US 20100139733A1

(19) **United States**

(12) **Patent Application Publication**

Jonczyk et al.

(10) **Pub. No.: US 2010/0139733 A1**

(43) **Pub. Date: Jun. 10, 2010**

(54) **FUSED WIRING HARNESS FOR A PHOTOVOLTAIC SYSTEM**

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(21) Appl. No.: **12/542,760**

(22) Filed: **Aug. 18, 2009**

Publication Classification

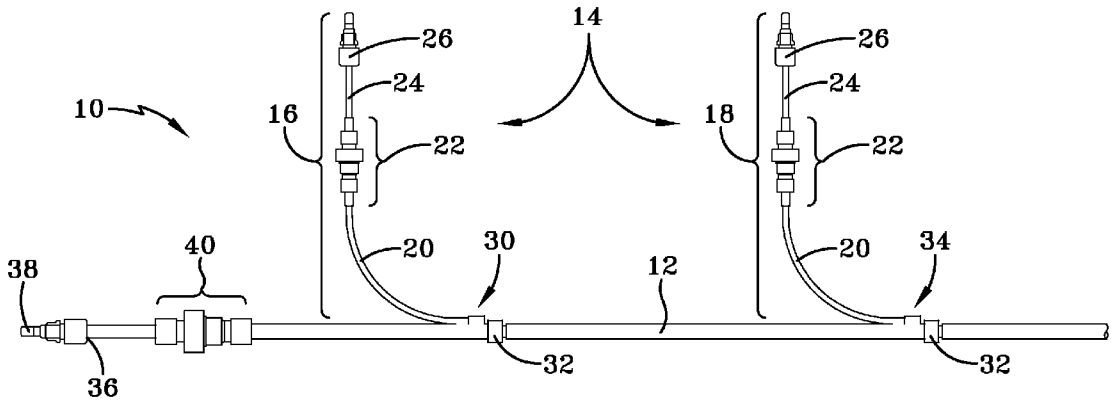
(51) **Int. Cl.**

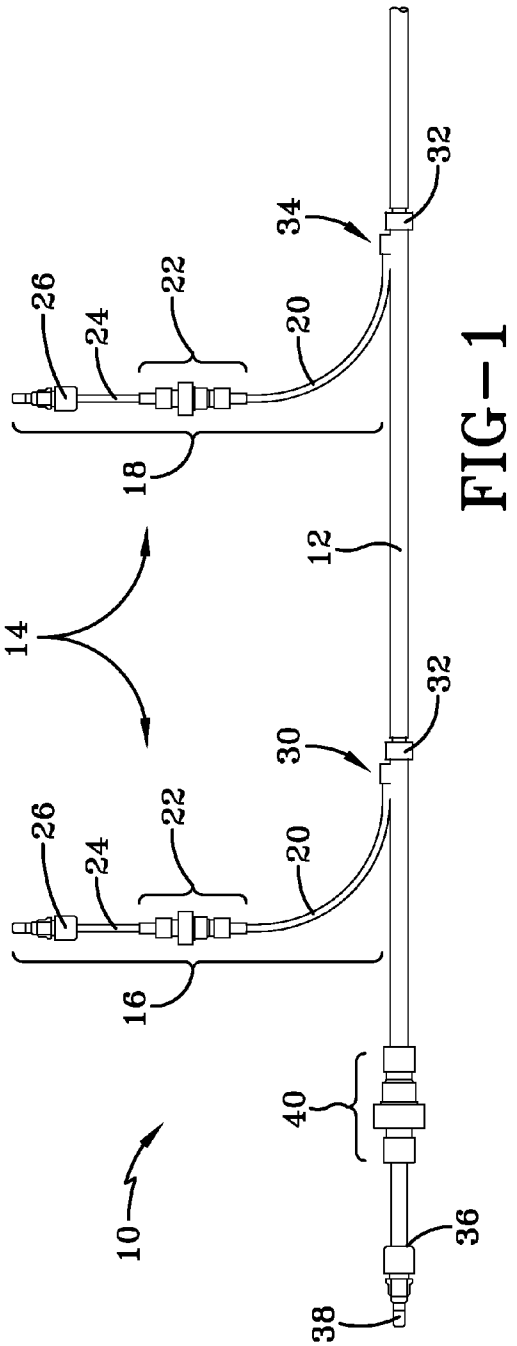
H01L 31/05	(2006.01)
H02B 1/20	(2006.01)
H01R 43/00	(2006.01)

(52) **U.S. Cl.** ..... **136/244**; 361/826; 29/825; 174/72 A

(57) **ABSTRACT**

A fused wiring harness having a fused wiring assembly and a second wiring assembly. The fused wiring assembly includes a first primary conductor, a first secondary fused conductor, and a second secondary fused conductor. The first secondary fused conductor is conductively connected to the first primary conductor at a first junction. The second secondary fused conductor is conductively connected to the first primary conductor at a second junction. The second wiring assembly includes a second primary conductor, a first secondary conductor, and a second secondary conductor. The first secondary conductor is conductively connected to the second primary conductor at a third junction. The fused wiring harness further includes a first overmold portion at least partially enveloping the first junction and the third junction, thereby securing the fused wiring assembly to the second wiring assembly.




10
12
14
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32
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38
40

FIG-1

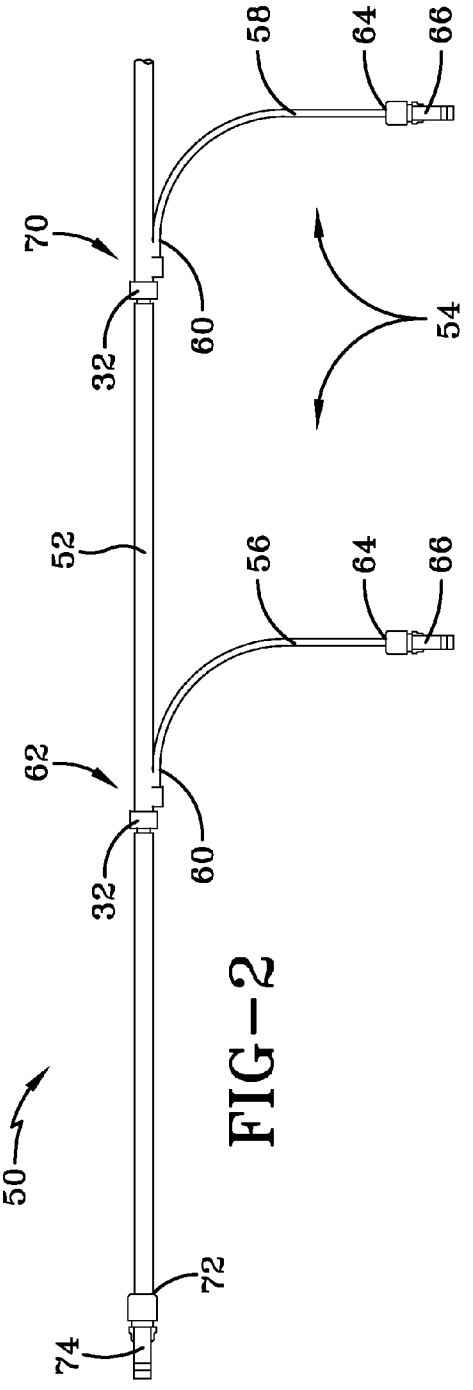
50
52
54
56
58
60
62
64
66
70
72
74

FIG-2

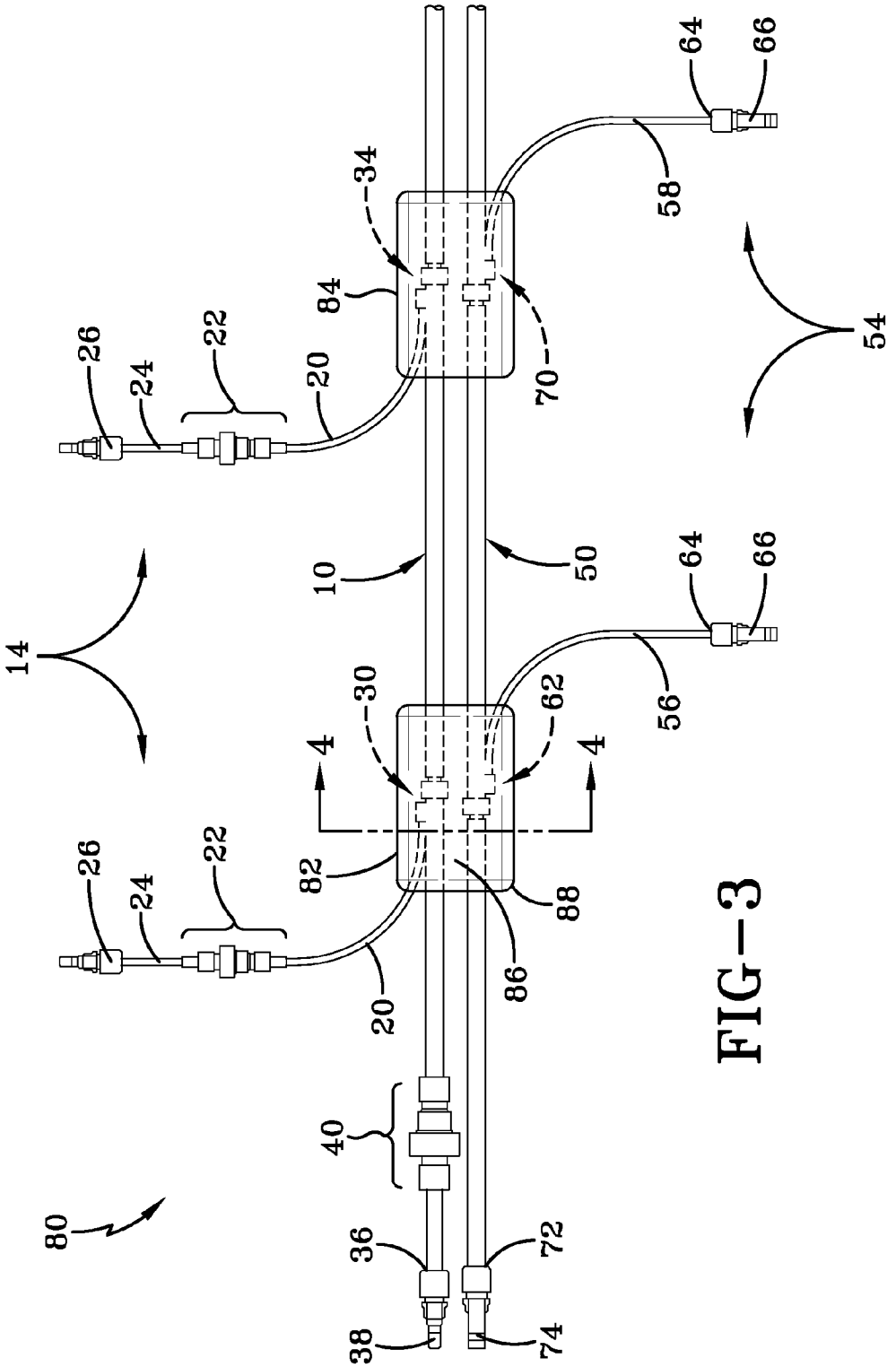
64
66
58
34
84
70
54
26
24
22
20
10
50
14
30
62
4
4
82
88
86
40
80
36
72
38
74

FIG-3

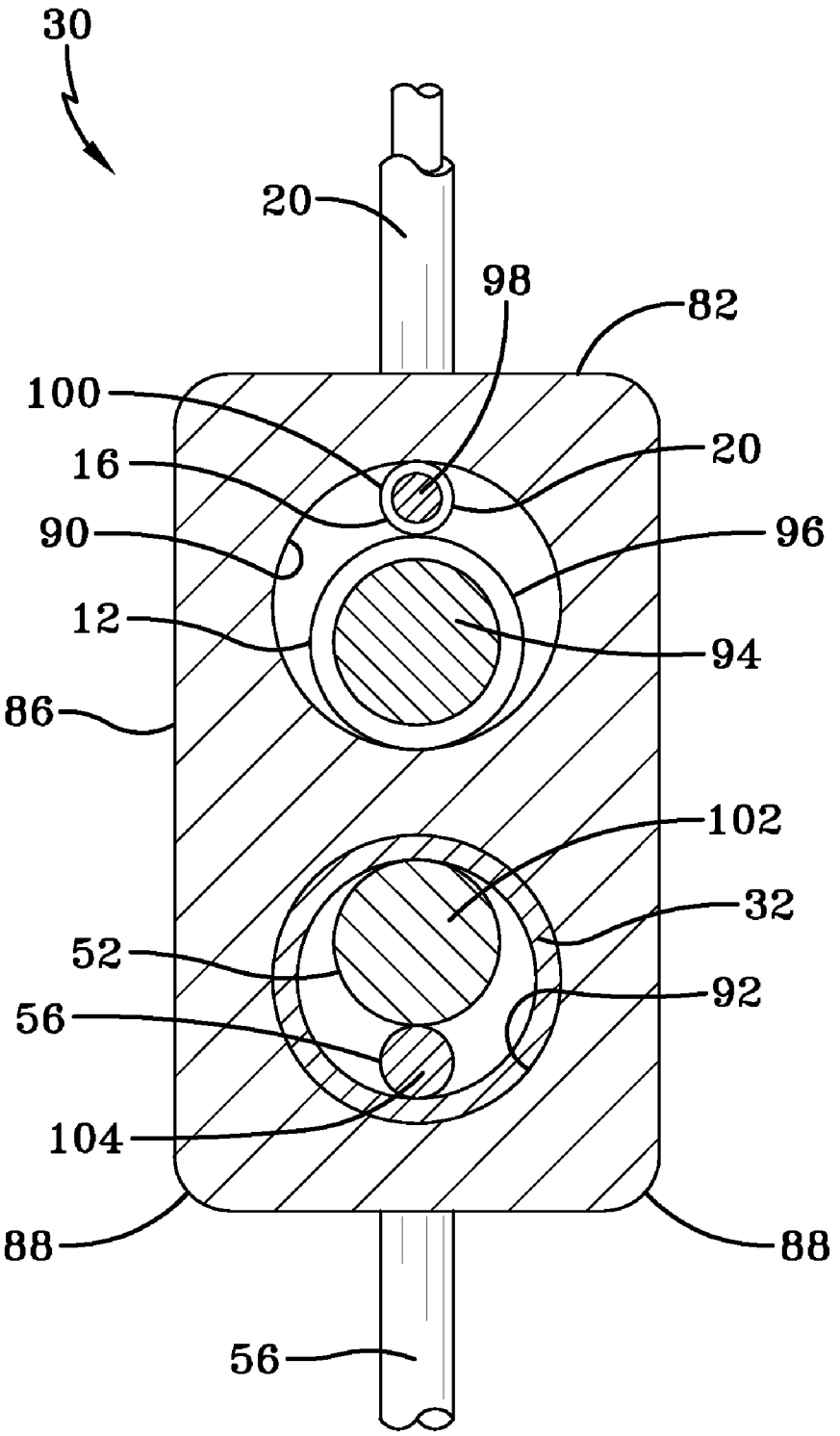

FIG-4

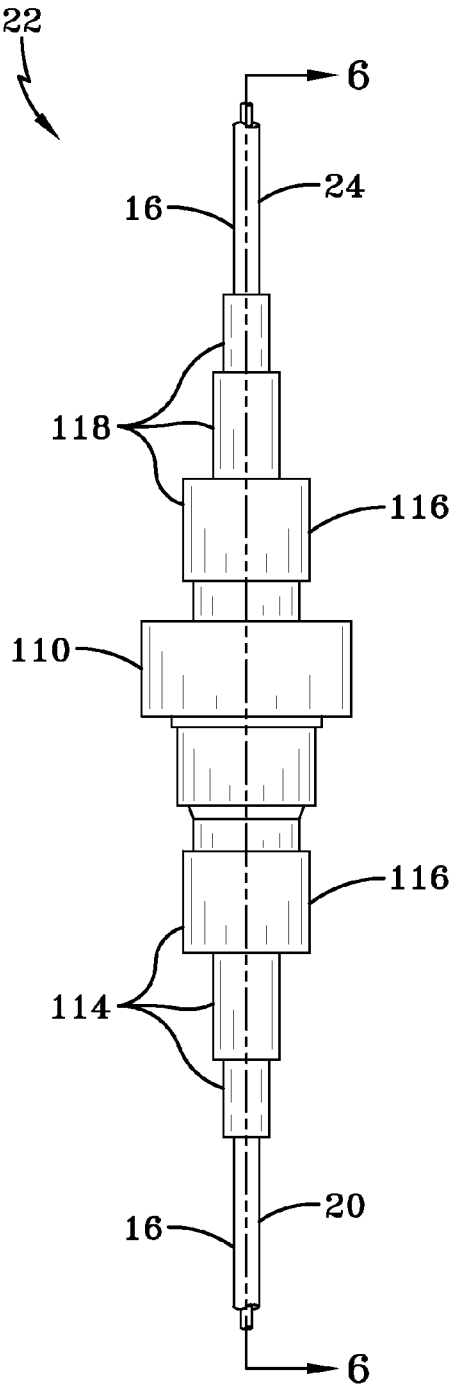
22
6
24
16
118
116
110
116
114
20
16
6

FIG-5

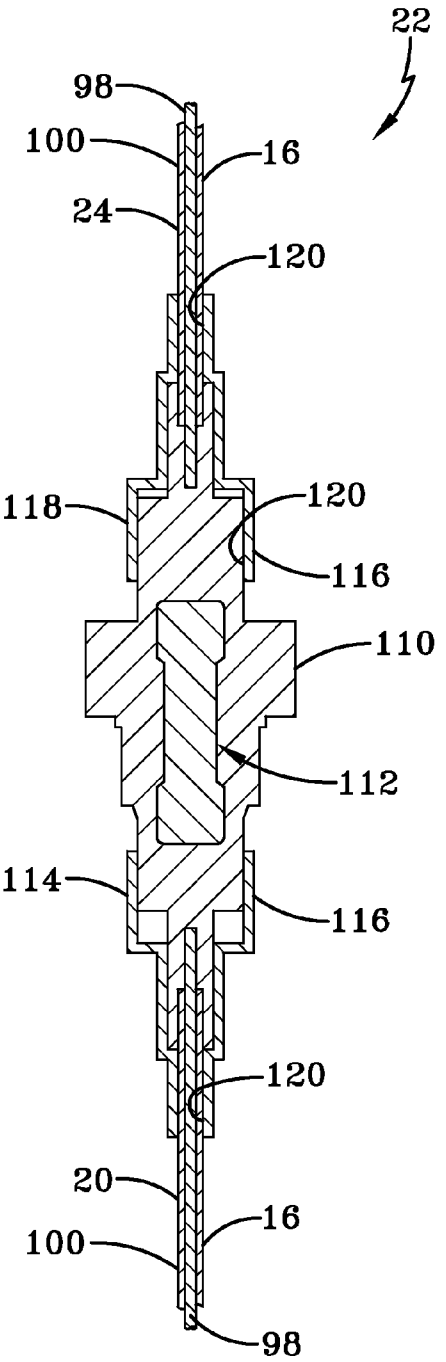
22
98
100
16
24
120
118
120
116
110
112
114
116
120
20
16
100
98

FIG-6

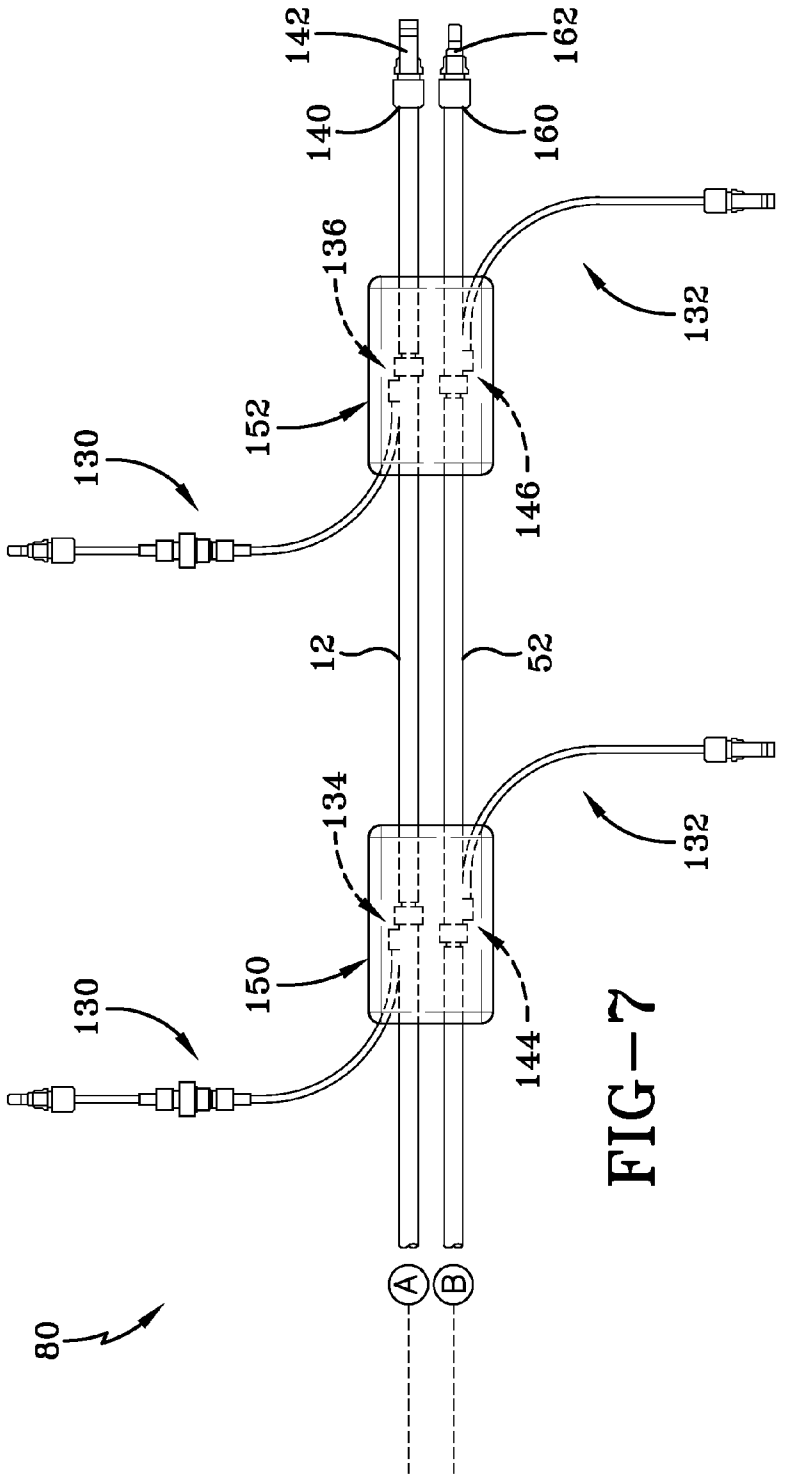
142
162
140
160
136
132
152
130
146
12
52
134
132
150
130
144
A
B
80

FIG-7

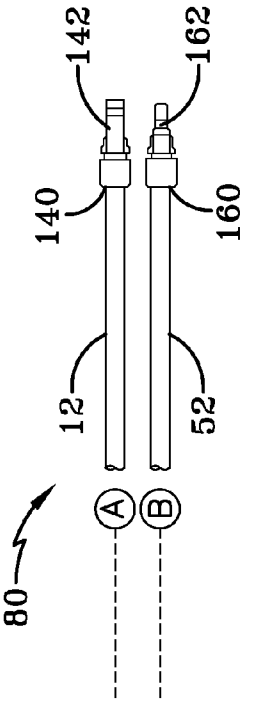
142
162
140
160
12
52
A
B
80

FIG-8

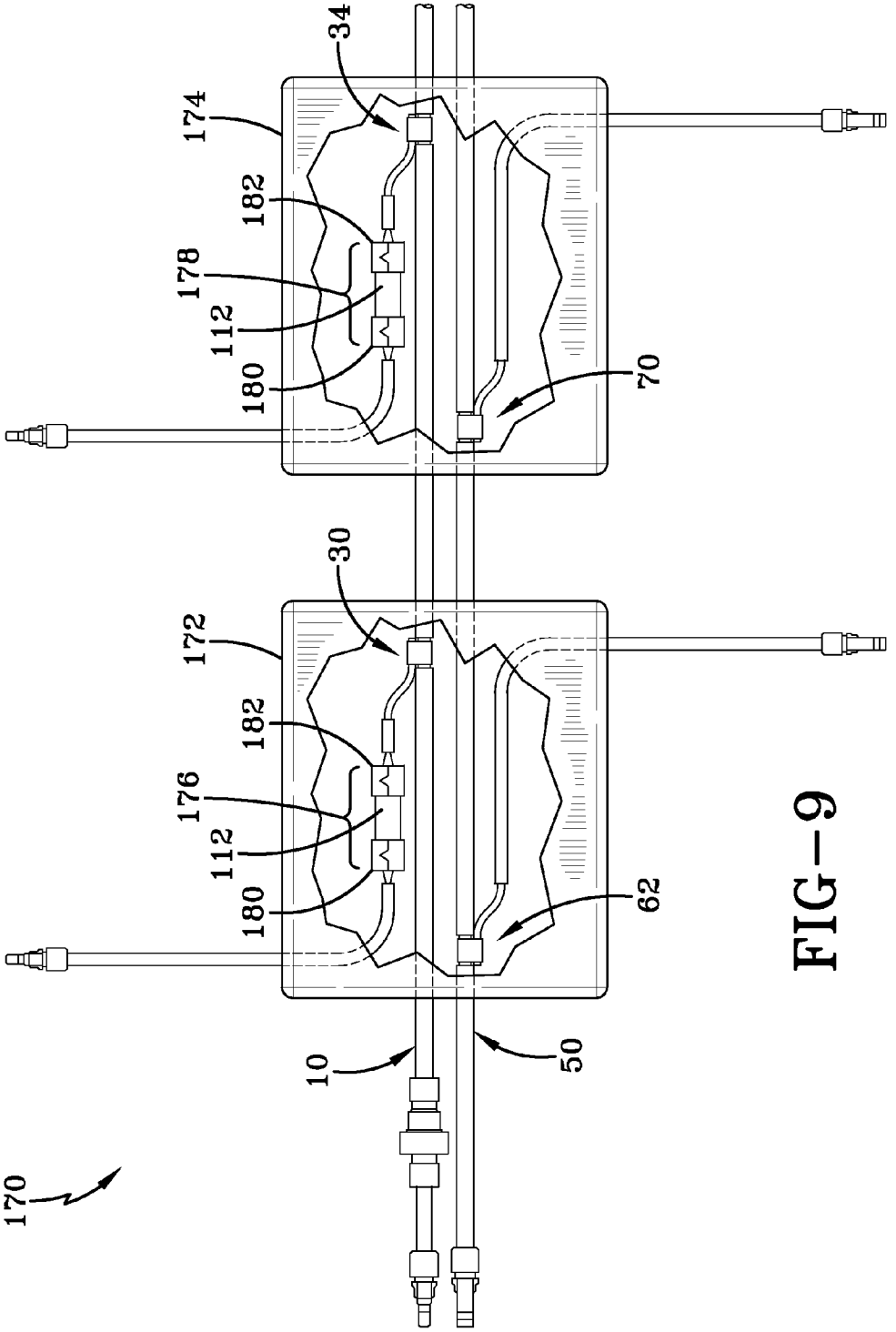

FIG-9

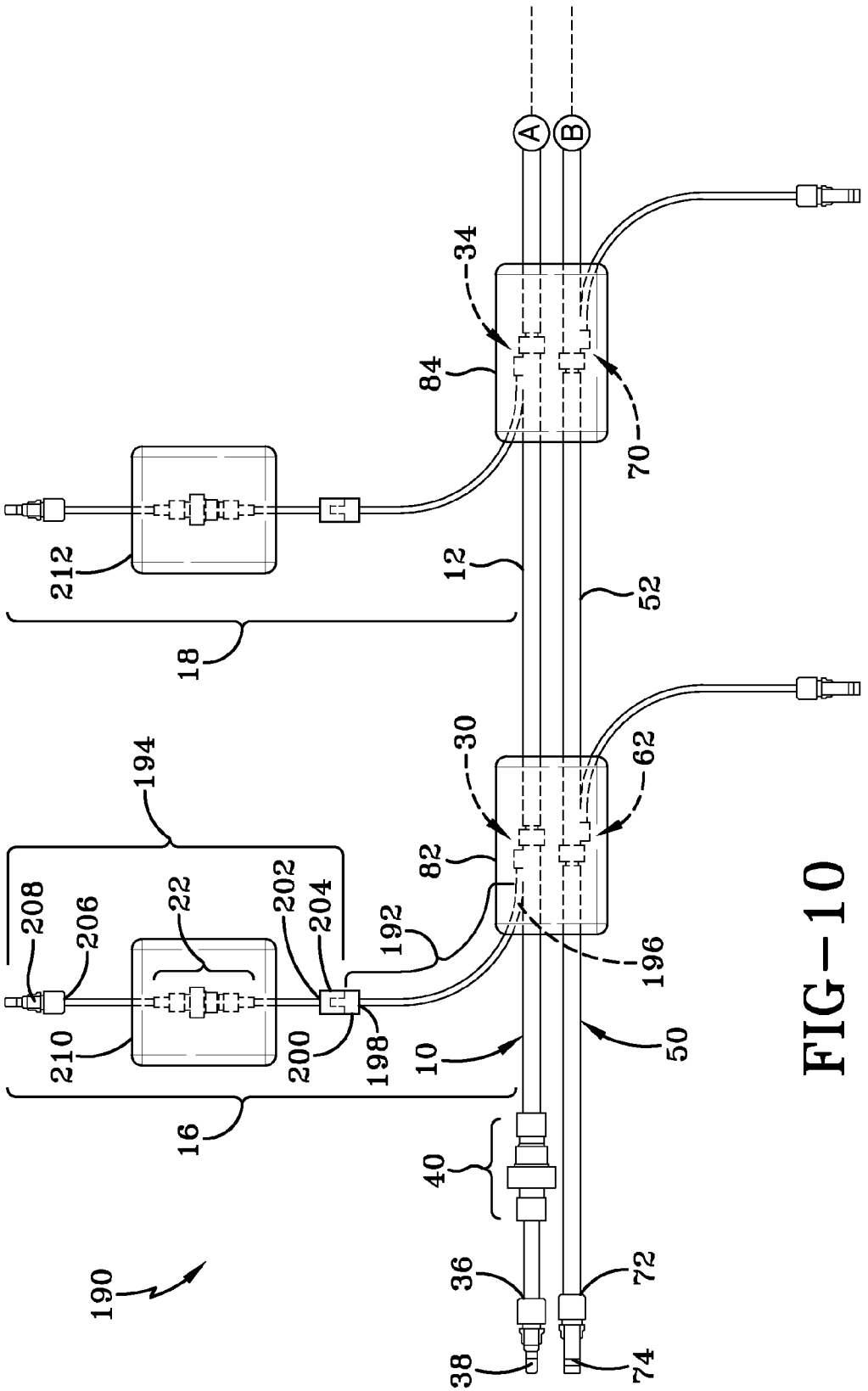
A
B
34
84
70
212
12
52
18
194
30
62
82
208
206
22
202
204
192
196
210
200
198
10
50
16
40
190
36
72
38
74

FIG-10

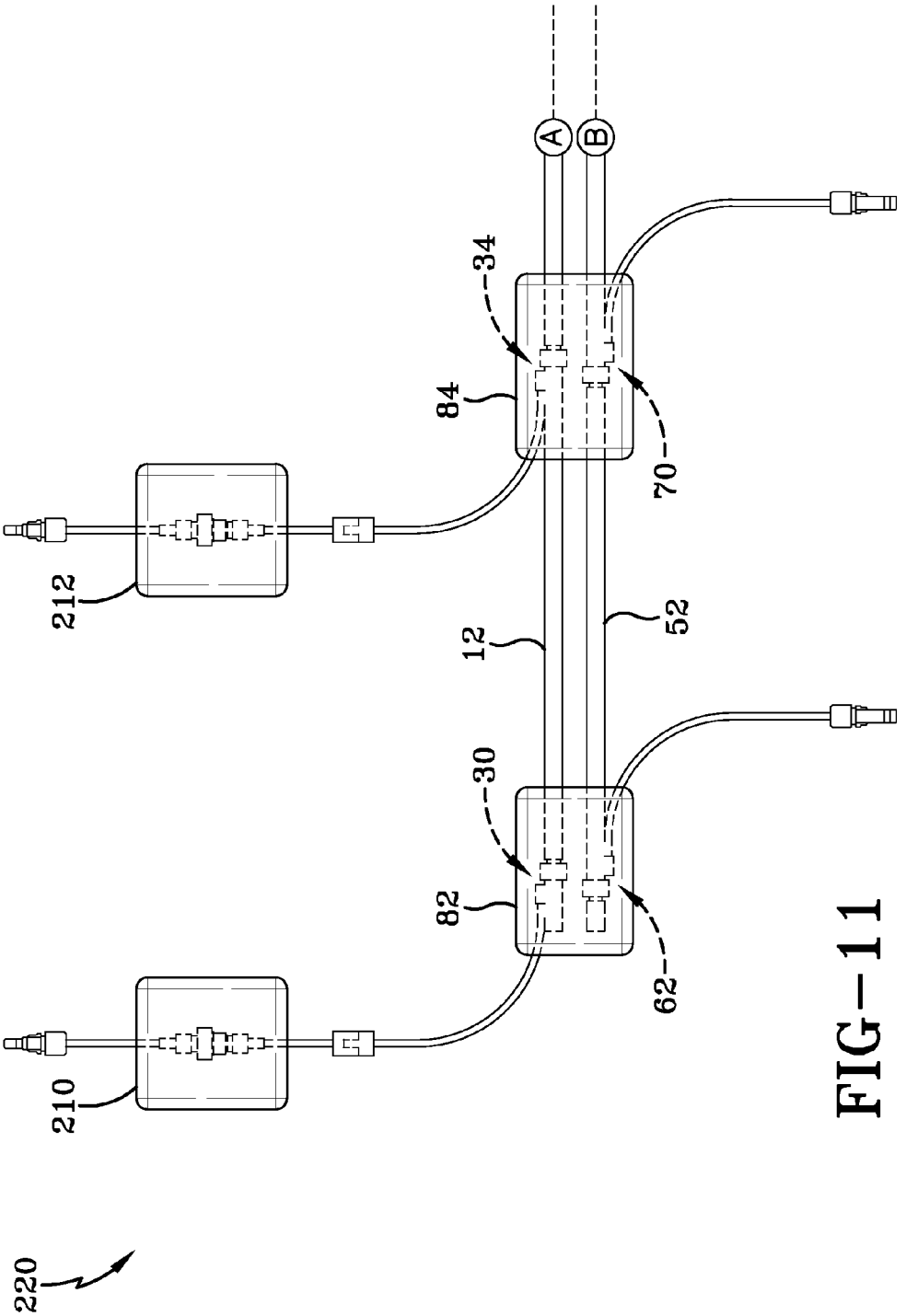

FIG-11

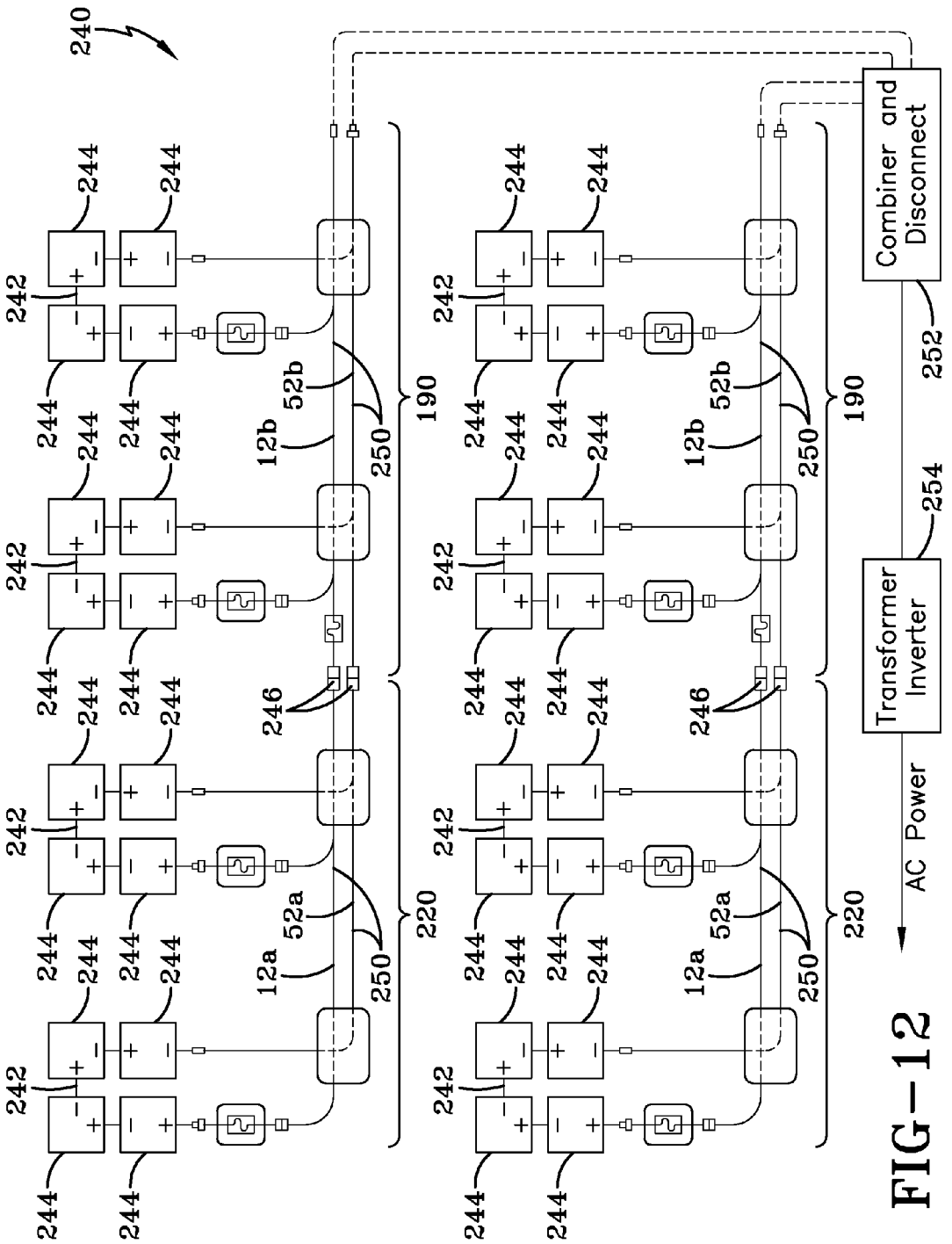
240
242
244
246
250
252
254
190
220
12a
12b
52a
52b
Combiner and Disconnect
Transformer Inverter
AC Power

FIG-12

FUSED WIRING HARNESS FOR A PHOTOVOLTAIC SYSTEM

FIELD OF THE INVENTION

[0001] The present disclosure is directed to a fused wiring harness for a photovoltaic system.

BACKGROUND

[0002] Large photovoltaic arrays are now being installed in the United States and have been installed in the European Union for some time. Recently, thin-film photovoltaic (PV) modules having a high voltage have been introduced. These PV modules present a challenge to the direct current (DC) collection system that collects the power output from each individual PV module and conducts it to the inverter, where it is inverted from DC to alternating current (AC) and subsequently fed to the power grid. More specifically, there is a voltage limit of 600V placed on the system by the National Electric Code (NEC) and to a lesser degree by inverter limitations. For many thin-film PV modules having a high voltage, as few as two of these modules can be connected in series, thus requiring the installation of several thousand individual circuits during the deployment of large photovoltaic arrays. Additionally, in many instances, there is a requirement that each of these individual circuits be protected by a fuse.

[0003] Accordingly, there is a need for a wiring harness for a PV system that protects each individual circuit and that provides for ease of installation during, for example, the deployment of large photovoltaic arrays.

SUMMARY

[0004] One aspect of the disclosure includes a fused wiring harness for a photovoltaic system. The fused wiring harness includes a fused wiring assembly and a second wiring assembly. The fused wiring assembly includes a first primary conductor, a first secondary fused conductor, and a second secondary fused conductor. The first secondary fused conductor, which is conductively connected to the first primary conductor at a first junction, includes a first connector that is configured to conductively connect to a first circuit comprising a photovoltaic module. The second secondary fused conductor, which is conductively connected to the first primary conductor at a second junction, includes a second connector, that is configured to conductively connect to a second circuit comprising a photovoltaic module. The second wiring assembly includes a second primary conductor, a first secondary conductor, and a second secondary conductor. The first secondary conductor, which is conductively connected to the second primary conductor at a third junction, includes a third connector that is configured to conductively connect to the first circuit comprising a photovoltaic module. The second secondary conductor, which is conductively connected to the second primary conductor at a fourth junction, includes a fourth connector that is configured to conductively connect to the second circuit comprising a photovoltaic module. The fused wiring harness further includes a first overmold portion at least partially enveloping the first junction and the third junction, thereby securing the fused wiring assembly to the second wiring assembly.

[0005] Another aspect of the present disclosure includes a photovoltaic system. The photovoltaic system includes a plurality of photovoltaic modules having at least a first photovoltaic module and a second photovoltaic module. The photovoltaic system further includes a fused wiring harness having a fused wiring assembly and a second wiring assembly. The fused wiring assembly includes a first primary conductor, a first secondary fused conductor, and a second secondary fused conductor. The first secondary fused conductor, which is conductively connected to the first primary conductor at a first junction, includes a first connector that is conductively connected to the first photovoltaic module. The second secondary fused conductor, which is conductively connected to the first primary conductor at a second junction, includes a second connector that is conductively connected to the second photovoltaic module. The second wiring assembly includes a second primary conductor, a first secondary conductor, and a second secondary conductor. The first secondary conductor, which is conductively connected to the second primary conductor at a third junction, includes a third connector that is conductively connected to the first photovoltaic module. The second secondary conductor, which is conductively connected to the second primary conductor at a fourth junction, includes a fourth connector that is conductively connected to the second photovoltaic module. The fused wiring harness further includes a first overmold portion at least partially enveloping the first junction and the third junction, thereby securing the fused wiring assembly to the second wiring assembly.

[0006] Still another aspect of the present disclosure includes a method for installing a photovoltaic system. The method includes providing a first circuit that includes a first photovoltaic module and providing a second circuit that includes a second photovoltaic module. The method further includes providing a fused wiring assembly. The fused wiring assembly includes a first primary conductor, a first secondary fused conductor, and a second secondary fused conductor. The first secondary fused conductor, which is conductively connected to the first primary conductor at a first junction, includes a first connector that is conductively connected to the first photovoltaic module. The second secondary fused conductor, which is conductively connected to the first primary conductor at a second junction, includes a second connector that is conductively connected to the second photovoltaic module. The second wiring assembly includes a second primary conductor, a first secondary conductor, and a second secondary conductor. The first secondary conductor, which is conductively connected to the second primary conductor at a third junction, includes a third connector that is conductively connected to the first photovoltaic module. The second secondary conductor, which is conductively connected to the second primary conductor at a fourth junction, includes a fourth connector that is conductively connected to the second photovoltaic module. The fused wiring harness further includes a first overmold portion at least partially enveloping the first junction and the third junction, thereby securing the fused wiring assembly to the second wiring assembly. The method includes connecting the first connector to the first circuit, connecting the second connector to the second circuit, connecting the third connector to the first circuit, and connecting the fourth connector to the second circuit.

[0007] An advantage of the present disclosure includes the ability to protect each individual circuit and the ability to provide for the relative ease of installation of large photovoltaic arrays by significantly reducing the wire length required, thereby conserving copper, and by reducing the number of field splices required.

[0008] Another advantage of the present disclosure includes the ability to combine current from several PV modules to more closely match the current carrying capacity of the wiring (12 AWG minimum per the NEC) used in conducting current generated by the PV modules.

[0009] Other features and advantages of the present disclosure will be apparent from the following more detailed description of the preferred embodiment, taken in conjunction with the accompanying drawings which illustrate, by way of example, the principles of the disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] FIG. **1** is a partial top view of an exemplary component of an embodiment of the fused wiring harness.

[0011] FIG. **2** is a partial top view of another exemplary component of the same embodiment of the fused wiring harness.

[0012] FIG. **3** is a partial top view of the embodiment of the fused wiring harness comprising the components shown respectively in FIGS. **1** and **2**.

[0013] FIG. **4** is an enlarged cross-section view, taken along lines **4-4** of FIG. **3**, of an exemplary first junction of the embodiment of the fused wiring harness.

[0014] FIG. **5** is an enlarged view of an exemplary secondary fused wiring assembly of the same embodiment of the fused wiring harness shown in FIG. **3**.

[0015] FIG. **6** is an enlarged cross-section view, taken along lines **6-6** of FIG. **5**, of the exemplary secondary fused wiring assembly.

[0016] FIG. **7** is a partial top view of an alternate embodiment of the fused wiring harness.

[0017] FIG. **8** is a partial top view of another alternate embodiment of the fused wiring harness.

[0018] FIG. **9** is a partial top view of another embodiment of the fused wiring harness comprising the exemplary components shown respectively in FIGS. **1** and **2**.

[0019] FIG. **10** is a partial top view of another embodiment of the fused wiring harness comprising the exemplary components shown respectively in FIGS. **1** and **2**.

[0020] FIG. **11**, which is alternatively supplemented by FIGS. **7** or **8**, is a partial top view of another embodiment of the fused wiring harness.

[0021] FIG. **12** is a schematic representation of a photovoltaic system comprising embodiments of the fused wiring harness.

[0022] Wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or like parts.

DETAILED DESCRIPTION OF THE INVENTION

[0023] The following detailed description includes references to the accompanying drawings, which form a part of the detailed description. The drawings show, by way of illustration, specific embodiments in which the disclosure may be practiced. These embodiments, which are also referred to herein as "examples," are described in enough detail to enable those skilled in the art to practice the disclosure. The embodiments may be combined, other embodiments may be utilized, or structural, logical and electrical changes may be made without departing from the scope of the present disclosure. The following detailed description is, therefore, not to be taken in a limiting sense, and the scope of the present disclosure is defined by the appended claims and their equivalents.

[0024] In this document, the terms "a" or "an" are used, as is common in patent documents, to include one or more than one. In this document, the term "or" is used to refer to a nonexclusive or, unless otherwise indicated.

[0025] FIGS. **1** and **2** respectively show two components of the fused wiring harness (see FIG. **3** at **80**): a fused wiring assembly **10** and an unfused wiring assembly **50**. Referring to FIG. **1**, fused wiring assembly **10** includes a first primary conductor **12** and a plurality of secondary fused conductors **14**. More specifically, the plurality of secondary fused conductors **14** includes without limitation a first secondary fused conductor **16** and a second secondary fused conductor **18**. First secondary fused conductor **16** includes, in series, a first segment **20**, a secondary fuse assembly **22**, a second segment **24**, and a secondary connector **26**. Secondary fuse assembly **22** connects first segment **20** and second segment **24**, and second segment **24** connects secondary fuse assembly **22** to secondary connector **26**. Stated another way, first secondary fused conductor **16** includes an in-line fuse, meaning that conductor **16** includes a fuse in series between two portions of the same conductor. More generally, as used herein, the adjective "fused" means that the referenced conductor or wiring assembly includes an in-line fuse. The adjective "unfused" means that the referenced conductor or wiring assembly does not include an in-line fuse. First segment **20** conductively connects to first primary conductor **12** at a first junction **30**, which in the example shown in FIG. **1**, is effected by a crimp barrel **32** or other suitable cable joint. Alternatively, other techniques or components may be used to conductively connect first segment **20** of first secondary fused conductor **16** to first primary conductor **12**. Exemplary techniques or components include soldering, screw terminals, welding, and splicing. While not so limited, an exemplary primary conductor is 8 AWG (American Wire Gauge) USE-2 (Underground Service-Entrance Type 2) PV wire that has a voltage rating of at least 600 V. Wiring of this type may be insulated by either PVC (polyvinyl chloride) or XLPE (cross-linked polyethylene) and is heat resistant, moisture resistant, and sunlight resistant. While not so limited, an exemplary secondary conductor is 10 AWG or 12 AWG USE-2 PV wire that has a voltage rating of at least 600 V. Wiring of this type may be insulated by either PVC (polyvinyl chloride) or XLPE (cross-linked polyethylene) and is heat resistant, moisture resistant, and sunlight resistant. Secondary connector **26** is configured to connect to a PV module and, preferably, is a male connector, as shown in FIG. **1**. An exemplary secondary connector **26** is a male latching connector that is compatible with 10 AWG or 12 AWG USE-2 or PV wire and has a current rating of 30 amps and a voltage rating of 1000V (600V UL). Exemplary contact materials for the male latching connector may include tin-plated copper.

[0026] Second secondary fused conductor **18** is substantially equivalent to first secondary fused conductor **16**. For example, second secondary fused conductor **18** includes, in series, a first segment **20**, a secondary fuse assembly **22**, a second segment **24**, and a connector **26**. First segment **20** of second secondary fused conductor **18** conductively connects to first primary conductor **12** at a second junction **34**, which, as shown in FIG. **1**, can be effected by a crimp barrel **32** or other suitable cable joint.

[0027] First primary conductor **12** includes a first end **36** having a first primary connector **38** and a second end (see, e.g., FIG. **7** at **140**), which is discussed later. An exemplary first primary connector **38** is a male latching connector that is

compatible with 8 AWG USE-2 or PV wire and has a current rating of 30 amps and a voltage rating of 1000V (600V UL). First primary conductor **38** includes a primary fuse assembly **40** proximate to first end **36**. More particularly, primary fuse assembly **40** is in series between first end **36** and first junction **30**. In turn, first junction **30** is in series between primary fuse assembly **40** and second junction **34**. An exemplary primary fuse for use in the primary fuse assembly **40** is a fast-acting 5A 600 VDC midget fuse. First primary connector **38** is configured to connect first end **36** of first primary conductor **12** to a primary conductor of another fused wiring assembly. Exemplary contact materials for the first primary connector **38** may include tin-plated copper. In another embodiment, first primary conductor **12** terminates at first junction **30** (see, e.g., FIG. **11**).

[0028] Referring to FIG. **2**, unfused wiring assembly **50** includes a second primary conductor **52** and a plurality of secondary unfused conductors **54**. Plurality of secondary unfused conductors **54** includes without limitation a first secondary unfused conductor **56** and a second secondary unfused conductor **58**. Second end **64** of first secondary unfused conductor **56** includes a connector **66**, which may include a female latching connector. First secondary unfused conductor **56** includes a first end **60** and a second end **62**. First end **60** conductively connects to second primary conductor **52** at a third junction **62**, which in the example shown in FIG. **2**, is effected by a crimp barrel **32** or other cable joint. Alternatively, similar to fused wiring assembly **10**, other techniques or components may be used to conductively connect first end **60** of first secondary unfused conductor **56** to second primary conductor **52**. Exemplary techniques or components include soldering, screw terminals, welding, and splicing. Similar to fused wiring assembly **10**, an exemplary primary conductor may be 8 AWG USE-2 PV wire having a voltage rating of at least 600 V. An exemplary secondary conductor may be 10 AWG or 12 AWG USE-2 PV wire having a voltage rating of at least 600 V. As in fused wiring assembly **10**, wiring is heat resistant, moisture resistant, and sunlight resistant, and may be insulated by either PVC (polyvinyl chloride) or XLPE (cross-linked polyethylene). Connector **66** is configured to connect to a PV module and, preferably, is a female connector, as shown in FIG. **2**. An exemplary connector **66** is a female latching connector that is compatible with 10 AWG or 12 AWG USE-2 or PV wire and has a current rating of 30 amps and a voltage rating of 1000V (600V UL). Exemplary contact materials for connector **66** may include tin-plated copper.

[0029] Second secondary unfused conductor **58** is substantially equivalent to first secondary unfused conductor **56**. For example, second secondary unfused conductor **58** includes a first end **60** and a second end **64**. First end **60** conductively connects to second primary conductor **52** at a fourth junction **70**, which in the example shown in FIG. **2**, is effected by a crimp barrel **32** or other cable joint. Second end **64** includes a connector **66**, preferably a female latching connector.

[0030] Second primary conductor **52** includes a first end **72** having a second primary connector **74** and a second end (see, e.g., FIG. **7** at **160**), which is discussed later. An exemplary second primary connector **74** is a female latching connector that is compatible with 8 AWG USE-2 or PV wire and has a current rating of 30 amps and a voltage rating of 1000V (600V UL). Third junction **62** is in series between first end **72** and fourth junction **70**. Unlike first primary conductor **12**, secondary primary conductor **52** does not include a fuse proximate to first end **72**. Second primary connector **74** is configured to connect first end **72** of second primary conductor **52** to a second primary conductor of another unfused wiring assembly. In another embodiment, second primary conductor **52** terminates at third junction **62** (see, e.g., FIG. **11**).

[0031] Referring to FIG. **3**, in which a fused wiring harness **80** is shown, fused wiring assembly **10** and unfused wiring assembly **50** are secured to one another by a first overmold portion **82** and a second overmold portion **84**. First overmold portion **82** at least partially envelops first junction **30** of fused wiring assembly **10** and third junction **62** of unfused wiring assembly **50**. Second overmold portion **84** at least partially envelops second junction **34** of fused wiring assembly **10** and fourth junction **70** of unfused wiring assembly **50**. The overmold portions **82**, **84** can be formed from a high-performance thermoplastic material such as a thermoplastic elastomer (TPE). Exemplary thermoplastic elastomers include, without limitation, thermoplastic vulcanizates (TPV). Suitable materials for overmolding are heat resistant, moisture resistant, and sunlight resistant. Preferably, first overmold portion **82** protects first junction **30** and third junction **62** from damage due to heat, moisture, and sunlight, especially in applications where fused wiring harness **80** is exposed to the weather. Second overmold portion **84** similarly protects second junction **34** and fourth junction **70** from such damage. Both first overmold portion **82** and second overmold portion **84** are approximately cuboid in geometry, although other geometries may be substituted. Preferably, as indicated in FIGS. **3** and **4**, the exterior surface **86** of first overmold portion **82** does not have a sharp corner or edge. Instead, exterior surface **86** has rounded edges **88** to reduce the risk of damage to the wiring in their proximity. Second overmold portion **84** is similar to first overmold portion **82** in this regard.

[0032] Referring to FIG. **4**, which is a cross-section view, first overmold portion **82** includes a first through-opening **90** and a second through-opening **92**. First primary conductor **12** and first segment **20** of first secondary fused conductor **16** are present within first through-opening **90**. The conductive core **94** and the insulative exterior **96** of first primary conductor **12** are visible in FIG. **4**, as are the conductive core **98** and the insulative exterior **100** of first secondary fused conductor **16**. Second primary conductor **52** and first secondary unfused conductor **56** are present within second through-opening **92**. Because line **4-4** of FIG. **3** intersects crimp barrel **32** of third junction **62**, crimp barrel **32** is visible in FIG. **4**. The conductive core **102** of second primary conductor **52** contacts the conductive core **104** of first secondary unfused conductor **56**, as the portions of these wires aligned with crimp barrel **32** are not insulated to yield a conductive connection. As stated previously, rounded edges **88** of exterior surface **86** of first overmold portion **82** are shown in FIG. **4**.

[0033] FIGS. **5** and **6** collectively show various components and features of secondary fuse assembly **22**. FIG. **5**, which is an enlarged view of secondary fuse assembly **22**, shows a fuse holder **110**. As shown in FIG. **6**, which is an enlarged section view, fuse holder **110** encloses a fuse **112**, thereby protecting fuse **112** from the environment and preventing contact by persons or objects, including other conductors, all of which could prematurely short fuse **112**. A first section **114** of shrink wrap **116** aids in securing first segment **20** of first secondary fused conductor **16** to fuse holder **110**. Similarly, a second section **118** of shrink wrap **116** aids in securing second segment **24** of first secondary fused conduc-

tor **16** to fuse holder **110**. Preferably, shrink wrap **116** includes an adhesive lining on an inner surface **120** (see FIG. **6**) to encourage a reliable and enduring connection. First secondary fused conductor **16** includes a conductive core **98** and an insulative exterior **100**, both of which are shown in FIG. **6**, in relation to both first segment **20** and second segment **24**. Primary fuse assembly **40** (see FIG. **1**) is substantially equivalent to secondary fuse assembly **22**. Primary fuse assembly **40** and secondary fuse assembly **22** may be waterproof and sunlight resistant.

[0034] FIGS. **7** and **8**, which relate to fused wiring harness **80** (see FIG. **3**), each show an option relating to a point (A) of first primary conductor **12** and a point (B) of second primary conductor **52**. As shown in FIG. **7**, embodiment **80** can include additional secondary fused conductors **130** and additional secondary unfused conductors **132**. Additional secondary fused conductors **130** are respectively conductively connected to first primary conductor **12** at a fifth junction **134** and a sixth junction **136**. Second end **140** includes a connector **142**, preferably a female latching connector as shown in FIG. **7**. Additional secondary unfused conductors **132** are respectively conductively connected to second primary conductor **52** at a seventh junction **144** and an eighth junction **146**. A third overmold portion **150** encloses fifth junction **134** and seventh junction **144**, and a fourth overmold portion **152** encloses sixth junction **136** and eighth junction **146**. Second end **160** of second primary connector **52** includes a connector **162**, preferably a male latching connector as shown in FIG. **7**.

[0035] Referring to FIG. **8**, which shows another option relating to a point (A) of first primary conductor **12** and a point (B) of second primary conductor **52** (see FIG. **3**), second end **140** of first primary conductor **12** and second end **160** of second primary conductor **52** terminate respectively in a female connector **142** and a male connector **162**. No additional secondary fused or unfused conductor is included.

[0036] FIGS. **7** and **8** in combination are intended to underscore an advantage of the fused wiring harness, specifically, that there is flexibility in the number of junctions, which is determined by the number of fused secondary conductors and corresponding unfused secondary conductors. In turn, this number can be influenced by the number of individual PV modules that can be connected in series in a single circuit without exceeding the final voltage, which is presently 600V in the United States. If a relatively large number of individual PV modules can be connected in a single circuit, then fewer junctions may be needed in the fused wiring harness. Contrarily, if only a relatively small number of individual PV modules can be connected in a single circuit without exceeding the final voltage (e.g., 600 V), then additional junctions in the fused wiring harness may be desirable. In these situations, a large plurality of fused wiring harnesses may be used to establish the necessary electrical connections. The final voltage even may be higher in some jurisdictions (e.g., 1000V), or a higher final voltage may be permissible provided there is compliance with more stringent sections of the NEC.

[0037] FIG. **9** shows another fused wiring harness **170**. As shown in FIG. **9**, fused wiring assembly **10** and unfused wiring assembly **50** are secured to one another by a first overmold portion **172** and a second overmold portion **174**. First overmold portion **172** at least partially envelops a first fuse assembly **176**, in addition to first junction **30** of fused wiring assembly **10** and third junction **62** of unfused wiring assembly **50**. Similarly, second overmold portion **174** at least partially envelops a second fuse assembly **178**, in addition to second junction **34** of fused wiring assembly **10** and fourth junction **70** of unfused wiring assembly **50**. An advantage of fused wiring harness **170** is that fuse assemblies **176**, **178** are afforded significant protection from heat, moisture, and/or sunlight. As shown in FIG. **9**, the protection afforded by the overmold portions is sufficient to render a fuse holder (see, e.g., FIG. **6** at **110**) and shrink wrap (see, e.g., FIG. **6** at **116**) unnecessary, potentially generating cost savings and increasing the ease of manufacture. Respective fuses **112** are secured by a first metal contact **180** and a second metal contact **182**, in combination.

[0038] FIG. **10** shows another fused wiring harness **190**. As in fused wiring harness **80** (see FIG. **3**), fused wiring assembly **10** and unfused wiring assembly **50** of fused wiring harness **190** are secured to one another by a first overmold portion **82** and a second overmold portion **84**. First overmold portion **82** at least partially envelops first junction **30** of fused wiring assembly **10** and third junction **62** of unfused wiring assembly **50**. Second overmold portion **84** at least partially envelops second junction **34** of fused wiring assembly **10** and fourth junction **70** of unfused wiring assembly **10**. Among the differences between fused wiring harness **190** and fused wiring harness **80** (see FIG. **3**) is that first secondary fused conductor **16** includes an unfused portion **192** and a detachable fused portion **194**. Unfused portion **192** includes a first end **196** that conductively connects to first primary conductor **12** and includes a second end **198** that terminates in a connector **200**, which may be a male connector, as shown in FIG. **10**. Detachable fused portion **194** includes a third end **202** having a corresponding connector **204**, which may be a female connector, configured to releasably connect to connector **200** of unfused portion **192**. Detachable fused portion **194** includes a fourth end **206** having a connector **208**, which may be a male connector, configured to connect to a PV module. Detachable fused portion **194** includes a fuse assembly **22** disposed in series between third end **202** and fourth end **206**. Fuse assembly **22** includes a fuse **112** enclosed in a fuse holder **110**, as previously discussed (see FIG. **6**). A first discrete fuse overmold portion **210** encloses and protects fuse assembly **22** and, preferably, does not significantly encroach third end **202** or fourth end **206** such as to inhibit a user from (1) detaching detachable fused portion **194** from unfused portion **192** by disengaging connectors **200**, **204** and (2) detaching detachable fused portion **194** from a PV module by disengaging connector **208** from the PV module. The foregoing features of embodiment **190** allow a user to readily replace fuse **112** (see FIG. **6**) by detaching detachable fused portion **194** and attaching a replacement detachable fused portion. In some instances, the protection afforded by first discrete fuse overmold portion **210** may be sufficient to render fuse holder **110** unnecessary, potentially generating cost savings and increasing the ease of manufacture. As shown in FIG. **10**, second secondary fused conductor **18** is substantially equivalent to first secondary fused conductor and includes a second discrete fuse overmold portion **212**.

[0039] FIG. **11** shows another fused wiring harness **220**, which is similar to fused wiring harness **190** shown and described above in the description of FIG. **10**. A significant difference between fused wiring harness **220** and fused wiring harness **190** is that, in fused wiring harness **220**, first primary conductor **12** terminates at first junction **30** and second primary conductor **52** terminates at third junction **62**. As

in fused wiring harness **80** (see FIG. **3**) both first junction **30** and third junction **62** are enclosed in first overmold portion **82**.

[0040] FIG. **12** is a simplified schematic representation showing fused wiring harness **190** (see FIG. **10**) and fused wiring harness **220** (see FIG. **11**) deployed in an exemplary PV system **240**. Fused wiring harness **220** is shown connected to two circuits **242**, each of which includes a series of four PV modules **244**. Similarly, fused wiring harness **190** is shown connected to two other circuits **242**, each of which also includes a series of four PV modules **244**. Fused wiring harness **220** is connected to fused wiring harness **190** at connection points **246**, allowing first primary conductors **12***a*, **12***b* and second primary conductors **52***a*, **52***b* to function as a bus line **250**. The electrical current resulting from capture of solar energy by the PV modules is conducted along bus line **250** to a combiner and disconnect **252**. Combiner **252** also receives electrical current from another bank of four PV modules, which are similarly connected to combiner by a duplicate fused wiring harness **220** and a duplicate fused wiring harness **190**. Current is conducted to a transformer inverter **254**, where it is converted from direct current (DC) to alternating (AC) power.

[0041] The embodiments of the fused wiring harness disclosed herein have been described as having certain connector types (e.g., male interlocking connector, female interlocking connector) at certain positions. The types of connectors and their positions, as identified in reference to these embodiments, are not intended to be limiting. For example, male connectors may be substituted for female connectors, while female connectors are substituted for male connectors. Additionally, other suitable electrical connectors, as will be identifiable by a person of ordinary skill in the relevant art, may be substituted in whole or in part.

[0042] While the invention has been described with reference to a preferred embodiment, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the scope of the invention. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the invention without departing from the essential scope thereof. Therefore, it is intended that the invention not be limited to the particular embodiment disclosed as the best mode contemplated for carrying out this invention, but that the invention will include all embodiments falling within the scope of the appended claims.

What is claimed is:

1. A fused wiring harness for a photovoltaic system, the fused wiring harness comprising:

a fused wiring assembly comprising:

a first primary conductor;

a first secondary fused conductor being conductively connected to the first primary conductor at a first junction, the first secondary fused conductor comprising a first connector, the first connector being configured to conductively connect to a first circuit comprising a photovoltaic module; and,

a second secondary fused conductor being conductively connected to the first primary conductor at a second junction, the second secondary fused conductor comprising a second connector, the second connector being configured to conductively connect to a second circuit comprising a photovoltaic module; and,

a second wiring assembly comprising:

a second primary conductor;

a first secondary conductor being conductively connected to the second primary conductor at a third junction, the first secondary conductor comprising a third connector, the third connector being configured to conductively connect to the first circuit comprising a photovoltaic module; and,

a second secondary conductor being conductively connected to the second primary conductor at a fourth junction, the second secondary conductor comprising a fourth connector, the fourth connector being configured to conductively connect to the second circuit comprising a photovoltaic module; and,

the fused wiring harness further comprising a first overmold portion at least partially enveloping the first junction and the third junction, thereby securing the fused wiring assembly to the second wiring assembly.

2. The fused wiring harness of claim **1**, wherein the first secondary fused conductor comprises a fuse that is enclosed within a fuse holder.

3. The fused wiring harness of claim **1**, wherein the first overmold portion at least partially envelops a fuse.

4. The fused wiring harness of claim **2**, wherein the first overmold portion at least partially envelops the fuse holder and the fuse.

5. The fused wiring harness of claim **1**, further comprising a discrete second overmold portion that at least partially envelops a fuse.

6. The fused wiring harness of claim **2**, further comprising a discrete second overmold portion that at least partially envelops the fuse holder and the fuse.

7. The fused wiring harness of claim **1**, further comprising a second overmold portion that at least partially envelops the second junction and the fourth junction.

8. The fused wiring harness of claim **1**, wherein the first primary conductor comprises a fifth connector, the fifth connector being configured to conductively connect to a device selected from the group consisting of a second fused wiring harness, a combiner, a disconnect, an inverter, and a transformer.

9. The fused wiring harness of claim **8**, wherein the first primary conductor further comprises a fuse disposed between a first end and the first junction, and wherein a sixth connector is attached to the first end, the sixth connector being configured to conductively connect to a third fused wiring harness.

10. The fused wiring harness of claim **1**, wherein the first secondary conductor is unfused.

11. The fused wiring harness of claim **1**, wherein the second wiring assembly is unfused.

12. A photovoltaic system comprising:

a plurality of photovoltaic modules comprising at least a first photovoltaic module and a second photovoltaic module;

a fused wiring harness comprising:

a fused wiring assembly comprising:

a first primary conductor;

a first secondary fused conductor being conductively connected to the first primary conductor at a first junction, the first secondary fused conductor comprising a first connector, the first connector being conductively connected to the first photovoltaic module; and,

a second secondary fused conductor being conductively connected to the first primary conductor at a second junction, the second secondary fused conductor comprising a second connector, the second connector being conductively connected to the second photovoltaic module; and,

a second wiring assembly comprising:

a second primary conductor;

a first secondary conductor being conductively connected to the second primary conductor at a third junction, the first secondary conductor comprising a third connector, the third connector being conductively connected to the first photovoltaic module; and,

a second secondary conductor being conductively connected to the second primary conductor at a fourth junction, the second secondary conductor comprising a fourth connector, the fourth connector being conductively connected to the second photovoltaic module; and,

the fused wiring harness further comprising a first overmold portion at least partially enveloping the first junction and the third junction, thereby securing the fused wiring assembly to the second wiring assembly.

13. The photovoltaic system of claim **12**, wherein the first primary conductor further comprises a fifth connector, the fifth connector being configured to conductively connect to a device selected from the group consisting of a second fused wiring harness, a combiner, a disconnect, an inverter, and a transformer.

14. The fused wiring harness of claim **13**, wherein the first primary conductor further comprises a fuse disposed between a first end and the first junction, and wherein a sixth connector is attached to the first end, the sixth connector being configured to conductively connect to a third fused wiring harness.

15. The fused wiring harness of claim **12**, wherein the second wiring assembly is unfused.

16. A method for installing a photovoltaic system, the method comprising:

providing a first circuit, the first circuit comprising a first photovoltaic module;

providing a second circuit, the second circuit comprising a second photovoltaic module;

providing a fused wiring harness comprising:

a fused wiring assembly comprising:

a first primary conductor;

a first secondary fused conductor being conductively connected to the first primary conductor at a first junction, the first secondary fused conductor comprising a first connector, the first connector being configured to conductively connect to the first circuit; and,

a second secondary fused conductor being conductively connected to the first primary conductor at a second junction, the second secondary fused conductor comprising a second connector, the second connector being configured to conductively connect to the second circuit; and,

a second wiring assembly comprising:

a second primary conductor;

a first secondary conductor being conductively connected to the second primary conductor at a third junction, the first secondary conductor comprising a third connector, the third connector being configured to conductively connect to the first circuit; and,

a second secondary conductor being conductively connected to the second primary conductor at a fourth junction, the second secondary conductor comprising a fourth connector, the fourth connector being configured to conductively connect to the second circuit; and,

the fused wiring harness further comprising a first overmold portion at least partially enveloping the first junction and the third junction, thereby securing the fused wiring assembly to the second wiring assembly;

connecting the first connector to the first circuit;

connecting the second connector to the second circuit;

connecting the third connector to the first circuit; and,

connecting the fourth connector to the second circuit.

17. The method of claim **16**, wherein the first primary conductor comprises a fifth connector, the fifth connector being configured to conductively connect to a device selected from the group consisting of a second fused wiring harness, a combiner, a disconnect, an inverter, and a transformer.

18. The method of claim **17**, further comprising:

providing the device selected from the group consisting of a second fused wiring harness, a combiner, a disconnect, an inverter, and a transformer; and,

connecting the fifth connector to the device.

19. The method of claim **18**, wherein the first primary conductor further comprises a fuse disposed between a first end and the first junction, and wherein a sixth connector is attached to the first end, the sixth connector being configured to conductively connect to a third fused wiring harness.

20. The method of claim **19**, further comprising:

providing the third fused wiring harness; and,

connecting the sixth connector to the third fused wiring harness.

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