

SPECIFICATION

FIRE-RESISTANT CONNECTOR FOR CABLE

TECHNICAL FIELD

[0001] The present invention relates to a fire-resistant connector for cable and specifically relates to a fire-resistant connector for cable used in a trunk cable, branched cable, etc.

BACKGROUND ART

[0002] In general, a connector for cable has a configuration where a socket, connected to a power supply side cable, and a plug, connected to a load side cable, are fitted together to make an electrical connection.

As a conventional example of such a connector for cable, there is known a connector described in Patent Document 1. With this connector, a socket and a plug are respectively attached to respective front ends of cables, and an electrical connection is made by a pin-like electrode member being fitted into a recessed electrode member. In each of the socket and the plug, a plurality of the electrode members are sealed and fixed in a state of being electrically insulated from each other by a resin. A base end of each electrode member is connected to a lead wire. Each cable is configured by insulatingly covering a plurality of the lead wires with a resin, etc.

[0003] Patent Document 1: Japanese Published Unexamined

Utility Model Application No. H05-73880

DISCLOSURE OF THE INVENTION

PROBLEM TO BE SOLVED BY THE INVENTION

[0004] However, with such a conventional connector configuration, when the cable including the connector becomes damaged due to fire, etc., there were no means of protecting the connector.

The present inventor thus added a fire-resistant structure to a connector for cable and thereby developed a fire-resistant connector capable of supplying power from a power supply to a load for only a required time even upon receiving damage due to fire. Further, it was found that by incorporating a fuse in the connector, the load, etc., can be protected in a case where lead wires (core wires, element wires) contact each other and become short-circuited due to combustion of a covering member by fire, etc., and based on this finding, the present inventor came to complete the present invention.

[0005] An object of the present invention is to provide a fire-resistant connector for cable capable of supplying power with stability to a load even in case of fire, etc.

Another object of the present invention is to provide a fire-resistant connector for cable capable of protecting a load from a current overload due to short-circuiting in a fire,

etc.

MEANS FOR SOLVING THE PROBLEM

[0006] A first aspect of the present invention provides a fire-resistant connector for cable including: a plurality of electrode members, respectively connected to respective front ends of a plurality of core wires of a cable; and a connector body, in which connection portions of the electrode members and the core wires are sealed in resin; and where, in the connector body, a disk, made of ceramic, is sealed at a base end side of the core wires with respect to the connection portions so as to be perpendicular to an axial direction of the core wires, a plurality of penetrating holes, penetrating through in a thickness direction of the disk, are formed spaced apart along a circumferential direction of the disk, the core wires are respectively inserted through the penetrating holes, and the core wires at the connection portions are respectively covered with a tape, made of glass mica, so that outer diameters of the core wires are made larger than inner diameters of the penetrating holes.

This connector for cable is used in a cable or a cord and can be applied to both a high-voltage power distribution line and a low-voltage power distribution line.

Any load may be used. Examples of the load include an

illuminating lamp, electrical distribution equipment, etc.

There is also no restriction in the number of the electrode members (pin type electrodes or socket type electrodes) of the fire-resistant connector for cable. For example, there may be three pins compatible with a single-phase, 3-wire system, or four pins compatible with a 3-phase, 4-wire system. Each electrode member is connected to a core wire (element wire or lead wire). Each core wire is formed, for example, by bundling together a plurality of copper wires, covering the copper wires with a fire-resistant, inorganic material, and thereafter covering with a resin, etc., and the plurality of core wires are covered with a resin to form the cable. The electrode members and the core wires, both of which are conductors, are connected, for example, by crimping.

The electrode members are electrically insulated from each other by being spaced apart and embedding the electrode members in an insulating resin.

The core wires are mutually spaced apart physically by the core wires being respectively inserted through the penetrating holes bored at spaced positions of the disk spacer, which is a fire-resistant member and is made, for example, of ceramic. This prevents mutual short-circuiting among the core wires in the connector when the resin that is the outer sheath

combusts. With regard to the ceramic disk that is the fire-resistant member, that of any of various shapes may be used.

[0007] With the fire-resistant connector for cable according to the first aspect, even when the connector is exposed to high temperatures due to a fire, etc., and the connector body (made of resin) is lost by combustion and the electrode members and the core wires become exposed, the electrode members and the core wires are held in mutually spaced states by the disk (spacer). Consequently, mutual short-circuiting among the core wires is prevented and supplying of electricity to the load is secured for a predetermined time. Lighting of an emergency lamp, etc., during a fire can thus be ensured to help evacuation be performed safely, etc. As the disk, that made of high-purity alumina is favorable. This is because an insulating property of the disk can then be maintained even when heated to 500°C.

Furthermore, the core wires can be protected from high heat by the tape made of glass mica. The tape can further be covered with a tape made of silicone resin, etc. Although the silicone resin tape, etc., combusts, for example, in an atmosphere of high temperature, it eliminates the possibility of occurrence of an insulation fault upon combustion of a

covering insulator (resin, etc.). Furthermore, when the disk made of ceramic is exposed to a high-temperature state, the insulating property of the disk decreases. Thus, by winding the tape made of glass mica around the core wires, mutual short-circuiting among the core wires can be prevented. Further, by winding the tape made of glass mica around the core wires, the core wires, which have been inserted through the penetrating holes of the disk, can be prevented from falling out from the penetrating holes.

Also, because the core wires are mutually spaced apart by the disk made of ceramic, short-circuiting can be prevented and a function as a connector can be maintained during a fire. Because the core wires are also covered with the tape made of glass mica, the fire-resistance performance and heat resistance of the covering can be maintained at a higher level.

Still further, because the connection portions are larger in diameter than the penetrating holes, in a case where the connector body is formed by injection molding and a molten resin is supplied at a predetermined pressure upon setting the electrode members, the connection portions, and the disk in a mold, positioning of the disk and the connection portions during the injection molding can be secured and positional deviation thereof can be prevented.

[0008] A second aspect of the present invention provides the fire-resistant connector for cable according to the first aspect where the connector body is a plug body or a socket body.

[0009] A third aspect of the present invention provides the fire-resistant connector for cable according to the first or second aspect where, in one of the electrode members, a fuse is embedded in a front end thereof via a coil spring made of beryllium copper.

With the third aspect of the present invention, by a fuse being interposed between the socket-side electrode member and the plug-side electrode member, the load can be protected against a current overload.

The fuse incorporated in the socket or the plug may be of any type and shape.

Also, any number of fuses may be disposed in the connector. In the case of the single-phase, 3-wire system, there may be at least one fuse besides a short-circuit line.

Further, a rated cutoff current of the fuse may be of any value.

Still further, when the socket and plug are connected, the fuse is clamped by the coil spring disposed between the electrode member (socket type electrode) of the socket and the electrode member (pin type electrode) of the plug that is

disposed opposingly in correspondence to the socket electrode member. Contacting of the fuse and the electrodes is facilitated by the use of the coil spring. Further, a plurality of types of fuses that differ in length can be installed.

As the coil spring, beryllium copper or other conductor is preferably used. Melting of the coil spring itself can then be prevented even when a large amount of current is made to flow through the coil spring.

EFFECTS OF THE INVENTION

[0010] With the fire-resistant connector for cable according to the present invention, it becomes possible to prevent mutual short-circuiting of the core wires even when a fire, etc., is encountered because the core wires are held while being completely spaced apart from each other by the ceramic plate, etc., that is the fire-resistant member. In particular, the core wires, which are copper wires, etc., can be protected from high heat by covering the core wires per se by the tape made of glass mica. Because the core wires are thus protected, even when the socket body and the plug body, which are made of resin, are lost, the supply of electricity to the load can be secured after the loss for the predetermined time until the inorganic member and the fire-resistant member melt. The connector is thus suited as a cable connector for

securing power for an emergency lamp.

Also, by incorporating a fuse in the socket or the plug, the load can be protected against damage due to a current overload.

Particularly, in a case where the connector with a fuse is used in a connection from a trunk cable of a power supply to a plurality of branched cables, when an abnormality occurs at a certain load, the fuse equipped in the connector fuses and the supply of power to the load from the trunk cable is cut off. However, the cutoff of power occurs only with the particular load and stable supply of power can be continued for the other loads.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] FIG. 1 is a partially broken-away front view of a portion of a fire-resistant connector for cable according to an embodiment of the present invention.

FIG. 2 is a partially sectional front view of a socket of the fire-resistant connector for cable according to the embodiment of the present invention.

FIG. 3 is a side view of the socket of the fire-resistant connector for cable according to the embodiment of the present invention.

FIG. 4 is a partially broken-away front view of a plug

of the fire-resistant connector for cable according to the embodiment of the present invention.

FIG. 5 is a side view of the socket of the fire-resistant connector for cable according to the embodiment of the present invention.

FIG. 6 is a sectional view of a socket body of the fire-resistant connector for cable according to the embodiment of the present invention.

FIG. 7 is a sectional view of a plug body of the fire-resistant connector for cable according to the embodiment of the present invention.

FIG. 8 is a perspective view of a ceramic spacer of the fire-resistant connector for cable according to the embodiment of the present invention.

FIG. 9 is a sectional view of a fuse-incorporated state of the fire-resistant connector for cable according to the embodiment of the present invention.

DESCRIPTION OF SYMBOLS

[0012] 10: connector

11: socket

12: plug

13: power supply side cable

13A, 13B: core wire

14: load side cable
14A, 14B: core wire
19: socket body
20: plug body
23, 24, 25, 26, 27, 28: electrode member
29: recess
30: protrusion
40: coil spring
41: fuse
48: glass mica tape
60: fire-resistant member (disk)

BEST MODES FOR CARRYING OUT THE INVENTION

[0013] An embodiment of the present invention shall now be described specifically.

EMBODIMENT 1

[0014] An embodiment of the present invention shall now be described with reference to FIGS. 1 to 9.

In this embodiment, a fuse-incorporated type fire-resistant connector for cable shall be described. Obviously, the present invention can also be applied to a connector of a type that does not have a fuse.

An overall configuration of the fire-resistant connector for cable shall now be described with reference to FIG. 1. In

this figure, 10 indicates the fire-resistant connector for cable, and the fire-resistant connector 10 for cable has a power supply side socket 11 and a load side plug 12. With the socket 11 and the plug 12, both of which are made of resin and have a generally cylindrical shape, a cylindrical body structure with a larger diameter than cables 13 and 14 is formed by the socket 11 and the plug 12 being fitted together. The socket 11 is coupled to a front end of the cable 13 and is thereby connected to a power supply, and likewise, the plug 12 is affixed to a front end of the cable 14 and is thereby connected to a load (electrical lamp, etc.). 17 indicates an identification color tube that is externally fitted onto a front end coupling portion of the cable 13 at the socket 11 side and indicates that this is the socket and not the plug.

When the socket 11 is fitted into the plug 12, the fitting portions become covered by connection cups 15 and 16. The cups 15 and 16, which are made of a resin (polyethylene, etc.), are firmly fastened together by threaded structures. A resin-molded/formed body 19 of the socket 11 and a molded resin body 20 of the plug 12 have structures that fit together mutually upon being abutted. A front end protrusion of the socket body 19 is inserted in a front end recess of the plug body 20. In this state, an O-ring 21 is interposed between fitting surfaces

(contacting surfaces) of the socket body 19 and the plug body 20.

[0015] FIGS. 2 and 3 show the socket 11, and a front end 19A of the body 19, which is formed of polyethylene, etc., is formed to protrude cylindrically by only a predetermined length. In the protruding, a cylindrical front end 19A, a retainer type pin 23 and split socket type pins 25 and 27, which are three electrode members, are embedded at positions spaced apart at equal intervals of 120 degrees each along an arc and centered about an axial line of the front end 19A. 29 is a positioning mark (recess groove) formed on an outer circumferential surface of the front end 19A. A mark 31A is also formed on a flange 31 at an opposite side in a circumferential direction of the mark 29. These marks 29 and 31A are disposed at positions that are mutually separated by 180 degrees in the circumferential direction.

[0016] FIGS. 4 and 5 show the plug 12, and a recess 20A with a predetermined depth and a circular cross section is formed at a front end of the plug body 20, which is made of polyethylene or other resin. The socket body 19 and the plug body 20 are fitted together by the front end 19A of socket body 19 being inserted into the recess 20A. In the recess 20A, pin 24 and 26 and a retainer type pin 28, which are three electrode members,

are embedded at positions spaced apart at equal intervals of 120 degrees each along an arc and centered about an axial line of the recess 20A. Front ends of the pins 24, 26, and 28 protrude with predetermined thicknesses and by only predetermined lengths inside the recess 20A, and when the socket body 19 and the plug body 20 are fitted together, the pins 24 and 26 fit with the socket type pins 25 and 27, respectively, to provide electrical contact. A coil spring 40 and a fuse 41, shown in FIGS. 6 and 7, are interposed between the retainer type pins 23 and 28. The fuse 41 of a generally cylindrical shape is pressed against a receptacle-like head of the retainer type pin 28 by the coil spring 40. That is, the coil spring 40 is made of beryllium copper and, by a front end thereof being latched to a front end of the fuse 41 and a rear end thereof being latched to a flange at a front end of the retainer type pin 23, urges the fuse 41 toward the retainer type pin 28 with a predetermined spring force. 30 is a positioning mark (protruding collar) formed on an inner circumferential surface of the recess 20A of the plug body 20. A recessed shape mark 32 is also formed in a flange 20B at the side opposite to the mark 30 in the circumferential direction. These marks 30 and 32 are disposed at positions spaced apart by 180 degrees.

[0017] FIG. 6 shows detailed connection structures of the

socket type pin (electrode member) 25 and the retainer type pin 23 that are embedded across the predetermined intervals from each other in the socket body 19 made of resin. As shown in this figure, the respective front ends of the pins 23, 25, and 27 oppose and face the pins 24, 26, and 28 of the plug 12 through holes 44, 44, and 46, embedded inside the front end 19A of the socket body 19, extending in the axial direction, and opening to a fitting surface. Base ends of the respective pins 23, 25, and 27 are respectively connected, for example, by crimping to three core wires (stranded copper wires) 13A, 13A, and 13B of the cable 13.

A glass mica tape 48 at an inner side and a silicone resin tape 50 at an outer side of the glass mica tape 48 are wound around and thereby doubly cover respective outer circumferential surfaces of connection portions of the core wires 13A, 13A, and 13B with the pins 23, 25, and 27 across a predetermined length. A fire-resistant structure is formed by the glass mica tape 48 covering the front ends of the core wires and large portions of the electrode pins.

Further, the cable 13 sides of the core wires 13A, 13A, and 13B inside the socket body 19 are mutually spaced apart by being respectively inserted into penetrating holes 61, 62, and 63 of a disk-like chip 60, shown in FIG. 8 and made of ceramic

(for example, an alumina-based ceramic). The penetrating holes are mutually disposed at 120 degree intervals along an arc. The core wires 13A, 13A, and 13B, the chip 60, and the pins 23, 25, and 27 are sealed in the resin of the socket body 19. With each of the three core wires 13A, 13A, and 13B, the copper wires that are conductors are covered with the glass mica tape 48 and further covered externally by an insulator. Further, the core wires 13A, 13A, and 13B are stranded together and covered with a resin that is an insulator to make up the cable 13. The three core wires 13A, 13A, and 13B are thus held while being mutually spaced apart by the fire-resistant member 60.

Still further, the connection portions are made larger in diameter than the penetrating holes. Thus, in a case where the connector body is formed by injection molding and a molten resin is supplied at a predetermined pressure upon setting the electrode members, the connection portions, and the disk in a mold, positioning of the disk and the connection portions during the injection molding can be secured and positional deviation thereof can be prevented.

[0018] FIG. 7 shows detailed connection structures of the pins (electrode member) 24 and 26 and the retainer type pin 28 that are embedded across the predetermined intervals from each other in the plug body 20 made of resin. Respective base

ends of the pins 24, 26, and 28 are embedded in resin in the front end of the body 20 and respective front ends of the pins 24, 26, and 28 protrude into the recess 20A. Mutual electrical connection of the cables 13 and 14 is made by the protruding front ends of the pins 24 and 26 fitting into the socket type pins 25 and 27 of the socket body 19, respectively. As mentioned above, the coil spring 40 and the fuse 41 are interposed in series between the pins 23 and 28. The respective base ends of the pins 24, 26, and 28 are respectively connected, for example, by crimping to three core wires (with each of which, copper wires that are stranded together are covered with a glass mica tape and an insulator) 14A, 14A and 14B of the cable 14.

A glass mica tape 48 at an inner side and a silicone resin tape 50 at an outer side of the glass mica tape 48 are wound around and thereby doubly cover respective outer circumferential surfaces of connection portions of the core wires 14A, 14A, and 14B with the pins 24, 26, and 28 across a predetermined length. A fire-resistant structure is formed by the glass mica tape 48 covering the front ends of the core wires and large portions of the electrode pins. In this case, although the silicone resin tape 50 combusts, for example, in a high-temperature atmosphere, it prevents carbon, generated when the polyethylene or other resin is combusted, from

penetrating into the glass mica tape 48 and thereby prevents an insulation fault of the tape 48.

Further, the cable 14 sides of the core wires 14A, 14A, and 14B inside the plug body 20 are mutually spaced apart by only predetermined distances by being respectively inserted into penetrating holes 61, 62, and 63 of a fire-resistant member 60, shown in FIG. 8 and made of ceramic (for example, an alumina-based ceramic). The penetrating holes are mutually disposed at 120 degree intervals along an arc. The core wires 14A, 14A, and 14B, the chip 60, and the pins 24, 26, and 28 are sealed in the resin (polyethylene, etc.) of the plug body 20. With each of the three core wires 14A, 14A, and 14B, the copper wires that are conductors are covered with the glass mica tape 48 that is an insulator and further covered externally by an insulator resin. Further, the core wires 14A, 14A, and 14B are stranded together and covered with a resin that is an insulator to make up the cable 14.

The core wires 14A, 14A, and 14B are thus held while being mutually spaced apart by the fire-resistant member 60. A high-purity alumina-based ceramic is favorable as a material of the fire-resistant member 60. This is because, as shown in Table 1, an insulation resistance is maintained even when the fire-resistant member is at a temperature of 500°C. In Table

1, Sample A is a fire-resistant member 60 using a low-purity alumina-based ceramic, and Sample B is a fire-resistant member 60 using a high-purity alumina based ceramic.

When the fire-resistant member 60 is exposed to a high temperature, the fire-resistant member 60 decreases in electrical resistance. However, because the core wires are covered with the glass mica tape 48, mutual short-circuiting among the core wires can be prevented.

Entire surfaces of the respective electrode members are plated with nickel, etc.

[0019] [Table 1]

		Sample A	Sample B
Alumina	Content (%)	17.0	99.9
Insulation resistance (MΩ)	Room temperature	2000<	2000<
	500°C	10	2000<

[0020] Actions of the fire-resistant connector for cable according to the present invention shall now be described. First, referring to FIGS. 1 and 9, the structure, in which the tubular fuse 41 is urged between the socket 11 and the plug 12 by the beryllium copper coil spring (spring) 40 that is high in electrical conductivity and excellent in spring elasticity,

shall be described. The tape-covered structure is omitted from illustration in this figure. That is, an exposed front end (copper wires) of a core wire 13A is joined to a base end of the pin 23 (by inserting through a hole and crimping) and the spring 40 is fitted on. Meanwhile, the tubular fuse 41 is made to be held in series on the receptacle-like front end of the pin 28 that is likewise joined to the core wire 14A by crimping, and by fitting the socket 11 and the plug 12 together, the fuse 41 and the spring 40 are abutted against each other. The connector incorporating the fuse is thus attached.

In this process, the socket 11 and the plug 12 are fitted together while matching the positions of the recess 29 and the protrusion 30.

The core wires of the cables 13 and 14 are thus connected electrically to each other via the pins and the power from the power supply is supplied to the load.

When a current of no less than a predetermined current value flows to the load, the fuse element inside the fuse 41 becomes fused. Supply of power from the cable 13 to the cable 14 is thereby cut off.

Or, for example, even when the connector 10 is exposed to a high temperature due to a fire, etc., and the connection cups 15 and 16, the socket body 19, and the plug body 20 are

lost, because the core wires 13A, 13A, and 13B and the pins 23, 25, and 27 at the socket side and the core wires 14A, 14A, and 14B and the pins 24, 26, and 28 at the plug side are covered by the fire-resistant structure, that is, by the glass mica tape 48 (inorganic member) and the core wires are held so as to be spaced apart from each other by the fire-resistant member 60, made of ceramic, short-circuiting of these members by contact can be prevented. Sufficient protection against high temperatures is thus provided by the double fire-resistant structure of the fire-resistant member 60 and the glass mica tape 48.

The fire-resistant structure of the above-described embodiment has a fire-resistance performance of BS6387 Cat C, Cat W, and Cat Z. The structure also has a waterproof, dustproof performance of IEC 60529 protection grade IP 68. In this case, a non-halogen, low smoke emission performance material (for example, polyethylene) is used as the material for the socket body 19 and the plug body 20. The connector is made high in quality and high in reliability by factory processing.

INDUSTRIAL APPLICABILITY

[0021] With the present invention, by addition of a fire-resistant structure to a connector for cable, power from a power supply can be supplied to a load for only a required

time even upon receiving damage due to fire. Further, by incorporating a fuse in the connector, the load, etc., can be protected in a case where lead wires (core wires, element wires) contact each other and become short-circuited due to combustion of a covering member by fire, etc.

WHAT IS CLAIMED IS:

1. A fire-resistant connector for cable comprising:
a plurality of electrode members, respectively connected to respective front ends of a plurality of core wires of a cable;
and
a connector body, in which connection portions of the electrode members and the core wires are sealed in resin; and
wherein, in the connector body, a disk, made of ceramic, is sealed at a base end side of the core wires with respect to the connection portions so as to be perpendicular to an axial direction of the core wires,
a plurality of penetrating holes, penetrating through in a thickness direction of the disk, are formed spaced apart along a circumferential direction of the disk,
the core wires are respectively inserted through the penetrating holes, and
the core wires at the connection portions are respectively covered with a tape, made of glass mica, so that outer diameters of the core wires are made larger than inner diameters of the penetrating holes.
2. The fire-resistant connector for cable according to Claim 1, wherein the connector body is a plug body or a socket body.
3. The fire-resistant connector for cable according to Claim

1 or 2, wherein in one of the electrode members, a fuse is embedded in a front end thereof via a coil spring made of beryllium copper.