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(54) Title: HIGH VOLTAGE ELECTRICAL CENTER WITH CONNECTORIZED BULKHEAD

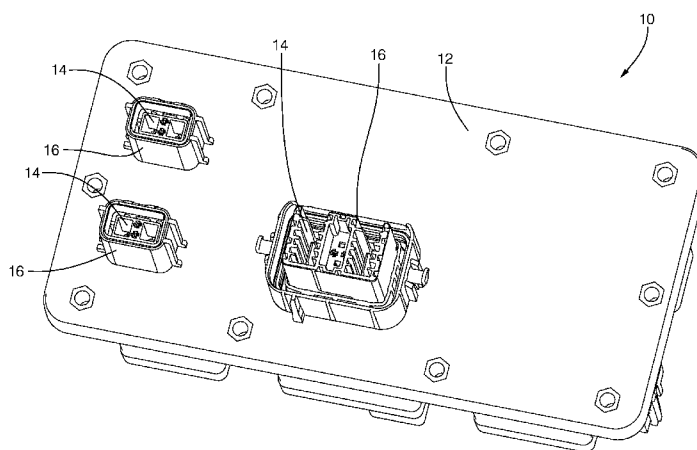


FIG. 2

(57) Abstract: An electrical assembly (10), such as a high voltage electrical center that controls the flow of electricity between a battery pack and the propulsion system of an electric or hybrid electric vehicle. The assembly (10) includes a plurality of electrical connectors (14) configured to receive and mate with a plurality of corresponding mating connectors and a housing containing a plurality of electrical devices interconnected to the plurality of electrical connectors (14). The housing includes a bulkhead (12) defining a plurality of connector shrouds that axially surrounds each connector in the plurality of electrical connectors (14). Each connector shroud is configured to receive a connector body of a corresponding mating connector. The plurality of connector shrouds is integral to the bulkhead (12). The bulkhead (12), and thereby the shrouds, may be formed of a composite conductive material containing electrically conductive fibers within a dielectric matrix.



HIGH VOLTAGE ELECTRICAL CENTER WITH CONNECTORIZED BULKHEAD

BACKGROUND OF THE INVENTION

[0001] Full electric and hybrid electric vehicles are equipped with a battery pack contained in a conductive housing, typically a metal box. The flow of power to and from the battery is switched on and off by and routed through a high voltage electrical center containing electrical devices such as relays, precontactors, fuses, and circuit boards. Among the functions of the housing is providing EMI shielding to and from these electrical devices. Shielded cables routed to vehicle devices powered by the battery must pass through the walls of the housing. Apertures that allow passage of cables through the walls of the housing must not reduce the shielding effectiveness of the box.

[0002] In some prior art battery packs, connector headers 1 were mounted by threaded fasteners 2 to a pattern of holes 3 cut through the wall 4 of the housing as shown in Fig. 1. The shielded header connectors 5 contained a conductive shield or “can” (not shown) which makes electrical contact to the conductive battery pack housing and the mating shielded connector thus closing or maintaining an electromagnetic shield over the connecting elements of the shielded connector.

[0003] The subject matter discussed in the background section should not be assumed to be prior art merely as a result of its mention in the background section. Similarly, a problem mentioned in the background section or associated with the subject matter of the background section should not be assumed to have been previously recognized in the prior

art. The subject matter in the background section merely represents different approaches, which in and of themselves may also be inventions.

BRIEF SUMMARY OF THE INVENTION

[0004] In accordance with one embodiment of this invention, an electrical assembly is provided. The electrical assembly includes a plurality of electrical connectors configured to receive and mate with a plurality of corresponding mating connectors and a housing containing a plurality of electrical devices interconnected to the plurality of electrical connectors. The housing includes a bulkhead that defines a plurality of connector shrouds. The plurality of connector shrouds axially surrounds each connector in the plurality of electrical connectors. Each connector shroud is configured to receive a connector body of a corresponding mating connector. The plurality of connector shrouds is integral to the bulkhead.

[0005] The bulkhead, and thereby the plurality of connector shrouds, is formed of a composite conductive material. The composite conductive material contains electrically conductive fibers within a dielectric matrix material.

[0006] In another embodiment of the present invention, a battery pack assembly is provided. The battery pack assembly includes a housing formed of a conductive metallic material and defining a cavity containing a plurality of electrical devices and defining an aperture within a wall of the housing. The battery pack assembly also includes a bulkhead received within the aperture. The bulkhead includes a plurality of electrical connectors configured to receive and mate with a plurality of corresponding mating connectors. The bulkhead defines a plurality of connector shrouds that axially surround each connector in the

plurality of electrical connectors. Each connector shroud is configured to receive a connector body of a corresponding mating connector. The plurality of connector shrouds is integral to the bulkhead. The plurality of electrical connectors is interconnected to the plurality of electrical devices.

[0007] The bulkhead, and thereby the plurality of connector shrouds, is formed of a composite conductive material. The bulkhead is attached to the housing by a conductive fastener. The composite conductive material contains electrically conductive fibers dispersed within a dielectric matrix material.

[0008] In yet another embodiment of the present invention, an electrical connector assembly is provided. The electrical connector assembly includes a bulkhead configured to be received within an aperture defined by a housing formed of a conductive metallic material. This housing defines a cavity containing a plurality of electrical devices. The bulkhead includes a plurality of electrical connectors that are configured to receive and mate with a plurality of corresponding mating connectors. The bulkhead defines a plurality of connector shrouds that axially surround each connector in the plurality of electrical connectors. Each connector shroud is configured to receive a connector body of a corresponding mating connector. The plurality of connector shrouds is integral to the bulkhead. The plurality of electrical connectors is configured to be electrically connected to the plurality of electrical devices.

[0009] The bulkhead, and thereby the plurality of connector shrouds, is formed of a composite conductive material. The bulkhead is attached to the housing by a conductive fastener. The composite conductive material contains electrically conductive fibers within a dielectric matrix material.

[0010] Further features and advantages of the invention will appear more clearly on a reading of the following detailed description of the preferred embodiment of the invention, which is given by way of non-limiting example only and with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

[0011] The present invention will now be described, by way of example with reference to the accompanying drawings, in which:

[0012] Fig. 1 is an exploded perspective view of bulkhead and connectors of a high voltage electrical center in accordance with the prior art;

[0013] Fig. 2 is a perspective view of a high voltage electrical center in accordance with one embodiment; and

[0014] Fig. 3 is an exploded perspective view of the inner surface of the bulkhead of the high voltage electrical center of Fig. 2 in accordance with one embodiment; and

[0015] Fig. 4 is an exploded perspective view of a battery pack module including the high voltage electrical center of Fig. 2 in accordance with one embodiment.

DETAILED DESCRIPTION OF THE INVENTION

[0016] A high voltage electrical center containing electrical devices such as relays, precontactors, fuses, and circuit boards and including headers molded from a conductive plastic to form a connectorized bulkhead is presented herein. This high voltage electrical center is mounted to and incorporated into an electric vehicle battery pack and contains the

switching circuitry used to control high voltage connections between the battery pack and the vehicle's electrical propulsion system. This high voltage electrical center reduces the number of unique components required compared to the prior art. This high voltage electrical center also reduces the overall assembly effort required to construct the battery pack compared to the prior art. Additionally the high voltage electrical center may be included as part of the battery housing assembly thereby eliminating cables required by the prior art.

[0017] Fig. 2 illustrates a non-limiting example of an electrical assembly, such as high voltage electrical center (HVEC), generally designated by reference number 10. The assembly 10 includes a connector bulkhead 12 having a number of electrical connectors 14 that are configured to mate with corresponding mating electrical connectors(not shown) in order to interconnect the assembly 10 to the vehicle electrical propulsion system (not shown). The bulkhead 12 defines a number of connector shrouds or headers 16 that axially surround each of the assembly's electrical connectors 14. As shown in Fig. 3, these headers 16 are configured to receive the connector bodies 18 of the corresponding mating connectors. The headers 16 are integrally formed with the bulkhead 12.

[0018] The bulkhead 12 and headers 16 are formed of a conductive composite material, for example nickel plated carbon or stainless steel fibers in a PA, acrylonitrile butadiene styrene (ABS), or polycarbonate (PC) matrix. Such materials are available from ElectriPlast Corporation of Fort Washington, Pennsylvania. The bulkhead 12 may be formed by a process such as injection molding.

[0019] As shown in Figs. 3, the assembly 10 also includes an electromagnetic shield 24 or "can" that is formed of a conductive material, such as a stamped and folded metal sheet.

The electromagnetic shield 24 is disposed within the connector headers 16 of the bulkhead 12 and is configured to interconnect to a corresponding electromagnetic shield in the corresponding connector, thereby providing shielding for the conductive elements of the connector and the corresponding mating connector. Because the headers 16 of the bulkhead 12 are conductive, they can provide electromagnetic shielding to the conductive elements of the connector and the corresponding mating connector. The design, materials, and fabrication methods of forming the electromagnetic shield 24 are well known to those skilled in the art.

[0020] As shown in Figs. 3, the assembly 10 includes a case 26 configured to contain the high voltage switching devices 22, as well as fuses 28, internal connectors 30, wiring (not shown), bus bars (not shown), bolts (not shown), nuts (not shown), terminal position assurance (TPA) devices (not shown), sensors (not shown), and other components in the assembly 10. The case 26 is formed of a thermoplastic material, for example a PBT or a NYLON material.

[0021] The assembly 10 also includes a compliant seal 32 to provide an environmental seal between the assembly 10 and the battery pack housing. The seal 32 may be co-molded with the bulkhead 12.

[0022] As illustrated in Fig. 4, the assembly 10 may be integrated into a battery pack module 34 of an electrical or hybrid electrical vehicle. The battery pack module 34 contains a number of battery modules 36 that are interconnected to provide a greater voltage and or current capacity than any of the battery modules 36 separately. The battery modules 36 are interconnected by a wiring harness 38 or bus bar configuration. The battery modules 36 are contained within a housing 40 formed of a conductive material, such as aluminum, that

encloses the modules 36 and provides environmental protection, electrical isolation, and electromagnetic shielding for/from the battery modules 36. The housing 40 defines an aperture 42 in which the assembly 10 is received. The wiring harness/buss bar 38 of the battery pack is electrically connected to the assembly 10. The electrical devices (e.g. relays, precontactors) of the assembly 10 control the flow of electrical power to and from the battery modules 36 in the battery pack. The assembly 10 also provides the shielded electrical connections for the battery pack to electrical propulsion system and control electronics.

[0023] Accordingly, an electrical assembly 10, such as a high voltage electrical center, having a bulkhead 12 with integrally formed connector headers 16 is provided. The bulkhead 12 provides the advantage of reducing the number of unique components in the assembly 10 and reducing the assembly time needed to attach separate headers to the bulkhead 12 as used in the prior art. Molding the bulkhead 12 from conductive plastic also allows for more complex geometry to contain electromagnetic energy within the battery pack case. It also more easily allows the formation of a groove to contain the seal 32 in the bulkhead 12 and/or allows the seal 32 to be co-molded with the bulkhead 12.

[0024] While this invention has been described in terms of the preferred embodiments of a high voltage electrical center, it is not intended to be so limited, but rather only to the extent set forth in the claims that follow. Moreover, the use of the terms first, second, etc. does not denote any order of importance, but rather the terms first, second, etc. are used to distinguish one element from another. Furthermore, the use of the terms a, an, etc. do not denote a limitation of quantity, but rather denote the presence of at least one of the referenced items.

WE CLAIM:

1. An electrical assembly (10), comprising:
 - a plurality of electrical connectors (14) configured to receive and mate with a plurality of corresponding mating connectors;
 - a case (26) containing a plurality of electrical devices interconnected to the plurality of electrical connectors (14), said case including a bulkhead (12) that defines a plurality of connector shrouds (16) that axially surrounds each connector in the plurality of electrical connectors (14), each connector shroud (16) is configured to receive a connector body of a corresponding mating connector, said plurality of connector shrouds (16) is integral to the bulkhead (12).
2. The electrical assembly (10) according to claim 1, wherein the bulkhead (12), and thereby the plurality of connector shrouds (16), is formed of a composite conductive material.
3. The electrical assembly (10) according to claim 2, wherein the composite conductive material contains electrically conductive fibers within a dielectric matrix material.
4. A battery pack assembly (34), comprising:
 - a housing (40) formed of a conductive metallic material and defining a cavity containing a plurality of electrical devices (36) and defining an aperture (42) within a wall of the housing (40),
 - a bulkhead (12) received within said aperture (42), said bulkhead (12) including a plurality of electrical connectors (14) configured to receive and mate with a plurality of corresponding mating connectors, wherein said bulkhead (12) defines a plurality of

connector shrouds (16) that axially surround each connector in the plurality of electrical connectors (14), each connector shroud (16) configured to receive a connector body of a corresponding mating connector, wherein said plurality of connector shrouds (16) is integral to the bulkhead (12) and wherein the plurality of electrical connectors (14) is interconnected to said plurality of electrical devices (36).

5. The battery pack assembly (34) according to claim 4, wherein the bulkhead (12), and thereby the plurality of connector shrouds (16), is formed of a composite conductive material, wherein the bulkhead (12) is attached to the housing (40) by a conductive fastener.

6. The battery pack assembly (34) according to claim 5, wherein the housing (40) is formed of a conductive metallic material and wherein the bulkhead (12) is attached to the housing (40) by a conductive fastener.

7. The battery pack assembly (34) according to claim 6, wherein the composite conductive material contains electrically conductive fibers within a dielectric matrix material.

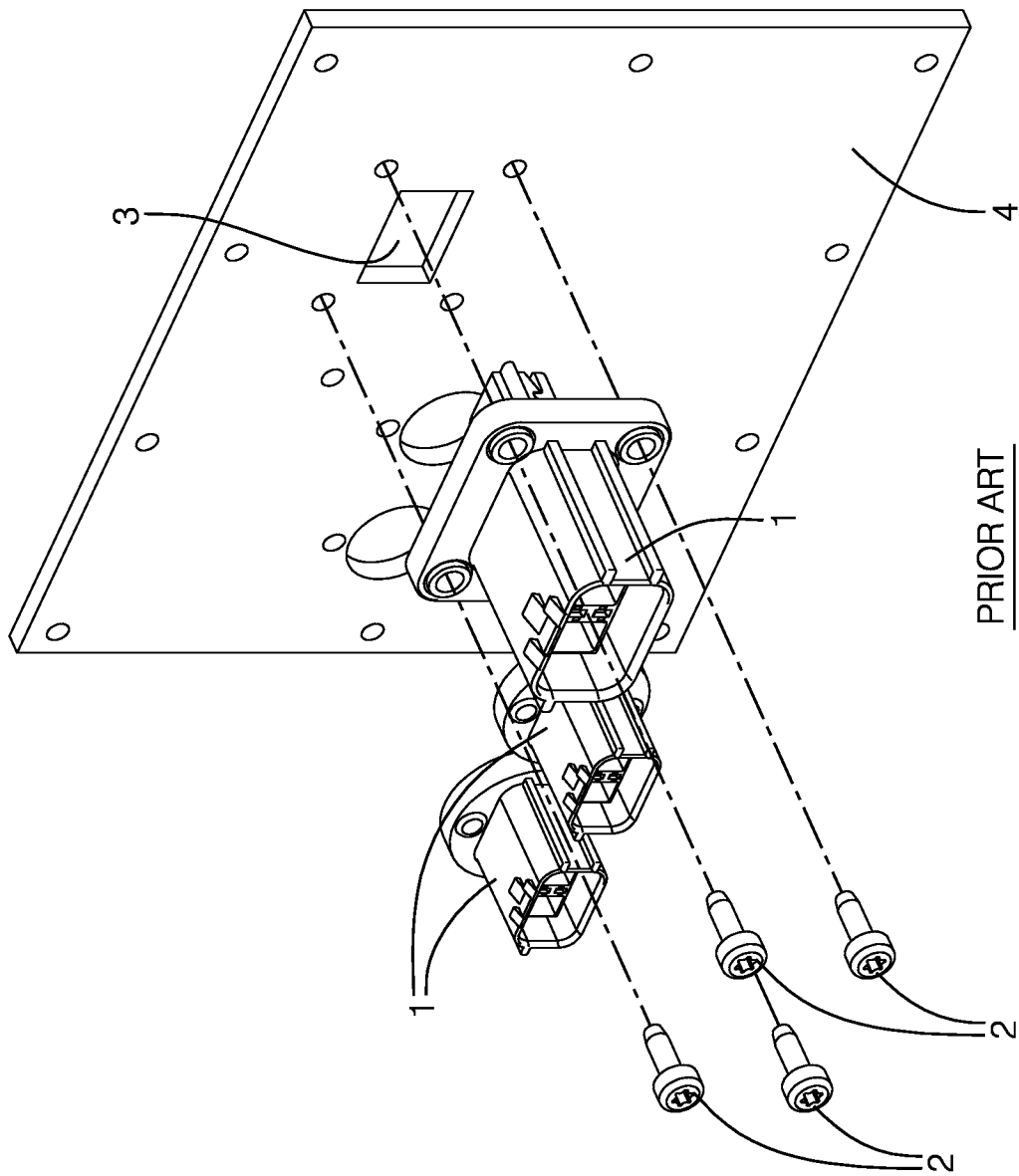
8. An electrical connector assembly (10), comprising:

a bulkhead (12) configured to be received within an aperture defined by a housing formed of a conductive metallic material, said housing defining a cavity containing a plurality of electrical devices, said bulkhead (12) including a plurality of electrical connectors (14) configured to receive and mate with a plurality of corresponding mating connectors, wherein said bulkhead (12) defines a plurality of connector shrouds (16) that axially surround each connector in the plurality of electrical connectors (14), each connector shroud (16) configured to receive a connector body of a corresponding mating connector, wherein said plurality of connector shrouds (16) is integral to the bulkhead (12) and wherein the plurality

of electrical connectors (14) is configured to be electrically connected to said plurality of electrical devices.

9. The electrical connector assembly according to claim 8, wherein the bulkhead (12), and thereby the plurality of connector shrouds (16), is formed of a composite conductive material, wherein the bulkhead (12) is attached to the housing by a conductive fastener.

10. The electrical connector assembly according to claim 9, wherein the composite conductive material contains electrically conductive fibers within a dielectric matrix material.



PRIOR ART
FIG. 1

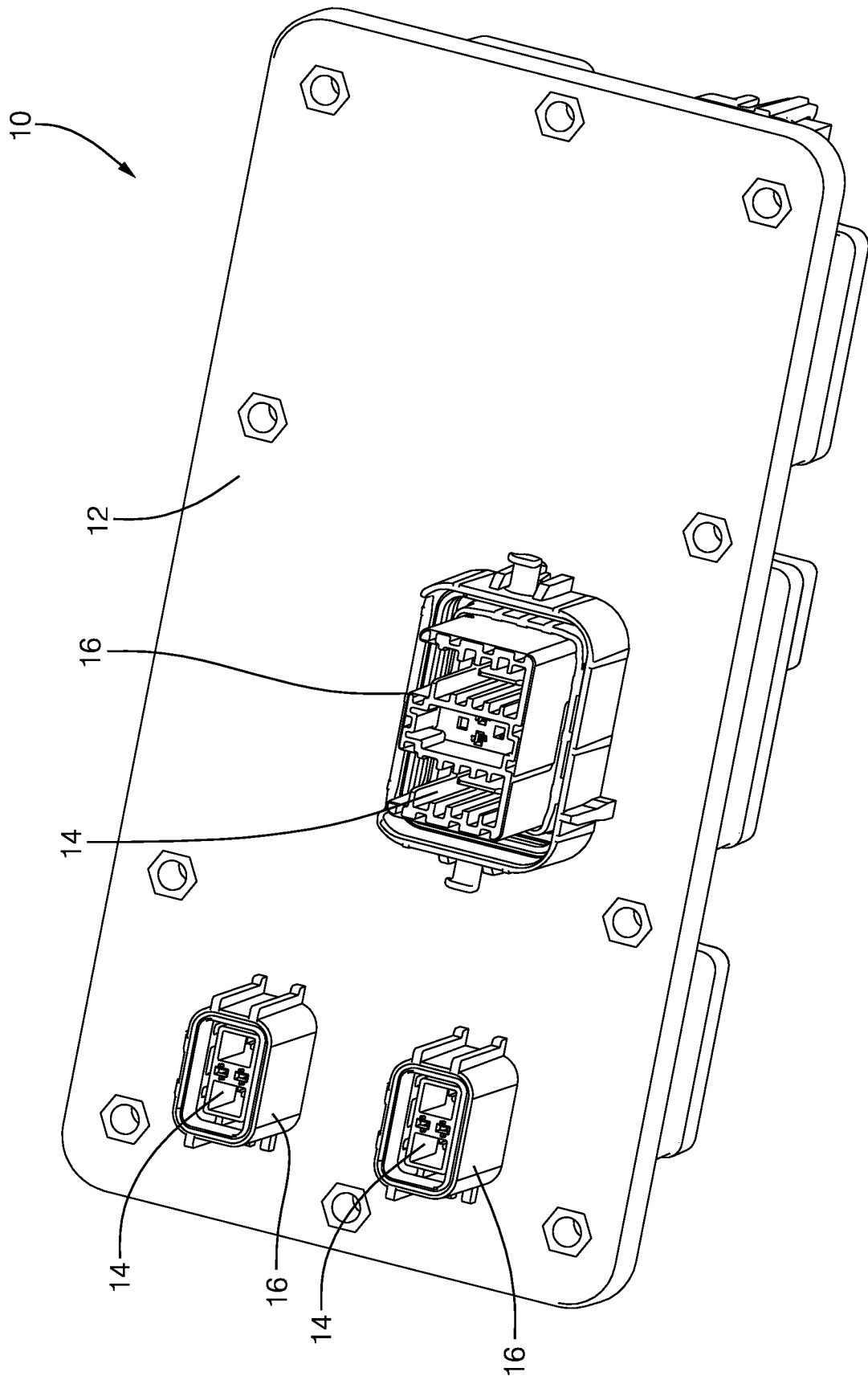


FIG. 2

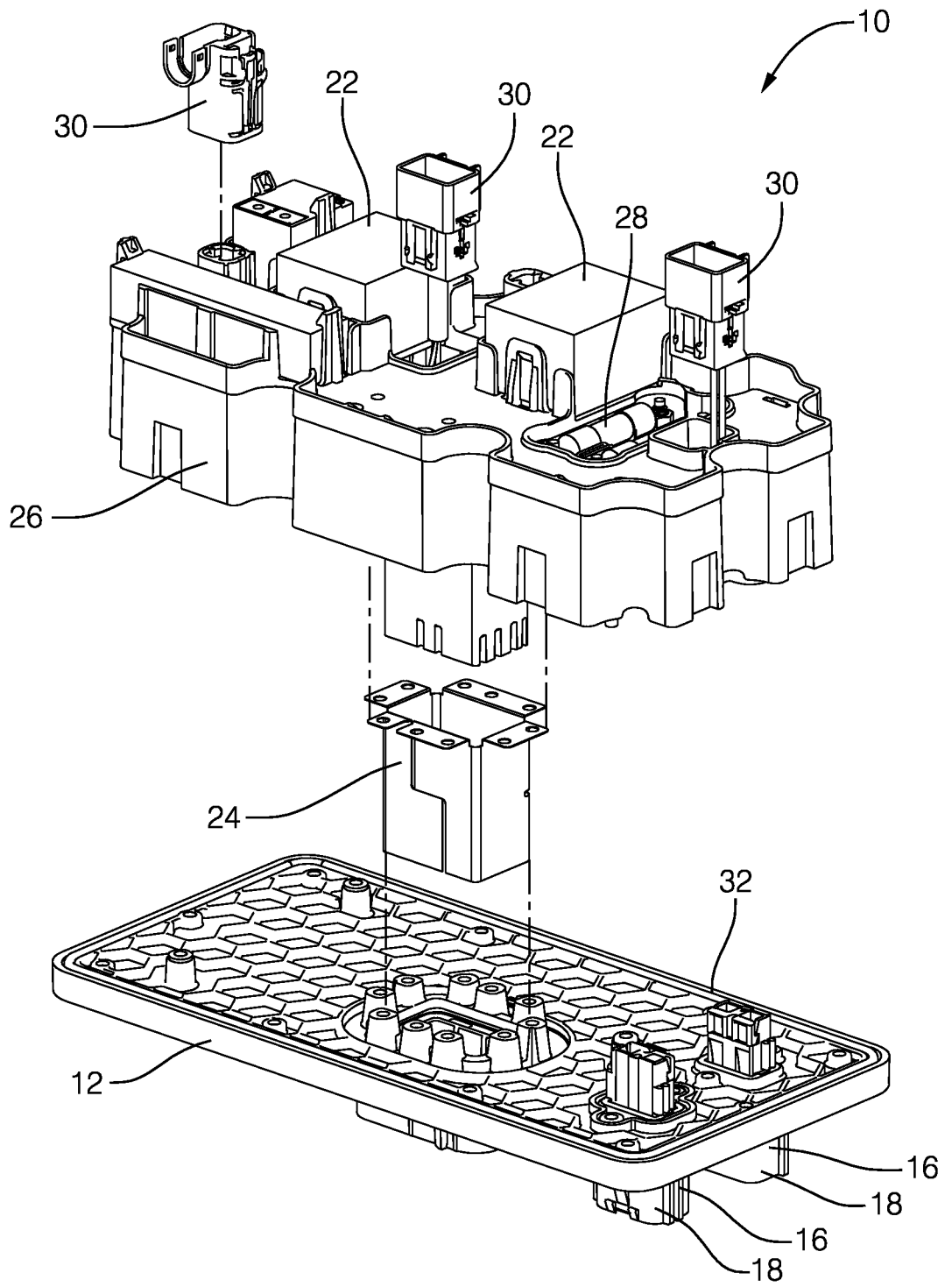


FIG. 3

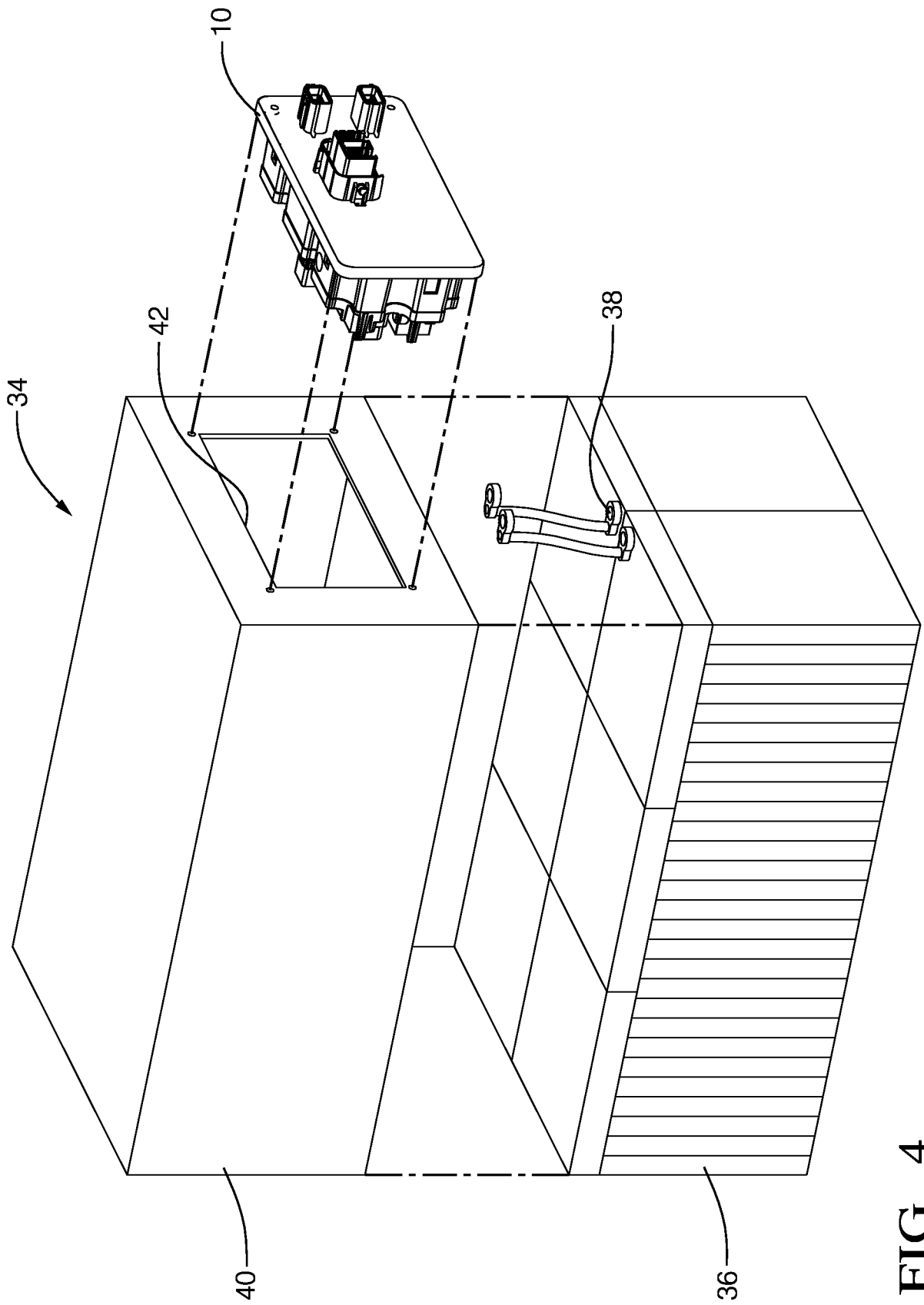


FIG. 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2014/047352**A. CLASSIFICATION OF SUBJECT MATTER****B60R 16/02(2006.01)i, B60L 11/18(2006.01)i, B60W 10/26(2006.01)i, B60K 6/28(2007.10)i, H01M 2/10(2006.01)i**

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B60R 16/02; B60L 11/18; H01M 6/00; B60R 16/04; H01M 2/10; B60K 1/04; H02B 1/48; H01G 9/00; B60W 10/26; B60K 6/28

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

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

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

eKOMPASS(KIPO internal) & keywords: connector, battery, electrical storage, housing, case, box, guard, shroud, protect, convert, and vehicle

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 103117365 A (GUIYANG PUTIAN LOGISTICS TECHNOLOGY CO., LTD.) 22 May 2013 See abstract; paragraphs [0021],[0022]; claim 8; and figures 1-3.	1-10
A	CN 202487998 U (TYCO ELECTRONICS (SHANGHAI) CO., LTD.) 10 October 2012 See abstract; claim 1; and figures 1-3.	1-10
A	JP 2001-145212 A (FUJI HEAVY IND. LTD.) 25 May 2001 See abstract; paragraphs [0018]-[0028]; and figures 1,2.	1-10
A	US 2008-0193832 A1 (DOFFIN et al.) 14 August 2008 See paragraph [0037] and figures 1,2.	1-10
A	US 2012-0244398 A1 (YOUNG et al.) 27 September 2012 See abstract; claim 1; and figure 1.	1-10

 Further documents are listed in the continuation of Box C. See patent family annex.

* Special categories of cited documents:

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

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

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

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

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

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

"&" document member of the same patent family

Date of the actual completion of the international search

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Name and mailing address of the ISA/KR

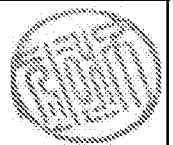
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2014/047352

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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