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### RECHARGING UNIT FOR AN ELECTRICALLY POWERED MOTOR VEHICLE

#### Abstract

A recharging unit for recharging one or more batteries of an electrically powered motor vehicle is provided permanently on board the motor vehicle. The unit includes an electrical connector carried by a charging cable, provided for connection to an external electrical socket. A hollow supporting and containment body is configured to receive the charging cable and the electrical connector. A receiving seat is provided for receiving and fixing the electrical connector in a resting position.

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## **Background/Summary**

### **FIELD OF THE INVENTION**

[0001] The present invention relates to a recharging unit for recharging one or more batteries of an electrically powered motor vehicle, permanently provided on board the motor vehicle.

### **PRIOR ART**

[0002] As is known in the sector in question, recharging of a battery pack of an electrically powered vehicle is obtained by means of electrical connectors configured for guaranteeing safe and effective charging.

[0003] According to the recharging equipment, the connectors may be of a traditional type, for example sockets for domestic use, or else connectors for industrial use. Usually, the first solution is used in areas where access is reserved to the owner of the motor vehicle, whereas the second solution is preferable in the public sphere.

[0004] One of the most widespread solutions regards provision of recharging columns that include inside them an electrical-connection cable and a connector provided with electrical terminals for connecting up to a corresponding connector element on board the motor vehicle.

[0005] The present invention stems from the desire to provide a solution for carrying out an operation of recharging an electric or hybrid vehicle that will be relatively simple to implement, of low cost, and compatible with the overall dimensions and installation spaces available on board the motor vehicle.

### **OBJECT OF THE INVENTION**

[0006] The object of the present invention is to provide a recharging unit of the type indicated at the start of the present description that will have a relatively simple and low-cost structure, at the same time enabling the recharging operations to be carried out in an intuitive and effective way.

[0007] A further object of the invention is to provide a modular recharging unit that can be adapted for different types of recharging connectors.

[0008] A further object of the invention is to provide a unit of the type referred to above that will be compatible with the overall dimensions and installation spaces available on board the motor vehicle, for example in the area of the engine compartment.

### **SUMMARY OF THE INVENTION**

[0009] With a view to achieving one or more of the aforesaid objects, the subject of the invention is a unit for recharging one or more batteries of an electrically powered motor vehicle, permanently provided on board said motor vehicle, wherein said recharging unit comprises: [0010] an electrical connector carried by a charging cable, provided for connection to an external electrical socket;

[0011] a hollow supporting and containment body configured for receiving said charging cable and said electrical connector, [0012] wherein hollow supporting and containment body defines a cavity, a proximal portion, and a distal portion, wherein said proximal portion has an opening from which it is possible to take said electrical connector out manually; and [0013] a receiving seat provided for receiving and fixing the electrical connector in a resting position, when the connector does not

have to be used to carry out a recharging operation, wherein said receiving seat is set in the proximity of the opening and is substantially shaped so as to reproduce in negative the shape of the electrical connector.

[0014] Further characteristics of the invention are specified in the annexed dependent claims.

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## Description

### BRIEF DESCRIPTION OF THE DRAWINGS

[0015] Further characteristics and advantages of the invention will emerge from the ensuing description with reference to the annexed drawings, which are provided purely by way of non-limiting example and in which:

[0016] FIGS. 1A and 1B are, respectively, a general perspective view of a motor vehicle and a perspective view at an enlarged scale of an area of the motor vehicle where a recharging unit according to a preferred embodiment is mounted;

[0017] FIGS. 2 and 3 are, respectively, a perspective view and a cross-sectional view of the recharging unit according to a preferred embodiment;

[0018] FIGS. 4 and 5 are perspective views at an enlarged scale, which represent various components illustrated in FIGS. 2 and 3;

[0019] FIG. 6 is a further perspective view of the recharging unit according to a preferred embodiment;

[0020] FIG. 7 is a view at an enlarged scale of some components illustrated in the FIG. 6; and

[0021] FIG. 8 is an exploded perspective view that illustrates further characteristics of the invention.

### DETAILED DESCRIPTION OF A NUMBER OF EMBODIMENTS

[0022] In the ensuing description, various specific details are illustrated aimed at enabling an in-depth understanding of examples of one or more embodiments. The embodiments may be obtained without one or more of the specific details, or with other methods, components, materials, etc. In other cases, known structures, materials, or operations are not shown or described in detail so that various aspects of the embodiments will not be obscured. Reference to “an embodiment” or “one embodiment” in the framework of the present description is intended to indicate that a particular configuration, structure, or characteristic described in relation to the embodiment is comprised in at least one embodiment. Hence, phrases such as “in an embodiment” or “in one embodiment” that may be present in various points in this description do not necessarily refer to one and the same embodiment. Moreover, particular conformations, structures, or characteristics may be combined in any adequate way in one or more embodiments and/or associated to the embodiments in a way different from what has been illustrated herein, so that, for example, a characteristic exemplified herein in relation to one figure may be applied to one or more embodiments exemplified in a different figure.

[0023] The references used herein are provided merely for convenience and hence do not delimit the sphere of protection or the scope of the embodiments.

[0024] In the annexed drawings, number 1 designates as a whole a unit for recharging one or more batteries of an electric or hybrid motor vehicle V, which is permanently provided on board the motor vehicle V.

[0025] FIGS. 1A and 1B are, respectively, a general perspective view of a motor vehicle V and a perspective view at an enlarged scale of an area of the motor vehicle V where the recharging unit 1 is mounted. According to a preferred embodiment, the recharging unit 1 is mounted on board the motor vehicle V in a front portion V1 substantially corresponding to a lateral portion of the engine compartment. However, it should be noted that the unit 1 may be installed in other positions, for example in a rear area of the vehicle, in the luggage compartment, in the proximity of a rear

lighting element such as a foglamp, in a lateral area of the vehicle, etc.

[0026] The recharging unit **1** may be used for recharging different types of battery cells and/or modules, which constitute battery packs for supplying a purely electric or a hybrid propulsion system.

[0027] According to the present invention, the recharging unit **1** comprises a hollow supporting and containment body **4** configured for housing a charging cable **3** provided on which is an electrical connector **2** for connection to an electrical socket external to the motor vehicle V. It should be noted that the electrical connector **2** may be of a type different from what is schematically illustrated, according to the respective coupling with an external recharging socket.

[0028] According to the embodiment illustrated, in particular in FIG. 2, the hollow supporting and containment body **4** is substantially tubular, defining a cavity **5** set within which are the charging cable **3**, a distal portion **7**, and a proximal portion **6**, which has an opening **8** from which it is possible to take out manually the electrical connector **2** to connect up to the external electrical socket (not shown).

[0029] According to the embodiment illustrated, the hollow supporting and containment body **4** has a curved pattern, in which provided between the proximal portion **6** and the distal portion **7** is a substantially vertical intermediate portion **12** (with reference to the configuration installed on board the motor vehicle) so as to provide a substantially S-shaped body **4**. The distal portion **7** defines a substantially horizontal stretch, and the proximal portion **6** comprises a head portion **13**, provided in which is the aforesaid opening **8** from which it is possible to take out the electrical connector **2**.

[0030] In one or more embodiments, as illustrated in FIG. 8, the hollow supporting and containment body **4** is formed by two half-shells **4'**, **4''**, for example made of plastic material, which can be coupled together with mutual-fixing means so as to form the tubular body and the cavity **5** within which the charging cable **3** is housed. Preferably, the hollow supporting and containment body **4** has a cross section of a circular shape. With reference to FIG. 5, it should be noted that the hollow supporting and containment body **4** comprises mounting portions **14** configured for fixing in position the hollow supporting and containment body **4** to the chassis of the motor vehicle. For instance, the mounting portions comprise connection elements in the proximity of the intermediate portion **12** and of the distal portion **7**, which are provided for connection to a bottom portion of the chassis of the motor vehicle V, by means of mutual-fixing elements.

[0031] The recharging unit **1** moreover comprises a further electrical connector **9** connected to the charging cable **3** at an end **10** opposite to the electrical connector **2** and facing the opening **8** for it to be taken out manually. The aforesaid further electrical connector **9** is configured for receiving a corresponding connector element (not illustrated) for connection to respective electronic components for managing the batteries mounted on the motor vehicle V. As illustrated in the view at an enlarged scale of FIG. 5, the aforesaid further electrical connector **9** is supported externally by said hollow supporting and containment body **4** on the distal portion **7**. More in particular, a fixing seat **19** is applied on the outer wall of the body **4** for receiving the aforesaid further electrical connector **9**. According to the example illustrated, the further electrical connector **9** has a plurality of electrical terminals **20** provided for connection with respective terminals of the corresponding connector element. The further connector **9** moreover comprises a mechanical arm **16** configured for being moved with a rotation of approximately 90° to obtain mechanical coupling with the corresponding connector element (not illustrated). It should be noted that the electrical cable **3** projects from the containment body **4** in a position corresponding to a terminal wall of the body **4**, with a substantially circular path to reach the further electrical connector **9** mounted on top of and outside the body **4**.

[0032] According to a further characteristic illustrated in FIG. 3, the hollow supporting and containment body **4** has an inner coating layer or lining **15** applied over the inner surface of the body **4** so as to obtain a layer set between the charging cable **3** and the material of which the body **4** is made. Thanks to this characteristic, it is possible to reduce drastically any noise when the motor

vehicle is travelling (due to the contact of the inner wall of the body **4** with the cable **3**), as well as to reduce friction (once again resulting from the contact of the inner wall of the body **4** with the cable **3**) during movement of the charging cable **3** to take the connector **2** out manually. According to an example of embodiment, the inner coating layer **15** is made of a material for acoustic insulation, for example of an elastomer type.

[0033] As illustrated in FIG. **2**, the charging cable **3** is a coiled cable, which, in a resting position, has a coiled pattern between the proximal portion **6** and the distal portion **7**, i.e., between the two connectors **2**, **9**, where the coiled cable has a coiled pattern substantially coaxial with respect to the hollow supporting and containment body **4**. In one or more embodiments, the overall length of the charging cable **3** is comprised between 3 and 7 m. Thanks to the coiled shape of the cable **3** and to the containment body **4**, it is possible to provide on board the motor vehicle electrical cables of significant length in a compact and safe way. As illustrated in FIG. **3**, the charging cable **3** has, at the ends of the coiled portion, a respective substantially rectilinear portion connected to the respective connector **2**, **9**.

[0034] According to a characteristic of the invention, within the head portion **13** a receiving seat **11** is provided, configured for receiving and fixing the electrical connector **2** in a resting position, when the connector **2** does not have to be used for carrying out a recharging operation. This receiving seat **11** is configured in such a way that the connector **2** is housed on the seat **11**, preventing any creation of noise in the passenger compartment due, for example, to movements of the charging cable **3** and of the connector **2** when the motor vehicle is travelling. Designated by the references **2'**, **3'** are, respectively, the cable and the connector in the resting position on the receiving seat **11**. It should be noted that the receiving seat **11** is substantially shaped to reproduce in negative the shape of the electrical connector **2**. In the embodiment illustrated in the drawings, the receiving seat **11** is provided inside the head portion **13**, projecting from a side wall substantially perpendicular to the opening **8**.

[0035] In operation, a user who has to carry out a recharging operation opens of a mobile hatch (not illustrated), applied to the opening **8**, so as to be able to access the charging cable **3** and the connector **2** present within the containment and supporting body **4**. The operator takes the connector **2** manually off the seat **11** to make the connection to an external recharging socket, exploiting the coiled shape and the overall length of the charging cable **3**.

[0036] According to a further characteristic illustrated in FIGS. **6** and **7**, the hollow supporting and containment body **4** has at least one drainage opening **17** provided for preventing collection of stagnant water inside the body **4**, which could otherwise damage the charging cable **3** and/or the connector **2**. This characteristic is to be considered particularly advantageous given that, during use, the cable **3** and the connector **2** can accumulate humidity from the external environment in which the recharging socket to which the connector **2** is to be connected is located. According to the embodiment illustrated, in a bottom area (with reference to the installed configuration) of the distal portion **7**, a plurality of drainage openings **17** are present spaced apart along a horizontal stretch of the body **4**. These drainage openings **17** may also be made of a material suited to enabling passage of water/humidity only at outlet from the body **4** and not at inlet thereto.

[0037] According to a further characteristic illustrated in FIG. **6**, at the head portion **13** a plurality of lighting sources **18** are present, for example LEDs, to light up the area where the electrical connector **2** is to be taken out and/or to represent the current state of charge of the batteries of the motor vehicle (for example, with a succession of LEDs that can emit a light source of different colours—green, yellow, red). According to a preferred example illustrated, the lighting sources **18** are applied within the head portion **13** to a top wall so as to emit a light source in the direction of the electrical connector **2**. Of course, the configuration of the lighting source illustrated in the drawings is provided herein purely by way of example.

[0038] Of course, without prejudice to the principle of the invention, the details of construction and

the embodiments may vary widely with respect to what has been described and illustrated herein purely by way of example, without thereby departing from the scope of the present invention.

## Claims

1. A recharging unit for recharging one or more batteries of an electrically powered motor vehicle, permanently provided on board said motor vehicle, wherein said recharging unit comprises: an electrical connector carried by a charging cable, provided for connection to an external electrical socket; a hollow supporting and containment body configured for receiving said charging cable and said electrical connector, wherein said hollow supporting and containment body defines a cavity, a proximal portion, and a distal portion, wherein said proximal portion has an opening from which it is possible to take said electrical connector out manually; and a receiving seat provided for receiving and fixing the electrical connector in a resting position when the connector does not have to be used to carry out a recharging operation, wherein said receiving seat is set in the proximity of the opening and is substantially shaped so as to reproduce in negative the shape of the electrical connector.
2. The recharging unit according to claim 1, wherein said receiving seat is set inside a head portion of the body, projecting from a lateral wall of the head portion substantially perpendicular to the opening.
3. The recharging unit according to claim 1, wherein the supporting and containment body defines a substantially S-shaped tubular body.
4. The recharging unit according to claim 1, wherein the supporting and containment body is made up of two half-shells that can be coupled together by mutual-fixing means.
5. The recharging unit according to claim 1, wherein said supporting and containment body comprises an inner coating layer applied over the inner surface of the body so as to obtain a layer of acoustic insulation and friction reduction, set between the charging cable and the material of which the body is made.
6. The recharging unit according to claim 1, wherein the charging cable is a coiled cable that, in a resting position, assumes a coiled pattern substantially coaxial with the hollow supporting and containment body.
7. The recharging unit according to claim 1, comprising a further electrical connector supported by said hollow supporting and containment body on said distal portion, wherein said further electrical connector is connected to said charging cable at an end opposite to said electrical connector and is configured for receiving a corresponding connector element for connection to respective electronic components for managing the batteries of the motor vehicle.
8. The recharging unit according to claim 1, wherein the supporting and containment body has at least one drainage opening provided for preventing any collection of stagnant water inside the body, wherein said at least one drainage opening is provided in a bottom area of the distal portion.
9. The recharging unit according to claim 1, comprising a plurality of lighting sources, for example LEDs, for lighting up the area from which the electrical connector can be taken out and/or for representing the current state of charge of the batteries of the motor vehicle.
10. An electrically powered motor vehicle comprising a recharging unit for recharging one or more batteries, which is permanently provided on board said motor vehicle, wherein said recharging unit comprises: an electrical connector carried by a charging cable, provided for connection to an external electrical socket, a hollow supporting and containment body configured for housing said charging cable and said electrical connector, wherein said hollow supporting and containment body defines a cavity, a proximal portion, and a distal portion, wherein said proximal portion has an opening from which it is possible to take said electrical connector out manually; and a receiving seat provided for receiving and fixing the electrical connector in a resting position, when the connector does not have to be used to carry out a recharging operation, wherein said receiving seat

is set in the proximity of the opening and is substantially shaped so as to reproduce in negative the shape of the electrical connector.

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