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(54) ELECTRICAL-TERMINAL ASSEMBLY WITH THERMAL MONITORING

(57) A terminal-assembly (10) includes a wire-cable (12), an electrical-terminal (18), a housing (40), and a temperature-sensor (60). The wire-cable (12) has an insulation-layer and an exposed-end (16). The electrical-terminal (18) has a first-end (20) and a second-end (22). The first-end (20) is bonded with the exposed-end (16). The first-end (20) defines a terminal-head (26) terminating at a first-shoulder (30). The first-end (20) further defines a shaft (34) extending from the first-shoulder (30) and terminating at a second-shoulder (36). The housing (40) has a skirt (42) that defines a first-cavity (44) and a cap (46) that defines a second-cavity (48). The first-end (20) is disposed within the first-cavity (44). The first-cavity (44) is isolated from the second-cavity (48) by a partition (54). The skirt (42) extends from the partition (54) along the mating-axis (28) and defines a slot (56) configured to slideably engage the terminal-head (26). The skirt (42) has locking-features (58) configured to releasably lock around the electrical-terminal (18) when the terminal-head (26) is fully inserted into the slot (56). The temperature-sensor (60) is disposed within the second-cavity (48) and is configured to detect a temperature of the electrical-terminal (18).

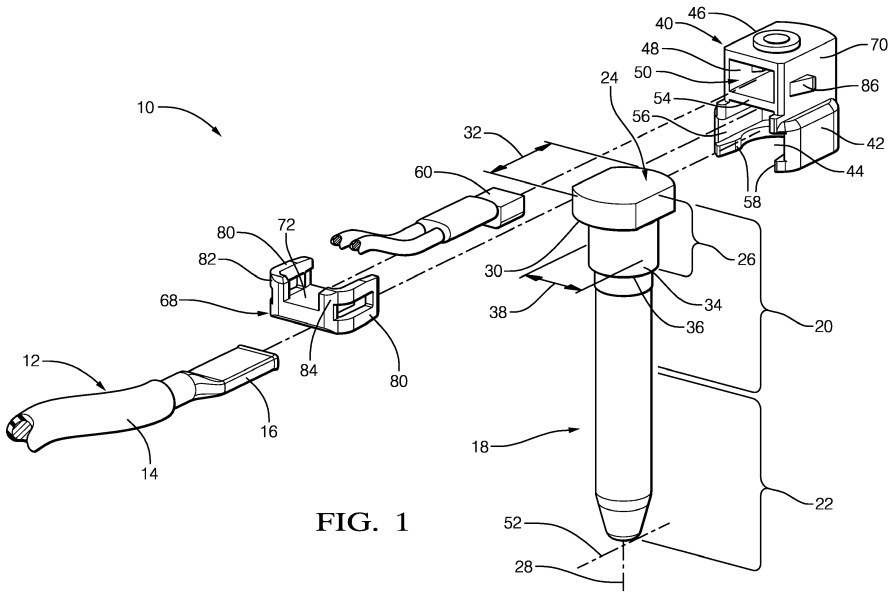

FIG. 1

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Description

TECHNICAL FIELD

[0001] The present invention relates generally to an electrical terminal assembly that determines a temperature of the terminal-assembly.

BACKGROUND OF THE INVENTION

[0002] The present invention relates more particularly to battery charging systems for electric vehicles where a temperature of the electrical-terminals may exceed a specified value, in a relatively short period of time, and cause damage to the charging system. A temperature rise may occur before the temperature sensing device measures the peak temperature due to a thermal latency of the electrical-terminals.

SUMMARY OF THE INVENTION

[0003] The present invention proposes to solve the above mentioned problem by providing a terminal-assembly that includes a wire-cable, an electrical-terminal, a housing, and a temperature-sensor. The wire-cable has an outer insulation-layer and an exposed-end extending beyond the outer insulation-layer. The electrical-terminal has a first-end and a second-end opposite the first-end. The first-end has a generally T-shape and defines an attachment-zone bonded with the exposed-end. The first-end further defines a terminal-head extending from the attachment-zone toward the second-end along a mating-axis of the electrical-terminal and terminating at a first-shoulder, the terminal-head having a generally cylindrical-shape defining a first-diameter. The first-end further defines a shaft extending from the first-shoulder toward the second-end along the mating-axis and terminating at a second-shoulder. The shaft has the generally cylindrical-shape and defines a second-diameter. The second-diameter is less than the first-diameter. The housing has a skirt that defines a first-cavity and a cap that defines a second-cavity overlaying the first-cavity, with the first-end disposed within the first-cavity. The cap defines an aperture aligned with a lateral-axis of the housing. The first-cavity is electrically isolated from the second-cavity by a partition extending along the lateral-axis. The partition overlays the exposed-end of the wire-cable. The skirt extends from the partition toward the second-end of the electrical-terminal along the mating-axis and defines a slot configured to slideably engage the terminal-head. The skirt has locking-features configured to releasably lock around the shaft when the terminal-head is fully inserted into the slot. The temperature-sensor is disposed within the second-cavity and extends through the aperture. The temperature-sensor is configured to detect a temperature of the electrical-terminal and is in direct contact with a first-portion of the partition.

[0004] According to other advantageous features of the present invention:

- the partition has a thickness of between 1.0mm and 1.5mm.
- an adhesive is interposed between and in direct contact with both the exposed-end of the wire-cable and the partition.
- the temperature-sensor is retained within the second-cavity with a locking-element configured to releasably-lock to an outer-surface of the housing.
- the locking-element includes a platform extending into the aperture and overlaying a second-portion of the partition, the platform defining a leading-edge in direct contact with a trailing-edge of the temperature-sensor, thereby inhibiting a removal of the temperature-sensor along the lateral-axis.
- a pair of opposed locking-tabs extend from a first-side and a second-side of the platform along the lateral-axis, the pair of opposed locking-tabs engaging a corresponding pair of locking-ramps extending from the outer-surface of the housing.
- the locking-element includes a flange that engages the housing at the aperture and inhibits a movement of the locking-element along the lateral-axis.
- the flange overlays an exposed-edge of the partition.
- the housing includes a plurality of guide-beams extending from a back-wall of the second-cavity along the lateral-axis, the plurality of guide-beams configured to inhibit a movement of the temperature-sensor along the mating-axis and along a longitudinal-axis orthogonal to both the mating-axis and the lateral-axis.
- the housing includes a stop extending from a back-wall of the second-cavity along the lateral-axis, the stop configured to inhibit a movement of the temperature-sensor along the lateral-axis.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] The present invention is now described by way of example with reference to the accompanying drawings in which:

- figure 1 is an exploded view of a terminal-assembly according to a preferred embodiment of the invention;
- figure 2a is a section view of the assembled terminal-assembly of figure 1;
- figure 2b is a magnified view of a portion of the terminal-assembly of figure 2a;
- figure 3 is a perspective view of a housing of the terminal-assembly of figure 1;
- figure 4a is a side view of the assembled terminal-assembly of figure 1;
- figure 4b is an end view of the assembled terminal-assembly of figure 1;
- figure 4c is a top perspective view of the assembled terminal-assembly of figure 1.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0006] Hereinafter, a terminal-assembly 10 for an electric vehicle battery charging system according to an embodiment of the present invention will be described with reference to the figures. Figure 1 is an exploded perspective view illustrating the overall structure of the terminal-assembly 10. The terminal-assembly 10 includes a wire-cable 12 having an outer insulation-layer 14 and an exposed-end 16 extending beyond the outer insulation-layer 14 (i.e., the outer insulation-layer 14 is stripped away exposing the underlying wire). The wire-cable 12 is preferably formed of an alloy of copper or aluminum and may include a conductive coating, such as tin. The wire-cable 12 may be a solid wire-cable 12, or may be a stranded wire-cable 12, and in the example illustrated in figure 1 is a stranded wire-cable 12.

[0007] The terminal-assembly 10 also includes an electrical-terminal 18 having a first-end 20 and a second-end 22 opposite the first-end 20. The electrical-terminal 18 is formed of a conductive material, such as an alloy of copper or aluminum, and may include the conductive coating tin. The first-end 20 has a generally T-shape and defines an attachment-zone 24 bonded (e.g., welded) with the exposed-end 16 of the wire-cable 12. The weld may be any type of weld that creates a metallurgical bond, and in the example illustrated in figure 1 is an ultrasonic weld.

[0008] The first-end 20 further defines a terminal-head 26 extending from the attachment-zone 24 toward the second-end 22 along a mating-axis 28 of the electrical-terminal 18 and terminating at a first-shoulder 30. The terminal-head 26 has a generally cylindrical-shape that defines a first-diameter 32. The terminal-head 26 also has opposed flattened sides to aid in an assembly of the terminal-assembly 10, as will be described in more detail below.

[0009] The first-end 20 further defines a shaft 34 extending from the first-shoulder 30 toward the second-end 22 along the mating-axis 28 and terminating at a second-shoulder 36. The shaft 34 also has the generally cylindrical-shape and defines a second-diameter 38 that is less than the first-diameter 32. In contrast to the terminal-head 26, the shaft 34 has a continuous circular cross section (i.e., no flat sides).

[0010] The terminal-assembly 10 also includes a housing 40. The housing 40 has a skirt 42 that defines a first-cavity 44 and a cap 46 that defines a second-cavity 48 overlaying the first-cavity 44, wherein the first-end 20 of the electrical-terminal 18 is disposed within the first-cavity 44 (see figure 2a). The housing 40 is formed of a polymeric dielectric material. The polymeric dielectric material may be any polymeric dielectric material capable of electrically isolating portions of the electrical-terminal 18, and is preferably a polyamide (NYLON). The polymeric dielectric material may include a fiber fill (glass or other fiber) to increase a temperature resistance and a strength of the housing 40.

[0011] The cap 46 defines an aperture 50 aligned with a lateral-axis 52 of the housing 40 configured to permit access to the second-cavity 48 along the lateral-axis 52. The first-cavity 44 is electrically isolated from the second-cavity 48 by a partition 54 extending along the lateral-axis 52 and overlays the exposed-end 16 of the wire-cable 12 (see figure 2a). In other words, the partition 54 forms a "ceiling" to the first-cavity 44 and forms a "floor" to the second-cavity 48, thereby creating a boundary between the first-cavity 44 and the second-cavity 48.

[0012] The skirt 42 extends from the partition 54 toward the second-end 22 of the electrical-terminal 18 along the mating-axis 28 and defines a slot 56 configured to slideably engage the opposed flattened sides of the terminal-head 26. The slot 56 exists on both sides of the skirt 42, as illustrated in figure 1. The skirt 42 has locking-features 58 configured to releasably lock around the shaft 34 when the terminal-head 26 is fully inserted into the slot 56. That is, the skirt 42 is configured to flex outwardly as the shaft 34 engages the locking-features 58 then returns to a neutral position locking around the shaft 34 when the electrical-terminal 18 is fully seated in the first-cavity 44.

[0013] A temperature-sensor 60 is disposed within the second-cavity 48 extending through the aperture 50 (see figure 2a). The temperature-sensor 60 may be any temperature-sensor 60 configured to detect a temperature of the electrical-terminal 18, and in the example illustrated in figure 1 is a 2-wire negative temperature coefficient type (NTC-type) temperature-sensor 60. The temperature-sensor 60 in direct contact with a first-portion 62 of the partition 54, as illustrated in figures 2a to 2b. The first-portion 62 of the partition 54 is distal to the aperture 50.

[0014] Figures 2a to 2b are section views of the assembled terminal-assembly 10 viewed along the mating-axis 28. The partition 54 has a thickness 64 of between 1.0mm and 1.5mm. The thickness 64 in this range has the technical benefit of electrically isolating the temperature-sensor 60 from the exposed-end 16 of the wire-cable 12, yet provides sufficient response-time for the temperature-sensor 60 to detect the temperature rise in the electrical-terminal 18. Preferably, an adhesive 66, such as an epoxy or other adhesive 66 suitable for the operating temperatures of the terminal-assembly 10 (that may be in excess of 125 degrees Celsius), is interposed between and in direct contact with both the exposed-end 16 of the wire-cable 12 and the partition 54, as illustrated in figure 2b. The adhesive 66 has the technical benefit of improving heat conduction between the exposed-end 16 and the partition 54, and improves the response-time for the temperature-sensor 60 to detect the temperature rise in the electrical-terminal 18. Preferably, any air-gap is eliminated by the presence of the adhesive 66.

[0015] Referring back to figure 1, the temperature-sensor 60 is retained within the second-cavity 48 with a locking-element 68 configured to releasably-lock to an outer-surface 70 of the housing 40. The locking-element 68 may be formed of the same polymeric material as the housing 40. The locking-element 68 includes a platform

72 extending into the aperture 50 and overlays a second-portion 74 of the partition 54, as illustrated in figure 2b. The second-portion 74 of the partition 54 is proximal to the aperture 50. The platform 72 defines a leading-edge 76 in direct contact with a trailing-edge 78 of the temperature-sensor 60, thereby inhibiting a removal of the temperature-sensor 60 along the lateral-axis 52 when the locking-element 68 is locked to the housing 40. A pair of opposed locking-tabs 80 extend from a first-side 82 and a second-side 84 of the platform 72 along the lateral-axis 52 and engage a corresponding pair of locking-ramps 86 extending from the outer-surface 70 of the housing 40. Referring again to figure 2b, the locking-element 68 includes a flange 88 that engages the housing 40 at the aperture 50 and overlays an exposed-edge 90 of the partition 54 that inhibits a movement of the locking-element 68 along the lateral-axis 52.

[0016] Figure 3 is a perspective view of the housing 40 isolated from the terminal-assembly 10 and illustrates the internal surfaces of the first-cavity 44 and the second-cavity 48. The housing 40 includes a plurality of guide-beams 92 extending from a back-wall 94 of the second-cavity 48 along the lateral-axis 52. The plurality of guide-beams 92 are configured to inhibit a movement of the temperature-sensor 60 along the mating-axis 28, and movement along a longitudinal-axis 96 orthogonal to both the mating-axis 28 and the lateral-axis 52. Each of the plurality of guide-beams 92 include chamfers to assist in the insertion of the temperature-sensor 60 into the second-cavity 48. In addition to the plurality of guide-beams 92, the housing 40 also includes a stop 98 extending from the back-wall 94 along the lateral-axis 52 that is configured to inhibit the movement of the temperature-sensor 60 along the lateral-axis 52. It will be appreciated that the stop 98 of the housing 40 and the flange 88 of the locking-element 68 provide the technical benefit of maintaining a position of the temperature-sensor 60 within the second-cavity 48.

[0017] Figures 4a to 4b illustrate the assembled terminal-assembly 10 in a side view, and end view, and a top perspective view, respectively.

Claims

1. A terminal-assembly (10), comprising:

a wire-cable (12) having an outer insulation-layer (14) and an exposed-end (16) extending beyond the outer insulation-layer (14);
an electrical-terminal (18) having a first-end (20) and a second-end (22) opposite the first-end (20);
the first-end (20) having a generally T-shape and defining an attachment-zone (24) bonded with the exposed-end (16);
the first-end (20) further defining a terminal-head (26) extending from the attachment-zone (24) toward the second-end (22) along a mating-axis (28) of the electrical-terminal (18) and terminating at a first-shoulder (30), the terminal-head (26) having a generally cylindrical-shape defining a first-diameter (32);
the first-end (20) further defining a shaft (34) extending from the first-shoulder (30) toward the second-end (22) along the mating-axis (28) and terminating at a second-shoulder (36), the shaft (34) having the generally cylindrical-shape and defining a second-diameter (38), the second-diameter (38) less than the first-diameter (32);
a housing (40) having a skirt (42) that defines a first-cavity (44) and a cap (46) that defines a second-cavity (48) overlaying the first-cavity (44), the first-end (20) disposed within the first-cavity (44);
the cap (46) defining an aperture (50) aligned with a lateral-axis (52) of the housing (40);
the first-cavity (44) electrically isolated from the second-cavity (48) by a partition (54) extending along the lateral-axis (52), the partition (54) overlaying the exposed-end (16) of the wire-cable (12);
the skirt (42) extending from the partition (54) toward the second-end (22) of the electrical-terminal (18) along the mating-axis (28) and defining a slot (56) configured to slideably engage the terminal-head (26);
the skirt (42) having locking-features (58) configured to releasably lock around the shaft (34) when the terminal-head (26) is fully inserted into the slot (56);
characterized in that a temperature-sensor (60) is disposed within the second-cavity (48) extending through the aperture (50), the temperature-sensor (60) configured to detect a temperature of the electrical-terminal (18), the temperature-sensor (60) in direct contact with a first-portion (62) of the partition (54).

2. The terminal-assembly (10) in accordance with claim 1, **characterized in that** the partition (54) has a thickness (64) of between 1.0mm and 1.5mm.

3. The terminal-assembly (10) in accordance with any one of the preceding claims, **characterized in that** an adhesive (66) is interposed between and in direct contact with both the exposed-end (16) of the wire-cable (12) and the partition (54).

4. The terminal-assembly (10) in accordance with any one of the preceding claims, **characterized in that** the temperature-sensor (60) is retained within the second-cavity (48) with a locking-element (68) configured to releasably-lock to an outer-surface (70) of the housing (40).

5. The terminal-assembly (10) in accordance with claim 4, **characterized in that** the locking-element (68) includes a platform (72) extending into the aperture (50) and overlaying a second-portion (74) of the partition (54), the platform (72) defining a leading-edge (76) in direct contact with a trailing-edge (78) of the temperature-sensor (60), thereby inhibiting a removal of the temperature-sensor (60) along the lateral-axis (52).

6. The terminal-assembly (10) in accordance with claim 5, **characterized in that** a pair of opposed locking-tabs (80) extend from a first-side (82) and a second-side (84) of the platform (72) along the lateral-axis (52), the pair of opposed locking-tabs (80) engaging a corresponding pair of locking-ramps (86) extending from the outer-surface (70) of the housing (40).

7. The terminal-assembly (10) in accordance with any one of claims 4 to 6, **characterized in that** the locking-element (68) includes a flange (88) that engages the housing (40) at the aperture (50) and inhibits a movement of the locking-element (68) along the lateral-axis (52).

8. The terminal-assembly (10) in accordance with claim 7, **characterized in that** the flange (88) overlays an exposed-edge (90) of the partition (54).

9. The terminal-assembly (10) in accordance with any one of the preceding claims, **characterized in that** the housing (40) includes a plurality of guide-beams (92) extending from a back-wall (94) of the second-cavity (48) along the lateral-axis (52), the plurality of guide-beams (92) configured to inhibit a movement of the temperature-sensor (60) along the mating-axis (28) and along a longitudinal-axis (96) orthogonal to both the mating-axis (28) and the lateral-axis (52).

10. The terminal-assembly (10) in accordance with any one of the preceding claims, **characterized in that** the housing (40) includes a stop (98) extending from a back-wall (94) of the second-cavity (48) along the lateral-axis (52), the stop (98) configured to inhibit a movement of the temperature-sensor (60) along the lateral-axis (52).

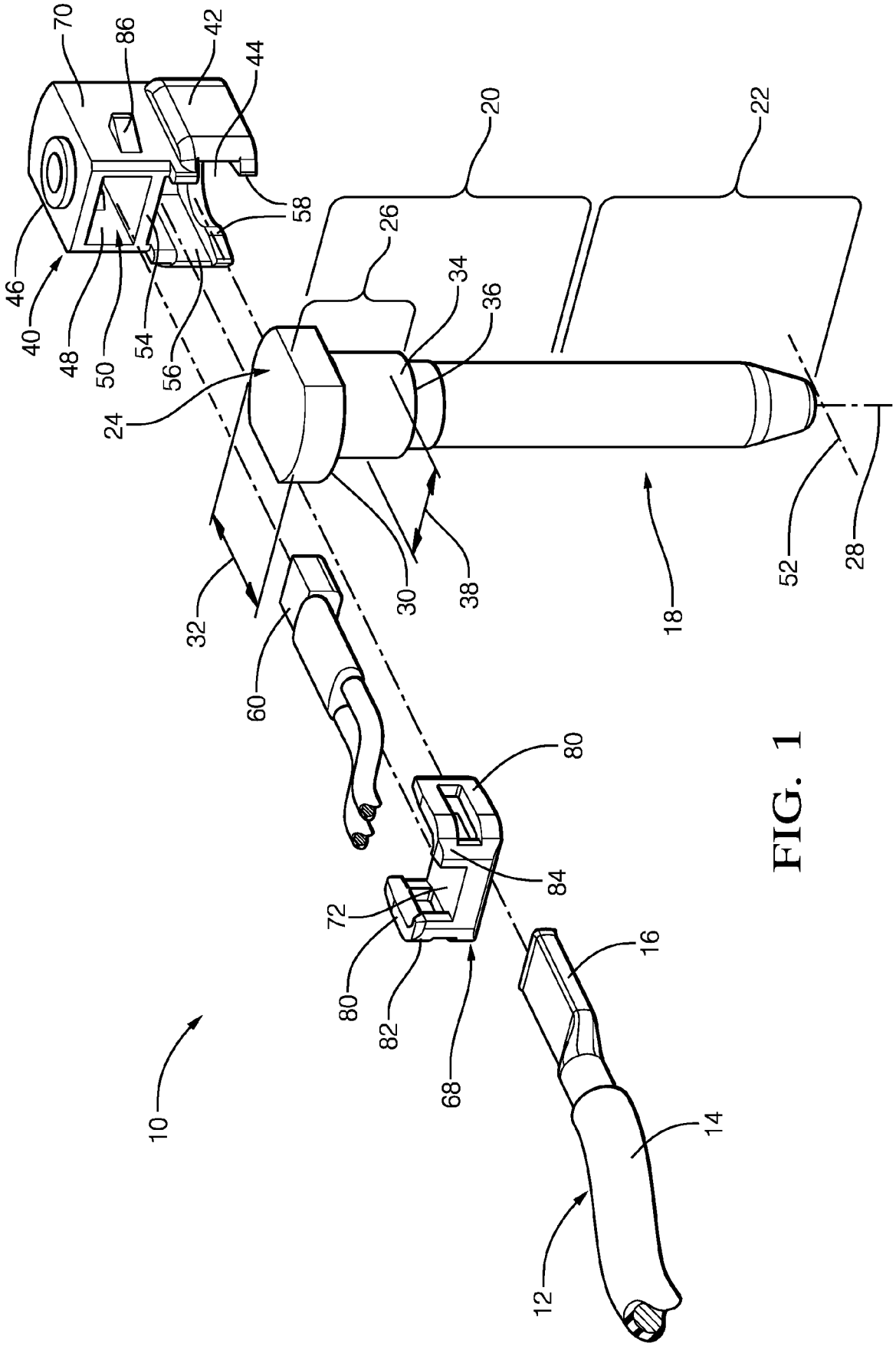
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FIG. 1

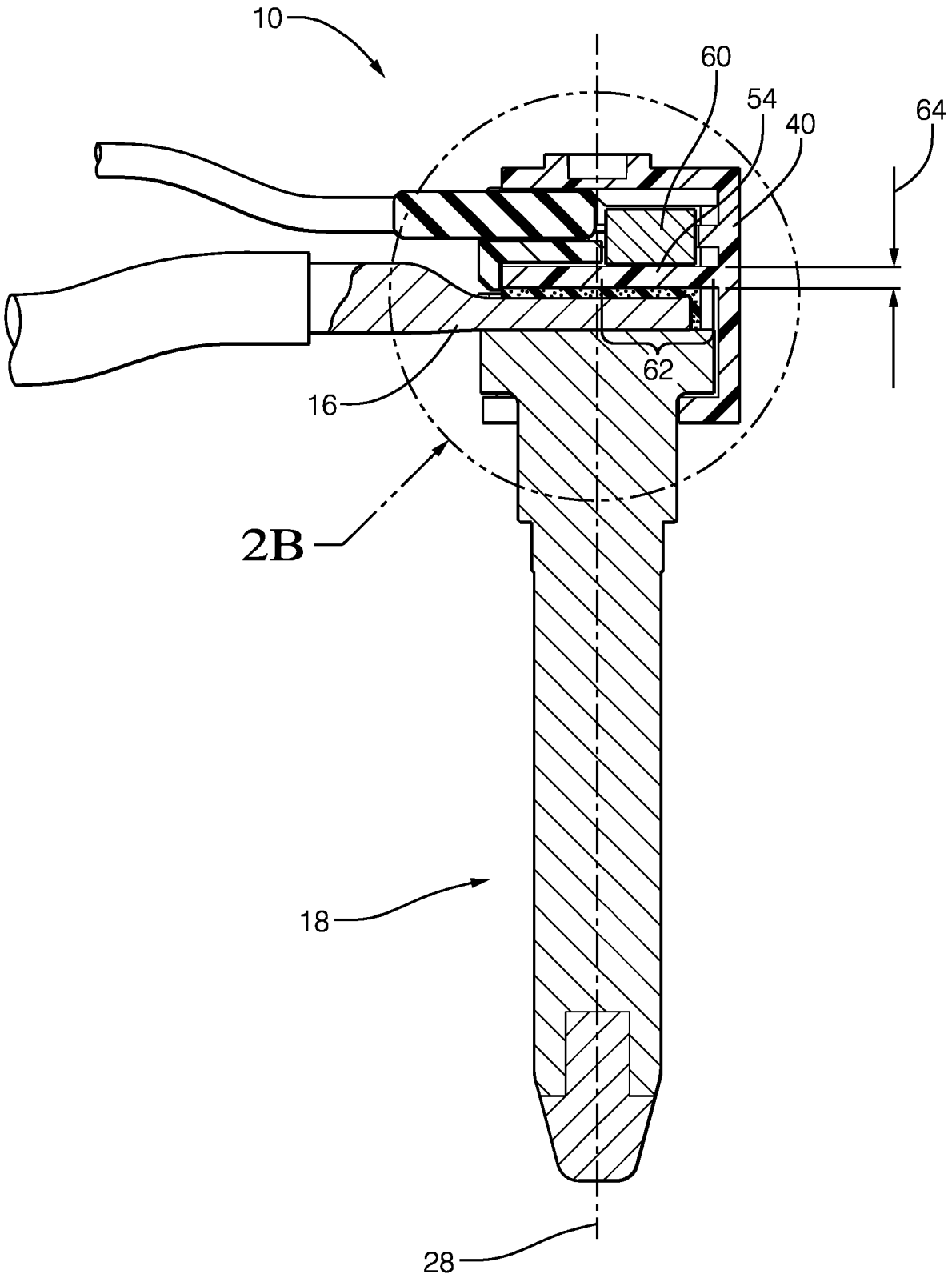

FIG. 2A

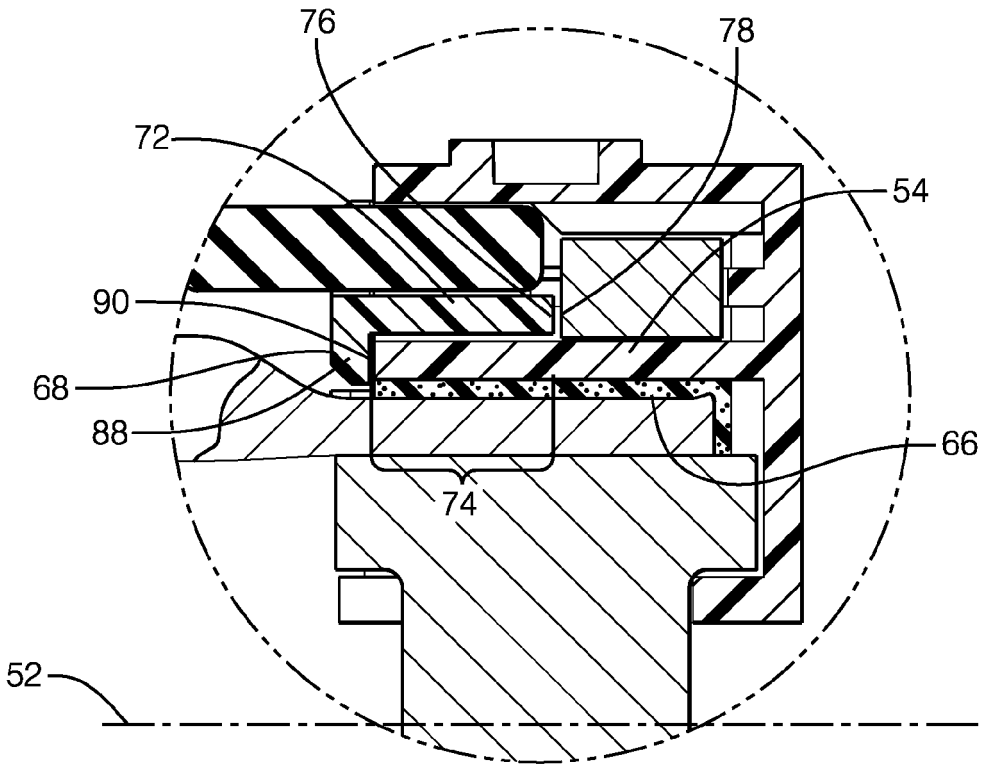
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FIG. 2B

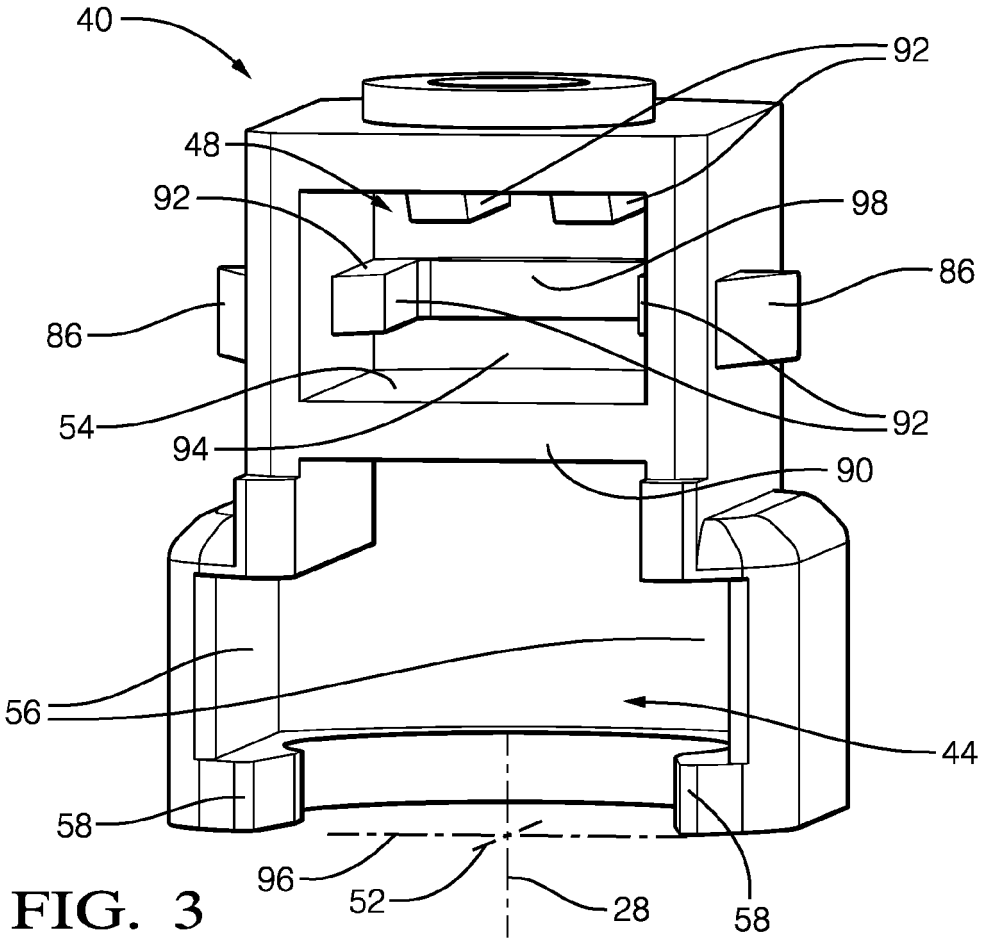
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FIG. 3

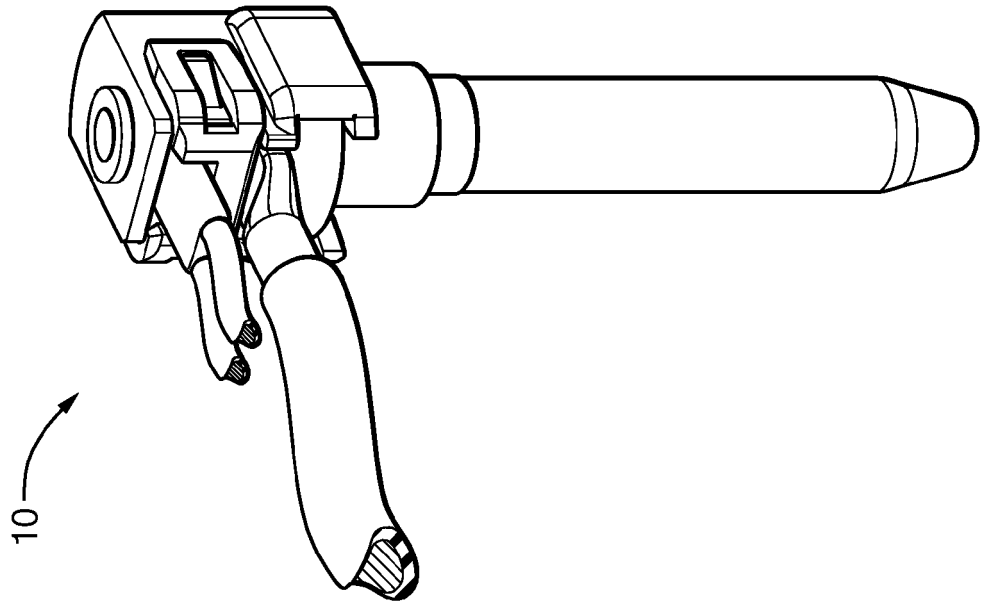

FIG. 4C

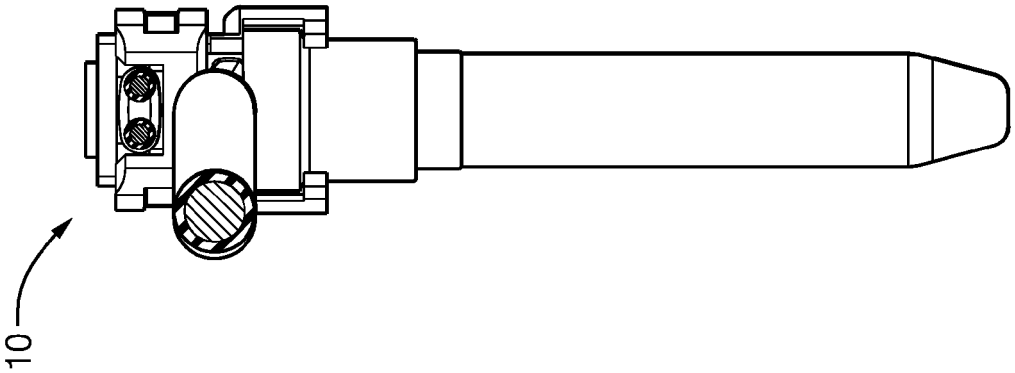

FIG. 4B

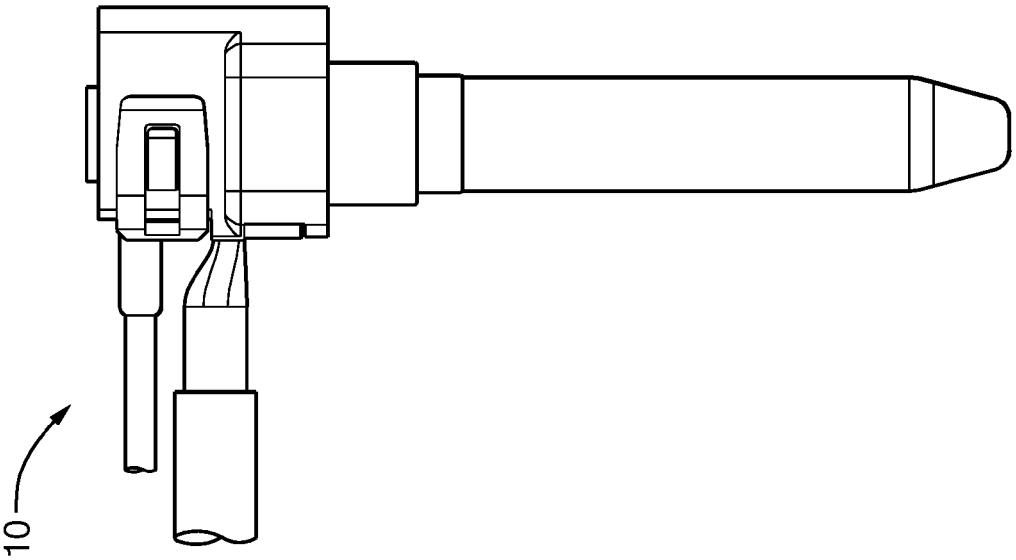

FIG. 4A

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EUROPEAN SEARCH REPORT

Application Number
EP 18 20 2924

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	EP 3 190 396 A1 (YAZAKI NORTH AMERICA INC [US]) 12 July 2017 (2017-07-12) * column 4, paragraph 31 - column 7, paragraph 44; figures 1-12 * -----	1-10	INV. H01R13/66 H01R13/422 ADD. H01R11/11 H01R13/02 H01R13/05 H01R13/506
A	EP 2 738 562 A1 (ISABELLENHÜTTE HEUSLER GMBH & CO KG [DE]) 4 June 2014 (2014-06-04) * column 6, paragraph 35 - column 8, paragraph 49; figures 1-2E * -----	1-10	

TECHNICAL FIELDS SEARCHED (IPC)

H01R
G01R

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	28 February 2019	Gomes Sirenkov E M.

CATEGORY OF CITED DOCUMENTS

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