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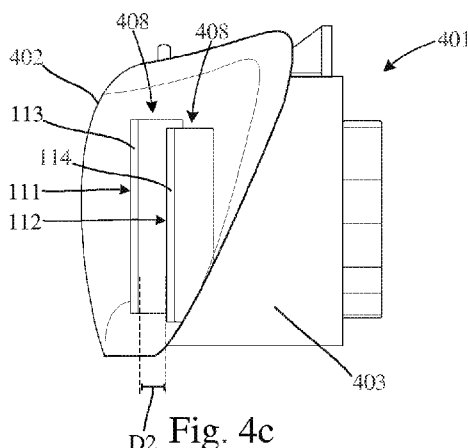


Fig. 4c

(57) Abstract: A vehicle (101) is disclosed. The vehicle (101) comprises a head or tail lamp assembly (105-108) mounted to a front or rear respectively of the vehicle. The lamp assembly (105-108) comprises: first and second light emitters (109, 110), each light emitter having a front surface (111, 112) for emitting light forward or rearward of the vehicle and having a side surface (113, 114) for emitting light sideward of the vehicle (101), wherein the first light emitter (109) is spaced from the second light emitter (110) such that the front surfaces (111, 112) of both light emitters are visible when the vehicle is viewed from the front or the rear, and the side surfaces (113, 114) of both light emitters are visible when the vehicle is viewed from a side.



VEHICLE LAMP ASSEMBLY

FIELD OF THE INVENTION

The present invention relates to vehicle lamps.

BACKGROUND OF THE INVENTION

Vehicles, such as passenger cars, usually comprise head lamps and tail lamps mounted to front and rear ends respectively of the vehicle. It is desirable to enhance the visibility of the lamps to make the vehicle more noticeable to other road users.

SUMMARY OF THE INVENTION

According to an aspect of the present invention, there is provided a vehicle having a head or tail lamp assembly mounted to a front or rear respectively of the vehicle, the lamp assembly comprising: first and second light emitters, each light emitter having a front surface for emitting light forward or rearward of the vehicle and having a side surface for emitting light sideward of the vehicle, wherein the first light emitter is spaced from the second light emitter such that the front surfaces of both light emitters are visible when the vehicle is viewed from the front or the rear, and the side surfaces of both light emitters are visible when the vehicle is viewed from the side.

The light emitters of the lamp assemblies are thus spaced in a sideways, i.e. transverse, direction of the vehicle such that the front surfaces of each of the light emitters is visible when the vehicle is viewed from the front, where the lamp assembly is a head lamp assembly mounted to a front end of the vehicle, or when the vehicle is viewed from the rear where the lamp assembly is a tail lamp assembly mounted to a rear end of the vehicle. Furthermore, the light emitters are spaced in a lengthways, i.e. longitudinal, direction of the vehicle, such that the side surfaces of each of the light emitters is visible when the vehicle is viewed from the side. The reference to the front surface being arranged for emitting light forward/rearward or sideward refers to an average direction of light emission from the surface. In other words, the front surface of each light emitter is arranged facing forward or rearward, and the side surface of each light emitter facing sideward.

In this arrangement an observer viewing the vehicle from the front, in the case of a head lamp assembly, or from the rear in the case of a tail lamp assembly, may simultaneously observe the light emission from the front surfaces of each of the light emitters. Furthermore, an observer viewing the vehicle from a side may simultaneously observe the light emission from the side surfaces of each of the light emitters. Consequently the total light emission observed by the observer in either the front/rear or side view of the lamp assembly is increased. As a result an observer may be more aware of the vehicle's presence which may reduce the risk of vehicle collisions occurring. Moreover, this arrangement may be particularly advantageous where the light emitters are assigned different lighting functions, as the observer may simultaneously observe both lighting signals. For example, the first light emitter could be assigned a running light function emitting constant white light, and the second light emitter could be assigned a direction indicator function and configured to emit pulsed amber light.

The first light emitter may be located inboard and forward of the second light emitter. The term "forward" in this context should be understood to refer to the light emitter's position within the lamp assembly relative to the rear of the lamp assembly, facing inwardly towards the vehicle, and the front of the lamp assembly, facing outwardly away from the vehicle. Because the inboard first light emitter is located forward of the outboard second light emitter, the second light emitter does not block an observer's view of the side surface of the first light emitter in a side view of the vehicle. In this arrangement, the side surface of the inboard light emitter is thus visible in a side view of the vehicle.

The side surface of each of the light emitters may have a height-width ratio of at least 4:1. That is to say, the side surface of each light emitter may be four times greater in height than in width. In this arrangement, the relatively great height of each side surface may allow a relatively great surface area to be maintained even where the side surface has a relatively narrow width. The relatively great surface area may advantageously be more visible to an observer viewing the vehicle in a side view. Furthermore, the relatively narrow width of the side surface may allow the light emitters to be spaced apart in the longitudinal dimension of the vehicle by only a relatively short distance, for example, by

just more than the width of either side surface, whilst maintaining visibility of the side surfaces of each light emitter, and visual distinction therebetween, in side view. The relatively small spacing of the light emitters in the longitudinal direction may advantageously reduce the overall depth of the light emitters, and accordingly the overall depth of the lamp assembly may be correspondingly reduced. This advantage may be even greater where the height-width ratio of the side surface of the light emitter is even greater. Thus, in alternative embodiments the height-width ratio of the side surface of each light emitter may be at least 5:1, or at least 6:1, or at least 7:1, or at least 8:1, or at least 9:1, or even at least 10:1. These relatively greater height-width ratios may allow the area of the side surface of each light emitter to be increased further still for a given depth of the lamp assembly, or alternatively for a given area may allow the depth of the lamp assembly to be reduced.

The first light emitter may be spaced from the second light emitter such that the whole of the front surfaces of both light emitters are visible when the vehicle is viewed from the front or the rear, and the whole of the side surfaces of both light emitters are visible when the vehicle is viewed from the side. In this arrangement the full area of the surfaces of the light emitters is thus visible to an observer. Consequently the visibility of the light emission from each light emitter to the observer is improved. As a result an observer may be more aware of the vehicle's presence which may reduce the risk of vehicle collisions occurring

The front surface of the first light emitter may be spaced from the front surface of the second light emitter in a sideways direction by a distance of at least 10 millimetre. The visual distinction between the light emissions from the front surfaces of the light emitters may be further enhanced where the spacing therebetween is increased. Thus, spacing the front surfaces of the light emitters apart by at least 10 millimetre, i.e. such that a minimum transverse distance therebetween is at least 10 millimetre, may reduce the risk of blurring of the respective light emissions, which could obscure the nature of a lighting signal or colour emitted by either of the light emitters. More preferably, the front surfaces of the

light emitters may be spaced apart by a distance of at least 20 millimetre, at least 30 millimeter, at least 40 millimetre, or even at least 50 millimetre.

5 The side surface of the first light emitter may be spaced from the side surface of the second light emitter in a forward direction by a distance of at least 10 millimetre. The visual distinction between the light emissions from the side surfaces of the light emitters may be further enhanced where the spacing therebetween is increased. Thus, spacing the side surfaces of the light emitters apart by at least 10 millimetre, i.e. such that a minimum longitudinal distance therebetween is at least 10 millimetre, may reduce the risk of
10 blurring of the respective light emissions, which could obscure the nature of a lighting signal or colour emitted by either of the light emitters. More preferably, the side surfaces of the light emitters may be spaced apart by a distance of at least 20 millimetre, at least 30 millimetre, at least 40 millimetre, or even at least 50 millimetre.

15 The first light emitter may comprise at least a first light source and the second light emitter may comprise at least a second light source. In this arrangement the first and second light sources may be controlled independently such that the light emitters may be assigned different lighting functions. For example, the first light source could be a white light LED and the first light emitter could be configured to emit white light, whilst the second light
20 source could be an amber light LED and the second light emitter could be configured to emit amber light. The vehicle may thus further comprise an electronic controller functional to independently control the operation of the first light source of the first light emitter and the operation of the second light source of the second light emitter.

25 Each of the first and second light emitters may comprise an illuminating portion which defines the front surface and the side surface thereof and an electrical light source for injecting light into the illuminating portion, and each said light source may be arranged to emit light into a further side surface of a respective illuminating portion. In this arrangement, because each light source injects light into a further side surface of a
30 respective one of the light emitters, the overall depth of each light emitter unit may be reduced as compared to a light emitter in which a light source is arranged behind the

illuminating portion to inject light into a rear surface of the illuminating portion. Consequently, the light emitters may advantageously be packaged in a relatively smaller volume lamp assembly. Furthermore, the reduced depth of each light emitter may advantageously allow the longitudinal spacing between the light emitters to be reduced even without the side surface of either light emitter being obscured from a side view of the vehicle by the other light emitter.

The illuminating portion of each light emitter may have a plate-like form having a major surface that defines the front surface, a first minor surface that defines the side surface, and a second minor surface that defines the further side surface. The plate-like form of each illuminating portion may advantageously facilitate a relatively small overall depth of each light emitter. Consequently, the light emitters may advantageously be packaged in a relatively smaller depth lamp assembly. Furthermore, the reduced depth of each light emitter may advantageously allow the longitudinal spacing between the light emitters to be reduced even without the side surface of either light emitter being obscured from a side view of the vehicle by the other light emitter.

The lamp assembly may comprise a housing defining a compartment defined between an optically transmissive front and an optically opaque rear, and the illuminating portion of each of the light emitters may be located in the compartment in front of the optically opaque wall and the light source of each of the light emitters is located outside of the compartment behind the optically opaque wall. In this arrangement, the illuminating portion of each light emitter is visible within the compartment through the lens, and moreover each illuminating portion may emit light outwardly of the lamp assembly through the lens. Locating the light source of each light emitter outside of the compartment behind the optically opaque wall advantageously ensures that stray light emission from either light source, i.e. light emission not injected into the respective light emitter, does not interfere with or blur the light emission from the front or side surfaces of the light emitters. Further, locating the light source of each light emitter behind the optically opaque wall obscures the light source from the view of an observer of the vehicle which may provide an improved aesthetic.

The lamp assembly may be a head lamp assembly mounted to a front end of the vehicle, the front surface of each light emitter may emit light forward of the vehicle, and the front surface of both light emitters may be visible when the vehicle is viewed from the front.

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The lamp assembly may be a tail light assembly mounted to a rear end of the vehicle, the front surface of each light emitter may emit light rearward of the vehicle, and the front surfaces of both light emitters may be visible when the vehicle is viewed from the rear.

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BRIEF DESCRIPTION OF THE DRAWINGS

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

15 Figure 1 is an illustrative side view of a passenger car comprising head lamps and tail lamps embodying the present invention;

Figure 2 is a front view of the passenger car showing the head lamps;

20 Figure 3 is an illustrative rear view of the passenger car showing the tail lamps;

Figures 4a, 4b, 4c and 4d are perspective, front elevation, side elevation and top views respectively of a head lamp of the passenger car;

25 Figures 5a and 5b show a light emitter device of the head lamp in isolation in perspective and exploded-perspective views respectively;

Figure 6 is an illustrative sectional view of the light emitter device depicting the operation of the device;

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Figure 7 is a top view of the head lamp in which the housing of the head lamp is depicted transparently and the internals of the head lamp are shown schematically;

Figures 8a, 8b and 8c are perspective, exploded-perspective and top-sectional views respectively of a first alternative light emitter device;

Figure 9 is a top view of a second embodiment of a head lamp embodying the invention in which the housing of the head lamp assembly is depicted transparently and the internals of the head lamp are shown schematically;

Figures 10a, 10b and 10c are perspective, front elevation and top-sectional views respectively of a second alternative light emitter device; and

Figure 11 is a top view of a third embodiment of a head lamp embodying the invention in which the housing of the head lamp is depicted transparently and the internals of the head lamp are shown schematically.

DETAILED DESCRIPTION OF THE INVENTION

A vehicle, in the form of a passenger car 101, embodying an example of the present invention is shown illustratively in Figures 1, 2 and 3.

Referring to the Figures, the vehicle 101 comprises a body structure 102 having a front end 103 facing in a forward direction of travel of the vehicle and a rear end 104 facing in a rearward direction of travel of the vehicle. Head lamp assembly pair 105, 106 are mounted to left and right sides respectively of the front end 103 of the body 102 for projecting light forwardly of the vehicle, and tail lamp assembly pair 107, 108 are mounted to left and right sides respectively of the rear end 104 of the body 102 for projecting light rearwardly of the vehicle.

Each of the lamp assemblies 105 to 108 comprises first and second light emitters 109, 110 arranged in a spaced-apart relationship. Each of the light emitters 109, 110 has a front surface 111, 112 respectively facing longitudinally, or lengthways, of the vehicle, i.e.

facing forwardly in the case of head lamp assemblies 105, 106, or rearwardly in the case of tail lamp assemblies 107, 108, of the vehicle, and a side surface 113, 114 respectively facing transversely, or sideways, of the vehicle, i.e. facing leftwardly of the vehicle in the case of lamp assemblies 105, 107, or rightwardly in the case of lamp assemblies 106, 108.

5 Each of the light emitters 109, 110 is configured to emit light from the respective front surface 111, 112 and side surface 113, 114 thereof. As shown best in Figure 1, the light emitters 109, 110 of each lamp assembly are spaced apart in the longitudinal direction of the vehicle such that the side surfaces 113, 114 of the light emitters 109, 110 respectively are both visible in a side view of the vehicle. Furthermore, as shown best in Figures 2 and
10 3, the light emitters 109, 110 of each lamp assembly are spaced apart in the transverse direction of the vehicle such that the front surfaces 111, 112 of the light emitters 109, 110 respectively are both visible in a front end view, in the case of head lamp assemblies 105, 106, or in a rear end view, in the case of tail lamp assemblies 107, 108, of the vehicle.

Each of the lamp assemblies 105 to 108 of the vehicle 101 is substantially identical in
15 construction. For brevity therefore only head lamp assembly 105 will be described in detail herein, although it should be understood that the same teachings are generally applicable also to lamp assemblies 106, 107 and 108.

Referring in particular to Figures 4a to 4d, head lamp assembly 105 comprises principally a housing indicated generally at 401, and the first and second light emitters 109, 110
20 which are located within the housing 401.

Housing 401 comprises an optically transparent lens 402 forming a front to the lamp assembly and a rear casing 403 forming a back to the lamp assembly. Lens 402 is formed of moulded polycarbonate plastic. The rear casing 403 is formed of moulded acrylonitrile butadiene styrene (ABS) plastic. The lens 402 is joined to the rear casing 403 by an
25 adhesive bond about its peripheral edge which creates a substantially hermetically sealed enclosure. A front compartment 404 is defined internally of the housing 401 behind the lens 402. The rear casing 403 comprises a wall 405 having a surface 406 which forms a back to the front compartment 404.

The surface 406 of the wall 405 is defined by an anti-reflective surface coating applied to the wall 405. The anti-reflective surface coating applied to the surface 406 functions to increase the proportion of light incident on the surface 406 that is absorbed by the wall 405 and thereby reduce the proportion of light incident on the surface 406 that is reflected by the wall 405. In the example, the anti-reflective surface coating comprises a matt black paint applied uniformly across the wall 405. The black paint is adapted such that the surface 406 has a relatively low reflection factor, specifically, in the example, a reflection factor of approximately 10 percent across its full area. The term 'reflection factor' as used herein is intended to characterise the ratio of reflected white light to incident white light at normal angles of incidence and reflection. In this respect, although the reflection factor measure only accurately characterises the reflectance of white light at the said angles of incidence and reflection, it may nevertheless be expected to be generally indicative also of the tendency of the surface to reflect other colours of light and/or light incident or reflected at alternative angles.

Many alternative coatings and treatments for the wall 405 to achieve a desirably low reflection factor are commercially available. For example, as an alternative to paint, the surface 406 could instead be defined by flock applied to the wall. As a further alternative, the surface 406 could be defined by micro-scale surface features, for example micro-recesses and/or protrusions formed on the wall 405. As a further exemplary alternative, the desired low reflection factor could alternatively be achieved by applying a suitable additive, such as a pigment or other colouring, into the plastic melt from which the wall is formed, thus negating the need for a separate manufacturing step of applying an anti-reflective coating to the wall 405 after setting of the plastic.

Each of the first and second light emitters 109, 110 comprises a generally plate-like illuminating portion 407, which defines the front surface 111, 112 respectively, and the side surface 113, 114 respectively thereof, and further comprises a light guide portion 408 arranged to guide light from a light source to the illuminating portion 407. In the example, the first and second light emitters 109, 110 are assigned different lighting functions. In the example, first light emitter 109 is assigned a running light function, and is configured to emit constant white light, whilst second light emitter 110 is assigned a direction

indicator function and configured to emit pulsed amber light. The construction of the light emitters 109, 110 will be described in further detail with particular reference to Figures 5a, 5b and Figure 6.

The illuminating portion 407 of each light emitter 109, 110 is located within the front compartment 404 behind the lens 402 and in front of the anti-reflective back surface 406. Each illuminating portion 407 is arranged with the respective front surface 111, 112 facing forwardly through the lens 402, i.e. with an axis A projecting in a forward direction normally from a centre of the front surface approximately parallel to a longitudinal centreline of the vehicle, and with the respective side surface 113, 114 thereof facing sidewardly through the lens 402, i.e. with an axis B projecting in a leftward direction normally from a centre of the side surface approximately orthogonal to the longitudinal centreline of the vehicle.

Referring in particular to Figure 4b, the illuminating portions 407 of the light emitters 109, 110 are spaced apart within the front compartment 404 of the housing 401 in the transverse direction of the vehicle, i.e. sideways, such that the front surfaces 111, 112 respectively of both of the light emitters are visible in a front view of the head lamp assembly. In the example, the illuminating portions 407 of the light emitters are spaced apart in the transverse direction by a distance D1 of approximately 50 millimetre. The front surface 111, 112 of the illuminating portion 407 of each light emitter is rectangular in area, specifically, approximately square in area. The light emitters 109, 110 thus each present a substantially square illuminated surface when the lamp assembly 105 is observed from a front of the vehicle generally along one of the axes A, as may typically be observed by another road user driving towards the vehicle in an opposite direction. The square shape of the illumination as perceived by such a road user may advantageously be easily recognised by an observer as marking a vehicle, as compared, for example, to resulting from a reflection of stray ambient light or another non-vehicular light source. Consequently an observer may be more aware of the vehicle's presence which may reduce the risk of vehicle collisions occurring.

The rectangular front surface 111, 112 of the illuminating portion 407 of each light emitter is substantially lesser in area than the back surface 406, and the illuminating portion 407 and wall 405 are relatively arranged such that the back surface 406 is visible about the area of the rectangular front surface 111, 112 of each of the light emitters 109, 110 respectively, adjacent at least three sides thereof, when the head lamp assembly 105 is viewed along a respective one of the axes A, i.e. in a front view of the vehicle. In this arrangement the anti-reflective back surface 406 thus appears to form a border about the rectangular front surface 406 of each illuminating portion 407 when the head lamp assembly is viewed in the said front view. Such a border is depicted illustratively by the contour 409 in Figure 4b, although because the back surface 406 has a uniform reflection factor across its full area, in the example the border area is indistinct from the remaining area of the back surface 406, such that the whole visible area of the back surface 406 could be said to constitute the border to the rectangular front surface 111, 112 of each light emitter. Because the back surface 406 has a relatively low light reflection factor, a relative high proportion of incident light will tend to be absorbed on incidence with the back surface rather than reflected. Consequently the back surface 406 may appear relatively dark in colour, so providing a relatively high degree of visual contrast with the light emission of the rectangular front surface 111, 112 of each light emitter 109, 110. The high degree of visual contrast may further accentuate the rectangular shape of the front surfaces of the light emitters and so increase the visual distinctiveness of the lamp assembly 105.

It has been found to be generally advantageous in this regard that the apparent border formed by the back surface 406 about the front surface 111, 112 of each light emitter 109, 110 is relatively great in width, that is to say, it is advantageous that the back surface 406 extends in a direction normal to the axes A a relatively great distance D3 outwardly of the sides of the illuminating portion 407. A relatively great width of the border provides a relatively large area with which the light emission of the rectangular front surfaces 111, 112 of the light emitters contrasts. It has been found that to be visually effective from a distance the border should ideally be arranged to have an apparent width of at least 10 millimetre. In the example, the light emitters 109, 110 and the wall 405 are arranged such

that the back surface 406 appears to form a border adjacent three sides of each illuminating portion 407 having a width D3 that is at least 20 millimetre in width.

Referring next in particular to Figure 4c, the illuminating portions 407 of the light emitters 109, 110 are spaced apart within the front compartment 404 in the longitudinal direction of the vehicle, i.e. in the fore and aft direction of the vehicle, such that the side surface 113, 114 of the illuminating portion 407 of each of the light emitters 109, 110 respectively is visible in a side view of the lamp assembly. In the example, the illuminating portions 407 of the light emitters are spaced apart in the transverse direction by a distance D2 of approximately 15 millimetre. As a result an observer to a side of the vehicle may simultaneously observe the light emission from the side surfaces 113, 114 of both light emitters of the lamp assembly. Consequently the total light emission observed and so the visibility of the vehicle may be increased. Moreover, this arrangement is particularly advantageous where the light emitters of each lamp assembly are assigned different functions, as in the present example, as even from a side of the vehicle the observer may simultaneously observe both light signals. In the example, the illuminating portion 407 of the inboard light emitter 109 is spaced forwardly of the illuminating portion 407 of the outboard light emitter 110. Consequently, the side surface 113 of the illuminating portion 407 of the inboard light emitter 109 is not obscured in side view by the outboard light emitter 110.

Light emitters 109 and 110 are substantially identical in construction, and for brevity therefore only light emitter 109 will be described in detail with reference to Figures 5a, 5b and 6.

Referring firstly particularly to Figures 5a and 5b, light emitter 109 comprises illuminating portion 407, light guide portion 408, and a base portion 501.

Illuminating portion 407 has a plate-like form and is formed of an optically translucent rigid plastic material. The illuminating portion 407 defines the rectangular front surface 111, a similarly rectangular rear surface 502 parallel to the front surface 111, and two pairs of parallel side surfaces 113, 503 and 504, 505 extending between the front and rear surfaces 111, 502 generally normal to the planes of the front and rear surfaces. The front

and rear surfaces 111, 502 of the illuminating portion are each substantially square-rectangular in area, having width and height dimensions of approximately 40 millimetre, and the side surfaces 113, 503 are generally rectangular in area having height and width dimensions of approximately 40 millimetre and 5 millimetre respectively. The rectangular front surface 111 and side surfaces 113, 503 are each optically transmissive, such that light may be injected into or emitted from the illuminating portion 407 therethrough. The rear surface 502 and each of the side surfaces 504, 505 are internally reflective, such that light propagating within the illuminating portion is reflected internally and substantially prevented from escaping through the rear surface 502 or the side surfaces 504, 505.

Light guide portion 408 is a generally L-shaped strip formed of the same rigid and optically translucent plastic material as the illuminating portion 407. The light guide portion 408 comprises major surfaces 506, 507, side surfaces 508, 509 and end surfaces 510, 511. The end surfaces 510, 511 of the light guide portion are each optically transmissive such that light may be injected into or emitted from the illuminating portion therethrough. The major surfaces 506, 507 and side surfaces 508, 509 are each internally reflective, such that light propagating within the light guide portion is reflected internally and prevented from escaping through the major surfaces 506, 507 or side surfaces 508, 509.

The base portion 501 comprises a body 512, a plurality of light emitting diodes (LEDs) 513, and an electrical wiring harness 514. The body 510 is formed of rigid plastic and the plurality of LEDs are mounted to the body 501 arranged in a column. The wiring harness 512 is electrically connected to the plurality of LEDs 511, and serves to electrically couple the LEDs to an electronic controller (not shown) mounted to the vehicle at a position remote from the head lamp assembly.

In the assembled state shown in Figure 6, the illuminating portion 407 and light guide portion 408 are arranged with their surfaces 503, 511 abutting, with the side surface 503 of the illuminating portion 407 optically and mechanically coupled to the end surface 511 of the light guide portion 408. The optical coupling between the light guide portion 408

and the illuminating portion 407 permits light to propagate between the interior of the light guide portion 408 and the interior of the illuminating portion 407 via the interface between surfaces 503 and 511. The mechanical coupling between the light guide portion 408 and the illuminating portion 407 provides a rigid coupling therebetween and allows the illuminating portion 407 to be freely supported within the housing 401 by the light guide portion 408. In the example, the coupling is achieved by an adhesive that is optically transparent when cured. Various alternative techniques for coupling the illuminating portion 407 to the light guide portion 408, for example, welding, are well known in the art. As an exemplary alternative to this two-piece construction, the illuminating portion 407 and the light guide portion 408 could instead have a unitary construction. For example, the illuminating portion 407 and light guide portion 408 could be formed of a single piece of optically transparent plastic. Such a unitary construction may advantageously simplify the process of assembling the light emitter 109, and may even be expected to improve propagation of light along the light emitter by removing the surface boundary between the light guide portion 408 and the illuminating portion 407.

The light guide portion 408 is in turn assembled with the end surface 510 optically and mechanically coupled to the base portion 501. The optical coupling between the base portion 501 and the light guide portion 408 is such that the plurality of LEDs 513 of the base portion 501 may inject light into the interior of the light guide portion 408 through the end surface 510. The mechanical coupling between the base portion 501 and the light guide portion 408 provides a rigid coupling therebetween and permits the light guide portion 408, and so the illuminating portion 407 also, to be freely supported by the base portion 501 within the housing 401 of the head lamp 105. In the example, the coupling between the light guide portion 408 and base 501 is achieved using the same optically transparent adhesive, although many alternative means of optical and/or mechanical coupling of the pair could be used, for example, by a simple interference fit between the light guide 408 and the base portion 501.

Referring in particular to Figure 6, in the assembled state the LEDs 513 of the base portion 501 inject light into the light guide portion 408 through the end surface 510 thereof. The light propagates along the length of the light guide portion 408 by total internal reflection

(TIR) off the surfaces 506, 507, 508 and 509. The reflection of the light off the surfaces 506, 507, 508 and 509 as it propagates along the light guide portion results in diffusion and mixing of the light emissions from the plurality of LEDs 513. As the light travels along the light guide portion 408 its average direction is turned through approximately 90
5 degrees. The light subsequently enters the illuminating portion 407 via the optical coupling between the surface 511 of the light guide portion 408 and the surface 503 of the illuminating portion 407. In the illuminating portion 407, light is again internally reflected by the surfaces 502, 504 and 505. By reflections off the surfaces 502, 504 and 505 light is thus guided along the illuminating portion 407, and in the process further
10 diffused to produce a relatively uniform distribution of light within the illumination portion 407. Rear surface 502 comprises surface features 601, which are micro-recesses, adapted to encourage reflection of incident light forwardly towards the front surface 111 in a direction generally normal to the rear surface 502. Light reflected off the back surface 502 at low angles of reflection, that is to say, angles approaching the normal to the rear
15 surface, will tend to be emitted through the front surface 111 of the illuminating portion 407. Light reflected off the back surface 502 at high angles of reflection, may tend to be emitted, along with a portion of light reflected off the side surfaces 504, 505, from the illuminating portion through the side surface 113.

Referring next to Figure 7, as previously described, the housing 401 comprises a front
20 compartment 404 defined between the lens 402 and the wall 405 of the rear casing 403. As shown best in Figure 7, the housing 401 further comprises a rear compartment 701 defined by the rear casing 403 behind the wall 405 and separated from the front compartment 404 by the wall. The rear casing 403 comprises an access aperture closed by an access cap 702 that is removable to facilitate access to the interior of the rear
25 compartment 701 for servicing of the lamp assembly 105.

Referring still particularly to light emitter 109, the base portion 501 of the light emitter 109 is located in the rear compartment 701 and rigidly fixed to the rear casing 403. The wiring harness 514 is electrically coupled to an electrical connector 703, and the connector 703 is in turn electrically coupled to an electronic controller of the vehicle (not
30 shown). Because the base portion 501 is located in the rear compartment 701 it is

obscured from a front or side view of the lamp assembly 105 through the lens 402, as would be the view of an observer external to the vehicle. The light guide portion 408 extends forwardly from the base portion 501, through a closely conforming aperture in the wall 405 of the rear casing 403, and into the front compartment 404. The illuminating portion 407 is then supported within the compartment 404, in front of the anti-reflective back surface 404 of the wall 405 and behind the lens 402, with the front surface 111 of the illuminating portion 407 arranged to face forwardly through the lens 402 so as to emit light in an averagely forward direction, and with the side surface 113 arranged to face sidewardly through the lens 402 so as to emit light in an averagely sideward direction.

Referring next to Figures 8a, 8b, 8c and Figure 9, a second example of a lamp assembly 105' embodying the invention is shown. The principle difference of the second example light assembly 105', as compared to the first example 105 already described with reference to Figures 1 to 7, is in the construction of the light emitters 109, 110. In all other respects the lamp assembly 105' is substantially identical to lamp assembly 105, and like reference numerals will be used to denote like features.

Lamp assembly 105' comprises like light emitters 801, 802, each of which comprises a base portion 501' and an illuminating portion 407'. The base portion 501' and illuminating portion 407' of each light emitter are substantially identical to the base portion 501 and illuminating portion 407 respectively of the light emitter 109 of lamp assembly 105. Thus, base portion 501' comprises a body 512' having a plurality of LEDs 513' mounted thereto, and illuminating portion 407' comprises an optically translucent plate having optically transmissive front and side surfaces 111', 113' and 503', and rear and side surfaces 502', 504' and 505' that are internally reflective. In this example base portion 501' is mechanically and optically coupled directly to the side surface of the illuminating portion 407', and the base portion is thus operable to inject light directly into illuminating portion 407' through the side surface 503'. Similarly to light emitter 109, light emitter 801 is thus operable to emit light via the rectangular front surface 111' and through side surface 113' in average directions that are normal to the respective surfaces, as indicated by the arrows in Figure 8c.

Referring in particular to Figure 9, the like light emitters 801, 802 are each mounted within the housing 401', arranged with their respective front surfaces 111', 112' facing forwardly through the lens 402' and with their respective side surfaces 113', 114' facing sidewardly through the lens 402'. The light emitters are mutually spaced apart in a side-
5 ways direction such that in a front view of the lamp assembly the front surfaces 111', 112' of both of the light emitters are visible, and spaced apart in a forward direction such that in a side view of the lamp assembly the side surfaces 113', 114' of both of the light emitters are visible. The base portion 501' of each light emitter is located in the rear compartment 701' and mechanically fixed to the rear casing 401'. The illuminating
10 portion 407' of each extends sidewardly through an aperture in the wall 405' and is supported within the front compartment 404' in front of the anti-reflective back surface 406' of the wall 405' and behind the lens 402'.

An advantage of this second example of a lamp assembly is in the relative simplicity and compactness of the light emitter 801 as compared to the light emitter 109. Specifically,
15 because the LEDs of the base portion 501' inject light into the illuminating portion 407' directly and light guide portion 408 is omitted, the process of assembling the light emitter 801 is simplified, and the volume occupied within the housing 401' by the light emitter 801, as compared to the light emitter 109, is reduced. However, omitting the light guide
20 portion stage 408 may disadvantageously reduce the degree of diffusion of the light that occurs within the light emitter 801 prior to emission of the light from the illuminating portion 407' via the front surface 111' and the side surface 113', which may thereby result in a less uniform distribution of light within the illuminating portion and therefore a less uniform luminosity of the front and side surfaces 111', 113'.

Referring next to Figures 10a, 10b, 10c and Figure 11, a third example of a lamp assembly
25 embodying the invention is shown. The principal difference of the third example light assembly 105'', as compared to the first and second examples, is in the construction of the light emitters. In all other respects the lamp assembly 105'' is substantially identical to lamp assembly 105 and lamp assembly 105', and again like reference numerals are used to denote like features.

Lamp assembly 105'' comprises like light emitters 1001, 1002, each of which comprises a base portion 501'' and an illuminating portion 407''. The base portion 501'' comprises a rigid plastic body 512'', to which are mounted a plurality of LEDs 513'' arranged in a 9 x 9 square array facing forward. The illuminating portion 407'' comprises a plate of optically translucent plastic similar to the illuminating portion 407, 407' of first lamp assembly 105 and second lamp assembly 105' respectively. The illuminating portion 407'' comprises optically transmissive front and rear surfaces 111'', 502'', optically transmissive side surface 113', and internally reflective side surfaces 503'', 504'', and 505'. The illuminating portion 407'' is optically and mechanically directly coupled to the base portion 501'' via the rear surface 502'', and arranged such that the array of LEDs 513'' of the base portion 501'' inject light into the illuminating portion 407'' through the rear surface 502''. The illuminating portion 407'' is adapted such that a degree of diffusion of the light emissions of the plurality of LEDs 513'' occurs within the illuminating portion 407''. Light is reflected internally by the side surfaces 503'', 504'' and 505'' and thus substantially prevented from escaping therethrough. Similarly to light emitters 109' and 109'', light from the plurality of LEDs 513'' is emitted from the illuminating portion 407'' through the rectangular front surface 111'' and the side surface 113'' in average directions that are normal to the respective surfaces, as indicated again by the arrows of Figure 10c.

Referring finally in particular to Figure 11, the like light emitters 109'', 110'' are each mounted within the housing 401'', arranged with their respective front surfaces 111'' facing forwardly through the lens 402'' and with their respective side surfaces 113'' 114'' facing sidewardly through the lens 402''. The light emitters are again mutually spaced apart in a side-ways direction such that in a front view of the lamp assembly the front surfaces 111'', 112'' of both of the light emitters are visible, and spaced apart in a forward direction such that in a side view of the lamp assembly the side surfaces 113'', 114'' of both of the light emitters are visible. The base portion 501'' of each light emitter is located in the rear compartment 701'' and mechanically fixed to the rear casing 402''. The illuminating portion 407'' of each light emitter extends forwardly through an aperture in the wall 405'' and is supported within the front compartment 404'' forwardly of the anti-

reflective surface 406'' of the wall 405'' and behind the lens 402''. Similarly to the lamp assembly 105'', this third example of the light emitter 109'' is advantageously relatively simpler in construction than the light emitter 109 of lamp assembly 105.

CLAIMS

1. A vehicle having a head or tail lamp assembly mounted to a front or rear of the vehicle, the lamp assembly comprising:

5 first and second light emitters, each light emitter having a front surface for emitting light forward or rearward of the vehicle and having a side surface for emitting light sideward of the vehicle,

wherein the first light emitter is spaced from the second light emitter such that the front surfaces of both light emitters are visible when the vehicle is viewed from the front
10 or the rear, and the side surfaces of both light emitters are visible when the vehicle is viewed from a side,

and wherein each of the first and second light emitters comprises an illuminating portion which defines the front surface and the side surface thereof and an electrical light source for injecting light into the illuminating portion, wherein each said light source is
15 arranged to emit light into a further side surface of a respective illuminating portion.

2. A vehicle according to claim 1, wherein the first light emitter is located inboard and forward of the second light emitter.

20 3. A vehicle according to any one of the preceding claims, wherein the side surface of each of the light emitters has a height-width ratio of at least 4:1.

4. A vehicle according to any one of the preceding claims, wherein the first light emitter is spaced from the second light emitter such that the whole of the front surfaces
25 of both light emitters are visible when the vehicle is viewed from the front or the rear, and the whole of the side surfaces of both light emitters are visible when the vehicle is viewed from the side.

5. A vehicle according to any one of the preceding claims, wherein the front surface
30 of the first light emitter is spaced from the front surface of the second light emitter in a sideward direction by a distance of at least 10 millimetre.

6. A vehicle according to any one of the preceding claims, wherein the side surface of the first light emitter is spaced from the side surface of the second light emitter in a forward direction by a distance of at least 10 millimetre.

5

7. A vehicle according to any one of the preceding claims, wherein the first light emitter comprises at least a first light source and the second light emitter comprises at least a second light source.

10 8. A vehicle according to any one of the preceding claims, wherein the illuminating portion of each light emitter has a plate-like form having a major surface that defines the front surface, a first minor surface that defines the side surface, and a second minor surface that defines the further side surface.

15 9. A vehicle according to any one of the preceding claims, comprising a housing defining a compartment defined between an optically transmissive front and an optically opaque rear, wherein the illuminating portion of each of the light emitters is located in the compartment and the light source of each of the light emitters is located outside of the compartment behind the optically opaque wall.

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10. A vehicle according to any one of the preceding claims, wherein the lamp assembly is a head lamp assembly mounted to a front end of the vehicle, the front surface of each light emitter emits light forward of the vehicle, and the front surfaces of both light emitters are visible when the vehicle is viewed from the front.

25

11. A vehicle according to any one of the preceding claims, wherein the lamp assembly is a tail light assembly mounted to a rear end of the vehicle, the front surface of each light emitter emits light rearward of the vehicle, and the front surfaces of both light emitters are visible when the vehicle is viewed from the rear.

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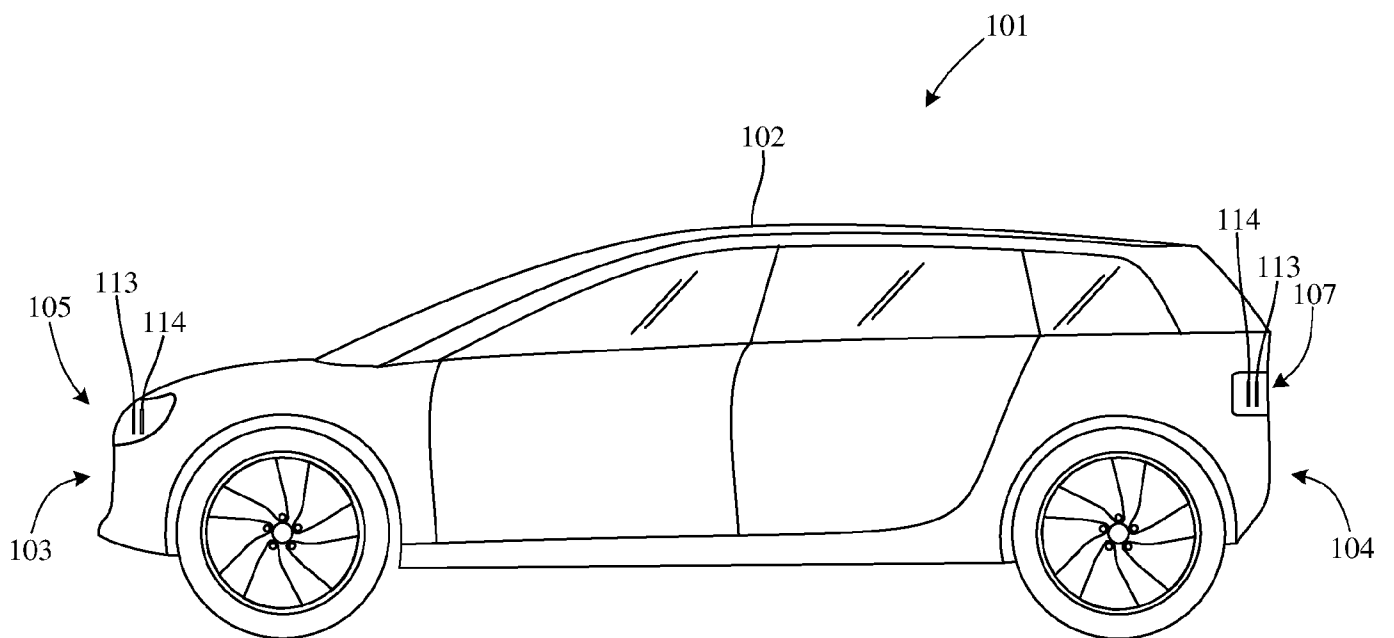


Fig. 1

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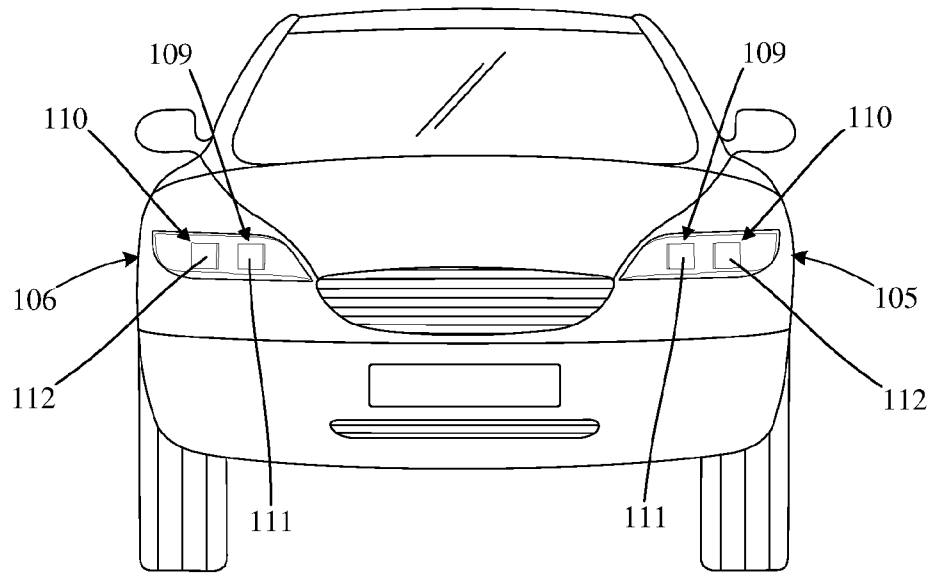


Fig. 2

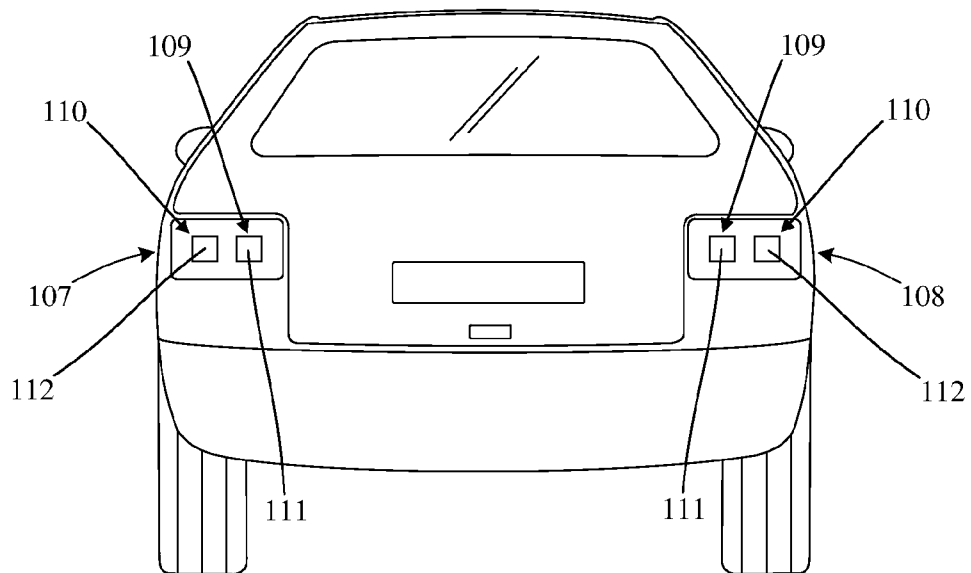
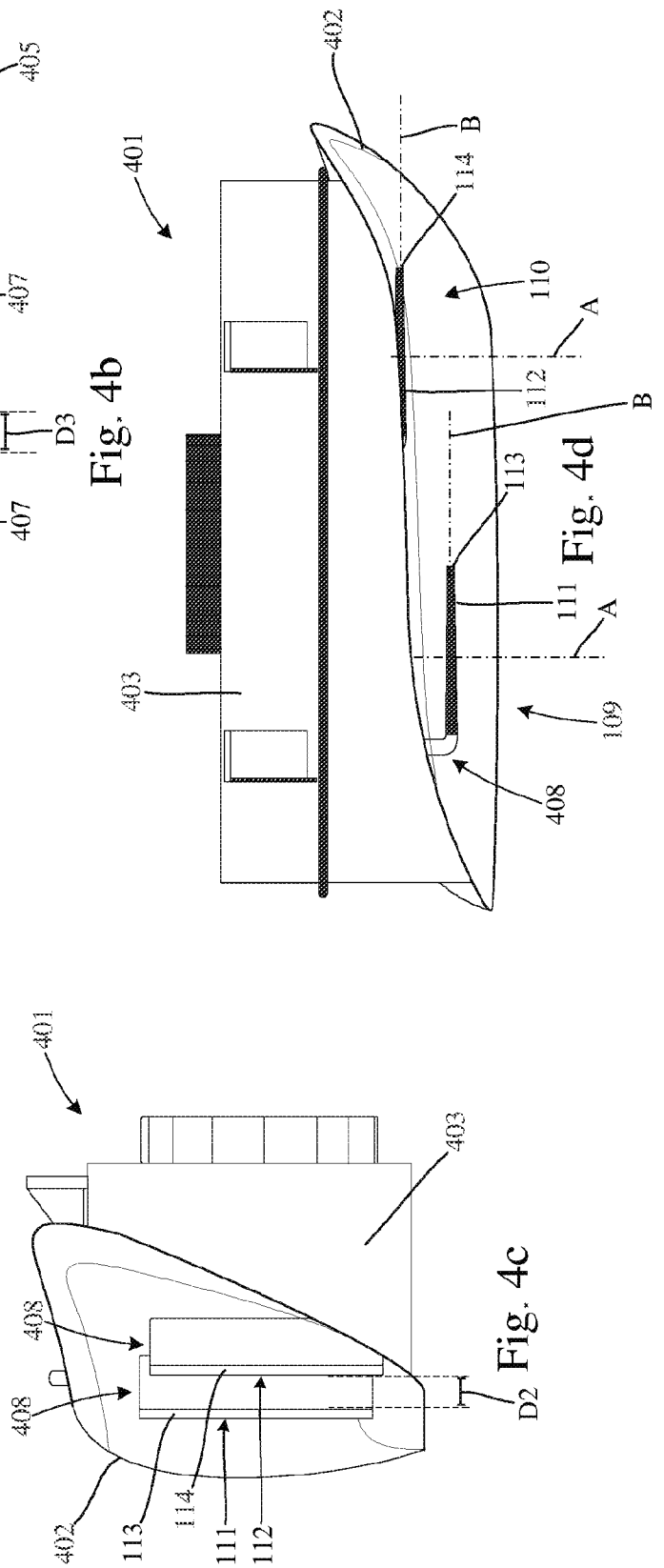
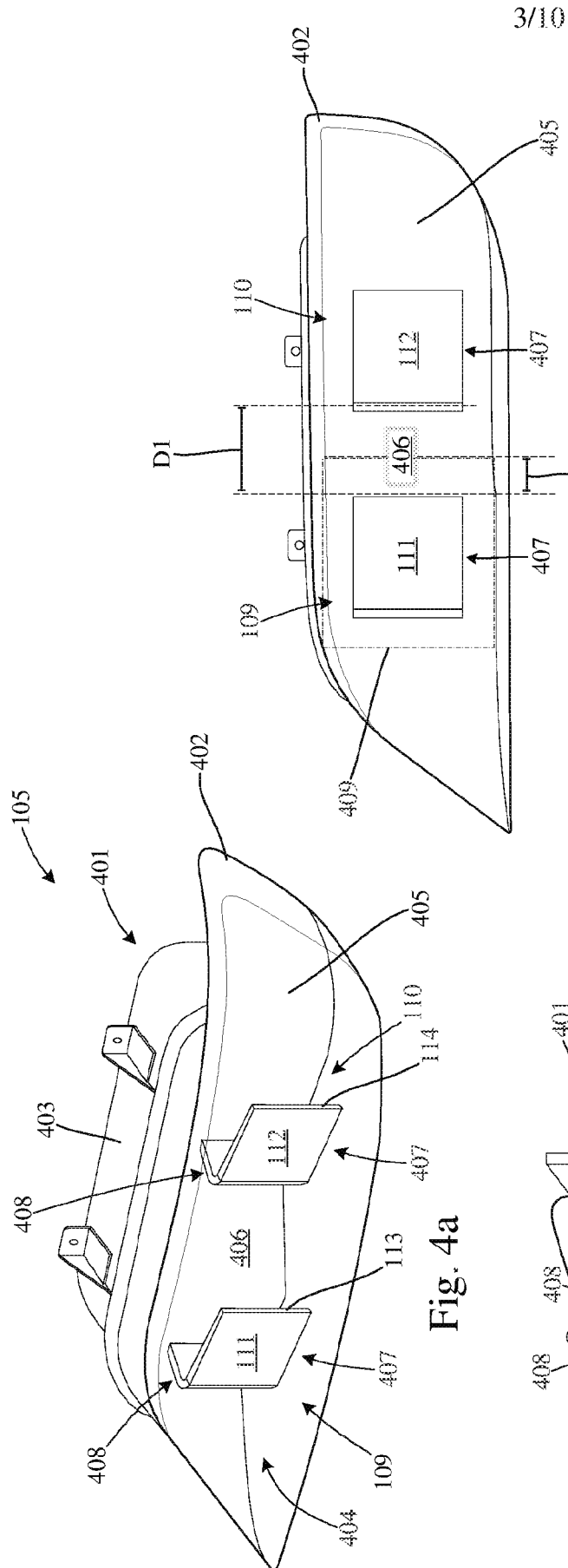


Fig. 3



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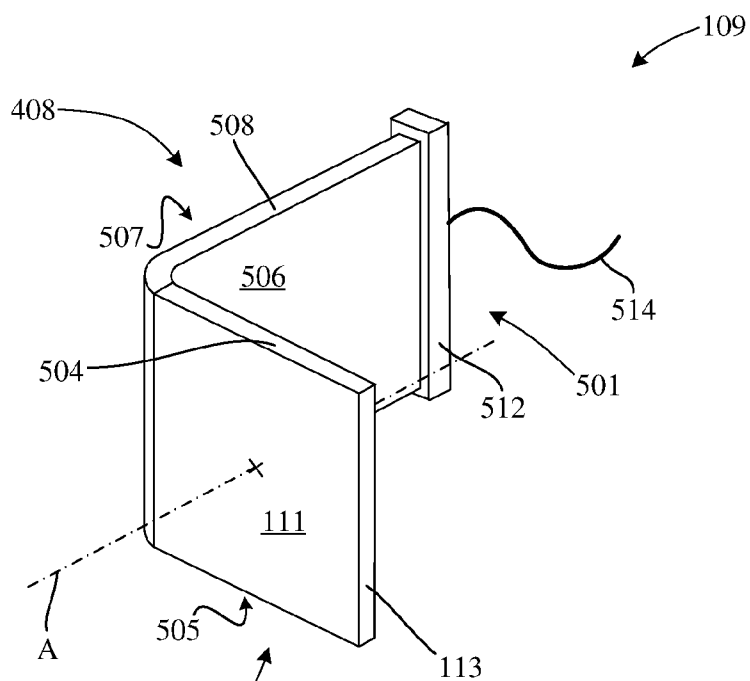


Fig. 5a

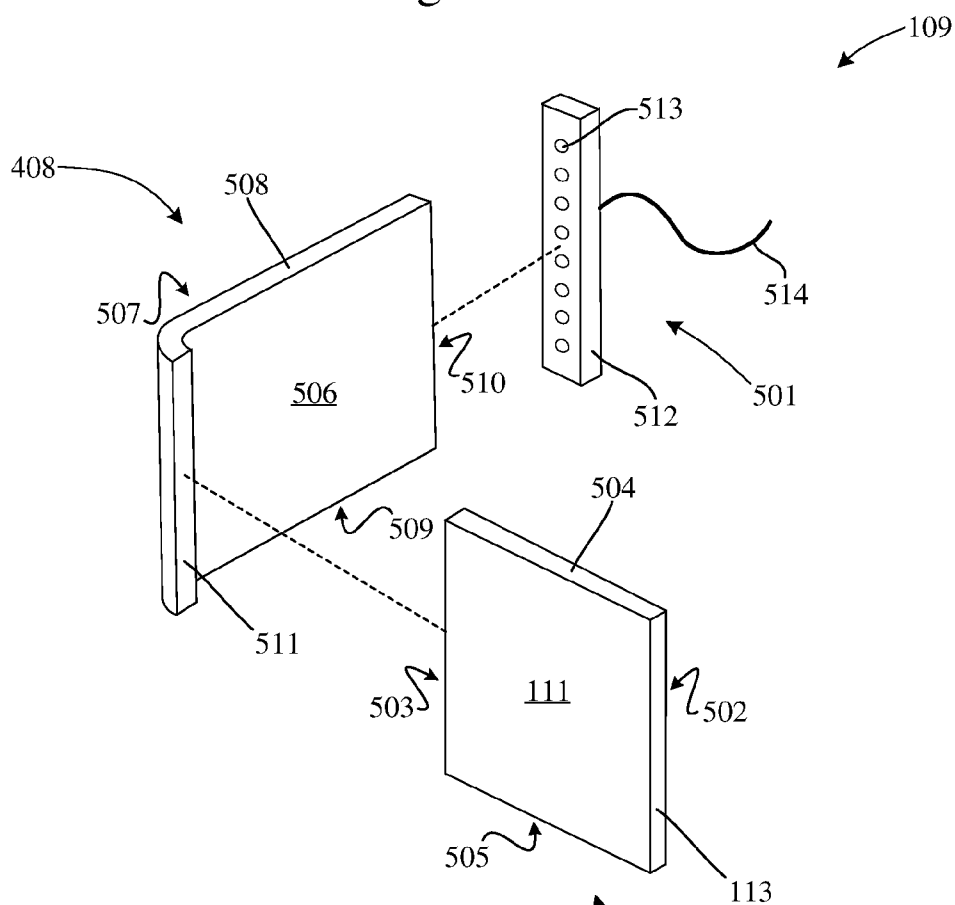


Fig. 5b

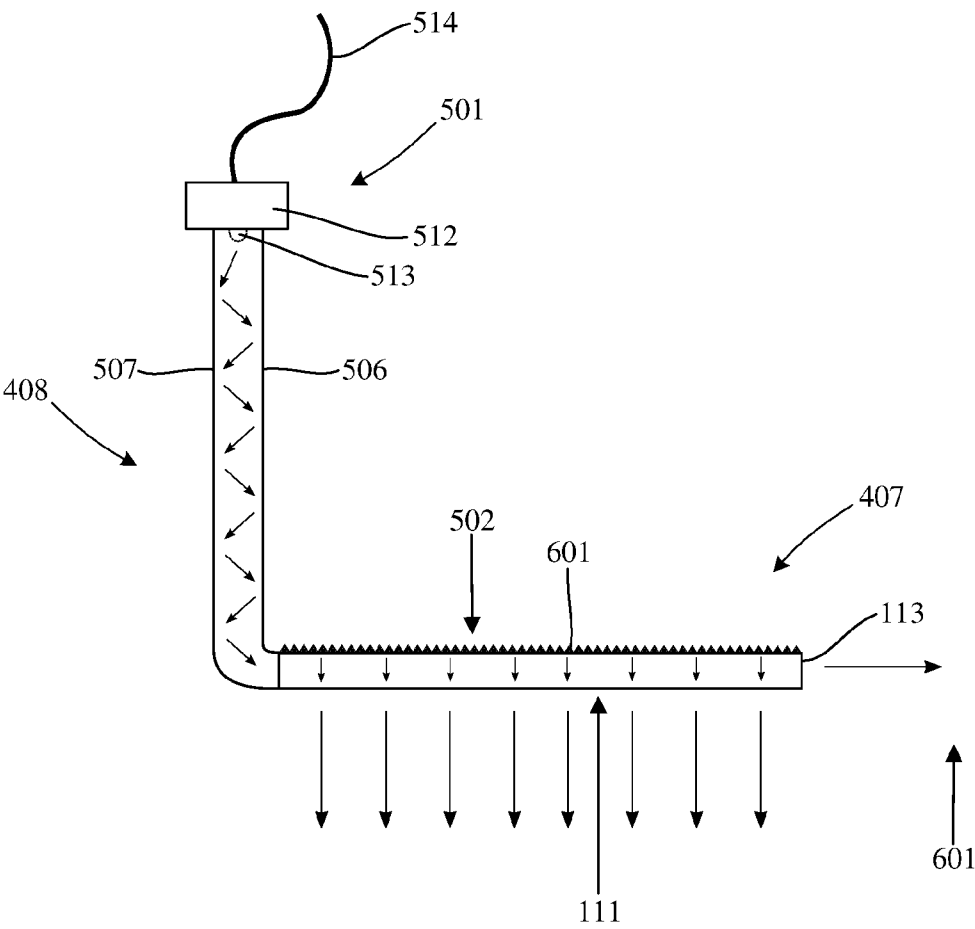
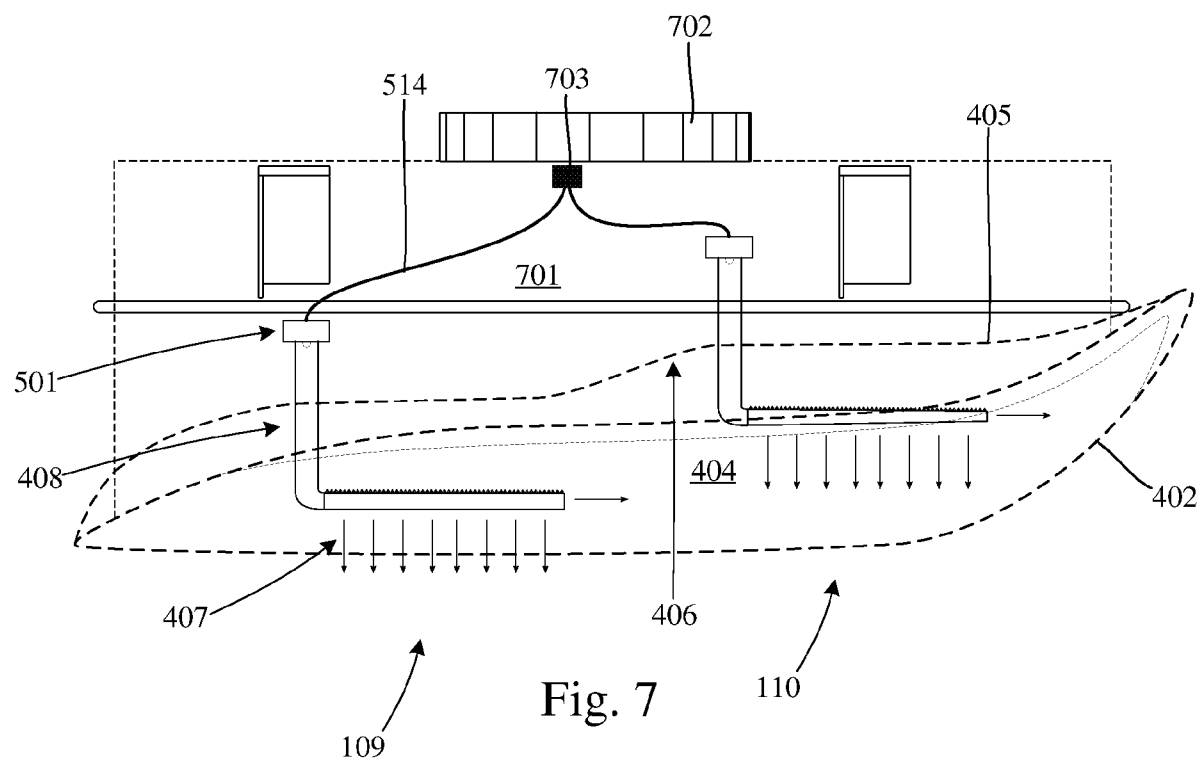


Fig. 6



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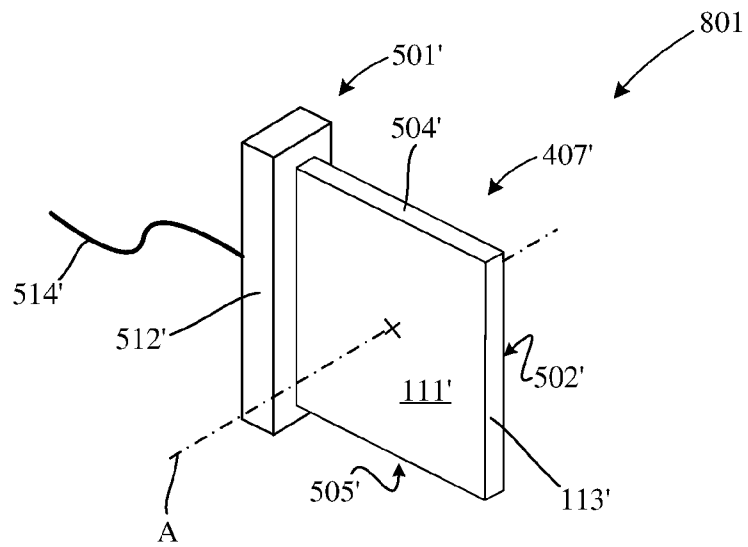


Fig. 8a

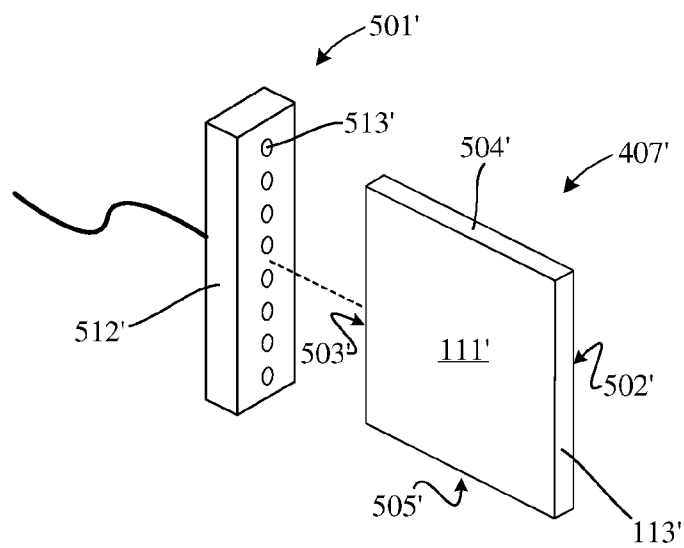


Fig. 8b

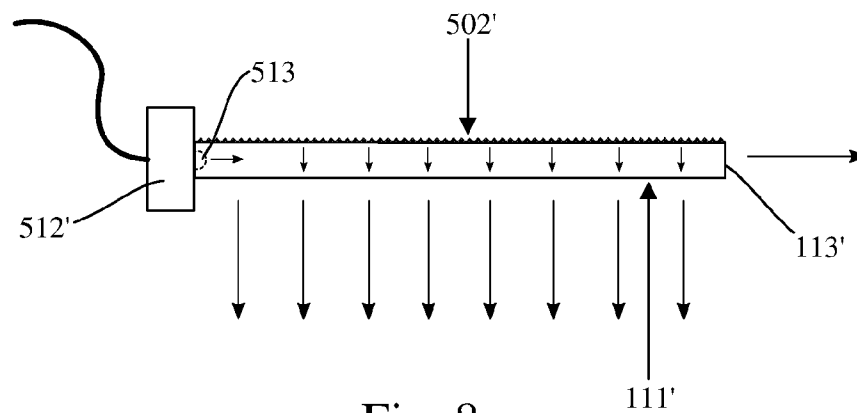


Fig. 8c

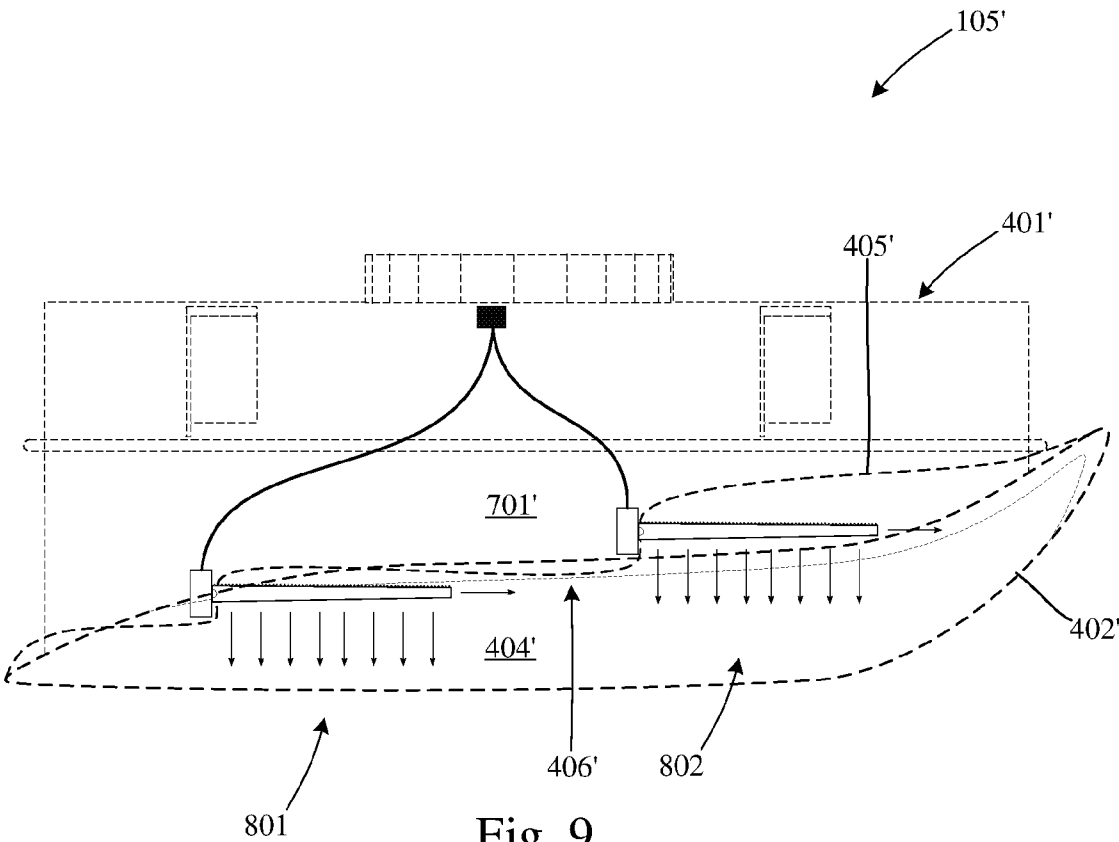


Fig. 9

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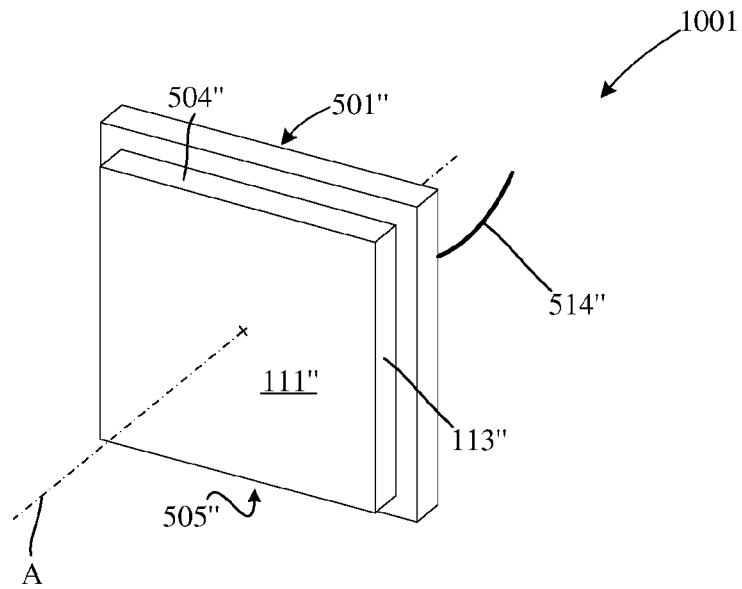


Fig. 10a

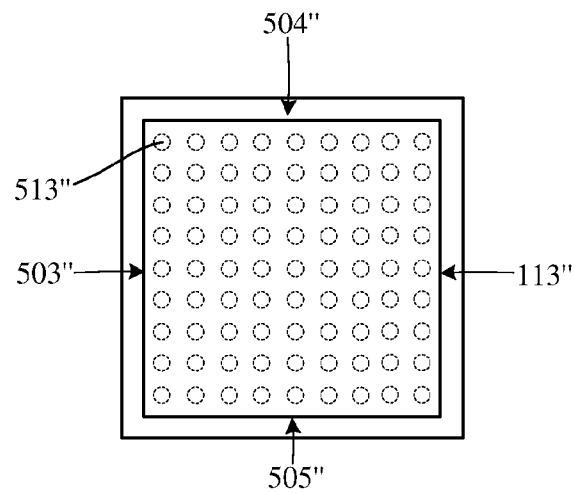


Fig. 10b

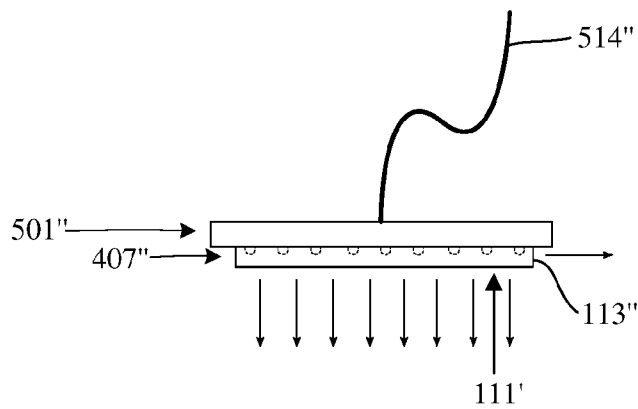


Fig. 10c

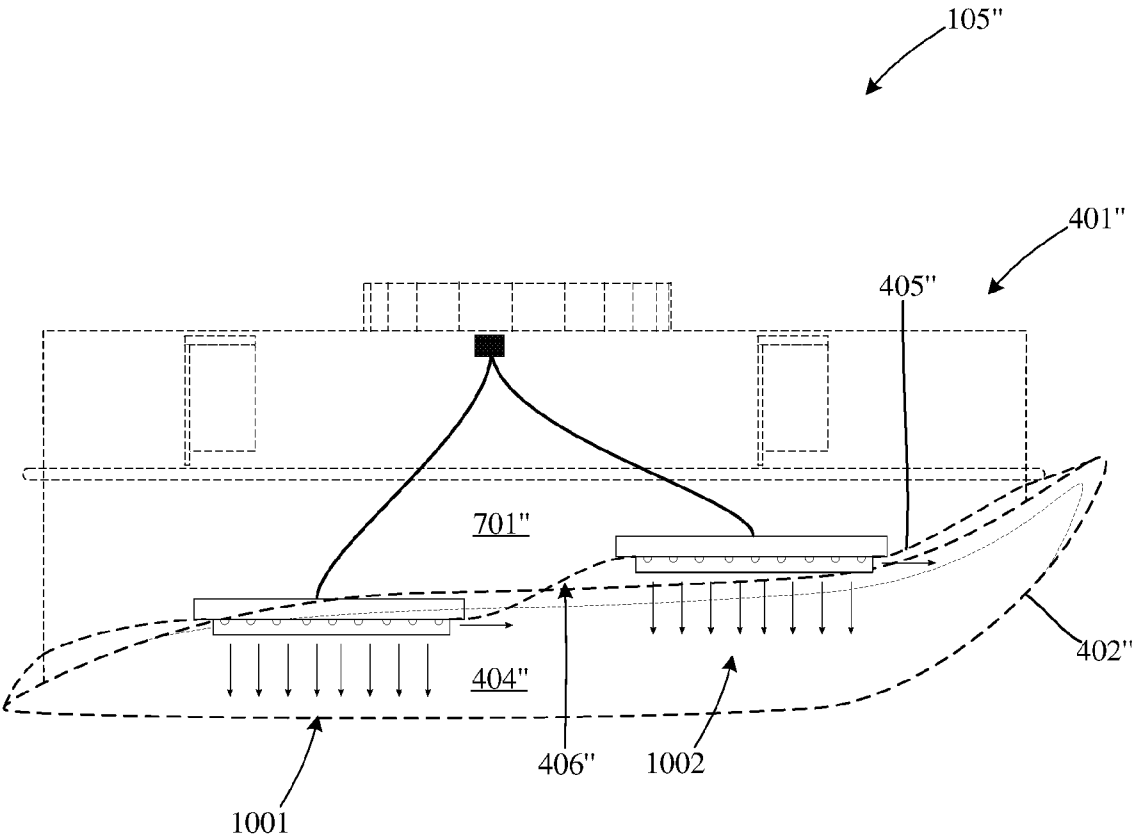


Fig. 11

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2020/051517

A. CLASSIFICATION OF SUBJECT MATTER

INV. F21S43/14 F21S43/239 F21S43/245 F21S43/249 F21S43/243
B60Q1/00 B60Q1/26

ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F21S B60Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Y	EP 3 447 369 A1 (STANLEY ELECTRIC CO LTD [JP]) 27 February 2019 (2019-02-27) claim 1; figure 1	4-6
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X	US 2012/170301 A1 (VERHEE PATRICK [DE]) 5 July 2012 (2012-07-05) paragraphs [0035] - [0040]; claims 1-20; figures 1-5	1,3,7-9, 11
	-/--	



Further documents are listed in the continuation of Box C.



See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search

17 September 2020

Date of mailing of the international search report

29/09/2020

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Giraud, Pierre

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2020/051517

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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Information on patent family members

International application No

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