



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
19.02.2020 Bulletin 2020/08

(51) Int Cl.:
H01R 4/20 (2006.01) **H01R 13/03** (2006.01)
C22C 21/00 (2006.01) **H01R 4/62** (2006.01)
H01R 11/12 (2006.01)

(21) Application number: **19190819.3**

(22) Date of filing: **08.08.2019**

(84) Designated Contracting States:
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO
PL PT RO RS SE SI SK SM TR**
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

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(30) Priority: **13.08.2018 JP 2018152300**

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(54) **TERMINAL-EQUIPPED ELECTRIC WIRE**

(57) A terminal-equipped electric wire (1) includes: an electric wire (2) including a conductor (3) formed of at least one element wire, and a covering (4) that covers an outer periphery of the conductor; and a compression terminal (5) fixed to an end of the conductor. The at least one element wire is made of a first material including

aluminum as a main component. At least a part, which contacts the conductor, of the compression terminal is made of a second material including aluminum as a main component. The first material has a tensile strength greater than a tensile strength of the second material.

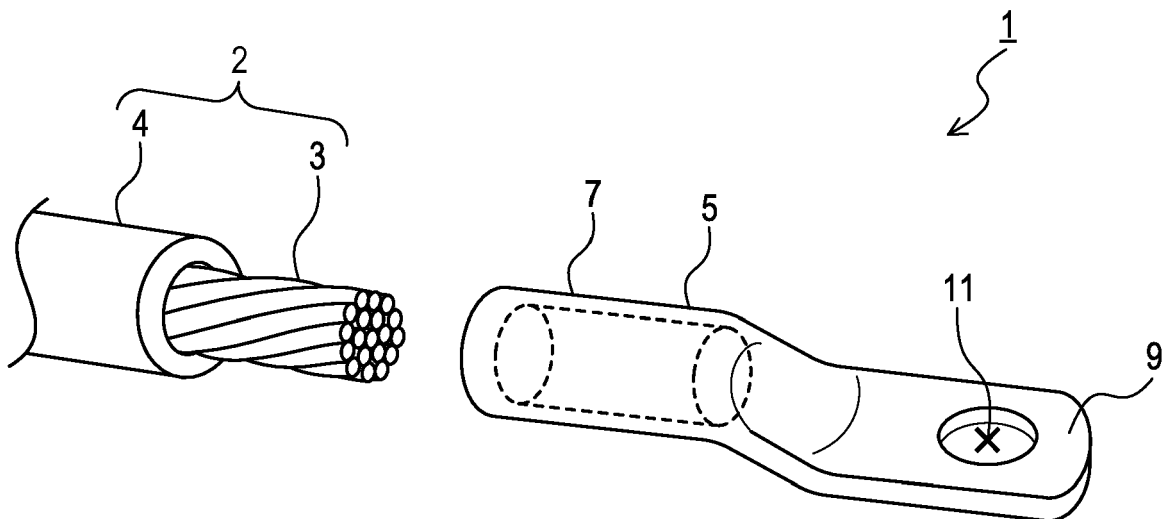


FIG. 1

Description

CROSS-REFERENCE TO RELATED APPLICATIONS

5 **[0001]** The present application claims the benefit of Japanese Patent Application No. 2018-152300 filed on August 13, 2018 with the Japan Patent Office, the entire disclosure of which is incorporated herein by reference.

BACKGROUND

10 **[0002]** The present disclosure relates to a terminal-equipped electric wire.

[0003] A conventionally known terminal-equipped electric wire has a configuration below. The terminal-equipped electric wire includes an electric wire and a compression terminal. The electric wire includes a conductor and a covering. The conductor is formed of, for example, an element wire. The element wire is also referred to as a "single wire". Alternatively, the conductor is, for example, a strand formed of multiple element wires twisted together. The covering covers an outer periphery of the conductor. At an end of the electric wire, the covering is removed, and the conductor is exposed. By inserting the exposed conductor into the compression terminal and then externally compressing the compression terminal, the compression terminal is fixed to the electric wire. Such a terminal-equipped electric wire is disclosed, for example, in Japanese Unexamined Patent Application Publication No. 2010-244895.

20 SUMMARY

[0004] A ratio of an electrical resistance value in a contact portion of the compression terminal to an electrical resistance value of the electric wire is referred to as an "electrical resistance ratio". The electrical resistance ratio of the terminal-equipped electric wire is required to be further reduced. One aspect of the present disclosure is to provide a terminal-equipped electric wire that enables a reduced electrical resistance ratio.

25 **[0005]** A terminal-equipped electric wire in one aspect of the present disclosure comprises: an electric wire that comprises a conductor formed of at least one element wire, a covering that covers an outer periphery of the conductor; and a compression terminal fixed to an end of the conductor. The at least one element wire is made of a first material comprising aluminum as a main component, and at least a part, which contacts the conductor, of the compression terminal is made of a second material comprising aluminum as a main component. The first material has a tensile strength greater than a tensile strength of the second material. The terminal-equipped electric wire in one aspect of the present disclosure has a small electrical resistance ratio. Also, the terminal-equipped electric wire in one aspect of the present disclosure has a small contact resistance between the conductor and the compression terminal.

35 BRIEF DESCRIPTION OF THE DRAWINGS

[0006] An embodiment of the present disclosure will be described hereinafter by way of example with reference to the accompanying drawings, in which:

40 FIG. 1 is a perspective view showing a configuration of a terminal-equipped electric wire 1 in a state where a conductor 3 and a compression terminal 5 are separated;
 FIG. 2 is a sectional view showing a section of the terminal-equipped electric wire 1 before compression taken along a section parallel to an axial direction of the conductor 3;
 FIG. 3 is a sectional view showing a section of the terminal-equipped electric wire 1 after compression taken along
 45 the section parallel to the axial direction of the conductor 3;
 FIG. 4 is a graph showing changes in compression strain and compression load of the conductor and the compression terminal while applying a compression load during production from an outer periphery of the compression terminal, and subsequently removing the compression load during production, in a case where a first material has a tensile strength greater than a tensile strength of a second material.
 50 FIG. 5 is a graph showing changes in compression strain and compression load of the conductor and the compression terminal while applying a compression load during production from an outer periphery of the compression terminal, and subsequently removing the compression load during production, in a case where the first material has a tensile strength smaller than a tensile strength of the second material;
 FIG. 6 is an explanatory diagram showing a measurement method of an initial resistance ratio R_{ratio} ; and
 55 FIG. 7 is a graph showing a relationship between a tensile strength difference and the initial resistance ratio R_{ratio} .

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

1. Configuration of Terminal-equipped Electric Wire

[0007] A terminal-equipped electric wire of the present disclosure comprises an electric wire and a compression terminal. The electric wire comprises a conductor and a covering. The conductor is formed of, for example, an element wire. The element wire is also referred to as a "single wire". Alternatively, the conductor may be, for example, a strand formed of multiple element wires twisted together. In a case where the conductor is formed of a strand, the element wires forming the strand are usually made of a same material.

[0008] The covering covers an outer periphery of the conductor. The covering is made of an insulating material, such as resin and rubber. At an end of the electric wire, the covering is partially removed, thereby exposing the conductor. Hereinafter, such an exposed conductor is referred to as an "exposed portion". The compression terminal is fixed to the exposed portion.

[0009] The terminal-equipped electric wire has a configuration, for example, as shown in FIGS. 1, 2, and 3. Specifically, a terminal-equipped electric wire 1 comprises an electric wire 2 and a compression terminal 5. The electric wire 2 comprises a conductor 3 and a covering 4. The covering 4 covers an outer periphery of the conductor 3. At an end of the electric wire 2, the covering 4 is removed, and the conductor 3 is exposed. The conductor 3 shown in FIGS. 1, 2, and 3 corresponds to the exposed portion.

[0010] The compression terminal 5 comprises a contact portion 7 and an extending portion 9. The compression terminal 5 is obtained, for example, by press-working one end of a pipe. The one end corresponds to the extending portion 9. Alternatively, the compression terminal 5 may be obtained, for example, by drilling a first end of a columnar base material, and press-working a second end thereof. The first end corresponds to the contact portion 7. The second end corresponds to the extending portion 9.

[0011] The contact portion 7 has a cylindrical shape with one open end. The extending portion 9 is connected to an end of the contact portion 7 opposite to the open end. The extending portion 9 has a plate shape to allow attachment to a not-shown terminal base. The extending portion 9 has a bolt hole 11 to allow a not-shown bolt to pass therethrough.

[0012] The terminal-equipped electric wire 1 is produced, for example, as described below. First, as shown in FIG. 2, an exposed end of the conductor 3 is inserted into the contact portion 7. Subsequently, a compression load is applied to the contact portion 7 from an outer periphery of the contact portion 7, to thereby compress the contact portion 7 and the conductor 3. The compression load is referred to as a "compression load during production". A direction of the compression load during production is a direction to radially contract the contact portion 7 and the conductor 3. Then, the compression load during production is removed, and a finished terminal-equipped electric wire 1 shown in FIG. 3 is obtained. In the finished terminal-equipped electric wire 1, an inner peripheral surface of the contact portion 7 contacts an outer peripheral surface of the conductor 3.

[0013] In the aforementioned compression process, a specified pressure is applied to the contact portion 7, for example, using a compression tool to cause compression deformation of the contact portion 7. The compression deformation is plastic deformation. It is preferable to cause compression deformation at multiple points. In a case of compression deformation at multiple points, improved properties of the terminal-equipped electric wire can be obtained. The multiple points for compression are preferably specified to be spaced apart from one another along a longitudinal direction of the conductor 3.

2. First Material and Second Material

[0014] The element wires forming the conductor 3 are made of a first material comprising aluminum as a main component. The main component means a component that accounts for 50% or more by mass of the entire mass. At least a part of the compression terminal that contacts the exposed portion of the conductor 3 is made of a second material comprising aluminum as a main component. In an embodiment shown in FIGS. 1, 2, and 3, the contact portion 7 is made of the second material.

[0015] Either the first material or the second material is not limited to a particular material, and may be, for example, pure aluminum or aluminum alloys as described below.

[0016] Pure aluminum is a material comprising Al and inevitable impurities. Examples of pure aluminum include electrically conductive pure aluminum (hereinafter also referred to as "ECA1").

[0017] Examples of aluminum alloys include Al-Fe-Zr and Al-Zr detailed below.

[0018] Al-Fe-Zr: an aluminum alloy comprising 0.2 to 1.0% by mass of Fe (iron), 0.01 to 0.10% by mass of Zr (zirconium), 0.1% by mass or less of Si (silicon), 0.01% by mass or less of Cu (copper), 0.01% by mass or less of Mn (manganese), 0.01% by mass or less of Mg (magnesium), 0.01% by mass or less of Zn (zinc), 0.01% by mass or less of Ti (titanium), and 0.01% by mass or less of V (vanadium), with the remainder comprising Al and inevitable impurities.

[0019] Al-Zr: an aluminum alloy comprising 0.03 to 1.5% by mass of Zr and 0.1 to 1.0% by mass of Fe and Si, with

the remainder comprising Al and inevitable impurities.

[0020] Regarding Al-Zr, "0.1 to 1.0% by mass of Fe and Si" means the following: In a case of comprising both of Fe and Si, a summed concentration of Fe and Si is 0.1 to 1.0% by mass. In a case of comprising Fe and not comprising Si, Fe concentration is 0.1 to 1.0% by mass. In a case of comprising Si and not comprising Fe, Si concentration is 0.1 to 1.0% by mass.

[0021] The first material has a tensile strength greater than a tensile strength of the second material. A measurement method of the tensile strength of the first material is as described below. A test piece is cut from the element wire forming the conductor. A tensile test on the test piece is conducted by a method according to Japanese Industrial Standards (JIS) Z2241, to thereby measure a tensile strength. The tensile test is conducted with a test speed of 10%/min and a gauge length of 200 mm.

[0022] A measurement method of the tensile strength of the second material is as described below. A test piece of a 2 mm by 2 mm square rod is cut from a part, which contacts the exposed portion, of the compression terminal. A tensile test on the test piece is conducted by a method according to JIS Z2241, to thereby measure a tensile strength. The tensile test is conducted with a test speed of 10%/min and a gauge length of 20 mm.

[0023] In a case where the conductor 3 is formed of a strand, multiple element wires are preferably made of a same material. The conductor 3 is, for example, formed of a complex strand. The complex strand is formed by preparing a collective strand by twisting multiple metal element wires, and then twisting multiple collective strands together. In a case where the conductor 3 is made of a complex strand, the tensile strength of the metal element wires forming the conductor 3 is equal to the tensile strength of the conductor 3, and the tensile strength of the collective strand.

[0024] A section area of a portion, to which the compression terminal is fixed, of the conductor 3 is defined as S1. Compression deformation has occurred in the portion to which the compression terminal is fixed. A section area of a portion, to which the compression terminal is not fixed, of the conductor 3 is defined as S2. Compression deformation has not occurred in the portion to which the compression terminal is not fixed. S1/S2 is preferably 0.5 or more and less than or equal to 0.95. When S1/S2 is within such range, the compression terminal holds the conductor with a greater holding force.

[0025] The terminal-equipped electric wire of the present disclosure may be used, for example, for buildings, wind power generations, railroads, and vehicles.

3. Effects Achieved by Terminal-equipped Electric Wire

[0026] The terminal-equipped electric wire of the present disclosure has a small contact resistance between the conductor and the compression terminal. In the terminal-equipped electric wire of the present disclosure, an initial resistance ratio of the conductor is particularly small. The initial resistance ratio means an electrical resistance ratio immediately after production of the terminal-equipped electric wire.

[0027] The terminal-equipped electric wire preferably has an electrical resistance ratio of 100% or less. Also, the contact resistance between the conductor and the compression terminal is preferably further small. The terminal-equipped electric wire of the present disclosure allows reduction in the electrical resistance ratio. This enables reduction in local overheat in a joint between the conductor and the compression terminal. As a result, disconnection of the electric wire and contact failure between the conductor and the compression terminal can be inhibited.

[0028] The reason for the small electrical resistance ratio in the terminal-equipped electric wire of the present disclosure is assumed as described below. FIG. 4 is a graph showing changes in compression strain and compression load of each of the conductor and the compression terminal in a case where the tensile strength of the first material is greater than the tensile strength of the second material, and where the compression load during production is applied to the compression terminal from its outer periphery, and subsequently the compression load during production is removed.

[0029] In FIG. 4, X1 is a curve showing changes in compression strain and compression load of the conductor in a case where the tensile strength of the first material is greater than the tensile strength of the second material, and where the compression load during production is applied to the compression terminal from its outer periphery, and subsequently the compression load during production is removed. A point A represents the compression strain and the compression load of the conductor when the compression load during production is completely removed.

[0030] In FIG. 4, Y1 is a curve showing changes in compression strain and compression load of the compression terminal in a case where the tensile strength of the first material is greater than the tensile strength of the second material, and where the compression load during production is applied to the compression terminal from its outer periphery, and subsequently the compression load during production is removed. A point B represents the compression strain and the compression load of the compression terminal when the compression load during production is completely removed.

[0031] The compression strain at the point A and the compression strain at the point B are equal. The compression strain at each of the point A and the point B is an amount of strain when springback occurs. Also, the compression load at the point A is equal in magnitude to the tensile load at the point B.

[0032] When the compression load during production is applied, the compression terminal and the conductor are

compressed. After completely removing the compression load during production, springback occurs in the compression terminal and the conductor in accordance with an initial Young's modulus. Since the tensile strength of the first material forming the conductor is greater than the tensile strength of the second material forming a contact portion of the compression terminal, a springback amount of the conductor is greater than a springback amount of the contact portion.

Thus, the compression load at the point A occurs in the conductor. The compression load occurring in the conductor is a force pressing the compression terminal in a radial direction of the conductor. The tensile load occurs in the compression terminal. The tensile load balances with the compression load occurring in the conductor. Accordingly, after the compression load during production is completely removed, a mutual pressing load occurs between the outer peripheral surface of the conductor and the inner peripheral surface of compression terminal.

[0033] An electrical resistance R_c at a contact between metals is expressed by following Formula (1):

$$\text{Formula (1): } R_c = \rho/2r$$

In Formula (1), " ρ " represents a resistivity of metal. On an assumption that the contact portion has a single circular section, " r " represents a radius of the circle and is expressed by following Formula (2):

$$\text{Formula (2): } r = [F/n\zeta\pi H]^{1/2}$$

In Formula (2), " F " represents a load applied between the metals, " n " represents the number of true contact portions, and " ζ " represents a coefficient that is determined based on a type of deformation of the metal. In a case of elastic deformation, " ζ " is 0.3 or less. In a case of coexisting elastic deformation and plastic deformation, " ζ " is more than 0.3 and less than or equal to 0.75. In a case of plastic deformation, " ζ " is more than 1.

[0034] As described above, in a case where the tensile strength of the first material is greater than the tensile strength of the second material, a mutual pressing load occurs between the outer peripheral surface of the conductor and the inner peripheral surface of compression terminal; thus, " F " is large. As a result, the electrical resistance R_c is small. Accordingly, the terminal-equipped electric wire of the present disclosure can achieve a small electrical resistance ratio.

[0035] FIG. 5 is a graph showing changes in compression strain and compression load of each of the conductor and the compression terminal in a case where the tensile strength of the first material is smaller than the tensile strength of the second material, and where the compression load during production is applied to the compression terminal from its outer periphery, and subsequently the compression load during production is removed.

[0036] In FIG. 5, X2 is a curve showing changes in compression strain and compression load of the conductor in a case where the tensile strength of the first material is smaller than the tensile strength of the second material, and where the compression load during production is applied to the compression terminal from its outer periphery, and subsequently the compression load during production is removed. A point C represents the compression strain and the compression load of the conductor when the compression load during production is completely removed.

[0037] In FIG. 5, Y2 is a curve showing changes in compression strain and compression load of the compression terminal in a case where the tensile strength of the first material is smaller than the tensile strength of the second material, and where the compression load during production is applied to the compression terminal from its outer periphery, and subsequently the compression load during production is removed. A point D represents the compression strain and the compression load of the compression terminal when the compression load during production is completely removed.

[0038] When the compression load during production is applied, the compression terminal and the conductor are compressed. After completely removing the compression load during production, springback occurs in the compression terminal and the conductor in accordance with an initial Young's modulus. Since the tensile strength of the second material forming the contact portion of compression terminal is greater than the tensile strength of the first material forming the conductor, no interacting force occurs between the compression terminal and the conductor.

[0039] The compression strain at the point C is greater than the compression strain at the point D. As a result, when the compression load during production is completely removed, a gap due to springback is formed between the outer peripheral surface of the conductor and the inner peripheral surface of the compression terminal. Thus, when the compression load during production is completely removed, no mutual pressing load occurs between the outer peripheral surface of the conductor and the inner peripheral surface of the compression terminal.

[0040] Accordingly, in a case where the tensile strength of the first material is smaller than the tensile strength of the second material, " F " in Formula (2) is small and the electrical resistance R_c is large.

[0041] As a difference between the tensile strength of the first material and the tensile strength of the second material is greater, the contact resistance between the conductor and the compression terminal becomes smaller, and the electrical resistance ratio becomes smaller. The difference between the tensile strength of the first material and the

tensile strength of the second material is preferably 20 MPa or more, and more preferably 30 MPa or more.

[0042] In a case where the difference between the tensile strength of the first material and the tensile strength of the second material is 20 MPa or more, changes in resistance ratio is small as compared with a case of less than 20 MPa in a 150°C current conduction test. The 150°C current conduction test is a test in which a current is set to heat a sample to 150°C, and the current is conducted for 50 hours.

4. Examples

(4-1) Production of Terminal-equipped Electric Wire

[0043] Terminal-equipped electric wires No. 1 to No. 6 in Table 1 were produced. Each of the terminal-equipped electric wires had a configuration as shown in FIG. 1 and FIG. 2. Each of the terminal-equipped electric wires had a combination of the first material and the second material as shown in Table 1. Except for the combination of the first material and the second material, all the terminal-equipped electric wires were the same. In each of the terminal-equipped electric wires, all the element wires forming the conductor were made of a same material. In each of the terminal-equipped electric wires, the conductor had a section area of 200 mm². The element wires forming the conductor each had a diameter of 0.45 mm. The number of element wires was 1,258.

[0044] Materials used for the first material and the second material are detailed below.

[0045] ECA1: ECA1 in accordance with Japanese Industrial Standards (JIS) A1070 was used.

[0046] Al-Fe-Zr: Aluminum alloy comprising 0.6% by mass of Fe, 0.02% by mass of Zr, 0.06% by mass of Si, 0.002% by mass of Cu, 0.002% by mass of Mn, and a total 0.006% by mass of Ti and V, and the remainder of Al.

[0047] Al-Zr: Aluminum alloy comprising 0.34% by mass of Zr, 0.15% by mass of Fe, 0.1% by mass of Si, and a total 0.03% by mass of Ti and V, and the remainder of Al.

[Table 1]

No.	Second Material	First Material	Tensile Strength Difference (MPa)	Initial Resistance Ratio (%)
1	ECAL	Al-Fe-Zr	-46	73
2	ECAL	Al-Zr	-24	76
3	Al-Fe-Zr	Al-Fe-Zr	-33	74
4	Al-Fe-Zr	Al-Zr	-11	87
5	Al-Zr	Al-Fe-Zr	60	118
6	Al-Zr	Al-Zr	82	142

(4-2) Evaluation of Terminal-equipped Electric Wire

[0048] For each of the terminal-equipped electric wires, the tensile strength of the first material and the tensile strength of the second material were measured. The measurement method was as described above. A tensile tester produced by ORIENTEC Co., Ltd. was used for measuring the tensile strengths. Next, a value was calculated by subtracting the tensile strength of the first material from the tensile strength of the second material (hereinafter referred to as a "tensile strength difference"). Table 1 above shows the calculated tensile strength differences.

[0049] For each of the terminal-equipped electric wires, an initial resistance ratio was measured. A measurement method of the initial resistance ratio was in accordance with JIS C2805. Specifically, measurement of the initial resistance ratio was conducted by a four-terminal method. FIG. 6 shows a test specimen used for measurement of the initial resistance ratio.

[0050] The test specimen comprises the conductor 3 prepared by removing the covering from the electric wire 2, and the compression terminals 5 fixed to both ends of the conductor 3.

[0051] A constant current 1A was supplied to the entire test specimen. In this state, a resistance R between a point P and a point Q was measured. The point P was a position of a top end of the contact portion between the conductor 3 and the compression terminal 5. The point Q was a position of the conductor 3 at which the conductor 3 did not contact the compression terminal 5. A point S was at an end, opposite to the point P, of the contact portion between the conductor 3 and the compression terminal 5. A resistance meter produced by HIOKI E.E. CORPORATION was used for measuring resistance.

[0052] An initial resistance ratio R_{ratio} was calculated by following Formula (3):

$$\text{Formula (3): } R_{\text{ratio}} = \{R \cdot L2 \times \alpha\} / \{L1 \times \alpha\}$$

In Formula (3), "L1" represents a distance between the point P and the point S, "L2" represents a distance between the point Q and the point S, " α " represents a resistance per unit length of the conductor 3. Here, " α " is a given value and may be, for example, measured in advance. Alternatively, " α " may be calculated by measuring a resistance in L2, and dividing the measured resistance by the length of L2.

[0053] Table 1 above shows the calculated initial resistance ratio R_{ratio} . FIG. 7 shows relationships between the tensile strength difference and the initial resistance ratio R_{ratio} . In FIG. 7, "ECA1 terminal" means that the second material is ECA1. "Al-Fe-Zr terminal" means that the second material is Al-Fe-Zr. "Al-Zr terminal" means that the second material is Al-Zr.

[0054] As shown in FIG. 7, when the tensile strength difference was a negative value, the initial resistance ratio was smaller than when the tensile strength difference was a positive value. Also, in comparison between two terminal-equipped electric wires, each having a tensile strength difference of a negative value, the initial resistance ratio was smaller as an absolute value of the tensile strength difference was larger.

5. Other Embodiments

[0055] Although one embodiment of the present disclosure has been described above, it is to be understood that the present disclosure is not limited to the above-described embodiment, but may be implemented in various forms.

(1) A function performed by a single element in the above-described embodiment may be achieved by a plurality of elements, or a function performed by a plurality of elements may be achieved by a single element. Also, a part of a configuration in the above-described embodiment may be omitted. Further, at least a part of a configuration in the above-described embodiment may be added to, or may replace, a configuration in another embodiment. Any form included in the technical idea defined only by the language of the appended claims may be an embodiment of the present disclosure.

(2) The present disclosure may be implemented, other than in the above-described terminal-equipped electric wire, in various forms, such as a system comprising the terminal-equipped electric wire, a manufacturing method of a terminal-equipped electric wire, and a method of fixing a compression terminal to an electric wire.

Claims

1. A terminal-equipped electric wire (1) comprising:

an electric wire (2) that comprises:

a conductor (3) formed of at least one element wire, and

a covering (4) that covers an outer periphery of the conductor; and a compression terminal (5) fixed to an end of the conductor,

wherein the at least one element wire is made of a first material comprising aluminum as a main component, wherein at least a part, which contacts the conductor, of the compression terminal is made of a second material comprising aluminum as a main component, and wherein the first material has a tensile strength greater than a tensile strength of the second material.

2. The terminal-equipped electric wire according to claim 1, wherein the first material is an aluminum alloy that comprises:

0.2 to 1.0% by mass of Fe;
0.01 to 0.10% by mass of Zr;
0.1% by mass or less of Si;
0.01% by mass or less of Cu;
0.01% by mass or less of Mn;
0.01% by mass or less of Mg;
0.01% by mass or less of Zn;

0.01% by mass or less of Ti;
0.01% by mass or less of V; and

a remainder comprising Al and inevitable impurities, and
wherein the second material is pure aluminum that comprises Al and inevitable impurities.

3. The terminal-equipped electric wire according to claim 1,
wherein the first material is an aluminum alloy that comprises:

0.03 to 1.5% by mass of Zr;
0.1 to 1.0% by mass of Fe and Si; and

a remainder comprising Al and inevitable impurities, and
wherein the second material is pure aluminum that comprises Al and inevitable impurities.

4. The terminal-equipped electric wire according to claim 1,
wherein the first material and the second material each comprise:

0.2 to 1.0% by mass of Fe;
0.01 to 0.10% by mass of Zr;
0.1% by mass or less of Si;
0.01% by mass or less of Cu;
0.01% by mass or less of Mn;
0.01% by mass or less of Mg;
0.01% by mass or less of Zn;
0.01% by mass or less of Ti;
0.01% by mass or less of V; and

a remainder comprising Al and inevitable impurities.

5. The terminal-equipped electric wire according to any one of claims 1 to 4,
wherein the tensile strength of the first material is greater than the tensile strength of the second material by 20 MPa
or more.

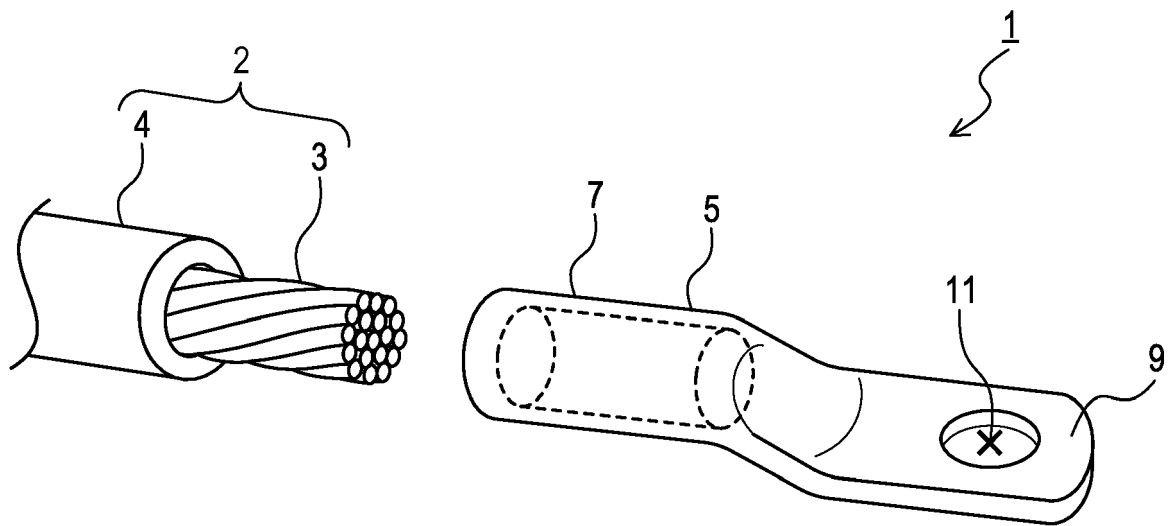


FIG. 1

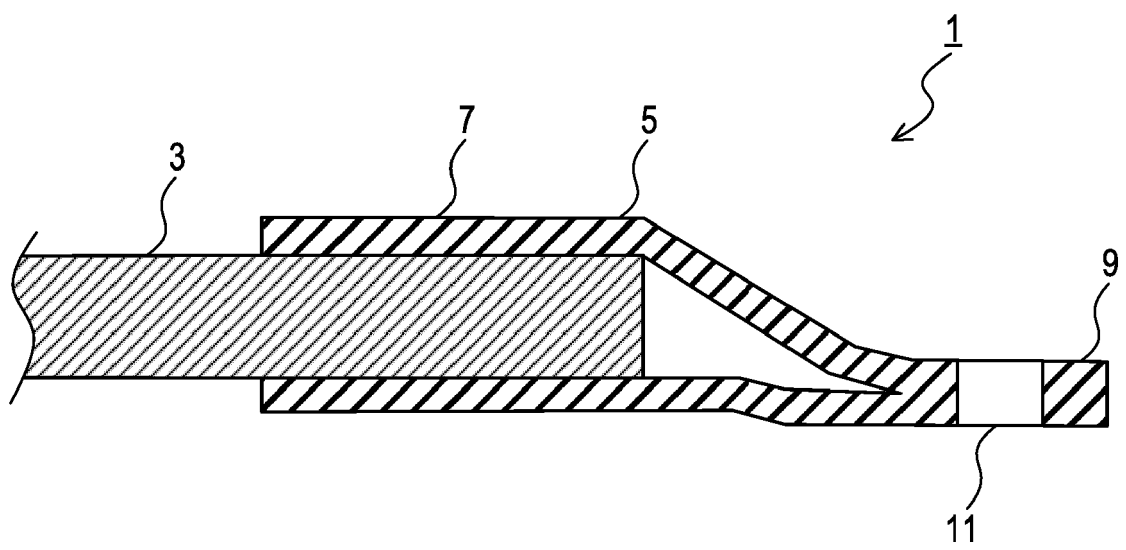


FIG. 2

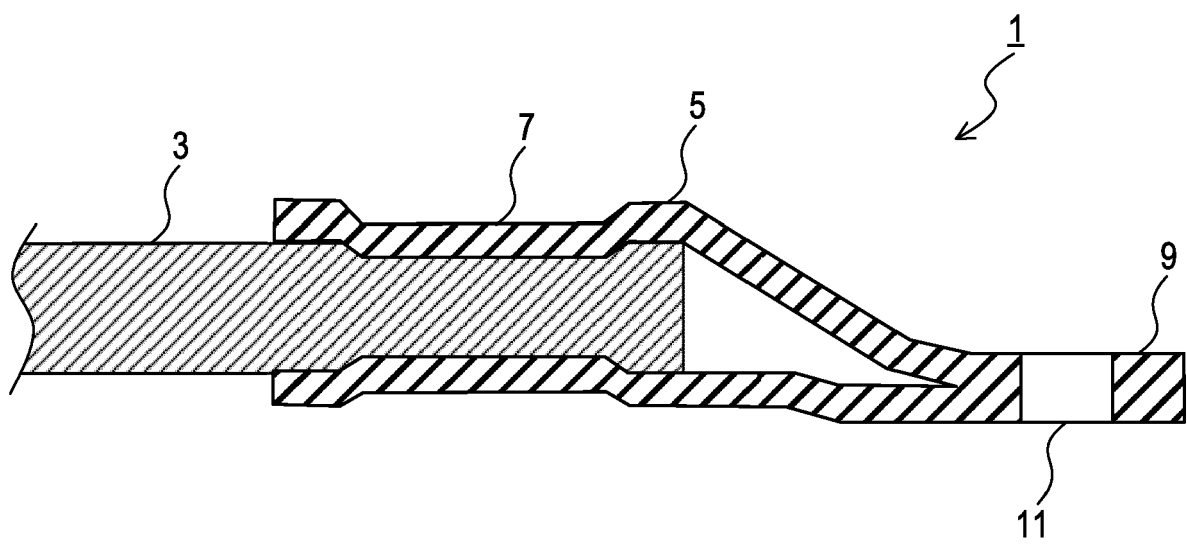


FIG. 3

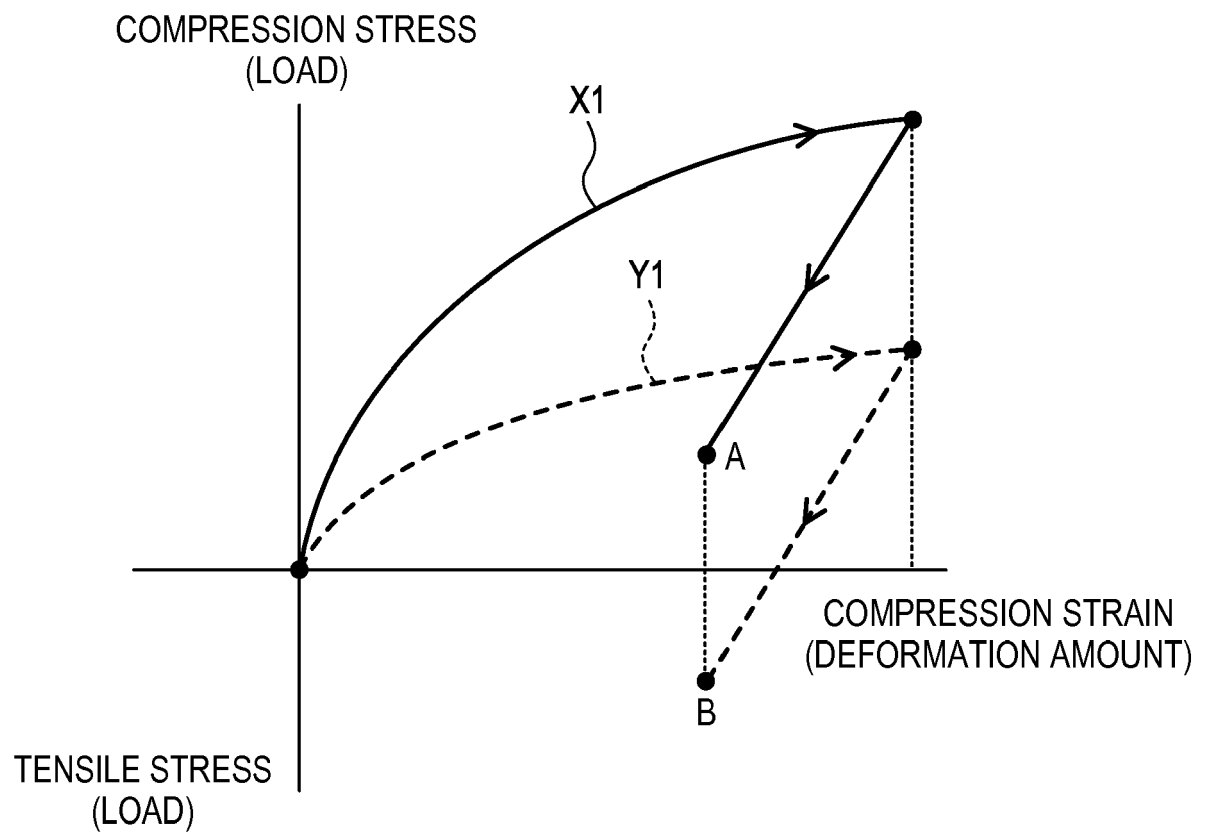


FIG. 4

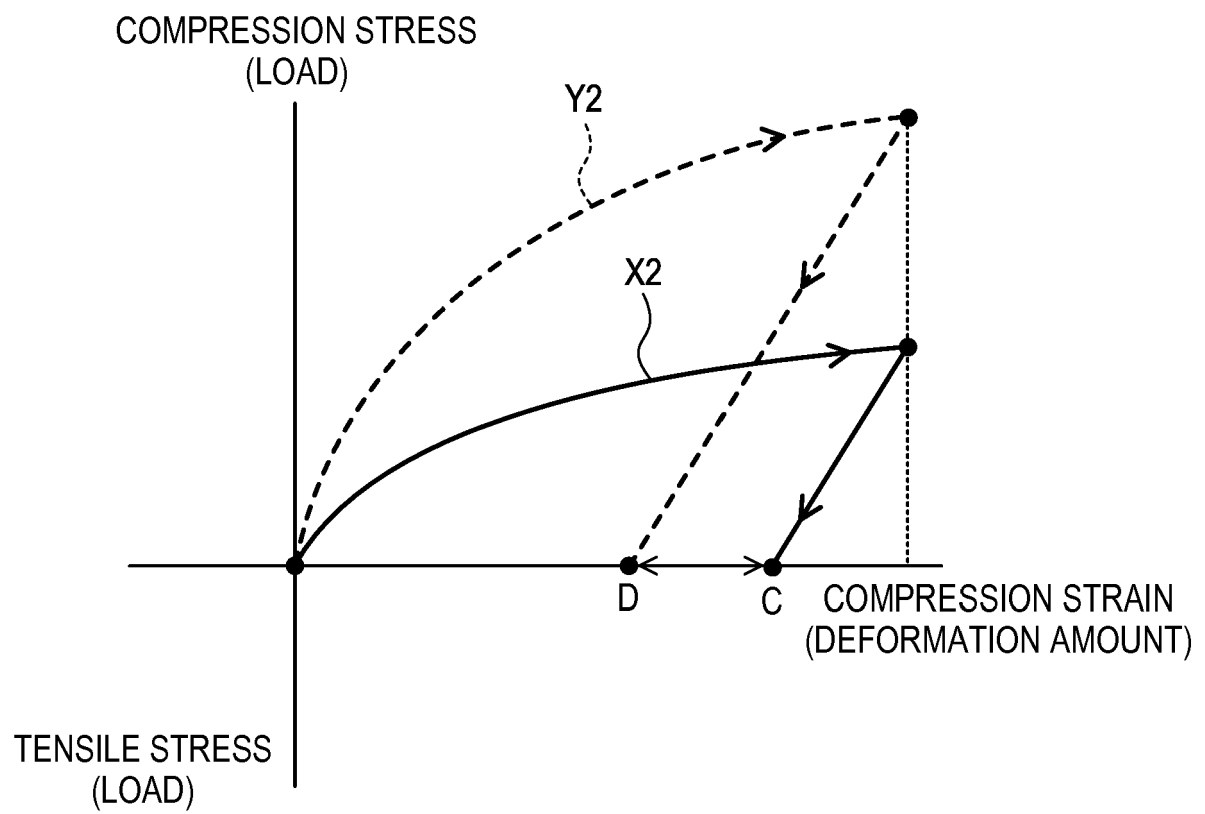


FIG. 5

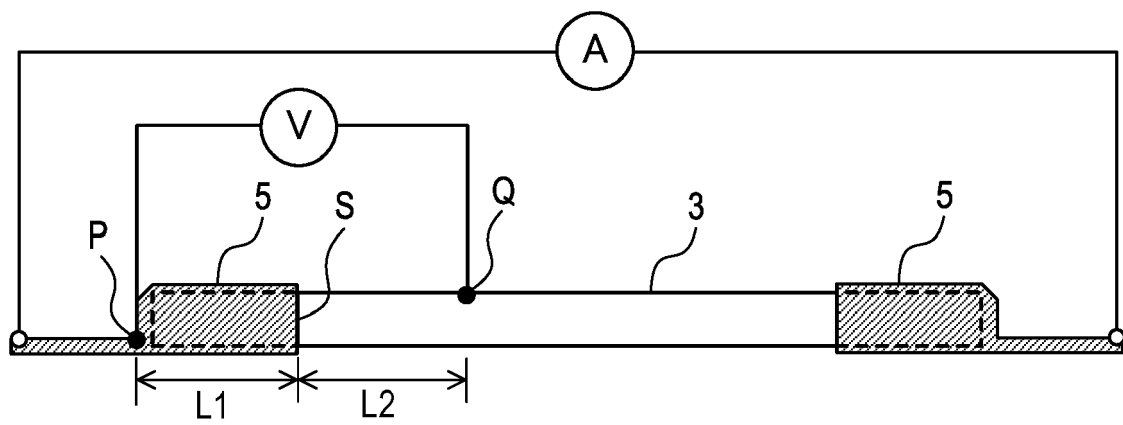


FIG. 6

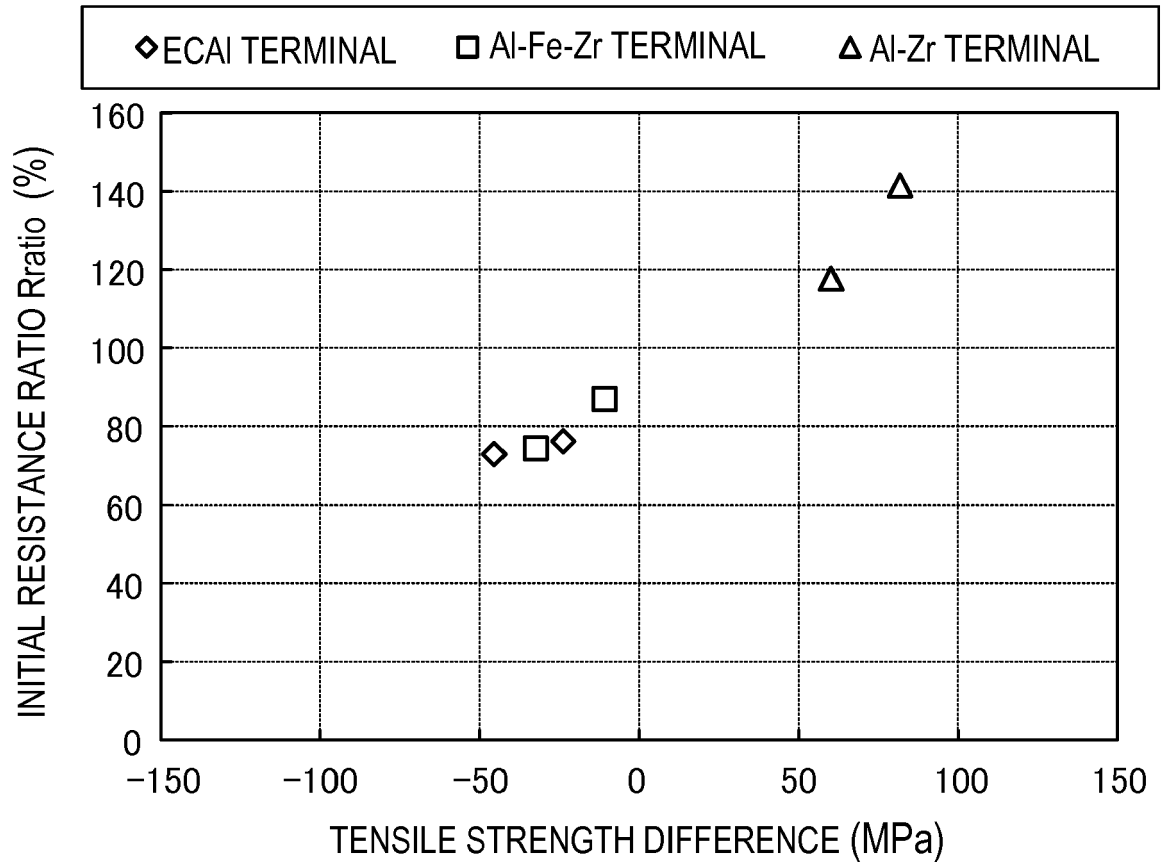


FIG. 7



EUROPEAN SEARCH REPORT

 Application Number
 EP 19 19 0819

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 3 912 358 A (MILLER ROGER D ET AL) 14 October 1975 (1975-10-14)	1,5	INV. H01R4/20
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