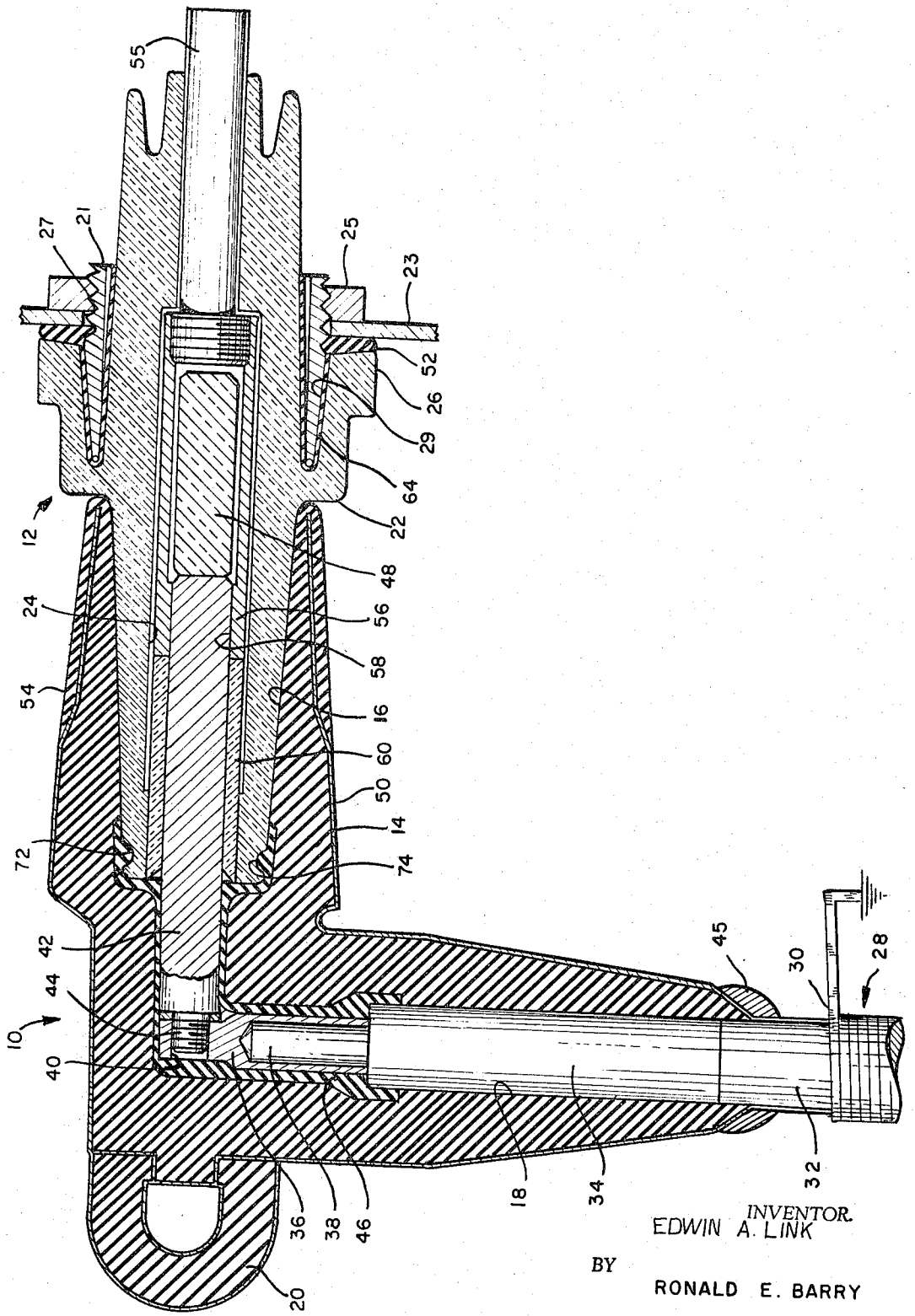
April 2, 1968

E. A. LINK

3,376,541

SAFE BREAK TERMINATOR

Filed March 11, 1966



INVENTOR.
EDWIN A. LINK

BY

RONALD E. BARRY

Attorney

United States Patent Office

3,376,541

Patented Apr. 2, 1968

3,376,541

SAFE BREAK TERMINATOR

Edwin A. Link, Waukesha, Wis., assignor to RFE Corporation, Waukesha, Wis.

Filed Mar. 11, 1966, Ser. No. 533,462
6 Claims. (Cl. 339—61)

ABSTRACT OF THE DISCLOSURE

Disclosed herein is an electrical connector including a first and second member one of which is made of an elastic material with each member having an electrically conductive part with each part adapted to be connected to the other and an electrically conductive layer on said one elastic member to shield the connection.

The present invention relates to improvements in electrical connectors for high voltage electric cables, and is more particularly applicable to load break current interrupters used in terminating such cables.

Load break current interrupters of the type contemplated herein are generally described in my co-pending application Ser. No. 343,527, filed Feb. 10, 1964. This type of current interrupter is designed specifically to eliminate the hazard of electric arc on disconnection of the high voltage cables.

However, on termination of the high voltage cable a charge will be exposed on the surface of the terminator of sufficient strength to shock the operator if he accidentally comes into contact with it due to the capacitance and conductance of the insulating material. Shielding has therefore been proposed for the terminator so as to interpose a ground or neutral potential between the operator and the high voltage present in the current carrying parts. External shields which are presently being used have created a further problem on termination. During the interrupting cycle, ionized gases are expelled and if of sufficient amount it is possible for a restrike arc to be established between a base shield and the male or female part. This would result in a short circuit between the current carrying parts and the grounded shield.

The primary object of the present invention is to provide an electrical connector for a high voltage cable which is externally shielded from the high electrical voltages normally encountered in such connection and thus be safe to handle and operate.

Another object of the present invention is to provide an improved electrical connector having an outer conductive shield which is insulated from possible restrike arcs which can occur on disconnection.

Another object of the present invention is to provide an improved electrical connector having a grounded layer between the operator and the hot conductor to protect the operator from the hot conductor.

A still further object of the present invention is to provide an improved method for fabricating an electrical connector for a high voltage cable having an electrically conductive shield.

These objects are accomplished using an electrical connector having an electrically conductive member embedded in a resilient connector housing with the conductive member projecting into a connection recess in the housing with an electrically non-conductive follower secured to the end of the conductive member. The receptacle for this connector is provided with an insulated sleeve immediately in front of an electrically conductive sleeve both of which are embedded in an electrically non-conductive housing. The connector housing and receptacle housing are both provided with an electrically conductive shield, which is either molded, painted or sprayed onto the housings or the housings are dipped into the conductive material, with the shield being connected to the grounded sheath of the cable to thereby form a continuation of the stress cone at the cable termination. This shield terminates near the open end of the housing and is insulated at the end by molding an additional layer of insulating material at the end of the housing and folding the additional material at the end of the housing over the outside surface of the shield. The end of the shield is then embedded within the connector housing material where it will not be exposed to the ionized gases created on disconnection of the cable.

Other objects and advantages will become more readily apparent from the following detailed description when read in connection with the accompanying drawing in which a cross-section view of a plug and receptacle is shown.

The electrical connector shown is particularly adapted for use with a ground level type transformer, but it should be obvious that the basic principle of the application is not so limited. The concept of this electrical connector can be used in any application where it is desirable to reduce or eliminate high electric stresses at the connection and also eliminate the hazard of establishing an uncontrolled electrical arc when breaking or disconnecting high voltage electrical cables.

Referring to the drawing, the electrical termination shown includes a plug assembly **10** and a receptacle assembly **12**. The plug assembly includes a hood **14** which is molded from a resilient insulated material such as an elastomer or rubber, and is provided with an electrical connection recess **16** and a cable termination recess **18**. These recesses are shown transverse to each other but they could be co-axially arranged if desired. A hook eye **20** may be provided on the housing to aid in disconnecting the plug from the receptacle.

Since the housing is made of resilient material, by pulling on the hook eye the housing will elongate and release from the receptacle with a snap action as more clearly defined below.

A conductive shield **50** is provided on the outer surface of the hood. This shield may be molded onto the hood or the hood can be coated with the shield by dipping, painting or spraying. The conductive material used to form the hood includes either lampblack, graphite or carbon black which is combined with a binder, a resin or an elastomer similar to or identical to the elastomer used to form the hood. The following is an example of a formula of the conductive material:

	Gms.
Nordel 1040 (binder)	100
Zinc oxide	5
Conductex S.C. (Columbia Carbon Corp.)	100
Flexon 865	20
Ethyl tellurac	1
Sulphur	1
Methyl zimate	1
Thiurian M	1
MBTS	2
Z 6040 silane	½

This mix is dissolved in a solution of xylene and ethyl hexylacetate dispersed in a mill to form a solution which is applied to the hood by dipping.

The end of the coating near the end of the hood is insulated by turning the end **54** of the housing back upon the conductive material as seen in the drawing. This is accomplished by molding the hood so that it is longer than required at the connection recess end. When the coating is applied to the hood it is terminated short of the end of the hood a distance sufficient to allow the end

to be turned back in an overlapping relation. The end of the conductive shield is thereby insulated from any possible restrike arc and provides a protection for the operator from electrical shocks.

Cable **28** is prepared for termination by stripping the electrically conductive stranding **30** back from the end **38** of the cable, and grounding it by an appropriate means as shown in the drawing. The conductive sleeve **32** is removed from the end of the cable to bare the high voltage insulation **34** which is stripped from the end **38** of the cable. An electrically conductive connector **36** is secured to the end **38** of the cable and is provided with a threaded aperture **40** for connection with an electrically conductive member **42**. When the cable is inserted into the cable termination recess, the aperture in the connector **36** will be aligned with the electrical connection recess.

The electrically conductive member **42** is inserted into the electrical connection recess until threaded end **44** is completely screwed into aperture **40**. A grease-like material **46** such as Silicone can be inserted into the recesses in the hood prior to making cable termination to eliminate any voids that may remain in the housing after termination. An electrically conductive tape **45** is wound around the end of the housing to electrically connect the conductive coating or shield to the conductive sleeve of the cable. Once this connection is made, the conductive shield will be grounded to the same ground connection as used for the conductive sleeve on the cable. The operator will thus have a ground shield between him and the cable at all times.

An arc extinguishing member **48** is secured to the end of the conductive member and forms a continuation of the conductive member. This member acts as an arc quencher as more clearly described below.

The receptacle assembly includes an insulated bushing **22** made from any of the known organic insulating materials or inorganic materials such as glue or porcelain which is provided with central recess **24** and flange **26**. A groove **29** is provided in the bushing which has a layer of conductive material **64** applied to the surface of the groove. A threaded section **21** is cemented in the groove for attaching the bushing in aperture **27** on panel or wall **23**. A nut **25** is used to hold the bushing on the wall or panel. A gasket **52** may be provided to form a seal between the flange and wall if the bushing is mounted on the wall of an oil filled type transformer. Since the conductive shield is inside of the bushing it will be insulated from restrike arcs.

Conductor **54** is coaxially mounted in the bushing and is connected to a high voltage line (not shown) on the inside of the wall. An electrically conductive sleeve **56** is secured to the end of the conductor within the bushing with end **58** of the sleeve having a reduced diameter to assure an electrical connection between the sleeve and conductive member **42**. An electrically non-conductive sleeve **60** is mounted in the bushing and forms a continuation of the sleeve **56**. The conductive shield on the bushing could also be applied to its outer surface and an insulating covering applied over the end of the shield to prevent restrike arcs.

The outer surface of the bushing is shown slightly tapered toward the end at approximately the same angle of taper as the connection recess. A snug interference fit between the plug assembly and receptacle assembly will be achieved on insertion of the bushing into the connection recess and may be moisture proofed by coating the surfaces with a grease-like material such as Silicone prior to connection. A groove **72** may also be provided on the outer surface of the end of the bushing to engage an annular rib **74** located at the inner end of the connection recess in the housing. As indicated above, when the housing is elongated for disconnection, the rib and groove arrangement and the tight fit between the parts will increase the amount of force necessary for disconnection and also the snap effect caused by the elongation of hood.

In connecting the plug assembly and receptacle assembly, insulated member **48** is inserted in sleeve **60** and the bushing aligned with the connection recess of the hood. The plug assembly is then pushed onto the receptacle until the reduced diameter section of the conductive sleeve engages conductive member **42**. The inner end of the bushing will then be seated in the connection recess of the hood with the rib seated in the groove of the bushing. The connection between the conductive members will be shielded from high electric stresses by the conductive coating on the outer surface of the housing which is connected to and grounded by the conductive sleeve of the cable. The operator will thereby be protected from the cable at all times.

When the plug asembly is withdrawn from the receptacle, a gap will occur between the electrically conductive member and the electrically conductive sleeve across which a high voltage arc is normally established. The insulated member will be drawn into the insulated sleeve lengthening the gap in the space between the insulated member and the insulated sleeve thus extinguishing the arc and interrupting current flow. Because some ionized gases are formed during the interruption a restrike arc might also occur between the stress relief coating and the female connection (**56**) but this is prevented by the overlapping of the hood over the shield to insulate the end of the conductive shield.

Although only one embodiment of the present invention has been shown and described, it should be apparent that various changes and modifications can be made herewith without departure from the scope of the appended claims.

I claim:

1. An electrical connector for high voltage cables comprising,

a first member having an electrically conductive means,

a second member adapted to be connected to said first member and having an electrically conductive part which is adapted to electrically engage said electrically conductive means when said members are connected,

one of said members being made of an elastic material,

an electrically conductive layer on the outer surface of and terminating adjacent the open end of said one member and shielding said connection, and a portion of said layer adjacent the open end of said one member being covered with an electrically non-conductive material.

2. An electrical connector for high voltage cables according to claim **1** wherein the electrically non-conductive material on the end of said one member is formed by turning the end of the said one member back on the layer of conductive material.

3. An electrical connector according to claim **1** wherein the electrically non-conductive material on the end of the layer adjacent the open end of the member is molded to the outer surface of the layer to insulate the layer from restrike arc.

4. An electrical connector for high voltage cables comprising a plug having

an electrically conductive member,

a receptacle having an electrically conductive sleeve mounted therein,

insulating means of arc extinguishing material operatively associated wtih the end of each of said conductive members,

a layer of electrically conductive shielding material supported by said plug and receptacle and surrounding said member and sleeve, said shielding material being electrically connected to ground,

insulating material covering the end of said layer adjacent the open end of the plug and receptacle,

whereby on disconnection of said plug and receptacle, the insulating members will interrupt load currents

of high voltage between said conductive members and the insulating material will prevent restrike arcs between the electrically conductive material and the electrically conductive member and sleeve.

5. An electrical connector and insulator for a high voltage cable comprising

a connector assembly including,

an elongated housing of resilient dielectric material having a passage extending through said material,

an electrically conductive member positioned in said passage,

a conductive shield covering the outer surface of said housing,

said shield terminating a predetermined distance from the end of said housing,

and a covering of resilient dielectric material covering the terminal portion of said shield.

6. A high voltage cable connector comprising,

a first housing of resilient dielectric material,

a conductive member embedded within said material and having one end exposed within a recess in said housing,

a cable conductor connected to the other end of said conductive member and having a cable shield connected to ground,

a layer of electrically conductive material covering substantially the entire outer surface of said housing and being connected to the grounded cable shield,

a covering of resilient dielectric material covering the end of said coating adjacent the exposed end of the connector,

a second housing of dielectric material having an electrically conductive member embedded therein,

a cable conductor connected to one end of the member,

and a shield of electrically conductive material embedded in said second housing adjacent the end of said conductive member.

References Cited

UNITED STATES PATENTS

1,376,844	5/1921	Weber	339—26
1,871,397	8/1932	Watts	339—60
2,254,280	9/1941	Gottheimer	339—61 XR
2,912,480	11/1959	Johnston et al.	174—73 XR
3,018,318	1/1962	Franklin	174—73
3,271,727	9/1966	Nelson	339—60
3,307,137	2/1967	Tordoff et al.	339—61

MARVIN A. CHAMPION, *Primary Examiner.*

PATRICK A. CLIFFORD, *Examiner.*