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Electrical connection assembly having two welded conductors and a layer of cyanoacrylate glue between the conductors, and method for this

Abstract

An electrical connection assembly includes a pair of conductors welded onto one another and a layer including a cyanoacrylate glue disposed in an area between the conductors.

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATION

(1) This application claims the benefit of the filing date under 35 U.S.C. § 119(a)-(d) of German Patent Application No. 102019200659.0, filed on Jan. 18, 2019.

FIELD OF THE INVENTION

(2) The present invention relates to an electrical connection assembly and, more particularly, to an electrical connection assembly having at least two conductors welded onto one another.

BACKGROUND

(3) When welding ribbon cables to battery contacts in electric vehicles, it is important to protect the conductors which are welded onto one another against electrochemical corrosion. Moreover, it is advantageous if the welding point has relief from tension.

SUMMARY

(4) An electrical connection assembly includes a pair of conductors welded onto one another and a layer including a cyanoacrylate glue disposed in an area between the conductors.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

(1) The invention will now be described by way of example with reference to the accompanying Figures, of which:

(2) FIG. **1** is a schematic diagram of a portion of power electronics;

(3) FIG. **2** is a schematic diagram of an electrical connection assembly of the power electronics;

(4) FIG. **3** is a schematic diagram of a detail of FIG. **2**;

(5) FIG. **4** is a schematic diagram of a detail of FIG. **2**; and

(6) FIG. **5** is a flowchart of a method for manufacturing an electrical connection assembly.

DETAILED DESCRIPTION OF THE EMBODIMENT(S)

(7) Exemplary embodiments of the present invention will be described hereinafter in detail with reference to the attached drawings. For the sake of simplicity, the same reference numbers are used in the drawings for elements which correspond to one another in terms of function and/or design. The combination of features depicted and described using the exemplary embodiments serves solely as an example and can be changed within the scope of the invention. For example, it is possible to omit a feature whose technical effect is of no importance in a particular application. Conversely, it is possible to add a feature which is not present in the depicted combination of features of the exemplary embodiment if the technical effect linked to this feature is required for a particular application.

(8) A portion of a power electronics **1**, shown in FIG. **1**, has an electrical connection assembly **2**. In an embodiment, the power electronics **1** are used in an electrically powered vehicle.

(9) The electrical connection assembly **2**, as shown in FIG. **1**, has at least two conductors **4**, **6** welded onto one another. In addition, the electrical connection assembly **2** may have further conductors **4***a*, **6***a*, which are merely indicated by dashed lines in FIG. **1**. One of the conductors, in this case the conductor **4**, may be part of a ribbon cable **8**. The other conductor, in this case the conductor **6**, may be connected to a battery **10**.

(10) At least one of the conductors **4**, **6** may be made of an aluminum-containing material, in order to keep the electrical resistances low. At least one of the conductors **4**, **6** may be produced from a sheet metal material and in particular may be configured in a disc or plate shape.

(11) The two conductors **4**, **6** lie on one another as planarly as possible. At least one layer **12** consisting of or containing a cyanoacrylate glue **14** is located between the conductors **4**, **6**, as shown in FIG. **1**. The area **16** in which the cyanoacrylate glue **14** is located surrounds, at least partially, a welding point **18** at which the at least two conductors **4**, **6** are materially connected to one another.

(12) As shown in FIG. **2**, at least one layer **20** comprising a material **22** which impedes or prevents the hardening of the cyanoacrylate glue **14** may be present close to or adjacent to the welding point **18**. The material **22** which impedes or prevents the hardening of the cyanoacrylate glue may be a moisture-absorbing material and/or an acidic substance, for example. A hydrophilic or hydrophobic

layer can be manufactured by a Pyrosil method, for example. The inhibition of hardening can be performed, for example, by the use of an acid with a solvent, such as formic acid and acetone. In an embodiment, the welding point **18** can be at least partially, or completely, surrounded by the material **22**.

(13) The layer **20** consisting of or comprising the material **22** may be arranged between the layer **12** of the cyanoacrylate glue **14** and a conductor **4**, **6** or between two opposing layers **12** of cyanoacrylate glue **14**. A layer **20** of the material **22** which impedes or prevents the hardening of the cyanoacrylate glue **14** may be present on one of the conductors **4**, **6** or on both opposing conductors **4**, **6**. The material **22** may be integrated into an electrical insulation of a conductor **4**, **6**, for example a ribbon cable, this material being released by the insulation upon welding. In an embodiment, a later hardening of the cyanoacrylate glue **14** can be achieved by exposing the cyanoacrylate glue **14** to an activator, for example an alkaline environment.

(14) The layer **12** and/or the layer **20** was originally also present at least partially at the point at which the welding point **18** is located after the conductors **4**, **6** are welded. The welding point **18** may have fully replaced the layer **20**, meaning that no remnant of the layer **20** is present any longer. However, as shown in FIG. **2**, there may still be remnants of the layer **20** between the conductors **4**, **6** outside the welding point **18**.

(15) In an area **16** of the respective conductor **4**, **6** which is coated with the cyanoacrylate glue **14**, the surface **4** may be at least partially roughened, i.e. have a greater roughness R than the sections of the remaining, non-roughened surface. The roughening is indicated by reference number **24** in FIG. **2**. The roughening may be performed by laser structuring, embossing, grinding, machining or sandblasting. As a result of the roughening **24**, a predetermined surface roughness R is obtained which differs only slightly over a multiplicity of different conductors **4**, **6**.

(16) The surface roughness R, in an embodiment, is measured in this case according to ISO 25178 and/or DIN 4760. The surface roughness R may be the mean roughness, the quadratic roughness, the averaged roughness depth or the maximum roughness depth in area **16** or a subarea thereof. The roughened area may have a greater surface roughness R than the non-roughened area which surrounds it at least partially. If the basic material of the conductor **4** or **6** already has a very great surface roughness R, the surface **4** may also be provided with a lower surface roughness R in area **16**, by means of polishing or smoothing, for example. A polished or smoothed area is then accordingly present instead of the roughening **24**.

(17) In FIG. **2**, only one surface **28** of the one conductor **4** has a roughening **24**. Of course, it is also possible for the two opposing surfaces **26**, **28** of the conductors **4**, **6** to be roughened.

(18) Only the conductor **6** is shown in FIG. **3** for the purposes of exemplification. The description, however, can similarly relate to the conductor **4**. The surface **28** of the conductor **6** has a surface roughness R. The layer **12** of the cyanoacrylate glue **14**, which has a layer thickness **30**, is located on the surface **28**. The layer thickness **30** corresponds to a maximum of double the surface roughness R and, in an embodiment, to at least one times the surface roughness R within a tolerance of ±30%.

(19) The layer thickness **30**, shown in FIG. **3**, corresponds at least approximately just to the surface roughness R, meaning that it just about covers or just releases the tips of the surface roughness R. At the tips of the surface roughness R, the layer thickness **30** is therefore, in an embodiment, virtually zero. The layer **12** may also be applied without roughening **24**, as shown in FIG. **2**. However, due to a varying surface roughness R, the layer thickness **30** under some circumstances is subject to relatively large deviations and the characteristics of the connection assembly **2** are less reproducible.

(20) FIG. **4** shows a subsection **34**, also shown in FIG. **2**, in which the layer **20** of the material **22** which impedes or prevents the hardening of the cyanoacrylate glue **14** is located. In an embodiment, the subsection **34** is located completely within the area **16**. The layer **20** consisting of or comprising the material **22** may be located directly on the conductor **6**. However, as indicated by

the dashed line, it may also be located on the layer **14** or on the conductor **4**.
(21) In order to manufacture the electrical connection assembly **2** shown in FIGS. **1**-**4**, the method steps shown in FIG. **5** are carried out.
(22) In a first, optional method step **40**, at least one of the conductors **4**, **6** is roughened in order produce a predetermined surface roughness R.
(23) In a step **42**, at least one of the conductors **4**, **6** is coated with cyanoacrylate glue **14**. Here, the layer thickness **30**, as described above, is a maximum of double the surface roughness R. If the conductor **4**, **6** on which the cyanoacrylate glue **14** has been applied has been roughened previously, then the cyanoacrylate glue **14** is applied onto the roughened area.
(24) A further optional step **44** of the method relates to the application of a layer **20** of the material **22** which impedes or prevents the hardening of the cyanoacrylate glue **14**. The step **44** can be carried out before or after step **42**. The material **22** which impedes or prevents the hardening of the cyanoacrylate glue **14** can be applied directly onto a conductor **4**, **6** or onto the layer **12**. In this case, the material **22** may be applied onto a conductor **4**, **6** which is not coated with cyanoacrylate glue **14**, as long as the layer **12** is located on the opposing conductor **4**, **6**. However, in this configuration, the two conductors **4**, **6** should be brought together directly after the coating, in order to inhibit or impede the hardening of the cyanoacrylate glue **14** in the subsection **34**.
(25) In a step **46**, the conductors **4**, **6** are then welded onto one another at at least one welding point **18**. The welding, in an embodiment, takes place by way of, in particular, ultrashort laser pulses. The welding point **18** is located in an area in which the layer **12** is located, i.e. in the area **16**. In addition, the welding point **18** is located where the layer **20** is also located, i.e. in the subsection **34** of the area **16**.
(26) In the final manufactured electrical connection assembly **2**, the conductors **4**, **6** are electrically connected to one another by the welding point **18**. The layer **12** of cyanoacrylate glue **14** represents an additional mechanically loadable connection which relieves the tension on the welding point **18**. Due to the thin layer thickness **30**, the glue may be applied prior to the welding **18**. The layer **12**, in an embodiment, hermetically encloses the welding point **18** and thus protects it from electrochemical corrosion. Outside the welding point **18**, the two conductors **4**, **6** can directly contact one another at tips of the surface roughness R, which further reduces the contact resistance between the conductors **4**, **6**.

Claims

1. An electrical connection assembly, comprising: a pair of conductors welded onto one another; a layer including a cyanoacrylate glue disposed in an area between the conductors, the conductors are welded onto one another at a welding point, a weld formed at the welding point is at least partially surrounded by the cyanoacrylate glue, the conductors have a pair of surfaces facing each other, at least one of the surfaces is at least partially roughened in the area, a thickness of the layer including the cyanoacrylate glue is a maximum of double a surface roughness of the at least one of the surfaces; and a material that impedes or prevents a hardening of the cyanoacrylate glue located at least in a subsection of the area.
2. The electrical connection assembly of claim 1, wherein the conductors are formed of a sheet metal material at least in the area.
3. The electrical connection assembly of claim 1, wherein at least one of the conductors is made of an aluminum-containing material.
4. The electrical connection assembly of claim 1, wherein the conductors directly contact one another outside the welding point.
5. The electrical connection assembly of claim 1, wherein one of the conductors is part of a ribbon cable.
6. A power electronics, comprising: a battery; and an electrical connection assembly including a

pair of conductors welded onto one another and a layer including a cyanoacrylate glue disposed in an area between the conductors, the conductors are welded onto one another at a welding point, a weld formed at the welding point is at least partially surrounded by the cyanoacrylate glue, the conductors have a pair of surfaces facing each other, at least one of the surfaces is at least partially roughened in the area, a thickness of the layer including the cyanoacrylate glue is a maximum of double a surface roughness of the at least one of the surfaces, one of the conductors is connected to the battery.

7. A method for welding a pair of conductors, comprising: coating an area of at least one of the conductors with a cyanoacrylate glue; at least partially roughening the area prior to the coating, the conductors have a pair of surfaces facing each other, at least one of the surfaces is at least partially roughened in the area, a thickness of a layer including the cyanoacrylate glue is a maximum of double a surface roughness of the at least one of the surfaces; applying a material that impedes or prevents a hardening of the cyanoacrylate glue onto at least a subsection of the area; and welding the conductors onto one another with a plurality of laser pulses after the coating, the welding is conducted in the subsection of the area and a welding point produced by the welding is at least partially surrounded by the cyanoacrylate glue.

8. The method of claim 7, wherein the material is applied before or after the coating step.

9. The method of claim 8, wherein the welding step occurs after applying the material.

10. The method of claim 7, further comprising exposing the cyanoacrylate glue to an activator.