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(54) **ELECTRODE DEVICE, METHOD FOR MAKING SUCH, AND HOUSEHOLD APPLIANCE INCLUDING SUCH**

(57) The invention relates to an electrode device 1 including at least one electrically conductive electrode 3 fixed to an electrically insulating carrier 2, the electrode 3 extended along a midline 4 and having a first end 5 and a second end 7, the second end 7 including a first tab 8 for mounting an electrical connector 15. The first end 5 includes a latch 6 inserted into a corresponding groove 11 in the carrier 2 and the second end 7 includes a register hole 10 registered with a corresponding register pin 13 formed on a flexible second tab 12 formed at the carrier 2. The invention also relates to a method for making such electrode device 1, and to a household appliance 16 including such electrode device 1. The household appliance may be a laundry dryer 16.

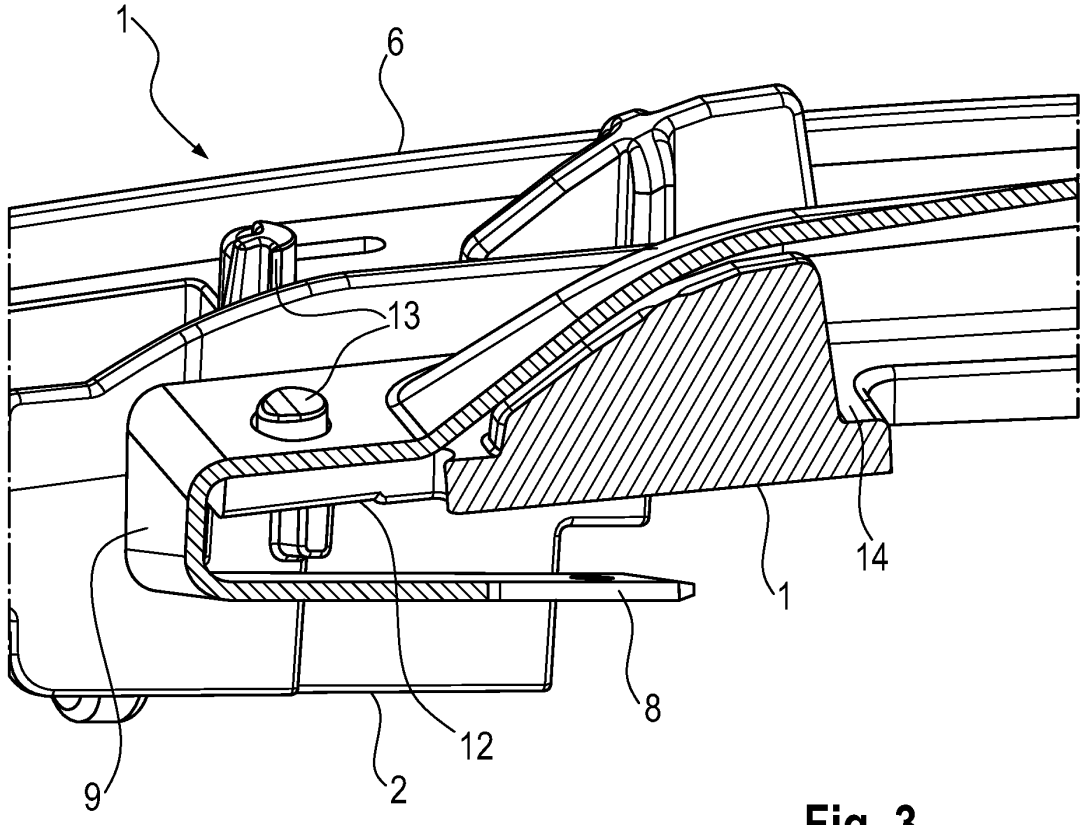

Fig. 3

EP 4 119 716 A1

Description

[0001] The invention relates to an electrode device including at least one electrically conductive electrode fixed to an electrically insulating carrier, the electrode extended along a midline and having a first end and a second end, the second end including a first tab for mounting an electrical connector.

[0002] The invention also relates to a method for making such electrode device.

[0003] The invention further relates to a household appliance including such device.

[0004] Document EP 2 695 989 A1 discloses an electrode device of the generic type defined above. The electrode device disclosed by this document includes two electrodes mounted adjacent to each other and is applied in a laundry dryer for use in measuring an electrical conductance of pieces of laundry being dried for application in process control by monitoring the electrical conductance as it decreases as pieces of laundry are being dried and thereby lose their content of water which is the primary material that makes the laundry electrically conductive.

[0005] Document KR 10-0508341 B1 discloses an electrode device including two electrodes applied in a laundry dryer and arranged adjacent to each other in a staggering fashion while maintaining a predetermined distance between each other. The electrodes are arranged at a surface inclined towards a drum wherein laundry to be dried is to be placed.

[0006] Document US 4,899,464 A discloses an electrode device embodied as a moisture sensor assembly and to be included into a laundry dryer for process control. Electrodes belonging to the assembly are sensor strips secured directly to an outlet grill provided for exiting process air and may be engaged by pieces of laundry being dried. Each sensor strip pivotally engages at one end with the grill and has an interference friction fit with the grill at an opposite end.

[0007] In the present context, a household appliance is an appliance determined for use in operating a private household to fulfil a specific and predetermined material purpose. A household appliance may be a laundry care machine such as a laundry dryer or a washer-dryer, or a dishwasher, or a cooling appliance such as a refrigerator or a freezer, or a heating appliance such as a water heater or a climatization device, all eventually equipped with a heat pump for drying, cooling, or heating purposes.

[0008] Installing an electrode device for measuring electrical conductivity in a household appliance requires great accuracy to ensure proper cooperation between the electrode device and a controller which conventionally applies the electrodes for measurements and evaluates the conductivity as an important input for process control. The accuracy must be provided in the dimensions of the electrodes themselves as well as in their placement and fixture in the household appliance, to ensure that measurements obtained with the electrode device are proper and reproducible. The fixture of the electrodes in the electrode device must be firm and durable, as the normal use of the electrodes requires them to engage moving items of considerable weights on purpose of making the required conductivity measurements within periods of normal use extending to ten years and beyond. Yet, there are also motivations for keeping costs of household appliances as low as possible and avoiding excess expenditure of materials and assembly time.

[0009] Accordingly, there is a need for improving the conventional electrode devices towards allowing better accuracy in production and assembly, improved durability, and easier assembly.

[0010] Therefore, it is an object of the invention to provide an electrode device of the generic type as defined above which allows to achieve better accuracy in production and assembly, improved durability, and easier assembly. It is also an object of the invention to provide a method for making such electrode device and a household appliance including such electrode device.

[0011] On purpose of solving such objects the present invention provides an electrode device of the generic type as defined in the generic part of the respective independent claim attached which also includes the features of the characterizing part of said independent claim.

[0012] The present invention also provides a method for making such electrode device and a household appliance including such electrode device as defined in the respective independent claim attached.

[0013] Preferred embodiments of the invention are defined in dependent claims attached as well as in the subsequent disclosure. Such preferred embodiments may also be applied in mutual combinations insofar as possible under technical considerations to any extent, even if not specified herein explicitly.

[0014] Accordingly, a first aspect of the present invention provides, as a solution to the problem as defined above, an electrode device including at least one electrically conductive electrode fixed to an electrically insulating carrier, the electrode extended along a midline and having a first end and a second end, the second end including a first tab for mounting an electrical connector. In addition, the first end includes a latch inserted into a corresponding groove in the carrier and the second end includes a register hole registered with a corresponding register pin formed on a flexible second tab formed at the carrier.

[0015] Accordingly, a second aspect of the present invention provides, as a solution to the problem as defined above, a method for making the electrode device according to the first aspect of the invention, the method comprising the following steps:

(a) providing the carrier and the electrode separately from each other;

(b) disposing the electrode with the midline at an angle with respect to a main plane defined by the carrier, and inserting the latch into the corresponding

groove;

(c) swivelling the electrode around the latch to align the midline with the main plane to contact the second end with the corresponding register pin;

(d) continuing to swivel the electrode, thereby bending the second tab to align the register hole with the register pin and have the second tab push the register pin to be inserted into the register hole.

[0016] Accordingly, a third aspect of the present invention provides, as a solution to the problem as defined above, a household appliance for treating items having an electrical conductance, the household appliance including an electrode device according to the first aspect of the invention and configured for contacting the items to be treated to measure the electrical conductance.

[0017] Advantages of the invention include that the electrode is fitted to the carrier by the latch at its first end and by the register pin inserted into its register hole at the second end so as to be irretrievable by any action within normal use, without extraction of the electrode device from the appliance that it has been associated to ands without application of specific tools that may eventually break the carrier or an electrode. Yet the electrode device is easily assembled from its components and easily installed. The components of the electrode device which include the carrier and the at least one electrode may be made with ease and applying conventional and reliable technologies such as stamping of metal sheet for making an electrode and injection moulding for making the carrier. The electrode device thus obtained is firm and durable in normal use and can stand all reasonably expectable strain without deformation and decomposition over a very long time period.

[0018] Principally the invention may be applied to any household appliance. The household appliance may be a laundry care machine such as a laundry dryer or a washer-dryer, or a dishwasher, or a cooling appliance such as a refrigerator or a freezer, or a heating appliance such as a water heater or a climatization device, all eventually equipped with a heat pump for drying, cooling, or heating purposes.

[0019] In a preferred embodiment of the invention the second end includes a U-shaped bend which is bent around the second tab. Such U-shaped bend may considerably ease access to the second tab for fixing a connector to a controller device for applying the electrode to conductivity measurement. More preferred the U-shaped bend is composed of two essentially orthogonal bends which further eases production.

[0020] In another preferred embodiment of the invention the midline is parallel to a main plane defined by the carrier. More preferred the midline is curved. Thereby the electrode may be aligned to the trajectory of moving items whose conductivity shall be measured, and the fixture of the electrode in the carrier is made easy.

[0021] In a further preferred embodiment of the invention the electrode includes a stamped elevation extending orthogonally to the main plane and along the midline. Such elevation greatly increases the firmness of the electrode and further ensures that the electrode remains without deformation under regular use. More preferred the latch and the second end are flat sections of the electrode and oriented parallel to the main plane. This makes the electrode easy to integrate to the carrier, and connect to a controller device, while also leaving some elasticity which may be practically applied in integrating the electrode device. Even more preferred the stamped elevation projects away from the carrier. Thereby the elevation exposes itself better to items to be contacted, particularly for applying the electrode to conductivity measurements.

[0022] In an additional preferred embodiment of the invention the electrode device is configured to be applied in a laundry care machine for measuring an electric resistance of pieces of laundry to be treated.

[0023] In yet another preferred embodiment of the invention the at least one electrode is two electrodes fixed to the carrier. Thereby the electrode device provides all electrical contacts which are necessary for a conductivity measurement on one carrier. Such electrode device is easy to make reproducibly, and easy to integrate reproducibly into a household appliance.

[0024] In yet a further preferred embodiment of the invention the household appliance has a controller connected to the at least one electrode and configured to measure the electrical conductivity.

[0025] In yet an additional preferred embodiment of the invention the household appliance is configured for treating items which are pieces of laundry, the household appliance including a rotatable drum for holding the pieces of laundry, the drum having an opening which is borne against a bearing shield, and the carrier forms a component of the bearing shield projecting into the opening and exposing the at least one electrode into the drum.

[0026] More preferred the household appliance is configured as a laundry drying machine. Still more preferred the household appliance is configured as a laundry dryer.

[0027] Preferred embodiments of the invention are now explained in detail with reference to the Figures of the attached drawing. These Figures show and exhibit as follows:

Fig. 1	shows a schematic view of an electrode for application in an embodiment;
Fig. 2	shows a detail of the electrode of Fig. 1;
Fig. 3	shows the electrode of Fig. 1 inserted in a carrier, forming an embodiment of an electrode device;
Fig. 4	shows the carrier of the embodiment of Fig. 3:
Fig. 5	shows a detail of the carrier of Fig. 4;

Fig. 6 shows an electrode device with two electrodes on one carrier;

Figs. 7 and 8 show details of the embodiment of Fig. 3 related to making the electrode device; and

Fig. 9 shows a schematic view of a household appliance including an embodiment of the electrode device.

[0028] As shown in Figs. 1 and 2, an electrically conductive electrode 3, electrode 3 to be fixed to an electrically insulating carrier 2 for forming an electrode device 1 as shown in Fig. 3, is extended along a midline 4 and has a first end 5 and a second end 7. Second end 7 includes a first tab 8 for mounting an electrical connector 19 (see Fig. 9 for related details). First end 5 includes a latch 6 to be inserted into a corresponding groove 11 in the carrier 2, as shown in detail in Fig. 4. Second end 7 includes a register hole 10 to be registered with a corresponding register pin 13 formed on a flexible second tab 12 formed at carrier 2 and as shown in detail in Figs. 4 and 5. Second end 7 includes a U-shaped bend 9 which is bent around second tab 12 as apparent from Figs. 4 and 5 once again. U-shaped bend 9 is composed of two essentially orthogonal bends.

[0029] A seen in Fig. 3 which exhibits the composition of carrier 2 and electrode 3 constituting electrode device 1, midline 4 is parallel to a main plane 14 defined by carrier 2. In the embodiment shown main plane 14 is defined as a plane on carrier 2 whereupon electrode 3 rests.

[0030] In the embodiment shown midline 4 is curved. This may be advantageous in the embodiment shown in Fig. 6 and in the application explained in more detail below with reference to Fig. 9 wherein two electrodes 3 on one carrier 2 are used for measuring electrical conductivity of items 17 contacting electrodes 3 while passing along in an essentially circular movement, by reducing friction between electrodes 3 and items 17 passing along.

[0031] Electrode 3 further includes a stamped elevation 15 extending orthogonally to the main plane 14 and along midline 4. Elevation 15 improves structural rigidity of electrode 3. In the application explained in more detail below with reference to Fig. 9, elevation 15 also improves exposition of electrodes 3 to items 17 passing along for purposes of measuring electrical conductivity. As an alternative to forming electrode 3 from a stamped metal sheet. electrode 3 may also be formed by casting or injection moulding liquid metal, to form electrode 3 as a cast component without any need for additional forming such as stamping.

[0032] As shown in Figs. 1 to 8, latch 6 and second end 7 are flat sections of electrode 3 and oriented parallel to main plane 14. Stamped elevation 15 projects away from carrier 2.

[0033] The embodiment of electrode device 1 as exhibited in Figs. 1 to 8 is configured to be applied in a laundry care machine 16 for measuring an electric resistance of pieces of laundry 17 to be treated, as explained below in further detail with reference to Fig. 9. Specifically, and as shown in Fig. 6, the at least one electrode 3 is two electrodes 3 fixed to one carrier 2, the two electrodes 3 being similarly shaped.

[0034] Figs. 3, 4, 5, and 6 exhibit carrier 2 as a component formed from plastic, specifically by injection moulding, and including two second tabs 12 with respective register pins 13 to be received by respective register holes 10 of electrodes 3 and including grooves 11 formed on main plane 14 for receiving respective latches 6 of electrodes 3. Grooves 11 are formed by respective hooks projecting out of main plane 14. As shown in Figs. 3 to 5 specifically, the shape of a register pin 13 need not conform in very detail to the shape of a corresponding register hole 10. Register hole 10 may be circular and register pin 13 may be a circular cylinder or a part of such as specifically apparent from Figs. 3 and 5.

[0035] Figs. 7 and 8 exhibit features related to a method for making electrode device 1 as exhibited in Figs. 1 to 5, the method comprising the following steps:

(a) providing carrier 2 and electrode 3 separately from one another;
(b) disposing electrode 3 with midline 4 at an angle with respect to main plane 14 defined by carrier 2, and inserting latch 6 into corresponding groove 11, as may be seen in Fig. 6;
(c) as exhibited in Fig. 7, swivelling electrode 3 around latch 6 to align midline 4 with the main plane 14 to contact second end 7 with corresponding register pin 13;
(d) as exhibited in Fig. 8, continuing to swivel electrode 3, thereby bending second tab 12 of carrier 2 to align register hole 10 with register pin 13 and have second tab 12 push register pin 13 to be inserted into register hole 10.

[0036] Fig. 9 exhibits a household appliance 16 for treating items 17 having an electrical conductance, the household appliance 16 including an electrode device 1 constituted as detailed with reference to Figs. 1 to 8 and configured for contacting items 17 to be treated to measure their electrical conductance. Household appliance 16 has a controller 18 connected to electrodes 3 by electrical connector 19 and configured to measure the electrical conductivity. Electrical connector 19 may include respective sockets wherein first tabs 8 of electrodes 3 are to be plugged in and cabling for providing connections to controller 18, as indicated in Fig. 9 by dashed lines.

[0037] Fig. 9 presents a schematic view of a vertical plane of household appliance 16 from inside to outside towards a front of household appliance 16. Household appliance 16 is configured for treating items 17 which are pieces of laundry 17, which are shown in Fig. 9 by dotted lines. Household appliance 16 includes a rotatable drum

20 for holding the pieces of laundry 17, drum 20 having an opening 21 which is borne against a bearing shield 22. Carrier 2 forms a component of bearing shield 22 projecting into opening 21 and exposing electrodes 3 into drum 20 for obtaining electrical contact to pieces of laundry 17 moving along carrier 2 by rotation of drum 20.

[0038] Specifically, household appliance 16 of Fig. 9 is a laundry dryer 16, whose further components are not shown in Fig. 8 for the sake of conciseness.

[0039] Advantages of the embodiments of electrode device 1 shown in the drawing include that electrode 3 is fitted to carrier 2 by latch 6 at its first end 7 and by register pin 13 inserted into its register hole 10 at second end 7 so as to be irretrievable by any action within normal use, without extraction of electrode device 1 from appliance 16 that it has been associated to ands without application of specific tools that may eventually break carrier 2 or electrode 3. Yet electrode device 1 is easily assembled from its components and easily installed. The components of electrode device 1 which include carrier 2 and at least one electrode 3 may be made with ease and applying conventional and reliable technologies such as stamping of metal sheet for making electrode 3 and injection moulding for making carrier 2. Electrode device 1 thus obtained is firm and durable in normal use and can stand all reasonably expectable strain without deformation and decomposition over a very long time.

List of Reference Numerals

[0040]

1	Electrode device
2	Carrier
3	Electrode
4	Midline
5	First end
6	Latch
7	Second end
8	First Tab
9	U-shaped bend
10	Register hole
11	Groove
12	Second tab
13	Register pin
14	Main plane
15	Stamped elevation
16	Household appliance, laundry care machine, laundry drying machine, laundry dryer
17	Items to be treated, pieces of laundry
18	Controller
19	Electrical connector
20	Drum, rotatable
21	Opening
22	Bearing shield

Claims

1. An electrode device (1) including at least one electrically conductive electrode (3) fixed to an electrically insulating carrier (2), the electrode (3) extended along a midline (4) and having a first end (5) and a second end (7), the second end (7) including a first tab (8) for mounting an electrical connector (19), **characterized in that** the first end (5) includes a latch (6) inserted into a corresponding groove (11) in the carrier (2) and the second end (7) includes a register hole (10) registered with a corresponding register pin (13) formed on a flexible second tab (12) formed at the carrier (2).

2. The electrode device (1) according to claim 1, wherein the second end (7) includes a U-shaped bend (9) which is bent around the second tab (12).

3. The electrode device according to claim 2, wherein the U-shaped bend (9) is composed of two essentially orthogonal bends.

4. The electrode device (1) according to one of the preceding claims, wherein the midline (4) is parallel to a main plane (14) defined by the carrier (2).

5. The electrode device (1) according to claim 4, wherein the midline (4) is curved.

6. The electrode device (1) according to one of claims 4 and 5, wherein the electrode (3) includes a stamped elevation (15) extending orthogonally to the main plane (14) and along the midline (4).

7. The electrode device (1) according to claim 6, wherein the latch (6) and the second end (7) are flat sections of the electrode (3) and oriented parallel to the main plane (14).

8. The electrode device (1) according to one of claims 6 and 7, wherein the stamped elevation (15) projects away from the carrier (2).

9. The electrode device (1) according to one of the preceding claims, which is configured to be applied in a laundry care machine (16) for measuring an electric resistance of pieces of laundry (17) to be treated.

10. The electrode device (1) according to one of the preceding claims, wherein the at least one electrode (3) is two electrodes (3) fixed to the carrier (2).

11. A method for making the electrode device (1) according to one of the preceding claims, the method comprising the following steps:

(a) providing the carrier (2) and the electrode (3)

separately from each other;
(b) disposing the electrode (3) with the midline (4) at an angle with respect to a main plane (14) defined by the carrier (2), and inserting the latch (6) into the corresponding groove (11);
(c) swivelling the electrode (3) around the latch (6) to align the midline (4) with the main plane (14) to contact the second end (7) with the corresponding register pin (13);
(d) continuing to swivel the electrode (3), thereby bending the second tab (12) to align the register hole (10) with the register pin (13) and have the second tab (12) push the register pin (13) to be inserted into the register hole (10).

12. A household appliance (16) for treating items (17) having an electrical conductance, the household appliance (16) including an electrode device (1) according to one of claims 1 to 9 and configured for contacting the items (17) to be treated to measure the electrical conductance.

13. The household appliance (16) according to claim 12, having a controller (18) connected to the at least one electrode (3) by the electrical connector (19) and configured to measure the electrical conductivity.

14. The household appliance (16) according to one of claims 12 and 13, which is configured for treating items (17) which are pieces of laundry (17), the household appliance (16) including a rotatable drum (20) for holding the pieces of laundry (17), the drum (20) having an opening (21) which is borne against a bearing shield (22), and the carrier (2) forms a component of the bearing shield (22) projecting into the opening (21) and exposing the at least one electrode (1) into the drum (20).

15. The household appliance (16) according to claim 14 which is configured as a laundry dryer (16).

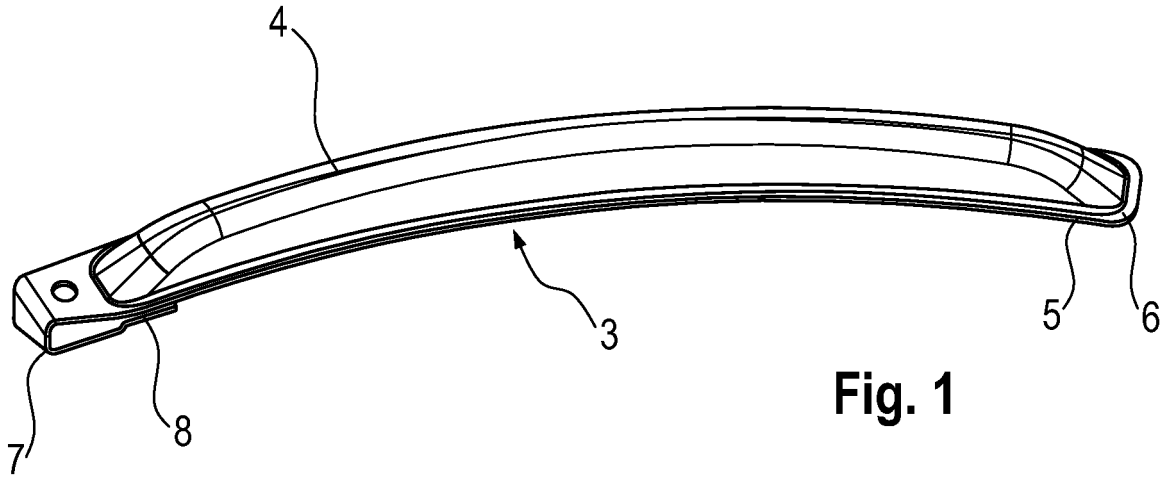

Fig. 1

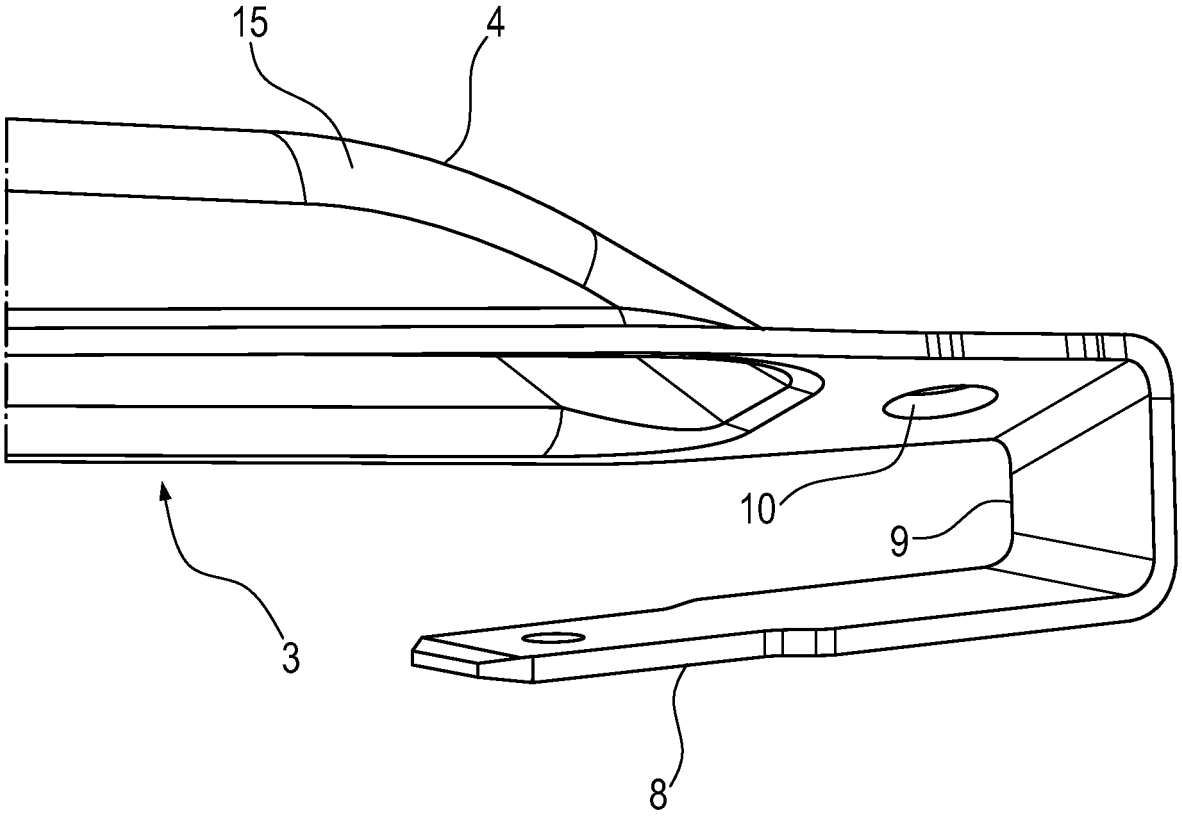

Fig. 2

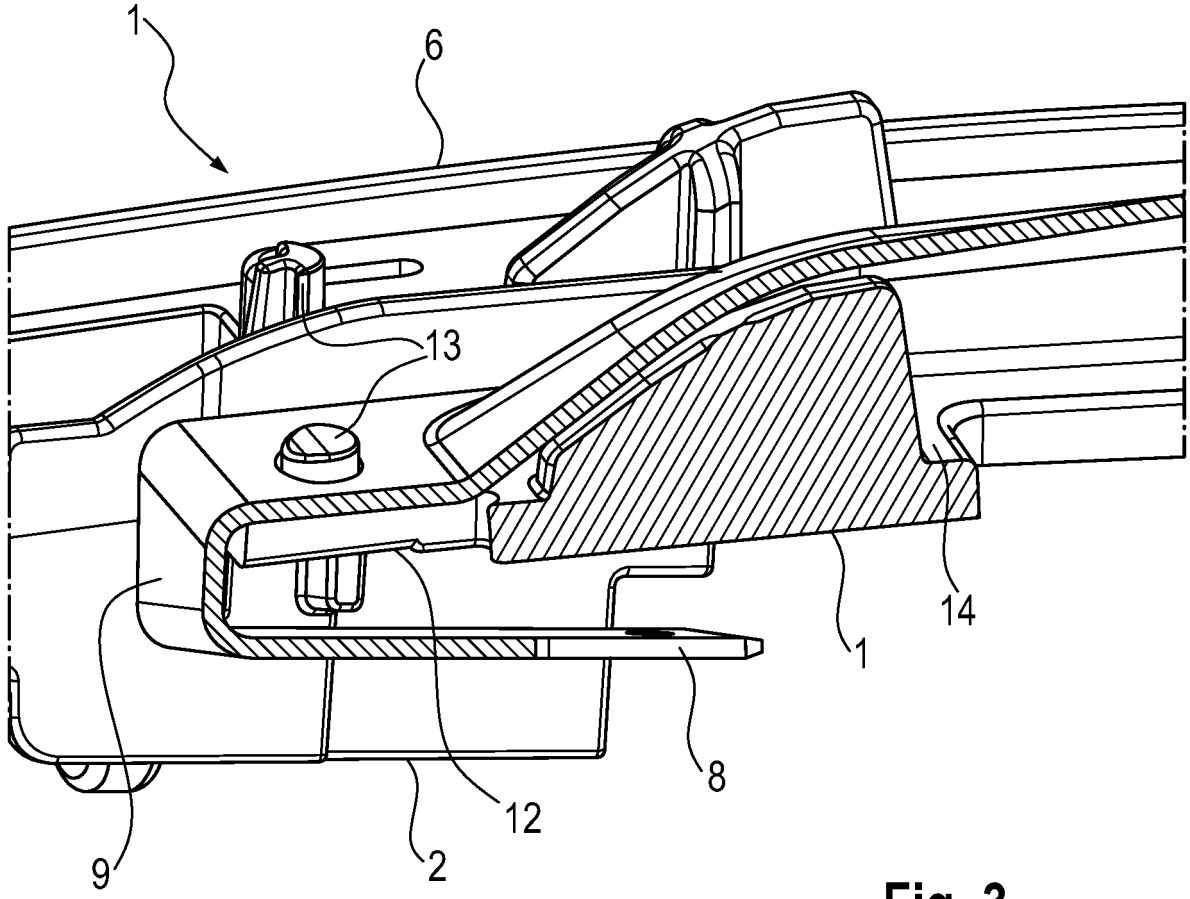

Fig. 3

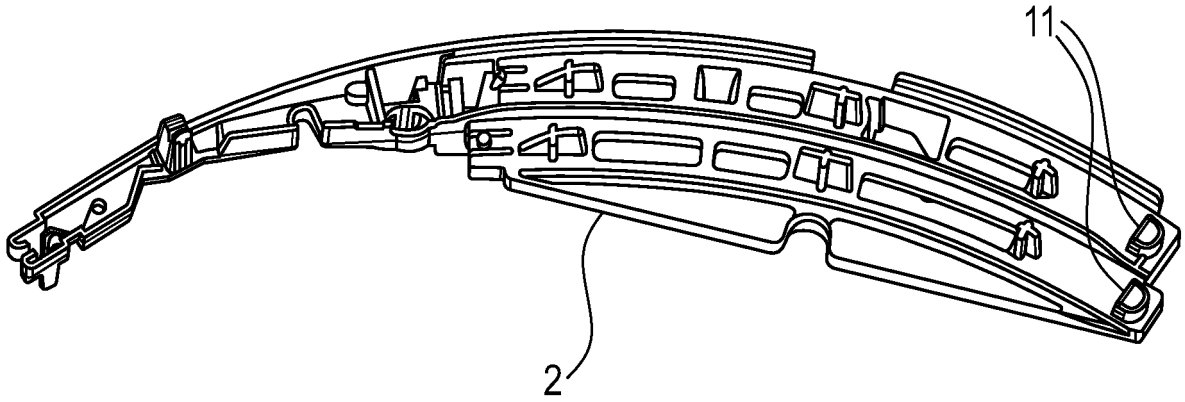

Fig. 4

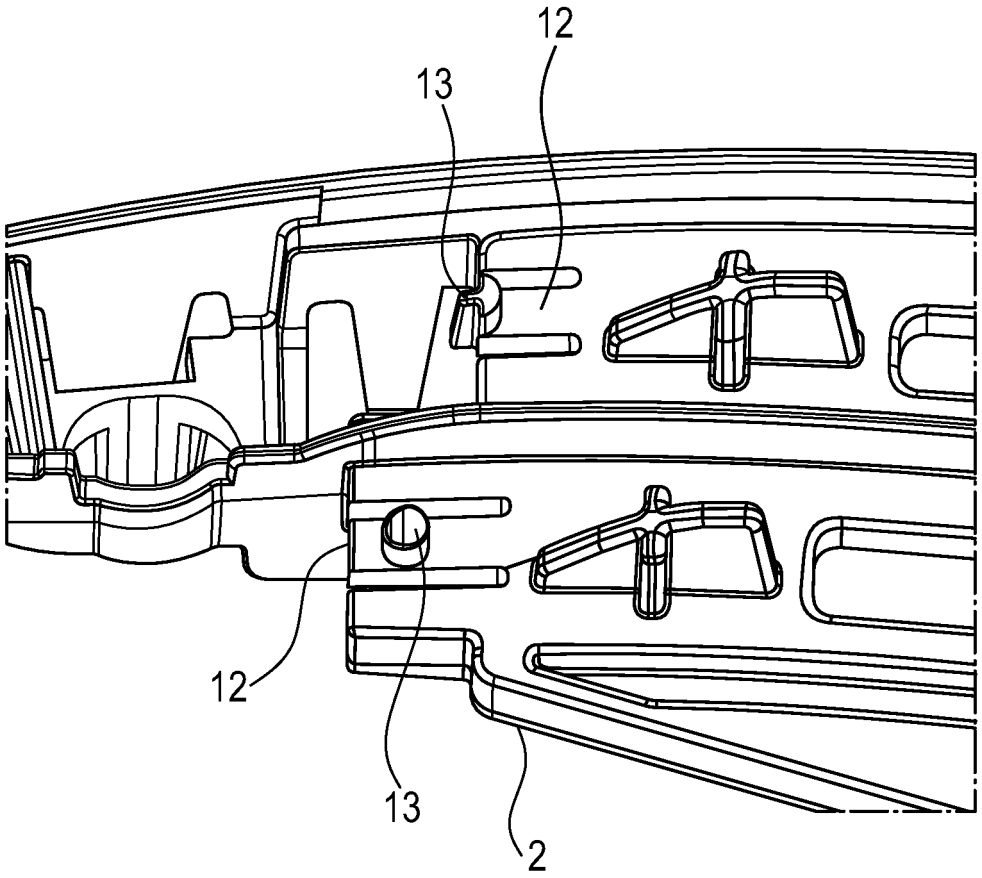

Fig. 5

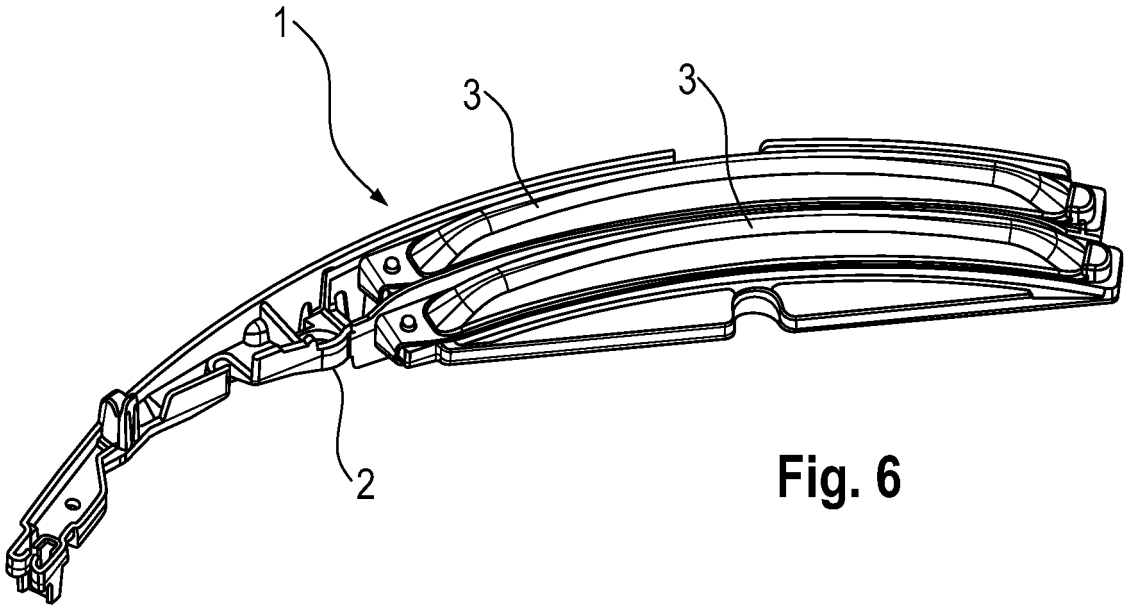

Fig. 6

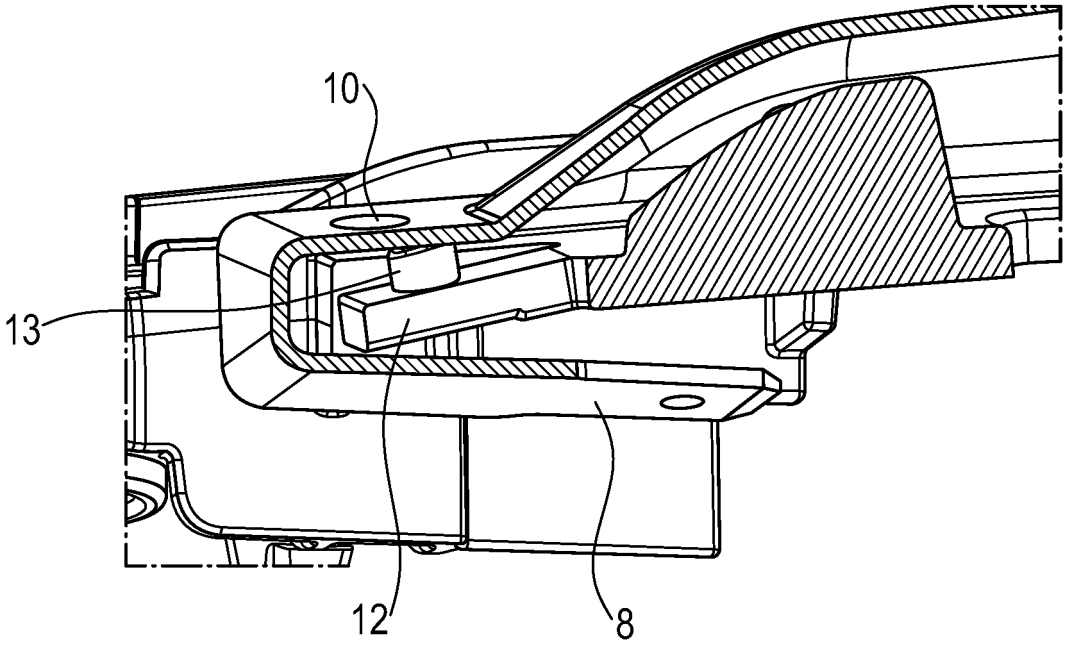

Fig. 7

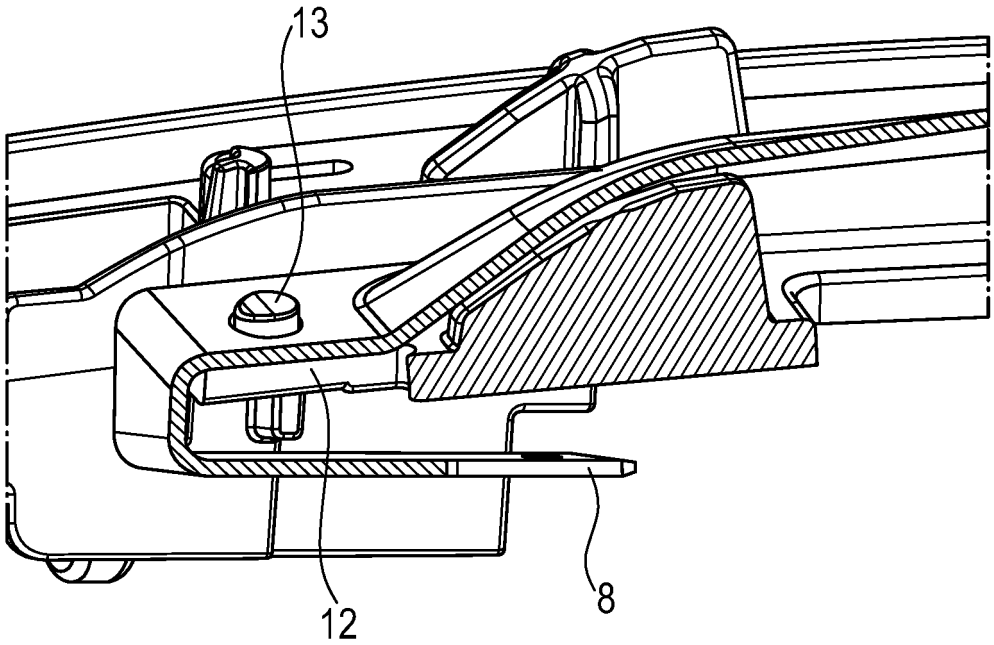

Fig. 8

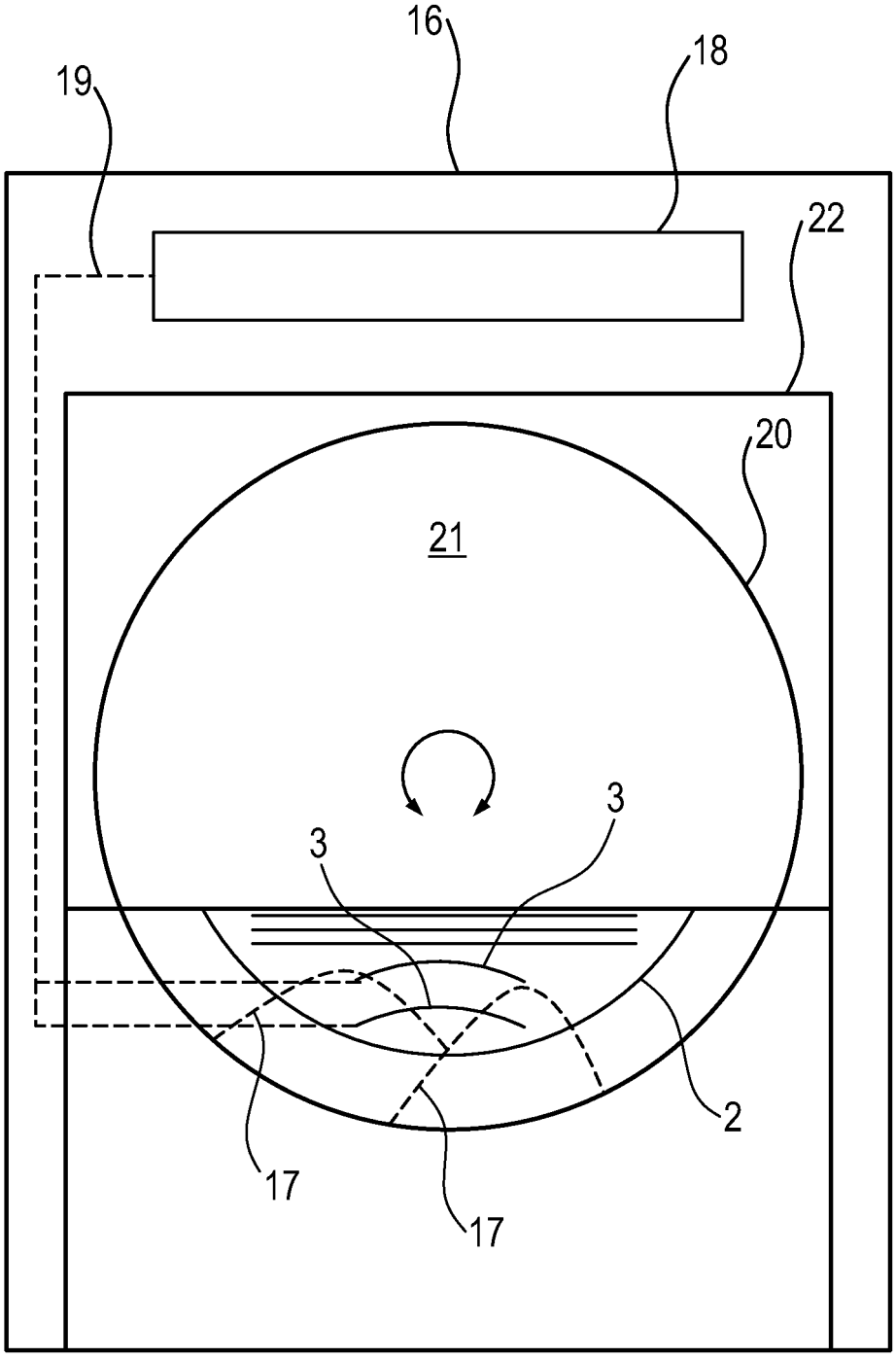

Fig. 9

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EUROPEAN SEARCH REPORT

Application Number
EP 21 18 5479

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A	US 2021/017698 A1 (BENSEL PETER HANS [US] ET AL) 21 January 2021 (2021-01-21) * the whole document *	1-15	
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2 The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	21 December 2021	Schindler, Martin

CATEGORY OF CITED DOCUMENTS

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