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(54) **CHARGING CONNECTOR**

(57) According to a first aspect, a charging connector (100) for charging a battery of a vehicle (206) is provided. The charging connector (100) comprises a contact compartment housing (106), which is configured to form at least one contact compartment for hosting electrical contacts (106) to provide a connection between a charging

station (204) and a vehicle (206), an external mechanical connector (102), an internal mechanical connector (104). The internal mechanical connector (104) encloses the contact compartment housing (106), and the external mechanical connector (102) encloses the internal mechanical connector

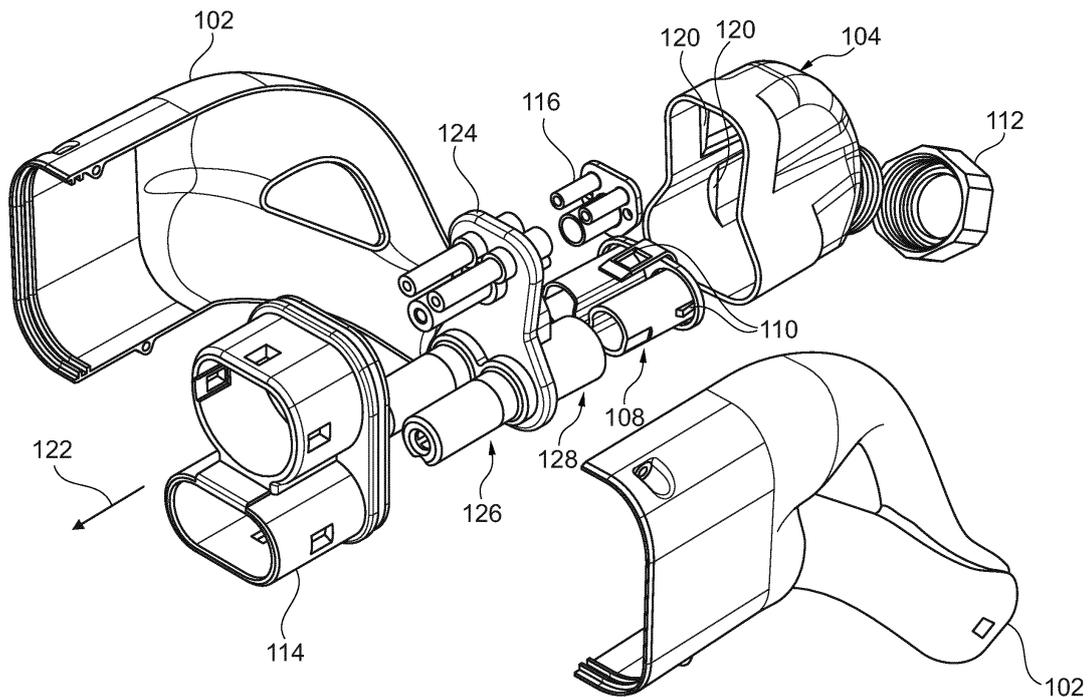


Fig. 1

## Description

### FIELD OF THE INVENTION

**[0001]** The present invention relates to a charging connector for charging a battery of a vehicle, a mating interface for a charging connector, a charging station comprising a charging connector, and a charging infrastructure.

### BACKGROUND

**[0002]** Charging stations transfer electrical power of several kW from the station to an electrically powered vehicle. The stations are fit with charging connectors that provide the electrical connection between the charging station and the vehicle. Due to the high energy to be transmitted, usually at several hundreds of volts, great demands are made on the composition of the charging connectors. In current designs, there is a risk of undesired flashovers between conducting components and fixing materials as, e.g., screws. Further, there is poor protection against mechanical damage and poor protection against dust and water ingress.

### SUMMARY

**[0003]** Therefore, there is a desire to create an easily maintainable charging connector with a sufficient dielectric design, which is protected against unfavorable environmental conditions as water, dust and humidity, and which is sufficiently protected against mechanical damage.

**[0004]** The problem is solved by the subject-matter of the independent claims. Embodiments are provided by the dependent claims, the following description and the accompanying figures.

**[0005]** The described embodiments similarly pertain to the charging connector for charging a battery of a vehicle, the mating interface for a charging connector, the charging station comprising a charging connector, and the charging infrastructure. Synergetic effects may arise from different combinations of the embodiments although they might not be described in detail.

**[0006]** Technical terms are used by their common sense. If a specific meaning is conveyed to certain terms, definitions of terms will be given in the following in the context of which the terms are used.

**[0007]** According to a first aspect, a charging connector for charging a battery of a vehicle is provided. The charging connector comprises a contact compartment housing, which is configured to form at least one contact compartment for hosting electrical contacts to provide a connection between a charging station and a vehicle, an external mechanical connector, and an internal mechanical connector. The internal mechanical connector encloses the contact compartment housing, and the external mechanical connector encloses the internal mechanical

connector. In other words, the connector is built as a matrix, with one internal mechanical connector inside another external mechanical connector. Within the internal mechanical connector, there is a further component building a housing for contact compartments. The contact compartments are the medium that receive the conductors when the charging connector is assembled. The described arrangement allows the inner main parts of the charging connector, i.e., the internal mechanical connector and the contact compartment housing, being kept together by the external mechanical connector without having screws in a critical distance from the electrical connectors or conductors. In this way, the undesired effect of degrading the dielectric properties by fitting the parts together with metallic means, is avoided.

**[0008]** According to an embodiment, the charging connector further comprises at least one blocker, wherein the at least one blocker comprises clips configured to attach the at least one blocker to the contact compartment housing and wherein the least one blocker is configured to keep the electrical contacts in position. The blockers may be, for example, a signal contact blocker and / or a DC blocker. That is, instead of using screws, clips are used to attach the blockers to the contact compartment housing, thereby providing favorable dielectric properties of the arrangement.

**[0009]** According to a further embodiment, the internal mechanical connector comprises walls having surfaces oriented towards the front end of the charging connector and which are configured to press the at least one blocker against the contact compartment housing. The internal mechanical connector itself has no means as, e.g., clips for fixing the blockers to the contact compartment housing. When assembling the charging connector, the internal mechanical connector is fixed by the form of the external mechanical connector inside the external mechanical connector, and the walls or protrusions, respectively, inside the internal mechanical connector press against the blockers such that they are again pressed into the contact compartment housing. The counter pressure is provided by a structure of the external mechanical connector holding a mating interface, against which the contact compartment is pressed. The arrangement of the external mechanical connector and the mating interface is explained further below in more detail.

**[0010]** According to a further embodiment, the contact compartment housing has a back end to provide the connection to the charging station and a front end to provide the connection to the vehicle, wherein the back end and the front end are sealed. That is, the compartments, formed by the compartment housing are open at both ends in a first manufacturing state, and are sealed or closed, respectively, in a further manufacturing state, such that no water, dust or humidity can intrude into the compartments. Between the front end and back end parts, there is a plate holding the compartments, which extrude from the plate to both ends. The internal mechanical connector abuts against the plate on the back-end

side of the contact compartment housing, and the yet mentioned mating interface abuts against the plate on the front-end side of the contact compartment housing.

**[0011]** According to a further embodiment, the contact compartment housing comprises at least one contact compartment for receiving an electrical conductor. Free volume of the at least one contact compartment including the front end and back end is filled with potting resin. The free volume is the remaining volume after the contacts or conductors, respectively, were inserted into the contact compartment. This measure is an alternative to the sealing of the front and the back end.

**[0012]** By sealing or filling the contact compartments, the compartments reach IP (Ingress Protection) class of IP67 or IP68.

**[0013]** According to a further embodiment, the internal mechanical connector has a front part enclosing the back end of the contact compartment housing. The contact compartment housing is coupled with the front part of the internal mechanical connector using sealing, gaskets, or welding. In this way, the contact compartments are coupled with the front part of the internal mechanical connector. In case of gaskets, the gaskets may be pressed with screws or clips.

**[0014]** According to a further embodiment, a back part of the internal mechanical connector receives a cable using a cable gland, wherein the cable gland seals the entrance of the cable. In other words, the back part of the internal mechanical connector receives the cable with the copper (Cu) conductors. The cable gland seals the entrance of the cable. In such way, the internal mechanical connector is built dust and water tight, also reaching ratings of IP67 or IP68. This means that in total, a double IP67 or IP68 rating is achieved. A first IP67 or IP68 rating is achieved for the contact compartments and a second IP67 or IP68 rating is achieved for the internal mechanical connector. Moreover, a double mechanical protection is already achieved.

**[0015]** According to a further embodiment, the charging connector further comprises a mating interface, wherein the external mechanical interface is in two parts, and a circumferential protrusion of the two parts engages a circumferential notch of the mating interface to impede a slipping of the mating interface out of the external interface.

**[0016]** According to a second aspect, a mating interface for a charging connector is provided. The mating interface comprises a circumferential notch, wherein the mating interface is attached to a two-parts external mechanical interface, and a circumferential protrusion of the two parts of the external mechanical engages the circumferential notch of the mating interface to impede a slipping of the mating interface out of the external interface. That is, the internal mechanical connector slides into the mating interface, and they are then locked together into the two half-shells that compose the external mechanical connector. The external mechanical connector is the third layer of mechanical protection of the contacts. It also

adds water ingress protection to some extent, although limited. Therefore, the external mechanical connector may be provided with drains to improve the IP rating. This arrangement allows to replace the mating interface or the external mechanical connector parts very easily and at low cost with respect to maintenance time, which may be, e.g., less than 30 minutes.

**[0017]** According to a third aspect, a charging station is provided. The charging station comprises a charging connector as described above.

**[0018]** According to a fourth aspect, a charging infrastructure is provided. The charging infrastructure comprises at least one charging station fitted with a charging connector as described above.

**[0019]** These and other features, aspects and advantages of the present invention will become better understood with reference to the accompanying figure and the following description.

## 20 SHORT DESCRIPTION OF THE FIGURES

### **[0020]**

Fig. 1 shows an illustration of a charging connector according to an embodiment,

Fig. 2 shows an illustration of a charging infrastructure according to an embodiment.

## 30 DETAILED DESCRIPTION OF EMBODIMENTS

**[0021]** Fig. 1 shows an illustration of a charging connector 100 according to an embodiment. The connector is built as a matrioska, with one internal mechanical connector 104 inside another external mechanical connector 102, and independent compartments for the contacts 106 within the internal mechanical connector 104 inside the external mechanical connector 102.

**[0022]** In Fig. 1, the contact compartment housing 106 comprises five cylindrical compartments, which are passing through the plate 124, which defines the position of the contact compartments. The left side of the contact compartment housing 106 comprises the front end 126 and the other side the back end 128. The contact compartments 106 are built without screws, and utilize blockers 108 to keep the contacts in position. The blockers 108, 116 have clips 110 that attach them to the contact compartments 106. They are pressed against the contact compartments 106 by walls 120 which are arranged inside the internal mechanical connector 104, the internal mechanical connector 104 being inside the external mechanical connector. The normal vector of the surface of the walls has the same direction as arrow 122, which points to the direction, where the vehicle will be connected. The direction 122 indicates also the direction of "front" ends or "front" parts. The volume of the contact compartments 106 not filled with contacts or blockers is occupied by a potting resin, or can also be protected by sealings in the front and in the back. In such way, the compart-

ments reach IP67 or IP68.

**[0023]** The contact compartments 106 are coupled with the front part of an internal mechanical connector 104. The back part of the internal mechanical connector 104 receives the cable to the charging station with the Cu conductors. A cable gland 112 seals the entrance of the cable. By such an arrangement, the internal mechanical connector 104 is dustproof and waterproof, fulfilling the ratings IP67 or IP68.

**[0024]** The internal mechanical connector 104 can be pushed into the mating interface 114. The mating interface 114 with the internal mechanical connector 104 can then be enclosed by the two parts of the external mechanical connector 102 and locked together. The external mechanical connector 102 represents the third layer of mechanical protection of the contacts and further provides a water ingress protection. Drains may be included in the external mechanical connector 102 to improve the IP rating.

**[0025]** The presented arrangement allows to replace the mating interface or the external mechanical connector parts very easily.

**[0026]** In the following, materials are proposed that ensure the mechanical robustness and the protection against external environmental conditions as humidity, intrusion of water and dust, etc.

**[0027]** The mating interface 114 may, for example, be made of a flexible and extremely tough material, such as thermoplastic polyurethane elastomers (TPU, TPE). By using of TPU/TPE mechanical damage can be avoided in all conditions. A specific grade with high hardness may be selected so that the flexible material is stiff enough to hold the weight of the connector and the cable during charging also at high ambient temperature, e.g., above 30°C. As an alternative, the mating interface may be made of a relatively stiff material which is tough at low temperature, such as polycarbonate and blends thereof or some polyamides impact modified, with or without glass fiber reinforcement.

**[0028]** The preferred materials for the external mechanical connector 102 may be polycarbonate and blends, and some types of polyamides so that the connector 102 is sufficiently stiff but mainly tough at low temperature to avoid mechanical damage.

**[0029]** The requirements for internal parts, i.e., the contact compartment housing 106 and the blockers 116 focus on a high comparative tracking index (CTI) and low moisture absorption to minimize the risk of dielectric failures. At the same time, the part should be stiff and have good mechanical strength. The preference is therefore on some types of polyamides with high CTI.

**[0030]** Similar to the external mechanical connector 102, polycarbonates may preferably be used for the internal mechanical connector 104 and the cable gland 112. In case that the internal mechanical connector 104 is welded to the contact compartments housing 106, the same material as the contact compartment housing 106 should be used, i.e., for example, polyamide with high

CTI.

**[0031]** Fig. 2 shows an example of a charging infrastructure 200. The charging infrastructure 200 comprises several charging stations 202, 206 which again comprise one or more charging connectors 100 as described above. In Fig. 2, the charging connector of charging station 204 is plugged into the vehicle 206.

**[0032]** Other variations to the disclosed embodiments can be understood and effected by those skilled in the art in practicing the claimed invention, from the study of the drawings, the disclosure, and the appended claims. In the claims the word "comprising" does not exclude other elements or steps and the indefinite article "a" or "an" does not exclude a plurality. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to advantage. Any reference signs in the claims should not be construed as limiting the scope of the claims.

## Claims

1. Charging connector 100 for charging a battery of a vehicle 206, comprising
  - a contact compartment housing 106, which is configured to form at least one contact compartment for hosting electrical contacts to provide a connection between a charging station 202 and a vehicle 206;
  - an external mechanical connector 102;
  - an internal mechanical connector 104;
  - wherein the internal mechanical connector 104 encloses the contact compartment housing 106, and the external mechanical connector 102 encloses the internal mechanical connector 104.
2. Charging connector 100 according to claim 1, further comprising at least one blocker 116, wherein the at least one blocker 116 comprises clips 110 configured to attach the at least one blocker 116 to the contact compartment housing 106 and wherein the least one blocker 116 is configured to keep the electrical contacts in position.
3. Charging connector 100 according to claim 2, wherein the internal mechanical connector 104 comprises walls having surfaces oriented towards the front end of the charging connector 100 and which are configured to press the at least one blocker 116 against the contact compartment housing 106.
4. Charging connector 100 according to any of the previous claims, wherein the contact compartment housing 106 has a back end 128 to provide the connection to the charging station 202 and a front end 126 to provide the connection to the vehicle 206,

wherein the back end 128 and the front 126 end are sealed.

- 5. Charging connector 100 according to claim 3, wherein the contact compartment housing 106 comprises at least one contact compartment for receiving an electrical conductor; and wherein free volume of the at least one contact compartment including the front end 126 and back end 128 is filled with potting resin. 5  
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- 6. Charging connector 100 according to any of claims 3 to 5, wherein the internal mechanical connector 104 has a front part enclosing the back end of the contact compartment housing 106 and wherein the contact compartment housing is coupled with the front part of the internal mechanical connector 104 using sealing, gaskets, or welding. 15
- 7. Charging connector 100 according to claim 5, wherein a back part of the internal mechanical connector 104 receives a cable using a cable gland 112, wherein the cable gland 112 seals the entrance of the cable. 20
- 8. Charging connector 100 according to any of the previous claims, further comprising a mating interface 114, wherein the external mechanical interface is in two parts, and a circumferential protrusion of the two parts engages a circumferential notch of the mating interface 114 to impede a slipping of the mating interface 114 out of the external interface. 25  
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- 9. Mating interface 114 for a charging connector comprising a circumferential notch, wherein the mating interface 114 is attached to a two-parts external mechanical interface, and a circumferential protrusion of the two parts of the external mechanical engages the circumferential notch of the mating interface 114 to impede a slipping of the mating interface 114 out of the external interface. 35  
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- 10. Charging station 202 comprising a charging connector according to one of claims 1 to 8.
- 11. Charging infrastructure, comprising a charging station 202 according to claim 10 with a charging connector according to any of claims 1 to 8. 45

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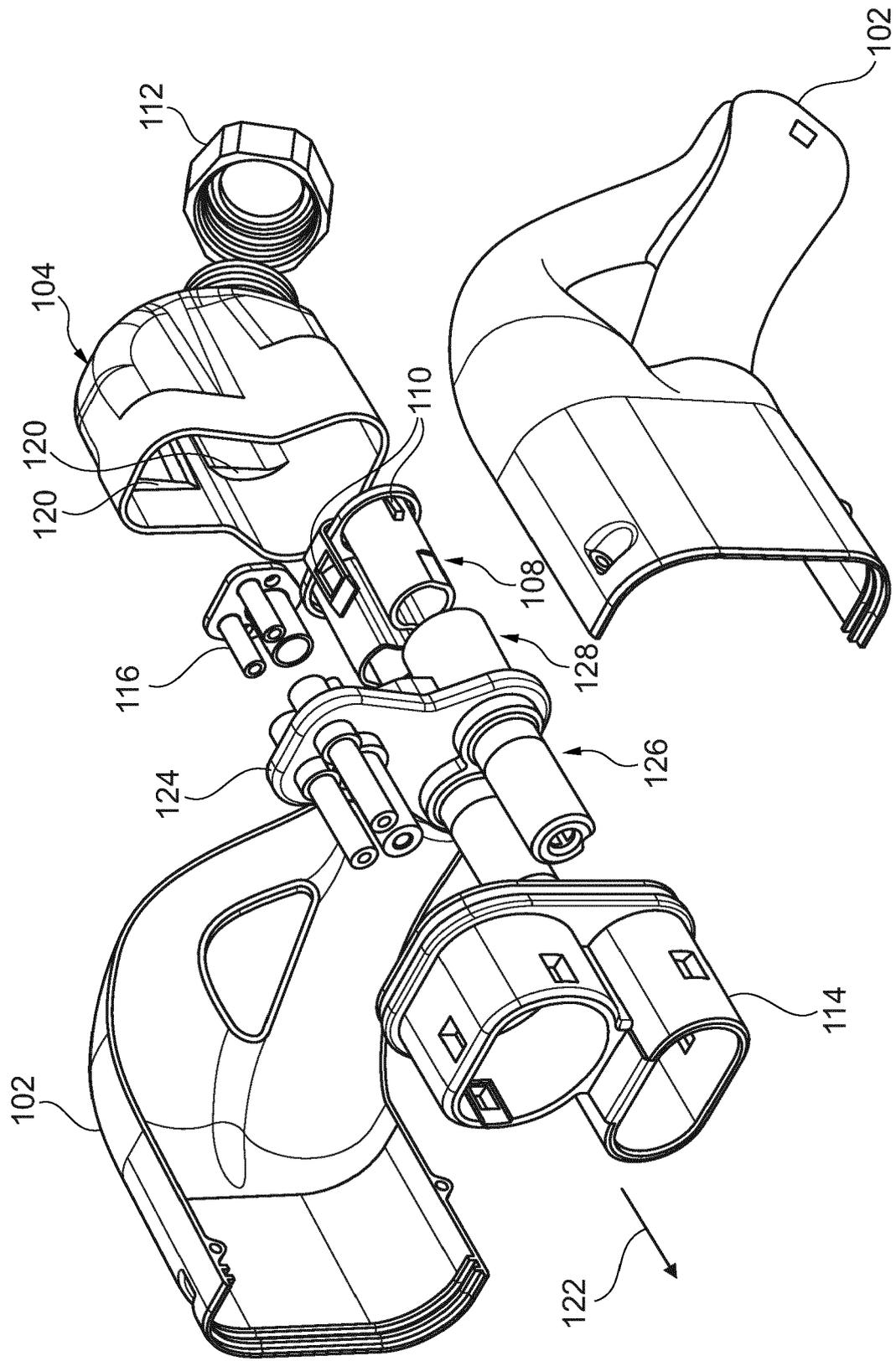


Fig. 1

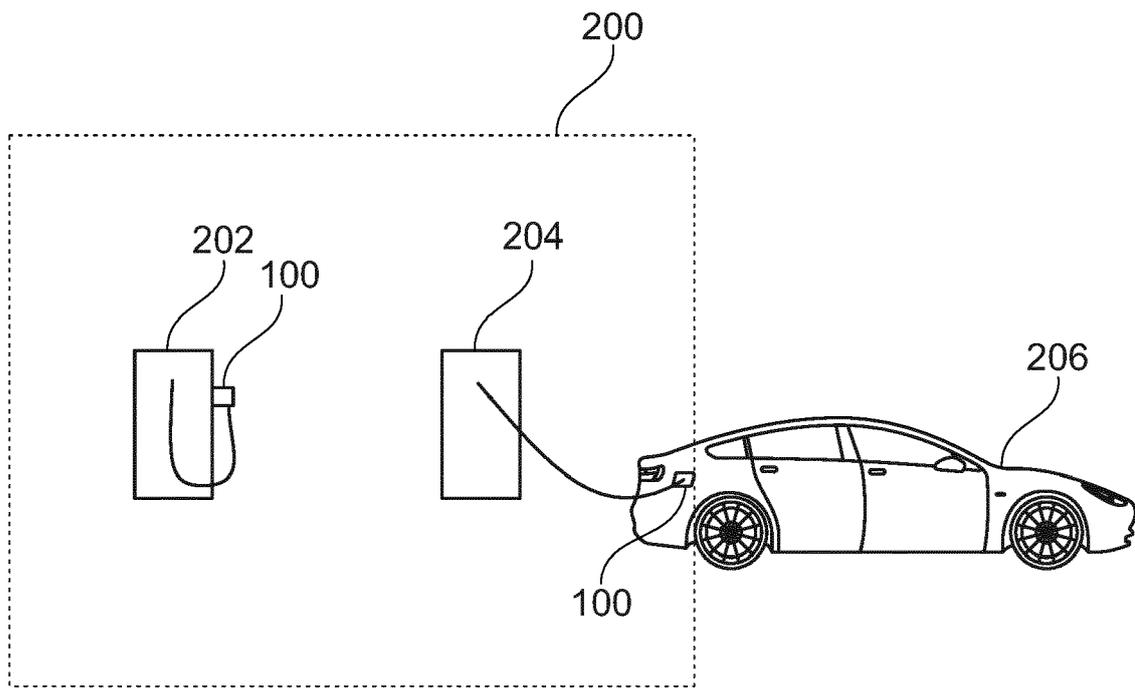


Fig. 2



EUROPEAN SEARCH REPORT

Application Number  
EP 20 15 7200

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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 22 May 2020	Examiner Bidet, Sébastien
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**ANNEX TO THE EUROPEAN SEARCH REPORT  
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