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(54) HEAT TRANSFER SYSTEM FOR A LIGHTING MODULE OF A MOTOR VEHICLE

**WÄRMEÜBERTRAGUNGSSYSTEM FÜR EIN BELEUCHTUNGSMODUL EINES
KRAFTFAHRZEUGS**

**SYSTÈME DE TRANSFERT DE CHALEUR POUR UN MODULE D'ÉCLAIRAGE D'UN VÉHICULE À
MOTEUR**

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Description

TECHNICAL FIELD

[0001] The present invention relates to a heat transfer system for a lighting module of a motor vehicle.

[0002] The invention also relates to a motor vehicle lighting device comprising such a lighting module.

STATE OF THE ART

[0003] For the illumination of path of automotive vehicles, the use of lighting modules comprising a light source using LEDs (light-emitting diodes) is known.

[0004] Such system lighting modules using light source comprising LEDs makes it possible to provide proper lighting in front of the vehicle. They are therefore used to perform various functions such as for example road lighting function to illuminate the path and also avoid dazzling other motorists, or for signaling functions.

[0005] During the operation, such a lighting module can become very hot due to the use of LEDs and the heat generated by the motor compartment. Excessive heating leads to malfunction of the LED or even destruction of the system and/or the control circuit. It is therefore needed to cool the lighting module, in order to keep the LED under their junction temperature, above which their performance is decreasing. In that end, the use of heat-sinks with airfoils or fins is known. However, such cooling means are not always sufficiently efficient in maintaining the lighting module below a damaging temperature. To improve the efficiency of such heat sink many solutions have been tried such as active cooling with fans blowing air toward the fins of the heat sink or anodization or cathaphoresis. Such systems have been explained in Patent such as KR 20160000832 U and US 2008175008 A1. This prior art discloses surface treated led lamp by arc plasma anodizing and also improvement of heatsink radiation by vacuum sputtering, vaporization and anodizing respectively. Both the prior art document, talk about anodizing of all the fins of the heat sink. Such methods are complicated in nature and therefore costly. EP 2 762 771 A2 and US 2011/068687 A1 disclose further lighting modules of the prior art.

SUMMARY OF THE INVENTION

[0006] An object of the present invention is to solve at least partially the disadvantages described above of known lighting module. In particular, it is the object of the present invention to provide a lighting module device with an improved and compact heat exchange system which is easy to implement and affordable.

[0007] According to the present invention there is provided a lighting module for an automotive vehicle comprising a light source for producing a light beam in front of the vehicle. The lighting module further comprises a heat exchange system for transferring heat away from

the light source, the heat exchange system. The heat exchange system has a heat sink plate and plurality of heat transfer airfoils thermally connected to the heat sink plate.

[0008] The heat transfer airfoils of the heat exchange system according to the present invention have a plurality of non-anodized heat transfer airfoils and a pair of anodized heat transfer airfoils. The pair of anodized heat transfer airfoils are at peripheral portion encompassing the plurality of non-anodized airfoils of the heat exchange system. Indeed, such an arrangement wherein only peripheral airfoils are anodized has shown to decrease significantly the junction temperature compared to a heat exchange system without any anodized airfoils and is quite as efficient than a full set of anodized airfoils, for a much better production cost. According to another embodiment of the present invention, the heat sink plate of the heat transfer system is provided with an enveloping airfoil over the plurality of non-anodized heat transfer airfoils and the pair of anodized heat transfer airfoils. The enveloping airfoil of the embodiment of the present invention is connected on the anodized heat transfer airfoil at peripheral portion of the heat exchange system. The enveloping airfoil is also anodized to improve the heat transfer. This arrangement increases further the heat transfer efficiency, while still limiting the cost compared to a full set of anodized airfoils.

[0009] According to another embodiment of the present invention, one of the heat transfer airfoil is provided at peripheral portion is orientated towards the visible side of the lighting module.

[0010] According to the embodiment of the present invention, the heat transfer airfoil oriented towards the visible side of the lighting module is anodized to improve the heat transfer.

[0011] According to the embodiment of the invention, the anodized heat transfer airfoil are provided with a thin plastic coating to improve the heat transfer and the aesthetic of the lighting module, when considering the heat transfer airfoil oriented towards the visible side of the lighting module.

[0012] According to the embodiment of the present invention, the thin plastic coating provided on the heat transfer airfoil is lower than 100 microns.

BRIEF DESCRIPTION OF THE INVENTION

[0013] To complete the description and to provide a better understanding of the invention, a set of drawings is provided. Said drawings form an integral part of the description and illustrate an embodiment of the invention, which should not be construed as restricting the scope of the invention, but only as an example of how the invention can be carried out. The drawings comprise the following characteristics.

Figure 1 shows a perspective view of a heat exchange system of a lighting module, according to the

embodiment of present invention. The figure shows the arrangement of the plurality of heat transfer airfoils arranged on a heat sink plate.

Figure 2 shows a perspective view of a heat exchange system of lighting module, according to another embodiment of the present invention. The figure shows an enveloping airfoil arranged on the plurality of airfoils of the heat sink.

Figure 3 is another embodiment of the lighting module of the present invention, wherein the anodized fin lies in a visible area of the lighting module.

Figure 4 shows the lighting module of the Figure 3. The figure shows airfoil of the heat sink plate coated with a thin plastic coating.

DETAILED DESCRIPTION OF THE INVENTION

[0014] Hereinafter, embodiments of the present invention will be described with reference to the accompanying drawings.

[0015] Figure 1 shows a perspective view of a heat exchange system 100 of lighting device having a light source 10 such as LED for producing a light beam, according to an embodiment of the present invention.

[0016] According to an embodiment of the present subject matter, the heat exchange system (100) shown in Figure 1 comprises a heat sink plate (11) provided with a plurality of heat transfer airfoils for transferring heat away from the heat sink plate 11. In lighting module of present subject matter, to avoid component failure due to heat generation, the lighting module is provided with such heat exchange system for reducing heat generated inside the module. Such heat sink plate are provided with plurality of airfoils to increase heat convection dissipation. To further to improve the heat dissipation by radiation, surface treatment such as anodization or cataphoresis is done to increasing radiation emissivity of the airfoils. But the only surface where this emissivity improvement is useful is the outer surface because of the emission of inner airfoils is compensated by the emission of its in front airfoils.

[0017] Accordingly, the pluralities of heat transfer airfoils of heat exchange system 100 of the present invention are made of two types. The heat exchange system 100 is provided with a plurality of non-anodized heat transfer airfoils 14 and a pair of anodized heat transfer airfoils 12. The pair of anodized heat transfer airfoils 12 is placed at peripheral portion of the heat sink plate 11. The pair anodized heat transfer airfoils 12 are arranged such that they encompass the plurality of non-anodized heat transfer airfoils 14 of the heat exchange system 100. As per the embodiment, it signifies that only the first and the last heat transfer airfoils or the peripheral airfoils are anodized and the remaining heat transfer airfoils are not anodized. The plurality of non-anodized heat transfer air-

foils 14 and the pair of anodized heat transfer airfoils 12 are thermally connected to the heat sink plate 11 and radiate outwards.

[0018] Comparative test showed that the design according to the invention allowed a decrease of 14.5 °C of the junction temperature of the LED compared to a heat sink plate provided with a full set of non anodized airfoils whereas a full set of anodized airfoils allowed to achieve a decrease of 18°C of the junction temperature of the LED.

[0019] Figure 2 shows another embodiment of the present invention. According to this embodiment of the present invention, the heat transfer system 100 comprises a heat sink plate 11, a plurality of non-anodized heat transfer airfoil 14 and a pair of anodized heat transfer airfoils 12. Additionally, the heat transfer system 100 comprises an enveloping airfoil 16. The enveloping airfoil 16 is connected on the pair of anodized heat transfer airfoil 12 provided at peripheral portion of the heat exchange system (100). The embodiment provides emissivity improvement on the outer side of this surface. The enveloping airfoil 16 of the present invention is also anodized to attain the objectives according to the scope of invention.

[0020] According to yet another embodiment of present invention as shown if Figure 3, at least one anodized heat transfer airfoil 12 at peripheral portion is orientated towards the visible side of the lighting module. The Figure shows a light source 10 such as a LED assembled inside the housing 20 of a motor vehicle lighting device. The figure also shows the heat sink plate 11 arranged in relation to the light source 10. The provision of the anodized airfoil in the visible area of the lighting device provides higher heat dissipation due to relatively lower temperature near the outer side of lighting device.

[0021] Figure 4 shows another embodiment of the present invention where the at least one anodized heat transfer airfoil 12, for instance here the one provided at peripheral portion, is coated with a thin plastic coating 12a. The size of the thin plastic coating 12a provided on the heat transfer airfoil 12 is lower than 100 microns. The thin plastic coating 12a is provided with additional aesthetic design or feature to improve the design of the lighting module. The addition of the thin plastic coating 12a further improves the emissivity of the heat sink and ensures better heat transfer in the lighting module.

Claims

1. A lighting module for a automotive vehicle comprising:
 - a light source (10) for producing a light beam; and
 - a heat exchange system (100) for transferring heat away from the light source (10), the heat exchange system (100) comprising:

- a heat sink plate (11);
characterized in that the heat exchange system (100) further comprises a plurality of non-anodized heat transfer airfoils (14) and a pair of anodized heat transfer airfoils (12), wherein the pair of anodized heat transfer airfoils (12) are at peripheral portion encompassing the plurality of non-anodized airfoils (14) of the heat exchange system (100).
2. The lighting module as claimed in claim 1, wherein the plurality of non-anodized heat transfer airfoils (14) and the pair of anodized airfoils (12) are thermally connected to the heat sink plate (11).
 3. The lighting module as claimed in claim 1 or 2, wherein at least one anodized heat transfer airfoil (12) at peripheral portion is orientated towards the visible side of the lighting module.
 4. The lighting module as claimed in claim 1 to 3, wherein the heat sink plate (11) is provided with an enveloping airfoil (16) over the plurality of non-anodized heat transfer airfoils (14) and the pair of anodized heat transfer airfoils (12).
 5. The lighting module as claimed in any of claim 1 to 4, wherein at least one anodized heat transfer airfoil (12) is provided with a thin plastic coating (12a).
 6. The lighting module as claimed in claim 5, wherein the thin plastic coating (12a) provided on the heat transfer airfoil (12) is lower than 100 microns.
 7. The lighting module as claimed in any of claims 4 to 6, wherein the enveloping airfoil (16) is connected on the two anodized heat transfer airfoil (12) at peripheral portion of the heat exchange system (100).
 8. The lighting module as claimed in any of claim 4 to 7, wherein the enveloping airfoil (16) is also anodized.
 9. The lighting module as claimed in any of preceding claims, wherein the light source (10) is a LED disposed on a LED circuit board.
 10. The lighting module as claimed in any of the preceding claims, wherein the plurality of non-anodized heat transfer airfoils (14) and the pair of anodized heat transfer airfoils (12) are made of aluminium.
 11. Motor vehicle lighting device comprising a lighting module according to any of the preceding claims.

Patentansprüche

1. Beleuchtungsmodul für ein Kraftfahrzeug, Folgendes umfassend:
 eine Lichtquelle (10) zum Erzeugen eines Lichtstrahls und
 ein Wärmetauschsystem (100) zum Übertragen von Wärme weg von der Lichtquelle (10), wobei das Wärmetauschsystem (100) Folgendes umfasst ein Kühlblech (11),
dadurch gekennzeichnet, dass das Wärmetauschsystem (100) ferner mehrere nicht anodisierte Wärmeübertragungsluftleitbleche (14) und ein Paar anodisierter Wärmeübertragungsluftleitbleche (12) umfasst, wobei sich das Paar anodisierter Wärmeübertragungsluftleitbleche (12) an einem Umfangsabschnitt befindet, der die mehreren nicht anodisierten Luftleitbleche (14) des Wärmetauschsystems (100) umschließt.
2. Beleuchtungsmodul nach Anspruch 1, wobei die mehreren nicht anodisierten Wärmeübertragungsluftleitbleche (14) und das Paar anodisierter Wärmeübertragungsluftleitbleche (12) thermisch mit dem Kühlblech (11) verbunden sind.
3. Beleuchtungsmodul nach Anspruch 1 oder 2, wobei mindestens ein anodisiertes Wärmeübertragungsluftleitblech (12) am Umfangsabschnitt hin zur sichtbaren Seite des Beleuchtungsmoduls ausgerichtet ist.
4. Beleuchtungsmodul nach Anspruch 1 bis 3, wobei das Kühlblech (11) mit einem umhüllenden Luftleitblech (16) über den mehreren nicht anodisierten Wärmeübertragungsluftleitblechen (14) und dem Paar anodisierter Wärmeübertragungsluftleitbleche (12) versehen ist.
5. Beleuchtungsmodul nach einem der Ansprüche 1 bis 4, wobei mindestens ein anodisiertes Wärmeübertragungsluftleitblech (12) mit einem dünnen Kunststoffüberzug (12a) versehen ist.
6. Beleuchtungsmodul nach Anspruch 5, wobei der dünne Kunststoffüberzug (12a), mit dem das Wärmeübertragungsluftleitblech (12) versehen ist, dünner als 100 Mikrometer ist.
7. Beleuchtungsmodul nach einem der Ansprüche 4 bis 6, wobei das umhüllende Luftleitblech (16) an einem Umfangsabschnitt des Wärmetauschsystems (100) mit den zwei anodisierten Wärmeübertragungsluftleitblechen (12) verbunden ist.
8. Beleuchtungsmodul nach einem der Ansprüche 4

bis 7, wobei das umhüllende Luftleitblech (16) ebenfalls anodisiert ist.

9. Beleuchtungsmodul nach einem der vorhergehenden Ansprüche, wobei die Lichtquelle (10) eine LED ist, die auf einer LED-Leiterplatte angeordnet ist. 5
10. Beleuchtungsmodul nach einem der vorhergehenden Ansprüche, wobei die mehreren nicht anodisierten Wärmeübertragungsluftleitbleche (14) und das Paar anodisierter Wärmeübertragungsluftleitbleche (12) aus Aluminium bestehen. 10
11. Kraftfahrzeug-Beleuchtungsanordnung, umfassend ein Beleuchtungsmodul nach einem der vorhergehenden Ansprüche. 15

Revendications

1. Module d'éclairage pour un véhicule automobile comprenant : 20
 - une source de lumière (10) pour produire un faisceau lumineux ; et 25
 - un système d'échange de chaleur (100) pour transférer la chaleur à l'écart de la source de lumière (10), le système d'échange de chaleur (100) comprenant une plaque de dissipation thermique (11) ; 30
 - caractérisé en ce que** le système d'échange de chaleur (100) comprend en outre une pluralité d'ailettes de transfert de chaleur non anodisées (14) et une paire d'ailettes de transfert de chaleur anodisées (12), dans lequel la paire d'ailettes de transfert de chaleur anodisées (12) se trouve au niveau de la partie périphérique englobant la pluralité d'ailettes non anodisées (14) du système d'échange de chaleur (100). 35
2. Module d'éclairage selon la revendication 1, dans lequel la pluralité d'ailettes de transfert de chaleur non anodisées (14) et la paire d'ailettes anodisées (12) sont connectées thermiquement à la plaque de dissipation thermique (11). 40
3. Module d'éclairage selon la revendication 1 ou 2, dans lequel au moins une ailette de transfert de chaleur anodisée (12) à la partie périphérique est orientée vers le côté visible du module d'éclairage. 45
4. Module d'éclairage selon l'une des revendications 1 à 3, dans lequel la plaque de dissipation thermique (11) est pourvue d'une ailette enveloppante (16) au-dessus de la pluralité d'ailettes de transfert de chaleur non anodisées (14) et la paire d'ailettes de transfert de chaleur anodisées (12). 50
5. Module d'éclairage selon l'une quelconque des revendications 1 à 4, dans lequel au moins une ailette de transfert de chaleur anodisée (12) est pourvue d'un revêtement plastique mince (12a). 55
6. Module d'éclairage selon la revendication 5, dans lequel le revêtement plastique mince (12a) prévu sur l'ailette de transfert de chaleur (12) est inférieur à 100 microns.
7. Module d'éclairage selon l'une quelconque des revendications 4 à 6, dans lequel l'ailette enveloppante (16) est reliée aux deux ailettes de transfert de chaleur anodisées (12) au niveau de la partie périphérique du système d'échange de chaleur (100).
8. Module d'éclairage selon l'une quelconque des revendications 4 à 7, dans lequel l'ailette enveloppante (16) est également anodisée.
9. Module d'éclairage selon l'une quelconque des revendications précédentes, dans lequel la source de lumière (10) est une LED disposée sur une carte de circuit LED.
10. Module d'éclairage selon l'une quelconque des revendications précédentes, dans lequel la pluralité d'ailettes de transfert de chaleur non anodisées (14) et la paire d'ailettes de transfert de chaleur anodisées (12) sont réalisées en aluminium.
11. Dispositif d'éclairage de véhicule automobile comprenant un module d'éclairage selon l'une quelconque des revendications précédentes.

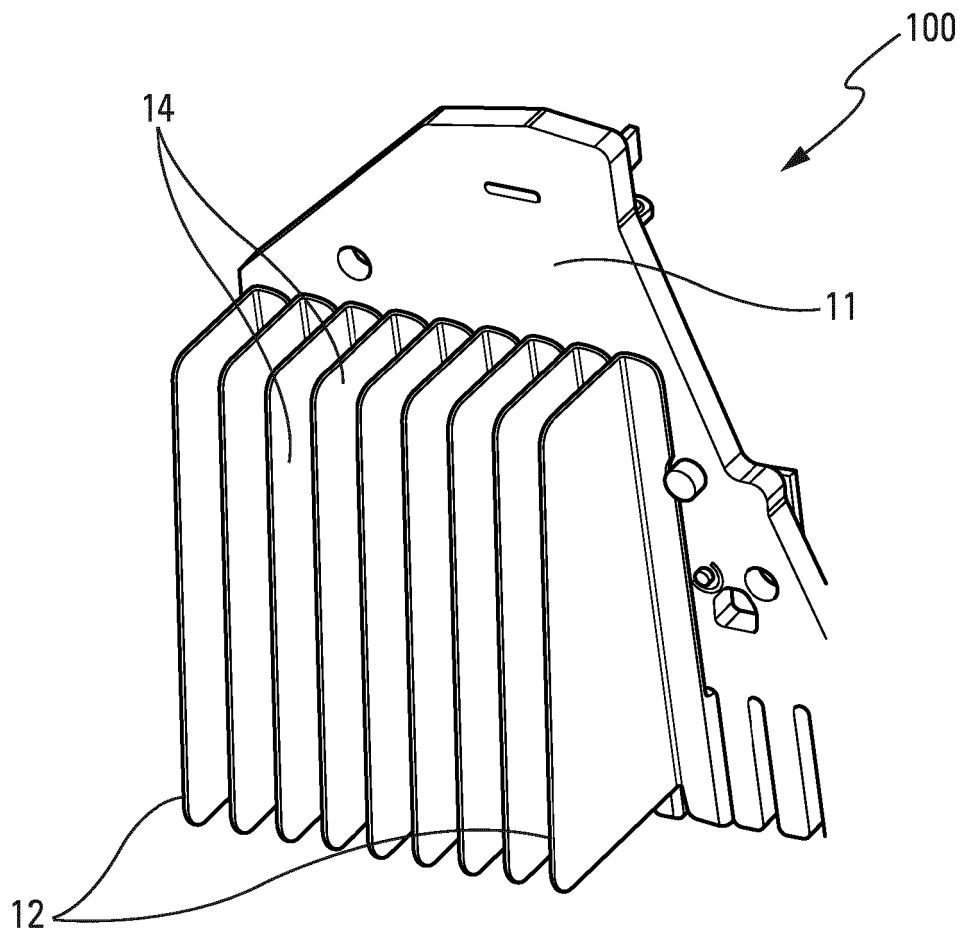


Fig. 1

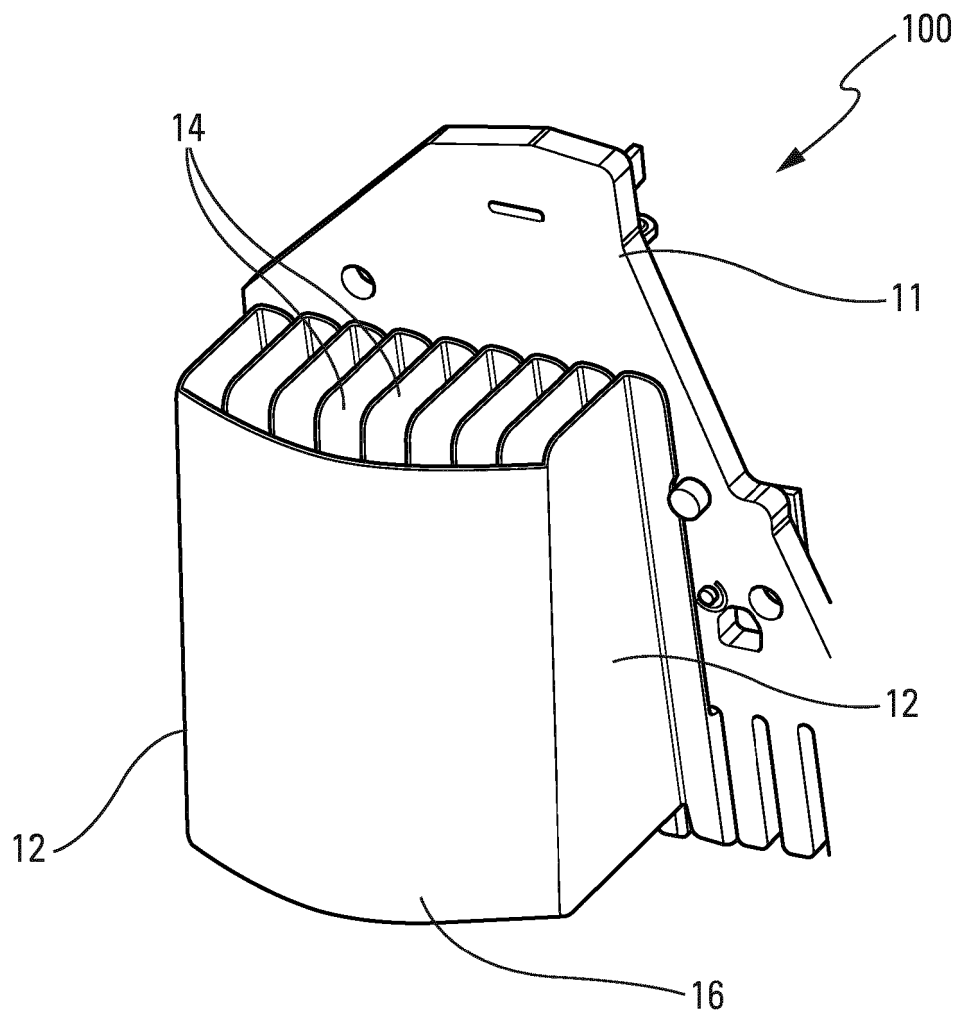


Fig. 2

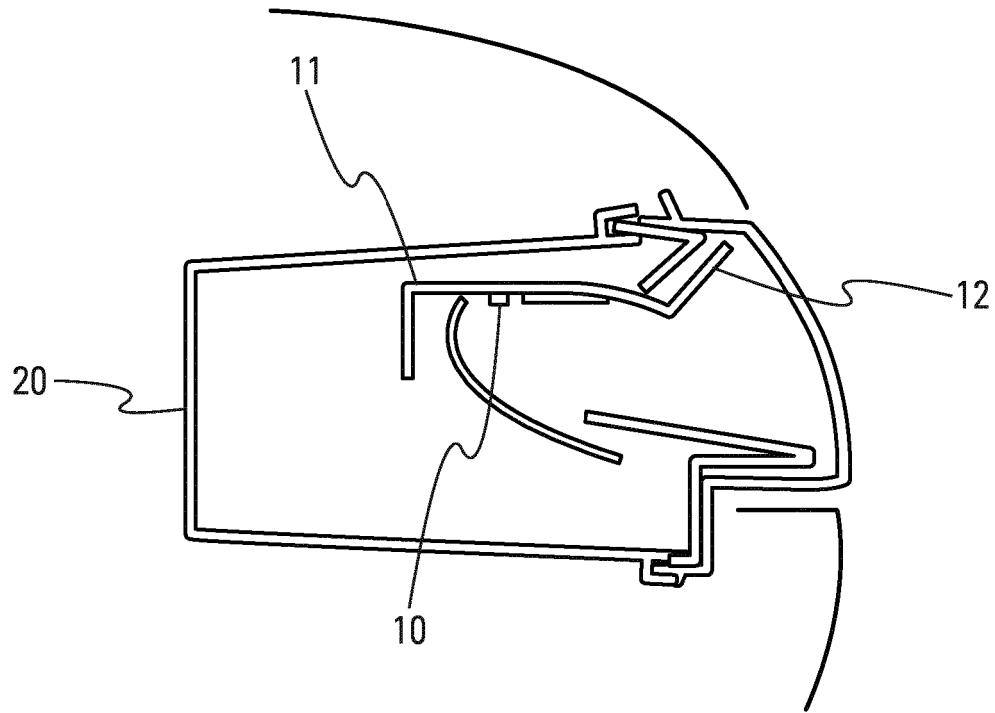


Fig. 3

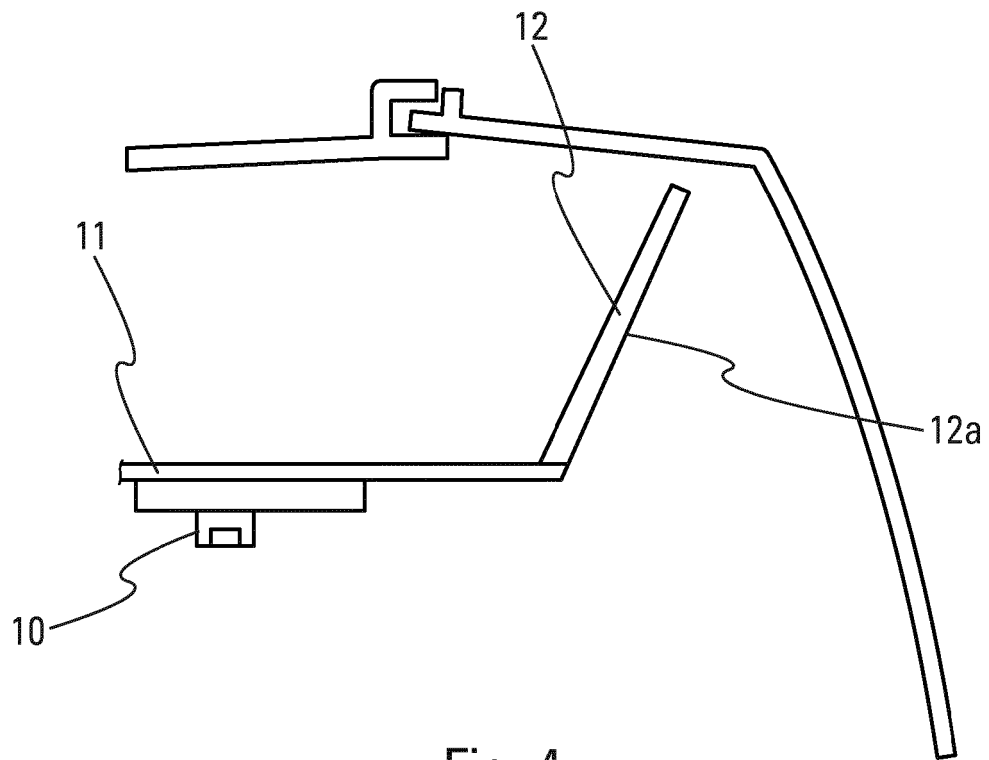


Fig. 4

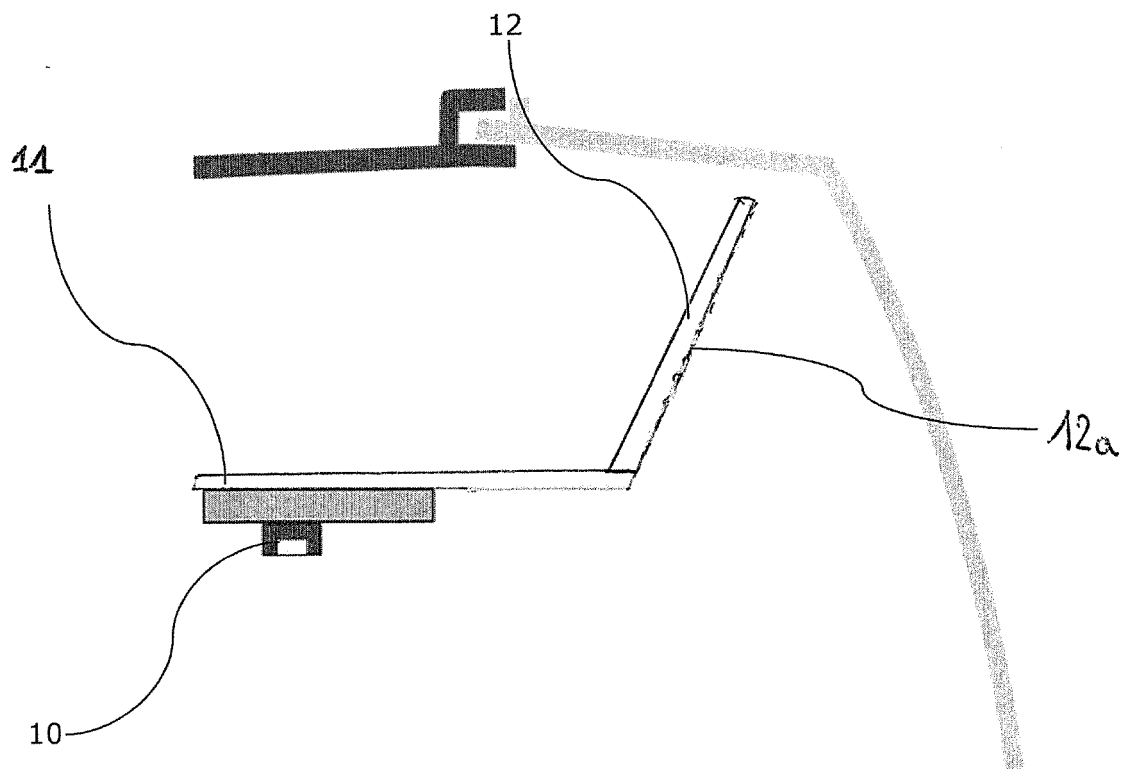


FIG. 4

REFERENCES CITED IN THE DESCRIPTION

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