such known mating contacts being in the form of either a pin inserted through cylindrical passage 4 or in the form of a knife switch contact inserted into transverse slots 7.

The arrangement of outer contact segments 2 define between segments one or more transverse slots 7. The slots 7 facilitate the introduction of a mating contact element in the form of a knife contact; yield by their resilient arrangement to accept mating contact elements of varying tolerances; and provide a means for temporary construction of a test circuit utilizing a plug which can be inserted in a transverse position into one of the transverse slots 7.

In the embodiment shown, the connector is shown as a tubular contact pin 1, which carries at its upper end (as shown in FIG. 2) two outer contact segments 2 arranged coaxially to the connector. The two outer contact segments 2 are similar in shape and disposed diametrically opposite one another at the top of the connector. Although a series of such symmetrically arranged outer contact segments could be utilized, the embodiment shown and described herein will be restricted to a single pair of outer contact segments 2 to simplify the description. Obviously, however, the construction of a connector need not be limited to only one pair of outer contact segments.

The outer contact segments 2 consist of a material secure against the burning-off which occurs as a result of arcing to the material and permit, due to their resilient arrangement, good electrical connection with a mating contact element. The outer contact segments 2 are provided with a large inlet incline 3 which serves two purposes. Besides guiding the mating contact element into the cylindrical passageway 4, the inlet incline, being the closest portion of the connector to the mating contact element upon separation, provides the surface to which the electrical arc will discharge. Thus, although outer segments 2 are of such a material that burning-off has substantially little effect, the fact that the arc actually discharges to the surface of inlet incline 3 leaves cylindrical passage 4 free of any destruction, thereby providing a clean and wearproof contact course for the mating contact element.

An inner contact spring 5 is disposed directly beneath and coaxial with the outer contact segments 2 and is in electrical contact therewith. Inner contact spring 5 is in the form of a tubular contact spring having an axially widenable sleeve-slot 8. Due to the coaxial placement of spring 5 with segments 2, a centering effect provided by the contact segments 2, permits the inner contact spring 5 to be of highly resilient material and yet be protected against bending by a mating contact element wrongly inserted. Since the outer segments provide the main support for the mating contact element, particular advantage is gained by utilization of the spring 5 with high specific contact pressure and automatic wiping action for cleaning of the contact surfaces. Such characteristics are highly desirable in connector construction and are not realizable in known connectors where support of the mating contact element is provided by the electrical contact itself.

Independent of the particular construction of contact spring 5, the primary object of this invention is obtained by the dual contact arrangement as described above. The inner contact spring 5, providing the low resistance electrical connection with a mating contact element, is protected against burning-off effects since, as the mating contact element is removed from connector 1, electrical contact is broken from contact spring 5 but is maintained with outer contact segments 2. While the particular material chosen for the construction of outer segments 2 is not of optimum electrical conductivity characteristics, nevertheless, sufficient conduction through outer segments 2 maintains current flow between the connector 1 and a mating contact element until the later-mentioned contact leaves the inlet incline 3 of connector 1. Upon total separation, the electrical arc, if any, will be received by the inlet incline 3 since this incline is the closest conductive portion of the connector 1 to a mating contact element thus removed. The arc, taking the path of least resistance, will dissipate against the surface of inlet incline 3 where any damage, if any, will not impede either physical reinsertion of the mating contact element of electrical connection with inner contact spring 5.

In the embodiment of the invention shown in FIG. 2, the contact spring 5 consists of a cylindrical spring with an axially extending widenable sleeve-slot 8. The spring 5 may also have circumferential slots 9 disposed at various axial positions thereon, so that the contact spring 5 has a number of spring arms 10 whose free ends lie in contact on the mating contact element.

From FIG. 2, it is apparent that on the contact pin 11 of connector 1, there is provided a conical receptacle connection 6 for connecting the connector 1 to an electrical conductor. Although the plug connection in accordance with the invention permits the use of any desirable type of connecting means to an electrical conductor, it was found that for rough handling (for example as experienced by transporting on a railroad), a so-called taper-pin-connection is much more favorable than other forms of connection. If the need arises, however, the connection may also be made by a screw connection, crimping, soldering, or the like.

Materials which are resistant to or impervious to burning-off are available in different alloys on the market. For the purposes of the present invention, an example of the material used in producing outer contact segments 2 is a material utilizing a tungsten alloy. The invention is not to be considered as limited to only tungsten alloys, however.

Countless tests have been performed using the connector in accordance with the present invention, which show that the connector and mating contact element may be separated many times under high current loads with minimal traces of wear. For example, 20,000 circuit cycles were carried out under a load of 110 volts and 10 amps at a plug speed of 0.4 m/s. It was found that the burning-off after 20,000 interruption cycles had left only slight traces of damage on the inlet incline 3 of the plug connector 1 which did not in the least influence the function of the contact element. After completion of 20,000 cycles, contact spring 5 (consisting of four stages as shown by way of example in the preferred embodiment illustrated in the drawing) remained free from any traces of burning-off.

An electric connector has been described, the construction of which insures a good mechanical connection upon insertion of a mating contact element into the connector 1. Additionally, an effective protection against burning-off upon separation of the contact-making parts of the two connector elements has been shown, the electrical arc resulting upon separation being positioned on the inlet incline 3. As a result, a clean and long enduring contact passage 4 is maintained, even though many circuit cycles of connection and disconnection are effectuated. The construction of the present invention is simple, and the concept disclosed herein is applicable to all plug connections which are to be separated under load.

Further features and advantages of the invention are apparent by one skilled in the art in view of the description and the example of a preferred embodiment shown in the drawing. In this connection, the preferred embodiment described and shown herein is not to be construed as limiting, and the scope of the invention is defined by the following claims.

What I claim is:

1. An electrical connector for receiving a mating contact member comprising:

a first contact element;

a second contact element;

and means electrically connecting said elements together, said elements being in coaxial alignment,

said first contact element being a tubular contact spring, and said second contact element comprising a plurality of contact segments symmetrically disposed and in coaxial relationship with said contact spring,

said first contact element being disposed internally of said connector, and said second contact element being disposed on an external end of said connector,

said second contact element being formed of a material having a high resistance to burning-off, and said first contact element being formed of a material of high electrical conductivity.

2. The electrical connector as claimed in claim 1, wherein said segments are arranged to permit insertion of a mating knife contact into transverse slots located between said segments.

3. The electrical connector as claimed in claim 1, wherein said second contact element has a cylindrical contact passageway leading inwardly of said connector, and an inwardly directed inlet inclined portion positioned at the outer extremity of said connector.

4. The electrical connector as claimed in claim 1, wherein said contact spring is constructed as a cylindrical spring with an axially parallel elastically extensible sleeve slot.

5. The electrical connector as claimed in claim 1, wherein said plurality of segments are two contact segments disposed diametrically opposite one another.

6. The electrical connector as claimed in claim 1, including an electrical contact pin located on the end of said connector opposite said second contact element, said pin including a conical clamping receptacle for attachment to an electric conductor.

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