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(54) **A HOUSING ARRANGEMENT**

(57) A housing arrangement for use in a vehicle, the arrangement comprising: a housing (2) configured to house an electrical device (3), the housing (2) incorporating a breather aperture (6) which permits air to flow out from the interior (7) of the housing (2) to the surrounding environment; and a first connector (4) which is carried by the housing (2), the first connector (4) comprising a

first connector formation (11) which extends at least partly around the breather aperture (6), the first connector formation (11) being configured to engage a second connector formation (15) provided on a second connector (14) such that the first and second connector formations (11, 15) at least partly block fluid in the surrounding environment from entering the breather aperture (6).

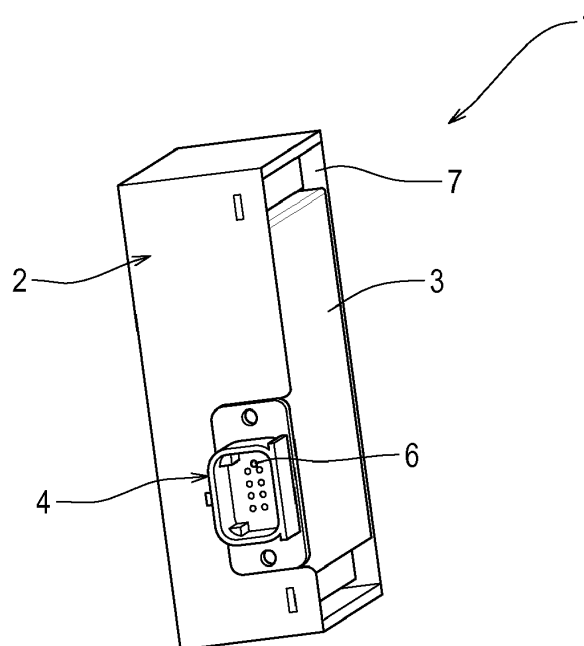


Figure 1

Description

Description of Invention

[0001] The present invention relates to a housing arrangement, and more particularly relates to a housing arrangement which is configured to house an electrical device for use in a vehicle.

[0002] An electrical device will typically generate heat when operating. For instance, a radar sensor unit or an electronic control unit (ECU) for use in a vehicle comprises processors and other electrical components which generate heat during operation. The electrical components are usually housed within a housing to protect the electrical components from damage from water, dirt, dust and other elements in the surrounding environment. The housing may be sealed hermetically or sealed such that the housing is resistant to elements in the surrounding environment.

[0003] If a housing is sealed hermetically, the air pressure within the housing increases when the air within the housing is heated by heat from the electrical components. The increased air pressure within the housing can damage the housing, for instance by distorting the housing or rupturing a seal between parts of the housing. In order to minimise this risk of damage, it is known to provide the breather aperture in a housing to enable air to escape to reduce the pressure within the housing.

[0004] The problem with a conventional housing that incorporates a breather aperture is that the breather aperture can become blocked by water or dirt which prevents air from escaping from the housing. Consequently, the air pressure within the housing can increase to a level which damages the housing.

[0005] The present invention seeks to provide an improved housing arrangement.

[0006] According to one aspect of the present invention, there is provided a housing arrangement for use in a vehicle, the arrangement comprising: a housing configured to house an electrical device, the housing incorporating a breather aperture which permits air to flow out from the interior of the housing through the breather aperture; and a first connector which is carried by the housing, the first connector comprising a first connector formation which extends at least partly around the breather aperture, the first connector formation being configured to engage a second connector formation provided on a second connector such that the first and second connector formations at least partly block fluid in the surrounding environment from entering the breather aperture.

[0007] Preferably, the arrangement further comprises: a second connector comprising a second connector formation, the second connector being connected to the first connector such that the first and second connector formations at least partly block fluid in the surrounding environment from entering the housing through the breather aperture.

[0008] According to another aspect of the present in-

vention, there is provided a connector arrangement for use in a vehicle, the arrangement comprising: a first connector which is configured to be carried by a housing, the first connector incorporating a breather aperture which is configured to permit air to flow through part of the first connector such that, when the first connector is carried by a housing, air can flow out from the interior of the housing through the breather aperture, the first connector comprising a first connector formation which extends at least partly around the breather aperture; and a second connector comprising a second connector formation, the second connector being configured to connect to the first connector such that the first and second connector formations at least partly block fluid in the surrounding environment from entering the breather aperture.

[0009] In some embodiments, a cavity is formed between part of the second connector formation and the housing when the second connector is connected to the first connector, the cavity being in fluid communication with the breather aperture so that air can flow from the interior of the housing through the breather aperture and into the cavity.

[0010] In some embodiments, part of the second connector formation is configured to engage with part of the first connector formation to form a substantially gas tight seal which inhibits air escaping from the cavity into the surrounding environment.

[0011] In other embodiments, part of the second connector formation is configured to engage with part of the first connector formation to form a partial seal to permit air to flow out from the cavity into the surrounding environment between the first and second connector formations.

[0012] Preferably, the second connector is provided with a further breather aperture which cooperates with the first breather aperture to provide a continuous fluid flow path from the first breather aperture to the surrounding environment through the further breather aperture.

[0013] Conveniently, the further breather aperture is at least partly aligned with the breather aperture of the housing when the second connector is connected to the first connector.

[0014] Advantageously, the second connector comprises a breather channel which provides a fluid flow path leading from the further breather aperture to the surrounding environment.

[0015] Advantageously, the further breather aperture is at least partly closed by a one-way valve arrangement.

[0016] In some embodiments, the one-way valve arrangement is a membrane which permits fluid to pass through the membrane in one direction but not in another direction.

[0017] Preferably, the first connector comprises an electrical contact which is configured to engage an electrical contact on the second connector.

[0018] Conveniently, a sealing element is provided on at least one of the first and second connectors to provide

a substantially watertight seal between the first and second connectors when the first and second connectors are connected to one another.

[0019] In some embodiments, the housing houses a radar sensor unit or an electronic control unit for use in a vehicle.

[0020] According to another aspect of the present invention, there is provided an electronic control unit for use in a vehicle, the electronic control unit comprising the arrangement of any one of claims 1 to 11 defined hereinafter.

[0021] According to a further aspect of the present invention, there is provided a radar sensor unit for use in a vehicle, the radar sensor unit comprising the arrangement of any one of claims 1 to 11 defined hereinafter.

[0022] So that the present invention may be more readily understood, embodiments of the present invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a schematic perspective view of a housing arrangement of an embodiment of the invention,

Figure 2 is a schematic cross-sectional view from above of the housing arrangement of figure 1,

Figure 3 is a schematic cross-sectional view from below of the housing arrangement of figure 1,

Figure 4 is a schematic perspective view of the front of a first connector of an embodiment of the invention,

Figure 5 is a schematic perspective view of the rear of the connector shown in figure 4,

Figure 6 is a cross-sectional side view of a second connector of an embodiment of the invention,

Figure 7 is a schematic perspective view of the second connector of figure 6,

Figure 8 is a schematic view of a second connector of a further embodiment which incorporates a membrane,

Figure 9 is a schematic cross-sectional view of an embodiment of the invention with a first connector connected to a second connector,

Figure 10 is a schematic cross-sectional view of a further embodiment of the invention with a first connector connected to a second connector, and

Figure 11 is a schematic cross-sectional view of a housing arrangement of a yet further embodiment of the invention with a first connector connected to a second connector.

[0023] Referring now to figures 1-3 of the accompanying drawings, a housing arrangement 1 of an embodiment of the invention comprises a housing 2 which is configured to house an electrical device 3. The electrical device 3 comprises electronic circuitry and components that are protected physically by the housing 2.

[0024] In embodiments of the invention, the housing 2 is configured to house an electrical device 3 for use in a vehicle, such as a radar sensor unit, an electronic control unit (ECU) or another type of vehicle sensor unit, processing unit or control unit.

[0025] The housing arrangement 1 further comprises a first connector 4 which is carried by the housing 2. In some embodiments, the first connector 4 is formed integrally with the housing 2 but in other embodiments the first connector 4 is a discrete component which is mounted to the housing 2.

[0026] In this embodiment, the first connector 4 is mounted to the housing 2 to at least partly close an aperture 5 in the housing 2. A sealing element or gasket (not visible in figure 3) is preferably provided between the first connector 4 and the housing 2. The sealing element is preferably a waterproof gasket or seal which provides a watertight or substantially watertight seal around the aperture 5 to minimise or prevent moisture, water or other liquids from entering the housing 2 through the aperture 5.

[0027] The sealing element is preferably of an elastically deformable material with an aperture having a shape that corresponds substantially to the shape of the aperture 5 in the housing 2. The sealing element is positioned so that the aperture in the sealing element is at least partly aligned with the aperture 5 in the housing 2. The first connector 4 is attached to the housing 2 so that at least part of the sealing element is trapped between the housing 2 and the first connector 4 to provide a watertight or substantially watertight seal between the first connector 4 and the housing 2.

[0028] The housing 2 comprises a base and a top cover (not shown) which provide a fluid or gas tight seal with the walls of the housing 2 to enclose the interior of the housing. In other embodiments, the housing may be of a different shape to the one shown in figures 1-3.

[0029] The housing arrangement 2 is provided with a breather aperture 6 which permits air to flow out from the interior of the housing 2 to the surrounding environment. The function of the breather aperture 6 will be described in more detail below.

[0030] Referring now to figure 4 of the accompanying drawings, the first connector 4 comprises a generally planar base 8 with mounting apertures 9, 10 to enable the first connector 4 to be mounted to the housing 2. In some embodiments of the invention, such as the embodiment shown in figure 4, the breather aperture 6 is provided in a portion of the planar base of the first connector 4.

[0031] The first connector 4 further comprises a first connector formation 11 which is coupled to the planar base 8 and extends at least partly around the breather

aperture 6. In some embodiments, such as the embodiment shown in figure 4, the first connector formation 11 surrounds the breather aperture 6 in the plane of base of the first connector 4. However, in other embodiments, the first connector formation 11 extends only partly around the breather aperture 6.

[0032] In the embodiments described above, the first connector formation 11 is a generally upstanding wall that extends around the breather aperture 6. However, in further embodiments, the first connector formation is a generally downwardly extending wall that extends at least partly around the breather aperture 6. For instance, in these further embodiments, the first connector formation is a channel or side wall that extends downwardly from the base of the first connector 4, adjacent to the breather aperture 6.

[0033] In some embodiments, the first connector 4 comprises an electrical contact provided on the planar base 8 which is at least partly surrounded by the first connector formation 11.

[0034] Referring now to figure 5 of the accompanying drawings, the housing arrangement of this embodiment comprises a plurality of electrical contacts 12 which extend through the planar base 8 of the first connector 4 to electrical contacts 13 which are provided on the rear side of the first connector 4. The electrical contacts 13 are configured to connect to the electrical device 3 within the housing 2.

[0035] Referring now to figures 6 and 7 of the accompanying drawings, a second connector 14 is configured to connect to the first connector 4. The second connector 14 is, for instance, an electrical connector which is provided at the end of a cable (not shown) which is configured to be connected electrically to the electrical device 3 within the housing 2 via the connectors 4, 14.

[0036] The second connector 14 comprises a second connector formation 15 which is configured to engage with the first connector formation 11 when the first and second connectors 4, 14 are connected to one another. The first connector formation 11 engages the second connector formation 15 such that the first and second connector formations 11, 15 at least partly block fluid in the surrounding environment from entering the breather aperture 6. The engagement of the first and second connectors 4, 14 preferably provides a watertight or substantially watertight seal between the connectors 4, 14 which minimises or prevents moisture, water or other liquids in the surrounding environment from entering the breather aperture 6. In the context of embodiments of the invention, the surrounding environment is the environment in the immediate vicinity of the first connector 4.

[0037] In some embodiments, a watertight sealing element or gasket (not shown) is provided on at least one of the first and second connectors 4, 14 so that, when the connectors 4, 14 are connected to one another, the sealing element provides a watertight or substantially watertight seal between the connectors 4, 14.

[0038] In some embodiments, the second connector

14 comprises electrical contacts 16 which are configured to contact the electrical contacts 12 on the first connector 4, when the connectors 4, 14 are connected to one another.

[0039] In this embodiment, the second connector 14 is provided with a further breather aperture 17. The further breather aperture 17 is positioned so that the further breather aperture 17 is at least partly aligned with the breather aperture 6 when the first and second connectors 4, 14 are connected together, as shown in figure 9.

[0040] In this embodiment, the second connector 14 comprises a breather channel 17a which extends through the body of the second connector formation 15. The further breather aperture 17 is provided at one end of the breather channel 17a and an outlet breather aperture 17b is provided at the other end of the breather channel 17a.

[0041] The further breather aperture 17 cooperates with the first breather aperture 6 and the breather channel 17a provides a continuous fluid flow path from the first breather aperture to the surrounding environment, through the outlet breather aperture 17b. The further breather aperture 17 therefore enables air flowing out from the interior of the housing 7 via the breather aperture 6 to escape to the surrounding environment.

[0042] Referring now to figure 8 of the accompanying drawings, the further breather aperture 17 on the second connector 14 is at least partly closed by a membrane 18. The membrane 18 is preferably of a material which enables fluid, such as air, to flow through the membrane 18 in one direction but which prevents fluid or debris, such as water or dirt, flowing through the membrane 18 in another direction. In other embodiments, the membrane 18 is omitted or replaced with a different one-way valve arrangement.

[0043] Referring now to figure 10 of the accompanying drawings, a housing arrangement 19 of other embodiments of the invention comprises the same components as the housing arrangement 1 described above. However, in these embodiments, the second connector 14 does not incorporate a further breather aperture. In these embodiments, the second connector formation 15 is configured to engage with the first connector formation 11 to form a watertight or substantially watertight seal.

[0044] When the second connector 14 is connected to the first connector 4, a cavity 20 is formed between the second connector 14, the housing 2 and parts of the first connector 4. The breather aperture 6 provides a fluid flow path between the interior chamber 7 of the housing 2 and the cavity 20. In this embodiment, the cavity 20 provides a space into which air from the housing 2 can flow when the pressure of the air within the housing 2 is raised, for instance by hot electronic components within the housing 2. The configuration of the cavity 20 therefore enables the air pressure within the housing 2 to be reduced to protect the housing 2.

[0045] Referring now to figure 11 of the accompanying drawings, a housing arrangement 21 of other embodi-

ments of the invention comprises the same components as the housing arrangement 19 of the further embodiment described above. However, in these other embodiments, there is a partial seal between the first and second connector formations 11, 15. Consequently, air flowing out from the housing 2 via the breather aperture 6 can flow into the cavity 20 and then out into the surrounding environment through the partial seal between the first and second connector formations 11, 15. This provides a further ventilating effect which reduces the air pressure within the housing 2.

[0046] The breather aperture 6 of embodiments of the invention reduces the air pressure within the housing 2 to minimise damage to the housing 2. When the second connector 14 is connected to the first connector 4, the breather aperture 6 is at least partly closed or sealed which minimises the risk of fluid or dirt passing through the breather aperture 6 and into the interior chamber 7 of the housing 2.

[0047] The breather aperture 6 is at least partly surrounded or enclosed by the connector formations which minimises the risk of the breather aperture 6 becoming blocked by fluid or dirt from the surrounding environment.

[0048] In embodiments where the first connector 4 is a discrete component that is not formed integrally with the housing 2, the first and second connectors 4, 14 form a connector arrangement in other embodiments of the invention. The connector arrangement is configured for use with a housing to provide ventilation to the housing via the breather aperture whilst minimising the risk of the breather aperture from becoming blocked by fluid or dirt from the surrounding environment.

[0049] When used in this specification and the claims, the term "comprises" and "comprising" and variations thereof mean that specified features, steps or integers and included. The terms are not to be interpreted to exclude the presence of other features, steps or compounds.

[0050] The features disclosed in the foregoing description, or the following claims, or the accompanying drawings, expressed in their specific forms or in terms of a means for performing the disclosed function, or a method or process for attaining the disclosed result, as appropriate, may, separately, or in any combination of such features, be utilised for realising the invention in diverse forms thereof.

Claims

1. A housing arrangement for use in a vehicle, the arrangement comprising:

a housing configured to house an electrical device, the housing incorporating a breather aperture which permits air to flow out from the interior of the housing through the breather aperture; and

a first connector which is carried by the housing, the first connector comprising a first connector formation which extends at least partly around the breather aperture, the first connector formation being configured to engage a second connector formation provided on a second connector such that the first and second connector formations at least partly block fluid in the surrounding environment from entering the breather aperture.

2. The arrangement of claim 1, wherein the arrangement further comprises:

a second connector comprising a second connector formation, the second connector being connected to the first connector such that the first and second connector formations at least partly block fluid in the surrounding environment from entering the housing through the breather aperture.

3. A connector arrangement for use in a vehicle, the arrangement comprising:

a first connector which is configured to be carried by a housing, the first connector incorporating a breather aperture which is configured to permit air to flow through part of the first connector such that, when the first connector is carried by a housing, air can flow out from the interior of the housing through the breather aperture, the first connector comprising a first connector formation which extends at least partly around the breather aperture; and

a second connector comprising a second connector formation, the second connector being configured to connect to the first connector such that the first and second connector formations at least partly block fluid in the surrounding environment from entering the breather aperture.

4. The arrangement of claim 2 or claim 3, wherein a cavity is formed between part of the second connector formation and the housing when the second connector is connected to the first connector, the cavity being in fluid communication with the breather aperture so that air can flow from the interior of the housing through the breather aperture and into the cavity.

5. The arrangement of claim 4, wherein part of the second connector formation is configured to engage with part of the first connector formation to form a substantially gas tight seal which inhibits air escaping from the cavity into the surrounding environment.

6. The arrangement of claim 4, wherein part of the second connector formation is configured to engage with

part of the first connector formation to form a partial seal to permit air to flow out from the cavity into the surrounding environment between the first and second connector formations.

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7. The arrangement of any one of claims 2 to 6, wherein the second connector is provided with a further breather aperture which cooperates with the first breather aperture to provide a continuous fluid flow path from the first breather aperture to the surrounding environment through the further breather aperture. 10
8. The arrangement of claim 7, wherein the further breather aperture is at least partly aligned with the breather aperture of the housing when the second connector is connected to the first connector. 15
9. The arrangement of claim 7 or claim 8, wherein the second connector comprises a breather channel which provides a fluid flow path leading from the further breather aperture to the surrounding environment. 20
10. The arrangement of any one of claims 7 to 9, wherein the further breather aperture is at least partly closed by a one-way valve arrangement. 25
11. The arrangement of claim 10, wherein the one-way valve arrangement is a membrane which permits fluid to pass through the membrane in one direction but not in another direction. 30
12. The arrangement of any one of claims 2 to 11, wherein a sealing element is provided on at least one of the first and second connectors to provide a substantially watertight seal between the first and second connectors when the first and second connectors are connected to one another. 35
13. The arrangement of any one of the preceding claims, wherein the first connector comprises an electrical contact which is configured to engage an electrical contact on the second connector. 40
14. An electronic control unit for use in a vehicle, the electronic control unit comprising the arrangement of any one of claims 1 to 12. 45
15. A radar sensor unit for use in a vehicle, the radar sensor unit comprising the arrangement of any one of claims 1 to 12. 50

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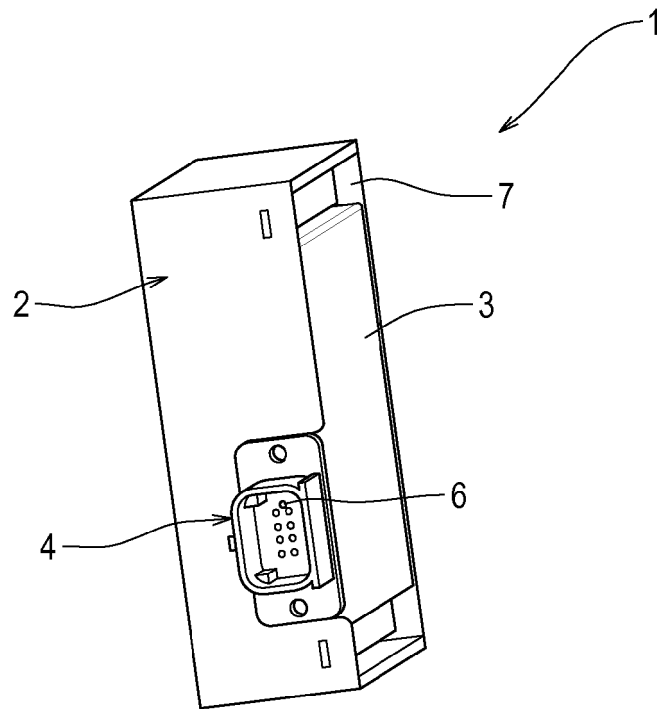


Figure 1

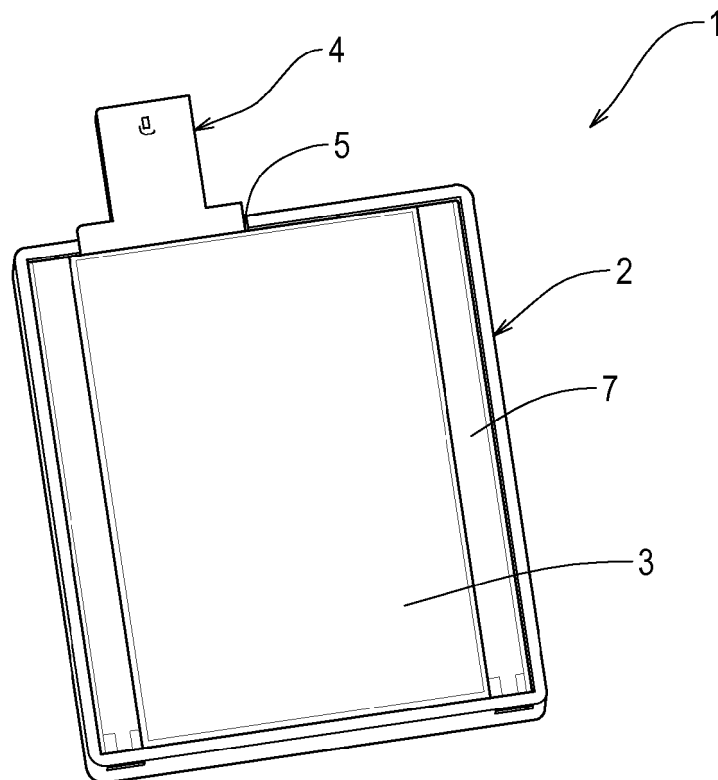


Figure 2

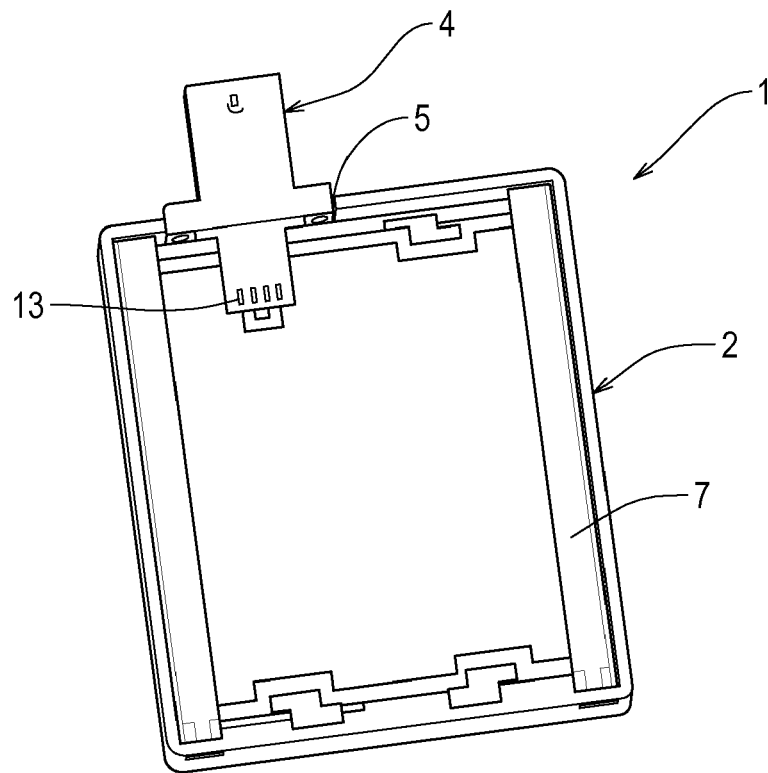


Figure 3

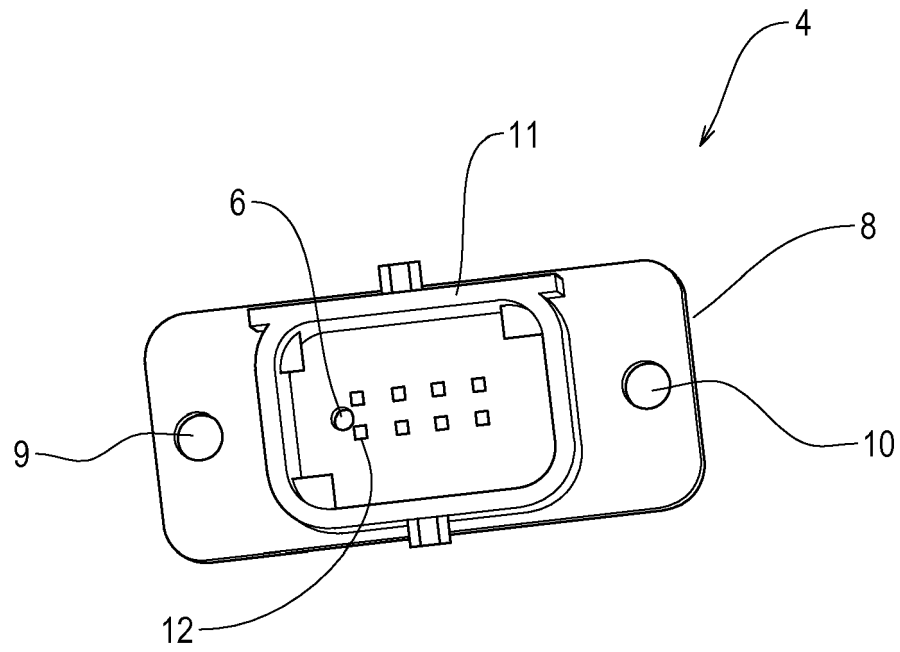


Figure 4

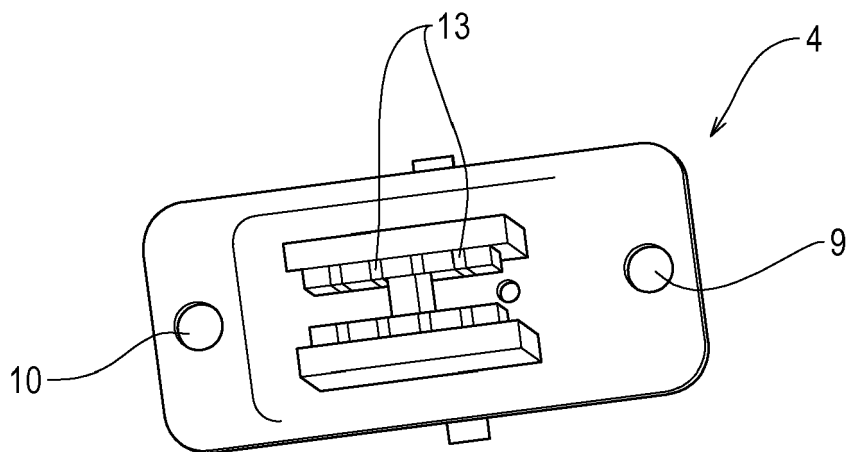


Figure 5

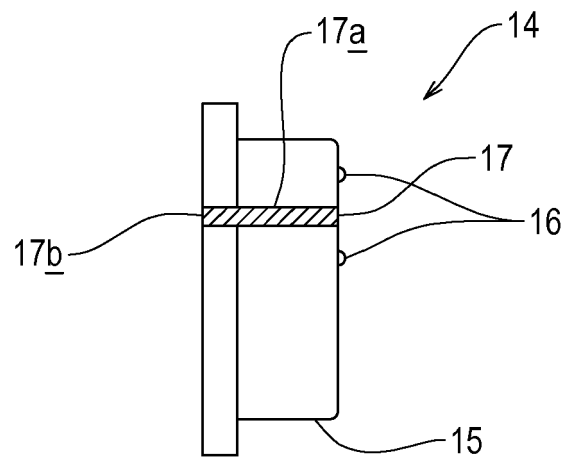


Figure 6

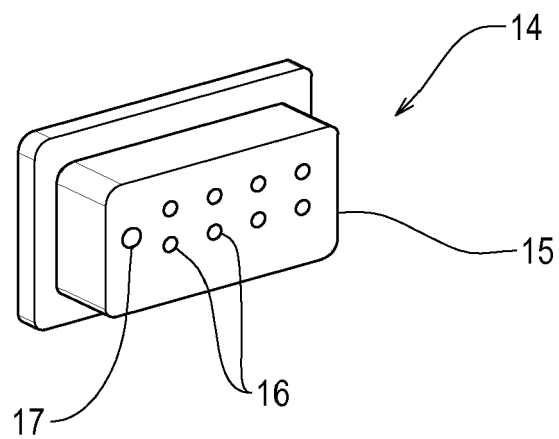


Figure 7

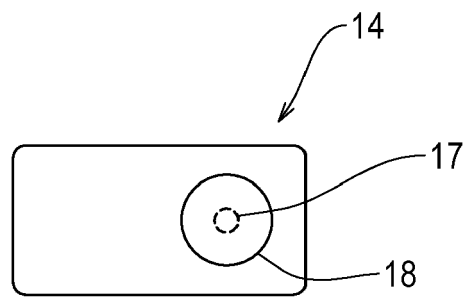


Figure 8

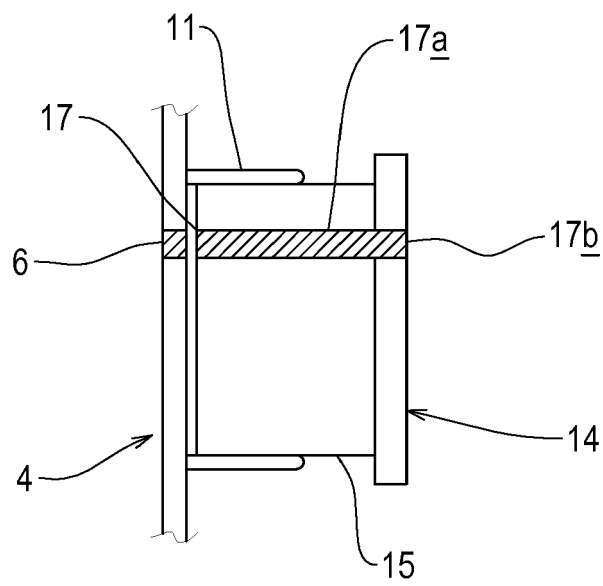


Figure 9

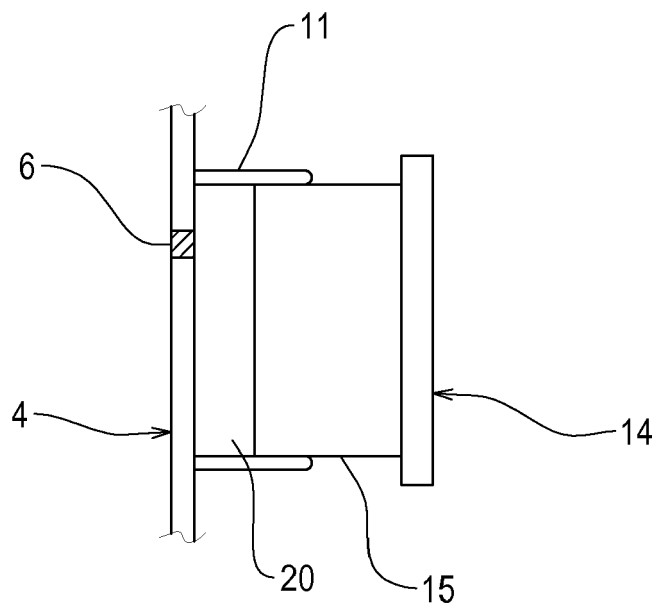


Figure 10

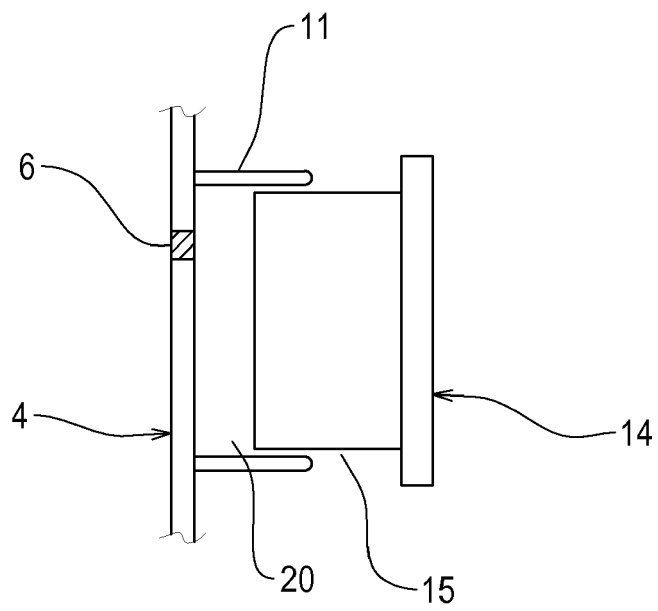


Figure 11



EUROPEAN SEARCH REPORT

 Application Number
 EP 17 17 0792

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Y	* paragraph [0001] - paragraph [0003]; figure 3 *	6-11	
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			H01R
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 27 October 2017	Examiner Corrales, Daniel
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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