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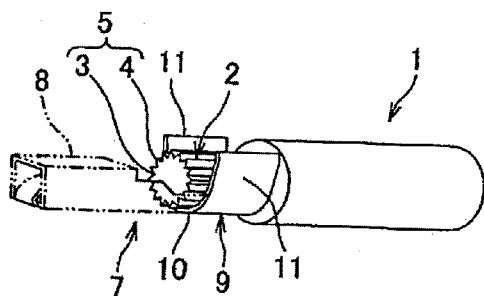
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(54) Title: TERMINAL CRIMPING STRUCTURE FOR SINGLE CORE ELECTRIC WIRE

FIG. 2A



(57) Abstract: The invention makes it difficult to cause, when a terminal is crimp-connected to an electrically conductive metal single core wire, local reduction of a contact pressure between a single core wire and a terminal due to creep or the like to thereby prevent increase of electric contact resistance. Plural concave portions 3 and 14 and plural convex portions 4, and 15 are provided on an outer periphery of an electrically conductive metal single core wire 2, 13, or 22'. A core wire crimping portion 9 of a terminal 7 or 7' is crimp-connected to a single core wire having plural concave portions and plural convex portions. The plural concave portions and plural convex portions are concave grooves and convex ridges, which extend in a longitudinal direction of a single core wire. Alternatively, the plural concave portions and plural convex portions are concave grooves and convex ridges, which extend in a circumferential direction of a single core wire. The single core wire 22 is provided with a slit 23 extending in a longitudinal direction. Folded distal end portions 11b of a pair of crimping pieces 11 of a core wire crimping portion 9 goes into the slit when crimping the terminal to the single core wire.

DESCRIPTION

TERMINAL CRIMPING STRUCTURE FOR SINGLE CORE ELECTRIC WIRE

5 Technical Field

The present invention relates to a terminal crimping structure for a single core electric-wire to crimp-connect a terminal to a fat single core wire formed of a single aluminum or copper wire.

10 Background Art

Hitherto, various structures have been proposed to crimp-connect an electrically conductive metal terminal to an electrically conductive metal core wire of an electric-wire.

For example, PTL 1 describes the following technique (not illustrated).

15 That is, an inclined portion is formed at a rear end of a crimper serving as an upper crimping jig to reduce a shear force applied on an electrically conductive portion of an aluminum electric-wire when a terminal is crimped thereto, that a release portion which extends obliquely upwardly is formed on a barrel (i.e., a crimping piece) of the terminal when the terminal is crimped thereto, and that
20 the shear force applied to the electrically conductive portion of the aluminum electric-wire is released along the release portion.

PTL 2 describes the following technique (not illustrated). That is, in order to stabilize the contact resistance of a crimping portion in a heat cycle or the like using a spring copper terminal, a rectangularly cross-sectionally
25 shaped spring portion is formed on each of a pair of left and right crimping

pieces of the terminal. Thus, when a conductor of an electric-wire is caused to contract, the crimping pieces are adapted to follow such contraction.

PTL 3 describes the following technique (not illustrated), though not concerning the crimping of an electric-wire and a terminal. That is, in order to
5 crimp-fix a tubular ferrule to an optical fiber core wire, a cross-sectionally hexagonally (or regular-polygonally) shaped groove is provided on upper and lower crimping jigs. In addition, a chevron bulging portion is formed at the center of each side of the groove. Valley-shaped clearance-grooves are formed on both sides of each of the bulging portions, respectively. Then, a
10 ferrule is crimped into a shape which is the same as that of the groove provided on the crimping jigs.

According to the above PTL 1 and PTL 2, the core wire of the electric-wire is a multicore wire obtained by twisting plural (or many) strands. However, a multicore wire is such that as the multicore wire increases in
15 cross-sectional area, the number of strands increases, and the manufacturing cost of the multicore becomes high. Thus, in order to reduce the manufacturing cost, an electric-wire used for a part which does not require flexibility is crimp-connected to an electrically conductive metal terminal using a single core wire formed of a single copper or aluminum wire in such an
20 electric-wire, instead of a multicore wire. An insulating coating electric-wire having a single core wire is called a single core electric-wire.

FIGS. 6A and 6B illustrate a configuration of a conventional terminal crimping structure for a single core electric-wire to crimp-connect a single core wire serving as an electrically conductive portion of a single core electric-wire
25 to a terminal.

As illustrated in FIG. 6A, a single core wire 43 is set on a substantially U-shaped crimping portion 9 of a terminal in a state in which the single core wire 43 is exposed at a substantially radial center by peeling an insulating coating 42 of a terminal portion of a single core electric-wire 41. Then, as
5 illustrated in FIG. 6B, the crimping portion 9 is crimped like a substantially laid-down B-shaped (i.e., substantially like eyeglasses) to the single core wire 43 with upper and lower crimping jigs (i.e., a crimper serving as the upper crimping jig and an anvil serving as the lower crimping jig (not shown)). The shape of the crimped portion 9 is known as a bullet shape or a Faston shape
10 ("Faston" is a registered trademark of TE Connectivity Limited).

In an initial state illustrated in FIG. 6A, the crimping portion 9 of the terminal consists of a cross-sectionally curved bottom plate portion 10, and a pair of crimping pieces 11 raised obliquely upwardly from both left and right sides of the bottom plate portion 10, respectively. When the terminal is
15 crimped to the electric-wire as illustrated in FIG. 6B, the pair of crimping pieces 11 are inwardly (or downwardly) folded to face each other, and curvedly flexed. A distal end portion 11b of each crimping piece 11 cuts into the single core wire 43. In addition, the bottom plate portion 10 and the bottom portion of each crimping piece 11 extend oblongly. Simultaneously with this, the single core
20 wire 43 is firmly pushed with the crimping portion 9 in an up-down direction so as to extend oblongly.

Citation List

Patent Literature

25 [PTL 1] Japanese Patent Publication No. JP-A-2009-87848

[PTL 2] Japanese Patent Publication No. JP-A-2009-224120

[PTL 3] Japanese Patent Publication No. JP-A-H5-288958

Summary of Invention

5 Technical Problem

The above conventional terminal crimping structure for an electric-wire, which is described in each of PTL 1 and PTL 2, corresponds to a core wire consisting of plural strands. Accordingly, there has been a fear that the above conventional terminal crimping structures are unsuitable for crimping a terminal
10 to a single core wire. The jigs having a cross-sectionally regular-polygonally shaped groove, which are described in Patent Document 3, can be applied to the tubular crimping portion of the terminal. However, there has been a fear that the jigs are unsuitable for swaging a pair of crimping pieces of a terminal.

In the above conventional terminal crimping structure for the single core
15 electric-wire 41 illustrated in FIGS. 6A and 6B, differently from the case of crimping a terminal to a multicore electric-wire, it is difficult to distribute a load at the time of crimping a terminal to the single core electric-wire 41. Thus, distal end portions 11b of the pair of folded-back crimping pieces 11 cut into the single core wire 43. Accordingly, the following phenomena easily occur.
20 That is, the contact-pressure between each crimping piece 11 and the single core wire 43 at the side of the distal end portion 11b of each crimping piece 11 (i.e., at a part A illustrated in FIG. 6B) is very high. Because the crimping pieces 11 and the single core wire 43 are compressed with the upper and lower crimping jigs, i.e., the upper and lower crimping jigs (i.e., the crimper and
25 the anvil) in an up-down direction, the contact pressure between the crimping

piece 11 and the single core wire 43 at the bottom plate portion 10 (i.e., a part B illustrated in FIGS. 6A and 6B) of the terminal is high. On the contrary, the contact pressure between each crimping piece 11 and the single core wire 43 is low at the left and right portions 11c (i.e., parts C illustrated in FIG. 6B), which respectively correspond to the pair of crimping pieces 11 and are substantially perpendicular to the bottom plate 10.

Thus, as illustrated in FIG. 7, there has been the following fear. That is, at the upper and lower portions (i.e., the upper part A and the lower part B illustrated in FIG. 7) of the crimping portion 9 of the terminal, the crimping portion 9 and the single core wire 43 may easily cause creep (i.e., a phenomenon in which the deformation of metal increases under constant load as time passes) and the like. Accordingly, the contact pressure may be lowered. In addition, electrical contact resistance may be increased.

In view of the above respects, the invention aims at providing a terminal crimping structure for a single core electric-wire, which is hard to cause, when a terminal is crimp-connected to an electrically metal single core wire, local reduction of a contact pressure between a single core wire and a terminal due to creep or the like, and which can prevent increase of the electrical contact resistance.

Solution to Problem

According to one aspect of the present invention, there is provided a terminal crimping structure for a single core electric-wire, comprising:

an electrically conductive metal single core wire having a plurality of concave portions and a plurality of convex portions provided on an outer

periphery thereof; and

a core wire crimping portion of a terminal which is crimp-connected to the single core wire having the plurality of concave portions and the plurality of convex portions.

5 With the above configuration, the single core wire of the single core electric-wire is set on the inner side of the core wire crimping portion of the terminal. The core wire crimping portion is radially pressed with a pair of crimping jigs and crimped to the single core wire to radially swage the single core wire of the single core electric-wire. At that time, if a part in which a
10 swaging force (i.e., a crimping force) is excessive is arranged in the circumferential direction of the single core wire, a concave portion of the single core wire absorbs an excessive crimping force while the core wire crimping portion convexly goes into the concave portion. The core wire crimping portion crimps the single core wire by a substantially uniform crimping force
15 over the entire circumference of the single core wire and is closely press-contacted with the single core wire by a substantially uniform contact pressure over the entire circumference of the single core wire.

 The plurality of concave portions and the plurality of convex portions may be concave grooves and convex ridges, which extend in a longitudinal
20 direction of the single core wire.

 With the above configuration, the concave grooves extending longitudinally, and the convex ridges extending longitudinally are alternately arranged in a circumferential direction of the single core wire. When the terminal is crimped to the single core wire, the concave groove absorbs an
25 excessive crimping force while the part of the core wire crimping portion of the

terminal, in which a crimping force is excessive, convexly goes into the concave groove.

The plurality of concave portions and the plurality of convex portions may be concave grooves and convex ridges, which extend in a circumferential direction of the single core wire.

With the above configuration, the concave groove extending longitudinally, and the convex ridge extending longitudinally are alternately arranged in the circumferential direction of the single core wire. When the terminal is crimped to the single core wire, the concave groove absorbs an excessive crimping force while the part of the core wire crimping portion of the terminal, in which a crimping force is excessive, convexly goes into the concave groove.

A longitudinal slit may be provided in the single core wire; and

when the terminal is crimp-connected to the single core wire, each of folded distal end portions of a pair of crimping pieces of the core wire crimping portion goes into the slit.

With the above configuration, the distal end portions of the pair of crimping pieces attempt to strongly push the single core wire in a folding direction (i.e., a radial direction). The distal end portion of each crimping piece goes into the slit, so that the excessive pressing force (crimping force) is absorbed. With the synergistic action of the distal end portions and the concave portions, the core wire crimping portion including the pair of crimping pieces is closely press-contacted with the single core wire over the entire circumference thereof by substantially uniform crimping force.

According to another aspect of the present invention, there is provided a

terminal crimping structure for a single core electric-wire, comprising:

an electrically conductive metal single core wire having a longitudinal slit provided therein; and

a core wire crimping portion including a pair of crimping pieces of a terminal which is crimped to the single core wire; wherein

a folded distal end portion of each of the pair of crimping pieces goes into the slit.

With the above configuration, the single core wire of the single core electric-wire is set in the core wire crimping portion of the terminal. The core wire crimping portion is pressed radially by a pair of crimping jigs and crimped to the single core wire of the single core electric-wire to radially swage the single core wire. At that time, the distal end portions of the pair of crimping pieces attempt to strongly push the single core wire in a folding direction (i.e., a radial direction). The distal end portion of each crimping piece goes into the slit, so that the excessive pressing force (crimping force) is absorbed. The core wire crimping portion including the pair of crimping pieces is closely press-contacted with the single core wire over the entire circumference thereof by substantially uniform crimping force.

Advantageous Effects of Invention

According to the invention as described above, when the terminal is crimp-connected to the electrically conductive metal single core wire, the excessive crimping force of a part of the terminal is absorbed by the concave portion of the single core wire. Thus, the local reduction of the contact pressure between the single core wire and the terminal due to creep or the like

is prevented. In addition, increase of the electric contact resistance is prevented. Consequently, the reliability of the electric connection between the terminal and the single core electric-wire can be enhanced.

Further, according to the invention as described above, the locally
5 excessive crimping force of a part of the terminal is absorbed by the longitudinal concave groove of the single core wire. Thus, the advantages of the invention can surely be exerted.

Further, according to the invention as described above, the locally
excessive crimping force of a part of the terminal is absorbed by the
10 circumferential concave groove of the single core wire. Thus, the advantages of the invention can surely be exerted.

Further, according to the invention as described above, the advantages
of the invention can be exerted more surely by the synergistic action of the folded distal end portions and the concave portions while the excessive
15 crimping force of each of the folded distal end portions of the pair of crimping pieces is absorbed.

Further, according to the invention as described above, when the terminal is crimp-connected to the electrically conductive metal single core wire, the locally excessive crimping force of each of the folded distal end
20 portions of the pair of crimping pieces of the terminal is absorbed by the slit formed in the single core wire. Thus, the local reduction of the contact pressure between the single core wire and the terminal due to creep or the like is prevented. In addition, increase of the electric contact resistance is prevented. Consequently, the reliability of the electric connection between
25 the terminal and the single core electric-wire can be enhanced.

Brief Description of the Drawings

FIGS. 1A and 1B illustrate a configuration of a single core electric-wire in a first embodiment of a terminal crimping structure for a single core electric-wire according to the invention. FIG. 1A is a perspective view illustrating the configuration of the single core electric-wire in the first embodiment. FIG. 1B is a front view illustrating the configuration of the single core electric-wire in the first embodiment.

FIGS. 2A and 2B illustrate a set state in which the single core electric-wire in the first embodiment is set in a terminal. FIG. 2A is a perspective view illustrating the set state. FIG. 2B is a front view illustrating the set state.

FIGS. 3A and 3B illustrate a crimped state in which the terminal is crimped to the single core electric-wire in the first embodiment. FIG. 3A is a perspective view illustrating the crimped state. FIG. 3B is a front view illustrating the crimped state.

FIG. 4 is a perspective view illustrating a configuration of a single core electric-wire in a second embodiment of the terminal crimping structure for the single core electric-wire according to the invention.

FIGS. 5A, 5B, and 5C illustrate a third embodiment of the terminal crimping structure for the single core electric-wire according to the invention in a process sequence. FIG. 5A is a perspective view illustrating a single core electric-wire. FIG. 5B is a perspective view illustrating a state in which a single core wire is formed with a slit. FIG. 5C is a front view illustrating a crimped state in which a terminal is crimped to the single core electric-wire.

FIGS. 6A and 6B illustrate a configuration of a conventional terminal crimping structure for a single core electric-wire. FIG. 6A is a front view illustrating a set state in which a single core wire is set in a terminal. FIG. 6B is a front view illustrating a crimped state in which the terminal is crimped to the single core wire.

FIG. 7 is a front view illustrating a problem of the conventional terminal crimping structure for a single core electric-wire.

Description of Embodiments

(First embodiment)

FIGS. 1A to 3B illustrate a first embodiment of a terminal crimping structure for a single core electric-wire according to the invention.

As illustrated in FIGS. 1A and 1B, an electrically conductive metal single core wire 2 of a single core electric-wire 1 includes plural concavo-convex shaped members (i.e., concavo-convex shaped portions) 5 formed on the outer periphery thereof. Each concavo-convex shaped member 5 may be formed over the entire length of the single core wire 2. Alternatively, each concavo-convex shaped member 5 may be formed on an exposed portion (designated with reference numeral 2, instead of the single core wire) of the circularly cross-sectionally shaped single core wire 2, which is exposed by peeling a synthetic resin insulating coating 6 from a terminal-portion of the single core electric-wire 1. A distal end surface of the single core wire 2 is designated with reference numeral 2a, while a cross-sectional surface exposed by peeling off the insulating coating 6 is designated with reference numeral 6a.

Each concavo-convex shaped member 5 extending over the entire length of the single core wire 2 may continuously be formed by providing a concavo-convex shaped member on the inner periphery of a die hole (not shown), e.g., when the drawing formation of the single core wire 2 is performed by passing the single core wire 2 through the die hole. The concavo-convex shaped member 5 of the exposed portion of the single core wire 2 may be formed by a pressing machine (not shown) or forming-processing such as rolling.

A machine adapted by forming the concavo-convex shaped member on the inner periphery of each of semicircular grooves of upper and lower forming molds is used as the pressing machine. Instead of the pressing machine, a pair of columnar rolling dies may be used, on the outer periphery of each of which a concavo-convex shaped member for spline or serration is formed. Forming the concavo-convex shaped member 5 on the single core wire 2 with such means is referred to as "forming-processing".

In the present embodiment, the concavo-convex shaped members 5 includes, e.g., plural inverted-V convex portions (i.e., mountain portions or convex ridges) 4, and plural V-shaped concave portions (i.e., valley portions or concave grooves) 3 provided between the convex portions 4. Each convex portion 4 has a pair of inclined surfaces 4a. A concave portion 3 is configured on the inner side of the opposite inclined surfaces 4a. The concavo-convex shaped members 5 are continuously formed over the entire circumference of the single core wire 2 at equal pitches. The single core wire 2 is formed using aluminum or copper as the material thereof. Not only the concavo-convex shaped members 5 formed on the copper single core wire 2 but those 5

formed on an aluminum single core wire 2 inferior in spreadability to copper perform the action of uniformizing the contact pressure between the single core wire and a terminal which is described below (i.e., the action of preventing local reduction of the contact pressure).

5 As illustrated in FIGS. 2A and 2B, a terminal 7 according to the present embodiment is an existing terminal that includes a female electric contact portion 8 provided at an anterior half thereof, and a core wire crimping portion 9 provided at a posterior half thereof. Instead of the female electric contact portion 8, a terminal including a male electric contact portion (not shown) may
10 be applied to the structure. The core wire crimping portion 9 is an existing portion that includes a curved bottom plate portion 10 and a pair of left and right crimping pieces 11 raised taperedly and obliquely upwardly from the bottom plate portion 10.

The single core wire 2 serving as an electrically conductive portion of
15 the single core electric-wire 1 is set on (i.e., on the inner side of) the core wire crimping portion 9 of the terminal 7. The distal ends (i.e., the tops) 11b' of the pair of crimping pieces 11 are located above the insulating coating 6 of the outer periphery of the single core electric-wire 1 to protrude therefrom. The bottom plate portion 10 of the core wire crimping portion 9 is arranged on an
20 anvil (not shown) serving as a lower crimping jig. A crimper (not shown) serving as an upper crimping jig is an existing one which is located above the pair of crimping pieces 11. The anvil is an existing one having a curved surface that receives the bottom plate portion 10. The crimper is an existing one having a substantially laid-down 3-shaped (i.e., a substantially laid-down
25 M-shaped) terminal pressing groove. The crimper descends to the anvil

integrally with a ram (not shown). The ram is moved up and down with a cylinder (not shown) or a motor (not shown).

The crimper (i.e., the upper mold) is caused to descend from a set state illustrated in FIGS. 2A and 2B. Thus, as illustrated in FIGS. 3A and 3B, the
5 core wire crimping portion 9 of the terminal 7 is crimp-connected like a substantially laid-down "B" (i.e., substantially eyeglasses) to the single core wire 2, while the concavo-convex shaped members 5 formed on the outer periphery of the single core wire 2 are misshapen.

Each of the concavo-convex shaped members 5 of the outer periphery
10 of the single core wire 2 is such that when the terminal 7 is crimped to the single core wire 2, the inner wall portion of each core wire crimping portion 9 of the terminal 7 is caused to convexly go into the concave portion (i.e., the concave groove) 3. Thus, each convex portion (i.e., the mountain portion) 4 is compressed in the direction of a radius of the electric-wire so as to be
15 misshapen, while the concave portion 3 absorbs an excessive pressing load (i.e., stress). Consequently, each convex portion 4 is closely press-contacted with the inner peripheral surface of the core wire crimping portion 9 of the terminal 7. Accordingly, the single core wire 2 is closely press-contacted with the entire surface of the inner periphery of the core wire crimping portion 9 at
20 uniform contact pressure. Thus, local reduction of the contact pressure due to the creep of the core wire crimping portion 9 and the single core wire 2 and the springback in a diameter increasing direction of the core wire crimping portion 9 is prevented.

That is, as illustrated in FIG. 3B, the distal end portions 11b of the pair of
25 left and right crimping pieces 11 of the core wire crimping portion 9 are

downwardly (or inwardly) folded back by a pressing force of a downwardly protruding portion at the center in the width direction of a crimper (not shown). Thus, the distal end portions 11b of the pair of left and right crimping pieces 11 cuts into an upper part (i.e., a part designated with reference character A) of the single core wire 2. At that time, each of the wall surfaces of the downward distal end portions 11b of a pair of crimping pieces 11 go into an associated one of the concave portions (i.e., the concave grooves) of the concavo-convex shaped members 5 at an upper side of the outer periphery of the single core wire 2 while each of the wall surfaces is convexly deformed.

Then, each of the convex portions 4 of the concavo-convex shaped members 5 at the upper side of the outer periphery of the single core wire 2 is crushed in the radial direction of the electric-wire while each concave portion 3 absorbs an excessive pressing force (i.e., a crimping force or stress) due to the downward distal end portions 11b. Thus, each of the convex portions 4 is elastically and closely press-contacted with the distal end portion 11b of each of the crimping pieces 11 and neighborhood portions thereof (i.e., a part designated with reference character A). Accordingly, the contact pressure acting between the core wire crimping portion 9 of the terminal 7 and the single core wire 2 in the part designated with reference character A is lowered, as compared with the contact pressure in a conventional case (corresponding to the part A illustrated in FIG. 6B).

The single core wire 2 is downwardly pressed by the downwardly folded-back distal end portions 11b of the pair of crimping pieces 11. Thus, the single core wire 2 is strongly contacted with the oblong large-diameter curved bottom plate portion 10 of the core wire crimping portion 9. At that

time, the inner wall portion 10a of the bottom plate portion 10 convexly goes into each of the concave portions 3 of the concavo-convex shaped members 5 at the lower side of the single core wire 2. Thus, each convex portion 4 is crushed in a radial direction of the electric-wire while the concave portions 3 absorb an excessive pressing force. Consequently, each convex portion 4 (in a part designated with reference character B) is elastically and closely press-contacted with the inner wall surface 10a of the bottom plate portion 10 of the core wire crimping portion 9. Accordingly, the contact pressure acting between the core wire crimping portion 9 of the terminal 7 and the single core wire 2 in the part designated with reference character B is lowered, as compared with the contact pressure in a conventional case (corresponding to the part B illustrated in FIG. 6B).

Thus, temporal reduction of the contact pressure in the conventional case (illustrated in FIG. 7) is prevented from occurring due to the creep or the like in the parts A and B. The core wire crimping portion 9 and the core wire portion 2 of the terminal 7 in each of the parts A and B are contacted with each other at uniform contact pressure comparable to the contact pressure therebetween in each of other parts including the part C. Accordingly, increase of the electric contact resistance between the terminal 7 and the single core wire 2 is prevented. Thus, the reliability of the electrical connection therebetween is enhanced.

The parts C are places including wall portions 11c of the pair of crimping pieces 11 substantially perpendicular to the bottom plate portion 10. The single core wire 2 compressed in an up-down direction extends to spread laterally (i.e., horizontally), and is elastically and closely press-contacted with

the inner surfaces 11a of the substantially perpendicular portions 11c of the pair of crimping pieces 11 in the parts C while each of the convex portions 4 of the concavo-convex shaped members 5 on the left and right sides of the single core wire 2 is crushed in a radial direction of the electric-wire.

5 The parts C of the conventional structure (i.e., the parts C illustrated in FIG. 6B) are such that the contact pressure is low. There is a little fear of reduction of the contact pressure due to the creep or the like. However, the contact pressure is favorably realized by elastically press-contacting each of the convex portions 4 of the concavo-convex shaped members 5 on the left
10 and right sides of the single core wire 2 with an associated one of the inner surfaces 11a of the substantially perpendicular portions 11c of the pair of crimping pieces 11, which are included in the parts C, while each convex portion 4 is crushed in a radial direction of the electric-wire. The contact pressure between the core wire crimping portion 9 and the single core wire 2 in
15 the part A, the contact pressure therebetween in the part B, and the contact pressure therebetween in the parts C are substantially uniformized (i.e., substantially equalized).

For example, the concavo-convex shaped members 5 may be eliminated only in the parts C. That is, in each of the parts C, the single core
20 wire 2 has a smoothly curved outer peripheral surface whose "height" (i.e., whose outside diameter) is equal to that of the convex portion 4 of the concavo-convex shaped member 5 in each of the upper and lower parts (i.e., the parts A and B). However, in an operation of setting the electric-wire 1 in the terminal 7, it requires great care to achieve the visual arrangement of the
25 concavo-convex shaped members 5 of the single core wire 2 in the upper and

lower parts.

As illustrated in FIG. 3A, an electric-wire crimping portion of the terminal 7 according to the present embodiment is only the core wire crimping portion 9. However, an insulating coating crimping portion having an insulating coating crimping piece (not shown) protruded to be "higher" than the core wire crimping piece 9 may be provided integrally with and in rear of the core wire crimping portion 9.

Incidentally, the concavo-convex shaped members 5 illustrated in FIG. 1 are such that the concave portions 3 and the convex portions 4 are finely and radially arranged. However, the concavo-convex shaped members 5 may be formed to be larger (or more coarse) than illustrated in FIG. 1. For example, six to ten convex portions 4 may be arranged on the circumference of the single core wire 2 at uniform pitch. In addition, the cross-sectional shape of the convex portion 4 is not limited to a substantially acute V-shape and may be a substantially cross-sectionally trapezoidal or rectangular shape whose top is flat (in this case, the cross-sectional shape of the concave portion 3 is a cross-sectionally inverted trapezoidal or rectangular shape).

(Second embodiment)

FIG. 4 illustrates a second embodiment of a terminal crimping structure for a single core electric-wire according to the invention. Each concavo-convex shaped member 16 of a single core wire 13 is shaped like a screw. Other components of the structure are similar to those illustrated in FIGS. 2A to 3B. Therefore, the detailed description of such components is omitted.

The concavo-convex shaped member 16 which is an example illustrated

in FIG. 4 is shaped like a male screw. A single core wire 13 is exposed by peeling the insulating coating 6 of a terminal end portion of the single core electric-wire 12. Then, each screw-shaped member is formed on the exposed portion of the single core wire 13 by rolling or the like. Screw-shaped members 16 may preliminarily be formed over the entire length of the single core wire 13. In addition, the single core wire 13 on which the screw-shaped members 16 are formed may be covered with the insulating coating 6. In this case, a cross-sectionally circular short straight portion (i.e., a rolling unavailable portion) 13b between each screw-shaped member 16 and the insulating coating 6 may be formed into a screw-shaped portion.

Screw-shaped or concavo-convex shaped members 16 are formed to be arranged spirally in a longitudinal direction of the single core wire 13. The concave portion 14 of each concavo-convex shaped member 16 is a mountain portion 15 or a convex ridge. A distal end surface of the single core wire 13 is designated with reference numeral 13a, while a cross-sectional surface exposed by peeling off the insulating coating 6 is designated with reference numeral 6a.

The direction of a screw of each screw-shaped member 16 may be either a right-handed one or a left-handed one. Instead of the screw-shaped members 16, plural annular convex portions (i.e., mountain portions or convex ridges (not shown) and plural concave portions (i.e., valley portions or concave grooves) may alternately be arranged in a longitudinal direction of the single core wire 13. The concavo-convex shaped members are located perpendicular to the axis center direction of the single core wire 13. In this case, plural annular concavo-convex shaped members can be formed by

press-working. Although the concave portion and the convex portion of each concavo-convex shaped member 5 are alternately arranged in the circumferential direction of the single core wire 2 in the embodiment illustrated in FIGS. 1A and 1B, the screw-shaped or concavo-convex shaped members 5 16 and the plural annular concavo-convex members 16 illustrated in FIG. 4 are alternately arranged at uniform pitch in the longitudinal direction of the single core wire 13.

Similarly to processing illustrated in FIGS. 3A and 3B, the core wire crimping portion 9 of the terminal 7 is crimp-connected to the screw-shaped or 10 concavo-convex shaped members 16 or to the plural annular concavo-convex members 16 in a state similar to the set state illustrated in FIGS. 2A and 2B, in which the screw-shaped or concavo-convex shaped members 16 or the plural annular concavo-convex members 16 are set in the terminal 7. At that time, in the parts A and B of FIG 3B, the core wire crimping portion 9 convexly goes 15 into the concave portion (i.e., the valley portion or the concave groove) 14 of the concavo-convex shaped member 16. The convex portion (i.e., the mountain portion or the convex ridge) 15 is crushed in the radial direction of the single core wire while the concave portion 14 absorbs excessive pressing forces of the crimper and the anvil. Then, the convex portion 14 is elastically 20 contacted with the folded-back distal end portions 11b of the pair of crimping pieces 11 and with the lower bottom plate portion 10 by favorable uniform contact pressure. In the part C, the convex portion 15 is crushed in the radial direction of the single core wire, and elastically contacted with the substantially perpendicular portions 11c of the pair of crimping pieces 11 by uniform 25 favorable contact pressure comparable with the contact pressure acting in

each of the parts A and B.

Consequently, temporal reduction of the contact pressure in the conventional case (illustrated in FIG. 7), i.e., increase of the electric contact resistance between the terminal and the single core wire is prevented from occurring due to the creep or the like in the parts A and B. Thus, the reliability of the electrical connection therebetween is improved.

Incidentally, the concave-convex shaped members 16 of the single core wire 13 illustrated in FIG. 4 are such that the concave portion 14 and the convex portion 15 are arranged at small pitch. However, the width in the longitudinal direction of the single core wire of the convex portion 15 can be made wider than the width of the concave portion 14 by, e.g., increasing the pitch between the convex portions 15 to be larger than the pitch illustrated in FIG. 4. In addition, the cross-sectional shape of the convex portion 15 is not limited to a substantially acute V-shape and may be a substantially cross-sectionally trapezoidal or rectangular shape whose top is flat (in this case, the cross-sectional shape of the concave portion 3 is a cross-sectionally inverted trapezoidal or rectangular shape).

(Third Embodiment)

FIGS. 5A to 5C illustrate a third embodiment of a terminal crimping structure for a single core electric-wire according to the invention.

This terminal crimping structure is featured in that a single core wire 22 is exposed by peeling the insulating coating 6 of a terminal end of an existing single core electric-wire 21 illustrated in FIG. 5A, that as viewed in FIG. 5B, a longitudinal slit 23 is notched in a central part in a radial direction of the exposed single core wire 22 to extend in the longitudinal direction of the single

core wire from a distal end surface 22a of the single core wire 22, and that a pair of left and right single-core-wire halved (or substantially semicircle) portions 22' are configured using the slit 23 as the boundary therebetween.

In FIG. 5A, a distal end surface of the single core wire 22 is designated with reference numeral 22a, and a peeling cross-section of the insulating coating 6 is designated with reference numeral 6a. The slit 23 illustrated in FIG. 5B is formed to have a length substantially comparable to a peeling length of the insulating coating 6 (i.e., the length of the exposed part of the single core wire 22). The slit 23 is cut and formed using a disc-like rotary cutter. If the slit 23 is formed with a die or the like when the single core wire 22 is formed by being passed through a die hole, in order to prevent the pair of single core wire portions 22' from being separated from each other, it is necessary to join the pair of single core wire portions 22' by filling the inside of the slit 23 with the insulating coating 6.

The spline-like concavo-convex shaped members 5 illustrated in FIGS. 1A and 1B, the screw-shaped members 16 illustrated in FIG. 4, and the plural annular concavo-convex shaped members (not shown) are formed on the outer periphery of each of the exposed single core wire portions 22'. As illustrated in FIG. 5C, the pair of single core wire portions 22' are crimp-connected to the pair of left and right crimping pieces 11 of the core wire crimping portion 9 of a terminal 7' separately (or individually).

As illustrated in FIG. 5C, the downwardly folded distal end portions 11b of the pair of crimping pieces 11 go into the slit 23 while the distal end portions 11b are opposed to an upper opening 23a of the slit 23 between the pair of single core wire portions 22'. This eliminates the interference between an

upper part of the single core wire 22 illustrated in FIG. 5A and each of the downwardly folded distal end portions 11b of the pair of crimping pieces 11 (i.e., this prevents the downwardly folded distal end portions 11b of the pair of crimping pieces 11 from cutting into the upper part of the single core wire 22).

5 That is, the slit 23 absorbs excessive pressing forces of the distal end portions 11b to thereby prevent the generation of an excessive stress load in the part A of the conventional structure illustrated in FIG. 6B. Simultaneously, the generation of an excessive stress load in the part B due to the excessive pressing force of the part A is prevented.

10 Advantages of this are achieved even if the concavo-convex shaped members are not provided on the outer periphery of the single core wire 22. However, the advantages are more enhanced by providing the concavo-convex shaped members 5 or 16 (see FIGS. 1A and 1B or FIG. 4) on the outer periphery of the single core wire 22 or each single core wire portion
15 22'.

That is, when the downwardly folded distal end portion 11b of each crimping piece 11 is strongly press-contacted with an upper part 22a' of each of the single core wire portions 22' provided on both of left and right sides of the slit 23, each folded distal end portion 11b convexly goes into the concave
20 portion 3 or 14 of the concavo-convex shaped member 5 or 16 (see FIGS. 1A and 1B, or FIG. 4) formed on the upper part of each single core wire portion 22'. Then, the convex portion 4 or 15 is crushed in the radial direction of the single core wire while the concave portion 3 or 14 absorbs an excessive pressing force of the folded distal end portion 11b. Thus, the convex portion 4 or 15 is
25 elastically and closely press-contacted with the inner surface of each crimping

piece 11 by favorable contact pressure.

In addition, each single core wire portion 22' is strongly and downwardly pressed by the folded distal end portion 11b of each crimping piece 11. Thus, a lower portion 22b' of the single core wire portion 22' is strongly
5 press-contacted with the oblong bottom plate portion 10 of the core wire crimping portion 9 of the terminal 7'. At that time, the bottom plate portion 10 convexly goes into the concave portion 3 or 14 of the concavo-convex shaped member 5 or 16 of a lower part 22b' of each single core wire portion 22'.
Thus, the convex portion 4 or 15 is crushed in the radial direction of the single
10 core wire while the concave portion 3 or 14 absorbs an excessive pressing force of the bottom plate portion 10. Consequently, the convex portion 4 or 15 is elastically and closely contacted with the inner surface of the bottom plate portion 10 by favorable contact pressure.

Incidentally, each concavo-convex shaped member 5 or 16 may be
15 formed on the single core wire 22 in a state in which the single core wire 22 illustrated in FIG. 5A is exposed. In this case, the slit 23 illustrated in FIG. 5B is formed after each concavo-convex shaped member 5 or 16 is formed. If the concavo-convex shaped members 5 or 16 are formed on the left and right single core wire portions 22' after the slit 23 illustrated in FIG. 5B is formed, the
20 concavo-convex shaped members 5 or 16 can be formed on the inner surface of the slit 23 by pressing or the like. Incidentally, the slit 23 is not limited to a longitudinal one. For example, two slits which cross each other at right angles may be formed. In this case, preferably, the concavo-convex shaped members 5 or 16 illustrated in FIG. 5A are provided.

25 The slit 23 is not necessarily passed through the wire in a radial

direction thereof. For example, a longitudinal slit 23 may be provided only in an upper half portion of the single core wire 22 illustrated in FIG. 5A. Even in this case, each of the distal end portions 11b of the pair of crimping pieces 11 folded at the crimping thereof goes into the upper opening 23a of the slit 23 while each of the distal end portions faces the upper opening 23a.

As illustrated in FIG. 5C, a terminal 7' includes a core wire crimping portion 9 and an insulating coating crimping portion 17 provided in rear of the core wire crimping portion 9. The core wire crimping portion 9 and the insulating coating crimping portion 17 are simultaneously crimped to the electric-wire between the crimper (not shown) serving as upper separate anteroposterior jigs and the anvil (not shown) serving lower jigs formed integrally with or separated from each other. The insulating coating crimping portion 17 is crimp-fixed to the insulating coating 6 of the electric-wire 21.

Incidentally, in the third embodiment illustrated in FIGS. 5A to 5C, both of the slit 23 and each concavo-convex shaped member 5 or 16 are formed on the single core wire 22. However, e.g., as a fourth embodiment, it is effective to provide only the slit 23 in the single core wire 22 and to omit the concavo-convex members.

Even in this case, the slit 23 is formed by being notched to pass through the radial center of the single core wire 22 in the longitudinal direction thereof. The slit 23 includes an opening 23a extending in an up-down direction, and a front opening. When the terminal is crimped to the electric-wire, the downwardly folded distal end portions 11b of the pair of crimping pieces 11 is opposed to the upper opening 23a of the slit 23. The distal end portion 11b of each crimping piece 11 goes into the slit 23 from the upper opening 23a. The

excessive pressing force of the distal end portion 11b of each crimping piece 11 is released (or absorbed) by the slit 23. Thus, an excessive stress load is prevented from being applied to the single core wire 22. The slit 23 may be formed only on an upper half portion of the single core wire 22.

5 In each of the above embodiments, the concavo-convex shaped members such as serration-shaped members 5, screw-shaped members 16, and plural annular ridges are formed by forming-processing. For example, each concave portion can be formed by providing, on the outer peripheral surface of the single core wire 22, plural bottomed hole portions such as
10 circularly cross-sectionally shaped or rectangularly cross-sectionally shaped hole portions. In addition, the outer peripheral surface among the hole portions (i.e., the concave portions) can be used as plural convex portions. The forming of the concave portions is performed by press-working or rolling.

In each of the above embodiments, the insulating coating 6 for the
15 single core electric-wires 1, 12, and 21 is formed on the outer side of each of the single core wires 2, 13, and 22 by resin-molding. However, a single core electric-wire can be configured by, e.g., crimping the terminal 7 or 7' to the single core wire 2, 13, or 22 provided with no insulating coating, and next forming, after the crimping of the terminal, the insulating coating 6 by
20 resin-forming or through insulating tape winding, insulating tube threading, or the like.

In each of the above embodiments, the terminal 7 or 7' having the core wire crimping portion 9 that includes a pair of crimping pieces 11 has been used. However, a terminal having, e.g., a tubular core wire crimping portion,
25 instead of the pair of crimping pieces 11, may be used. A single core

electric-wire 1, 12, or 21, in which various concavo-convex shaped members 5 or 16 and the slit 23 are provided on the single core wire 2, 13, or 22', is applied to the structure using a terminal adapted to crimp the tubular core wire crimping portion to a single core wire in a state in which a single core wire is inserted into the tubular core wire crimping portion. Thus, the concavo-convex shaped members 5 or 16 and the slit 23 are caused to absorb variation (i.e., an excessive pressing force) of the pressing force in the circumferential direction of the single core wire, which is generated when the tubular core wire crimping portion is pressed in a diameter reducing direction by circularly or hexagonally cross-sectionally shaped pressing grooves serving as the upper and lower crimping jigs. Consequently, increase in electric contact resistance can be prevented by uniformizing contact pressure.

The configuration described in each of the above embodiments is effective as a terminal processing structure for a single core electric-wire, a terminal processing method for a single core electric-wire, a terminal crimping method for a single core electric-wire, and the like, in addition to a terminal crimping structure for a single core electric-wire.

The present application is based on Japanese patent application No. 2011-169241 filed on August 2, 2011, and the contents of the patent application are incorporated herein by reference.

Industrial Applicability

A terminal crimping structure for a single core electric-wire according to the invention can be utilized to make, when a terminal is crimp-connected to a single core wire such as a fat aluminum wire for a vehicle including an electric

car, it difficult to cause local reduction of a contact pressure between the single core wire and the terminal due to creep or the like, to thereby prevent increase of electric contact resistance.

5 Reference Signs List

- 1, 12, 21 single core electric-wires
- 2, 13, 22 single core wires
- 3, 14 concave portions (concave grooves)
- 4, 15 convex portions (convex ridges)
- 10 7, 7' terminals
- 9 core wire crimping portion
- 11 crimping piece
- 11b distal end portion
- 22' single core wire portion (single core wire)
- 15 23 slit

CLAIMS

1. A terminal crimping structure for a single core electric-wire, comprising:
an electrically conductive metal single core wire having a plurality of
5 concave portions and a plurality of convex portions provided on an outer
periphery thereof; and
a core wire crimping portion of a terminal which is crimp-connected to
the single core wire having the plurality of concave portions and the plurality of
convex portions.

10

2. A terminal crimping structure for a single core electric-wire according to
claim 1, wherein:

the plurality of concave portions and the plurality of convex portions are
concave grooves and convex ridges, which extend in a longitudinal direction of
15 the single core wire.

3. A terminal crimping structure for a single core electric-wire according to
claim 1, wherein:

the plurality of concave portions and the plurality of convex portions are
20 concave grooves and convex ridges, which extend in a circumferential
direction of the single core wire.

4. A terminal crimping structure for a single core electric-wire according to
one of claims 1 to 3, wherein:

25 a longitudinal slit is provided in the single core wire; and

when the terminal is crimp-connected to the single core wire, each of folded distal end portions of a pair of crimping pieces of the core wire crimping portion goes into the slit.

- 5 5. A terminal crimping structure for a single core electric-wire, comprising:
an electrically conductive metal single core wire having a longitudinal slit
provided therein; and
a core wire crimping portion including a pair of crimping pieces of a
terminal which is crimped to the single core wire; wherein
10 a folded distal end portion of each of the pair of crimping pieces goes
into the slit.

FIG. 1A

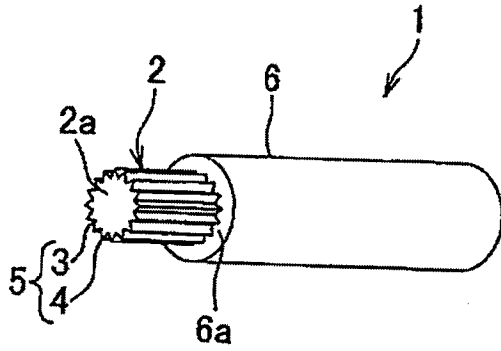


FIG. 1B

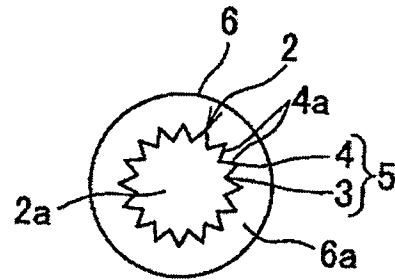


FIG. 2A

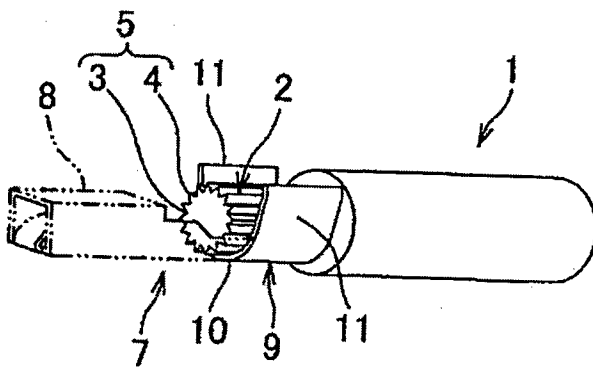


FIG. 2B

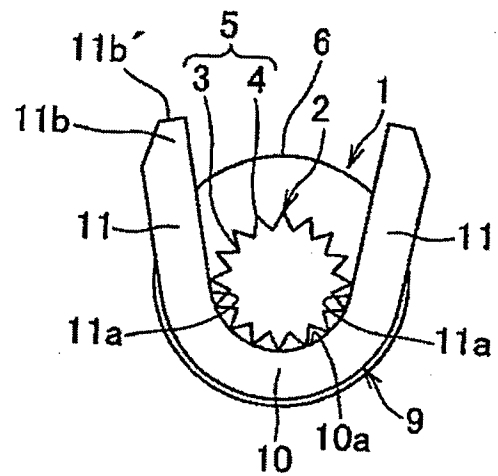


FIG. 3A

FIG. 3B

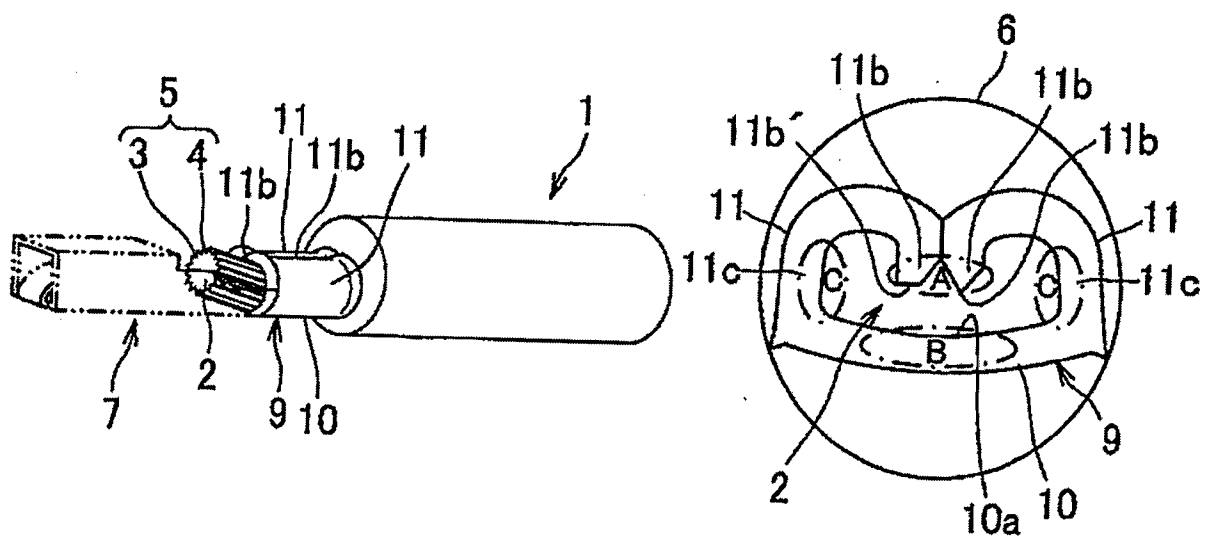


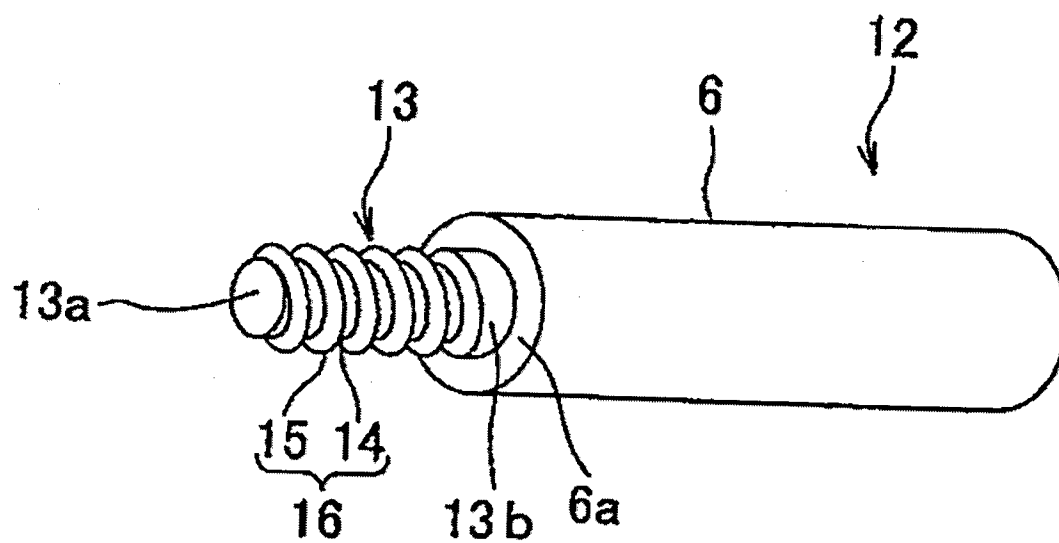
FIG. 4

FIG. 5A

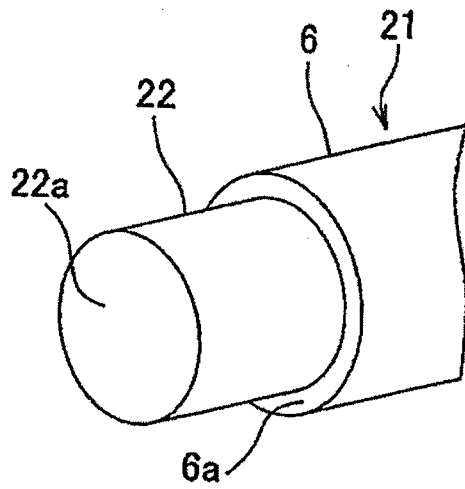


FIG. 5B

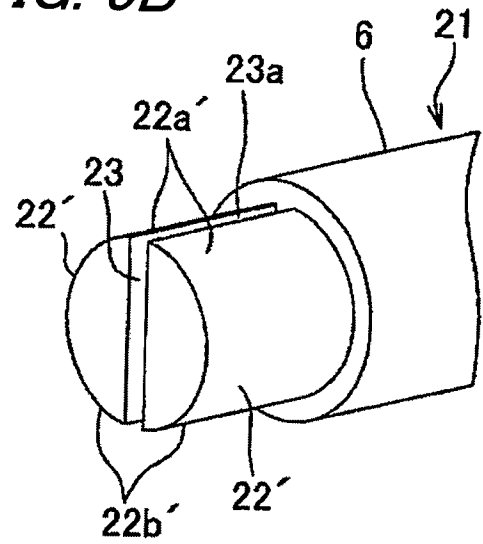


FIG. 5C

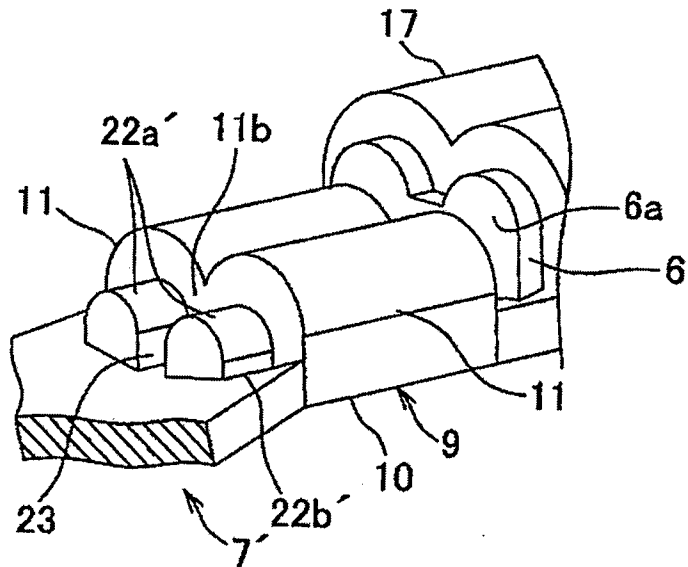


FIG. 6A

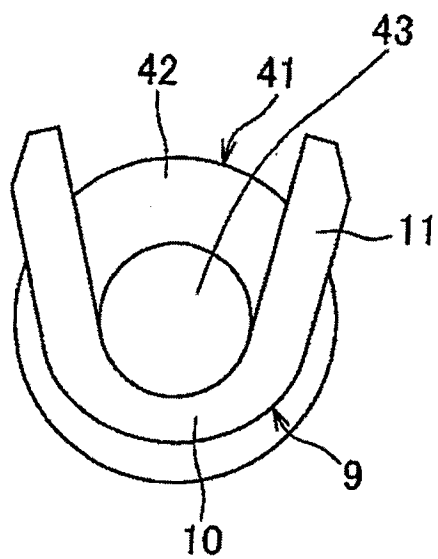


FIG. 6B

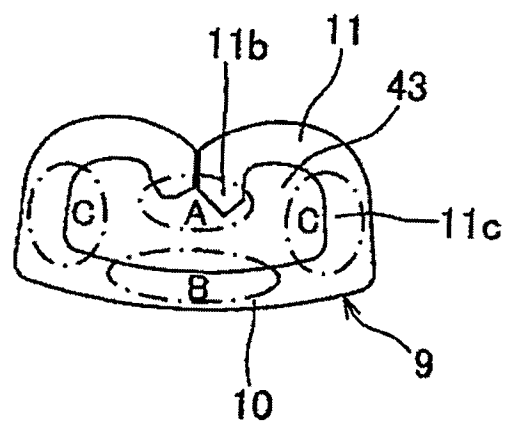
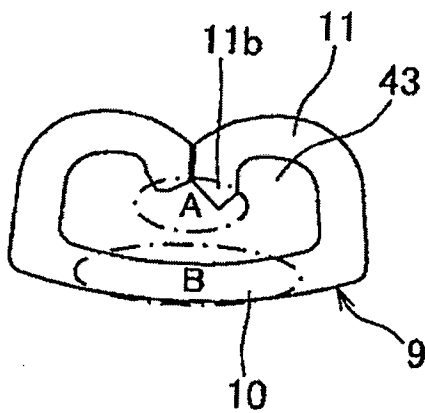


FIG. 7



INTERNATIONAL SEARCH REPORT

International application No
PCT/JP2012/070132

A. CLASSIFICATION OF SUBJECT MATTER
INV. H01R4/18 H01B7/00
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H01R H01B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2009/090853 A1 (YAZAKI CORP [JP]; HORIIKE TSUNEYUKI [JP]; KATO HIDEKI [JP]; MATSUNO TA) 23 July 2009 (2009-07-23)	1-3
A	claims 1-4; figures 1,4-8 -----	4
A	US 2009/229880 A1 (WATANABE KUNIHICO [JP]) 17 September 2009 (2009-09-17) paragraphs [0060] - [0061]; figures 6-7 -----	4,5
A,P	US 2012/000069 A1 (HAGI MASAHIRO [JP] ET AL) 5 January 2012 (2012-01-05) claim 1; figures 3,13 -----	1
A	EP 1 863 039 A2 (PANDUIT CORP [US]) 5 December 2007 (2007-12-05) claim 1; figure 2 ----- -/-	1



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

27 November 2012

Date of mailing of the international search report

05/12/2012

Name and mailing address of the ISA/

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INTERNATIONAL SEARCH REPORT

International application No

PCT/JP2012/070132

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2006/272844 A1 (BERGHOFER PETER [AT] ET AL) 7 December 2006 (2006-12-07) abstract; figure 1a -----	1
A	EP 1 124 284 A2 (MITSUBISHI ELECTRIC CORP [JP]) 16 August 2001 (2001-08-16) paragraphs [0017] - [0018]; figure 7 -----	5

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/JP2012/070132

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WO 2009090853	A1	23-07-2009	CN 101911215 A 08-12-2010 DE 112008003627 T5 04-11-2010 JP 2009170315 A 30-07-2009 US 2010282494 A1 11-11-2010 WO 2009090853 A1 23-07-2009
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EP 1124284	A2	16-08-2001	DE 60007717 D1 19-02-2004 DE 60007717 T2 28-10-2004 EP 1124284 A2 16-08-2001 JP 3668661 B2 06-07-2005 JP 2001231209 A 24-08-2001 KR 20010081942 A 29-08-2001 US 6369474 B1 09-04-2002

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2012/070132

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☒ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-4

A terminal crimping structure for a single core electric-wire, comprising:
an electrically conductive metal single core wire having a plurality of concave portions and a plurality of convex portions provided on an outer periphery thereof; and
a core wire crimping portion of a terminal which is crimp-connected to the single core wire having the plurality of concave portions and the plurality of convex portions.

2. claim: 5

A terminal crimping structure for a single core electric-wire, comprising:
an electrically conductive metal single core wire having a longitudinal slit provided therein; and
a core wire crimping portion including a pair of crimping pieces of a terminal which is crimped to the single core wire; wherein
a folded distal end portion of each of the pair of crimping pieces goes into the slit.
