(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 366 982 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
29.08.2018 Bulletin 2018/35

(51) Int Cl.:
F21S 8/10 *(2006.01)* *F21Y 115/10* *(2016.01)*

(21) Application number: **17158273.7**

(22) Date of filing: **28.02.2017**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
MA MD

(71) Applicant: **Farba Otomotiv Aydinlatma ve Plastik Fabrikalari Anonim Sirketi**
16140 Bursa (TR)

(72) Inventors:
- **BAHAR, Enver**
  Bursa (TR)
- **I IK, Mesut**
  Bursa (TR)
- **HA AL, Orhan**
  Bursa (TR)

(74) Representative: **Yamankaradeniz, Kemal et al**
Destek Patent, Inc.
Eclipse Business D
Blok No. 5 Maslak
34398 Istanbul (TR)

(54) A LIGHTING APPARATUS AND A VEHICLE FRONT HEADLIGHT EQUIPPED THEREWITH

(57) Disclosed herein is a lighting apparatus (100) for a vehicle front headlight (900) and vehicle front headlight (900) equipped therewith. The lighting apparatus comprises at least one first projection light unit (700) for providing a low-beam function and a second projection light unit (500, 600) for providing a high-beam function, as well as a light shield (4) arranged in a central plane (40) extending between the first and second projection light units (700, 500, 600). Each projection light unit (700, 500, 600) has at least one LED (7, 5, 6) as the light source. The lighting apparatus (100) is provided with a common lens (1), for the first and second projection light units (700, 500, 600), positioned in front in the main irradiation direction. The light shield (4) extends outwards from the focal point (10) of the lens (1) disposed at the side thereof facing the projection light unit (700, 500, 600) in parallel to the optical axis (101) of the lens (1). The first projection light unit (700) is arranged at a side along the central plane (40). The LED (7) thereof reflects its light outwards from the central plane (40), upwards along the first axis (70). The first projection light unit (700) comprises a first optical element (800), said element orienting the light distributed by the LED (7) thereof towards the focal point (10) of the lens (1). The second projection light unit (500, 600) is arranged under the light shield (4). The LED (5, 6) thereof is oriented towards the focal point (10) of the lens (1) and it reflects its light over a second axis (50, 60) intersecting a focal point (10) of the lens (1). The second projection light unit (500, 600) comprises a second optical element (200, 300) which is designed as a collimation unit, said element aligning the light emitted by its LED (5, 6) in the focal point (10) direction of the lens (1). A light conducting element (2, 3) is present which is designed as a refractor or a light refracting body to serve as the second optical element (200, 300), the light coupling area (21, 31) of which faces towards the LED (5, 6) of the second projection light unit (500, 600) and the light output area (25, 35) of which is oriented to the focal point (10) of the lens (1). Each light emitted by an LED (5, 6) within the light conducting element (2, 3) is subject to one light deflection at most via total internal reflection (TIR). The light conducting element (2, 3) comprises a surface (20, 24, 30, 34) having a continuous, parabolic geometry

EP 3 366 982 A1

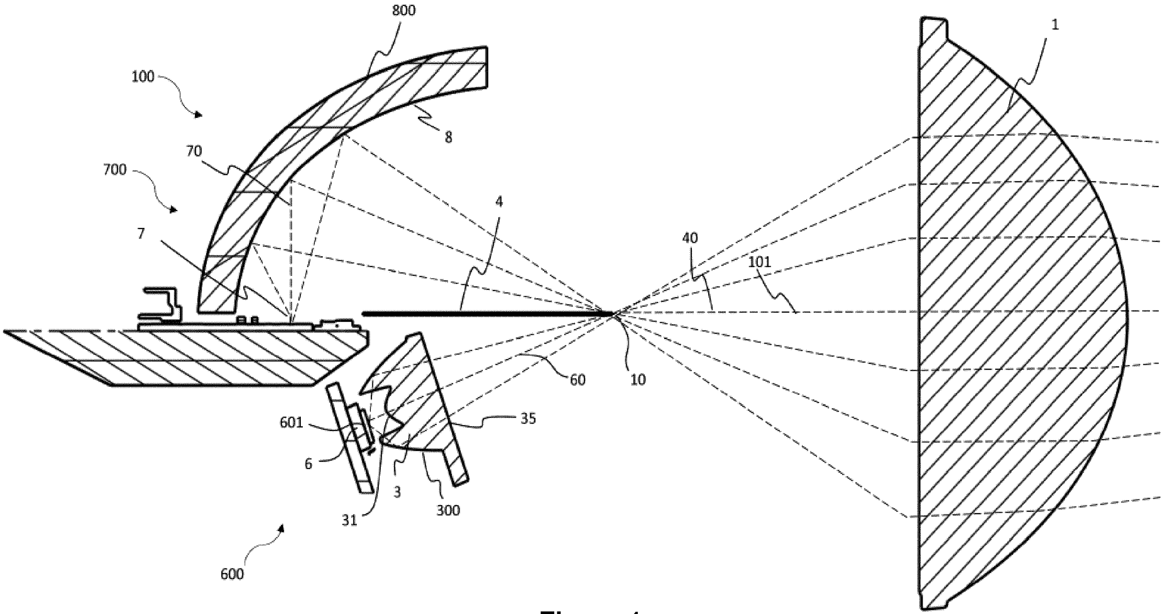

Figure 1

Description

[0001] The invention relates to a lighting apparatus having at least two LEDs as light source according to the preamble of Claim 1, and to a vehicle front headlight provided with at least one such lighting apparatus according to the preamble of Claim 14.

[0002] A typical vehicle light generally comprises the following for providing the vehicle light with at least one lighting function: a lamp housing, a lamp internal portion which is at least partially covered by a lighting glass, and a lighting apparatus covering at least one light source and which is at least accommodated therein.

[0003] Each vehicle light serves for one or more functions or tasks depending on the design thereof. In order to fulfill each function or task, the vehicle light is provided with a lighting function.

[0004] Each lighting function must be able to provide a light distribution, which is for example legally defined herein. Said light distribution maintains the light fluxes to be at least provided, known as illumination in daily use, stable at least in the spatial angle ranges to be provided. Here, depending on the lighting function, in order, for example, to eliminate the glare effect experienced by the other drivers while driving, spatial angle ranges into which no or little light will be radiated have been defined.

[0005] At least one light source of a lighting apparatus of a vehicle light may be provided with at least one or more optical elements for contributing to the regulation of light distribution in terms of light refraction.

[0006] Said optical elements may allow light transmission with at least one reflector and/or at least one lens, and/or at least one or more optical glasses located between the light source and lighting glass of the lighting apparatus, or the like.

[0007] For instance, the lamp internal portion may be provided with a reflector which is located behind at least one light source of at least one lighting apparatus. The reflector may be formed, at least partially, by a separate part and/or at least one part of the lamp housing, for example by, at least partially, applying a reflective coating.

[0008] Alternatively or additionally, the lighting glass itself may be designed as an optical element; for example, it may be provided, at the internal side thereof, with an optical structure which contributes to the formation of the aforementioned one or more light distribution. Thus, the use of an optical glass can be omitted, when necessary.

[0009] With view to produce such optical structures in a precise and cost-effective manner, the lighting glasses of today are typically made of a transparent coating of a plastic material.

[0010] The lamp housing or the lamp internal portion may be divided into a plurality of chambers each having its own light sources and/or lighting apparatuses and/or optical elements, and when needed lighting glasses, wherein more than one chamber may serve for the same function and/or each chamber may serve for different lighting functions.

[0011] Lighting functions may, for example, be a low-beam and/or high-beam function in accordance with the embodiment of the vehicle front headlight.

[0012] High-beam function, just as in the low-beam function, is obligatory for motor vehicles in traffic.

[0013] The low-beam function of a vehicle front headlight is used both for illuminating the road ahead of the vehicle and for the visibility of the vehicle itself.

[0014] On the other hand, high-beam function is generally used when it is too dark and while driving through a road which is poorly lighted. As, for safety reasons, the drivers are only allowed to drive at a speed fast enough to stop the vehicle at a visible distance, the visible area which is extended using high-beam headlamps will allow higher driving speeds.

[0015] Contrary to the high-beam function in which the illumination is as far as possible, the illuminated area is shorter in low-beam function in order to prevent glare effect experienced by the other drivers in traffic. As per the regulations, the area illuminated by motor vehicles shall end at a distance 100 times as the mounting height in front of the vehicle, i.e. the gradient of the light cone must have an inclination of 1 %. In other words, in case of mounting the headlight at a height of 65 cm, the light illuminates as far as 65 m.

[0016] Today, low-beam headlamp in vehicles generally illuminate the road in an asymmetrical manner - in the countries where right-hand traffic is preferred, the right-hand side is illuminated more strongly; on the other hand, in the countries where left-hand traffic is preferred, the left-hand side is illuminated more strongly. Hence, the drivers of the other side of the road are subject to less glare effect, but at the same time the right-hand side of the road is more visible for the driver; as a result, it is easier for the drivers to notice the pedestrians, cyclists, and wild animals by the road immediately.

[0017] The asymmetric configuration here can be obtained, for example, by providing the lighting glass of the vehicle front headlight, said glass being designed as diffusing glass today, with inclined shapes, and/or by providing the reflectors, which are designed as free-form reflectors in modern headlights, with the required shapes.

[0018] Low-beam function and the high-beam function are often formed in a common vehicle front headlight. The lighting apparatuses which are embodied in order to perform one common, or two or more separate low-beam and high-beam function/s must be located such that the light distribution defined for low-beam function will be provided.

[0019] It is known, for example, to use a double-filament lamp as the lighting apparatus; of these two filaments designed as incandescent filament, the first filament can be utilized as a light source serving for the low-beam function while the second filament can be utilized as a light source serving for high-beam function. In this case, the first incandescent filament configured for providing low-beam function is partially shielded by a sheet metal light shield, i.e. diaphragm. Said sheet metal light shield is mounted under the incandescent filament, whereby the light reflection in upward direction is refracted downwards over the headlamp reflector.

[0020] In addition or as an alternative to the lighting lamps described above, gas discharge lamps and particularly light-emitting diodes, which are being used increasingly due to the high efficiency in converting electrical current to light. Thus low power consumption achieved in vehicle lighting elements such as headlights.

[0021] Light-emitting diodes consists of at least a light-emitting diode semiconductor chip, namely a LED chip and at least one contacting means for electrical connection of said LED chip. In general, each light-emitting diode has a bonding wire for each LED chip, each one of said bonding wires electrically connecting the LED chip. Said bonding wire constitutes a first contacting means for the LED chip of the light-emitting diode. The bonding wire may be connected via a first electrical contact, wherein said contact may be provided, for example, with a first conductive line of a lighting apparatus support for electrical contact of the light-emitting diode. A second contacting means of the LED chip of the light-emitting diode is the LED chip itself. For electrical contact, the LED chip may be connected via a second electrical contact, wherein said contact may be provided, for example, with a second conductive line of a lighting apparatus support for electrical contact of the light-emitting diode.

[0022] Apart from that, the light-emitting diode may have a primary reflector directly surrounding the LED chip. Said primary reflector may, for example, be formed by the walls of a recess which surrounds the LED chip and/or a housing in which the LED chip is located. Said housing may be connected to the aforementioned second contact, wherein they form, enclose, or are enclosed by said housing.

[0023] In particular embodiments of the light-emitting diodes, one or all of the contacting means may provide electrical contact themselves, wherein various alternatives of contact/connection of the light-emitting diodes are as described below.

[0024] Light-emitting diodes are known, for example through hole technology (THT), surface mounted devices (SMD), as well as the light-emitting diodes in which the LED chip is directly contacted with the lighting apparatus support via chip on board (COB) technique.

[0025] THT light-emitting diodes are commonly known light-emitting diodes. They are called as wired light-emitting diodes due to the fact that they have at least one transparent capsule in the direction of the desired radiation, e.g. an injection or molded capsule, and that these capsules, in turn, have a bonding wire which connects the LED chip via a first electrical contact, for example an anode connection, or a second electrical contact, for example a cathode connection. Protruding from the capsule are only the first electrical contact wires and second contact wires, which are known as legs, as the anode and cathode connections of the light-emitting diode. For example, the second electrical contact embodied in the form of cathode connection may be provided herein with a housing as described above, in which the LED chip being accommodated. The bonding wire, protrudes, for example, from the first contact embodied in the form of anode connection, towards the LED chip out of the housing.

[0026] SMD light-emitting diodes, on the other hand, consist of a lead frame with at least one mounting surface for at least one LED chip and electrical contact surfaces. Said lead frame is partially injection-coated by a plastic body having a recess such that the at least one mounting surface will be released. The electrical contact surfaces of the lead frame are also freed, as the electrical contacts of the SMD light-emitting diodes, for subsequent surface mounting. The at least one LED chip is at least essentially located in the recess suited for the at least one mounting surface and is electrically contacted. Here, said LED chip is disposed with a first part of the lead frame connecting said at least one electrical contact surface. A bonding wire connects the LED chip with the second part of the lead frame, said second part being connected by means of at least one second electrical contact surface. The recess essentially suited for the mounting surface may be designed in reflector-like manner. In this case, the walls of the recess form the aforementioned first reflector. Here, the walls may be coated in a reflective manner.

[0027] COB light-emitting diodes, on the other hand, consist of a non-coated LED chip and a bonding wire, which are to be directly located on the lighting apparatus support. The back side of the LED chip forms the first electrical contact of the COB light-emitting diode. For electrical contact, the LED chip is electrically contacted from its back side directly to a conductive line of the lighting apparatus support, for example by brazing or welding. The bonding wire which forms the second electrical contact of the COB light-emitting diode is also electrically contacted with the second conductive line of the lighting apparatus support, again by brazing or welding.

[0028] It must also be noted, for the sake of integrity, that the connections in which the contacting means of the LED chip are directly contacted by means of a conductive material, e.g. the so-called flip-chip structure. In such cases, no bonding wire is used.

[0029] It is known, in at least THT and SMD light-emitting diodes, that at least a part of the capsule partially covering the LED chip is designed as the partially optical body, which may include a light conducting body made by injection method.

[0030] In brief, the light-emitting diodes comprise at least one LED chip and a primary optical body which is made by injection method and which, completely or partially, surrounds at least one LED chip. Also known are the light-emitting diodes where pure LED chips are used without forming primary optical bodies therein. Therefore, in the following, unless otherwise stated, no distinction is made between the light-emitting diode and LED chip; instead, the term LED is representatively used for both the designs for simplicity.

[0031] Distinctive features of the LEDs, when compared to conventional light sources of the lighting apparatuses, include a considerably longer service life and a significantly higher light efficiency with the same power consumption, as well as their relatively smaller dimensions. Thus, it is made possible, in conjunction with the light-emitting diodes, to produce light sources for lighting apparatus which can be adapted to any mounting position. Here, one or more, individual or a set of LEDs, for instance a plurality of LEDs arranged side by side in the form of a strip may be configured as at least one light source of a lighting apparatus.

[0032] Due to the former reason and to their smaller dimensions, and hence the requirement of smaller mounting areas, LED use makes it possible to realize vehicle lights of substantially compact sizes as light sources for lighting apparatuses, and these lighting apparatuses can be adapted to any intended use.

[0033] While developing vehicle lights and the lighting apparatuses intended therefor, not only maximum light efficiency of the used light sources, but also the re-emission ratio of the light reflected by the lighting glass of the vehicle light at a desired or determined light distribution and assigned to a lighting function, as well as the light emitted by the light source for fulfilling the respective lighting function, is of great importance when it comes to high optical quality.

[0034] Each optical element, or even light sources, particularly the primary optical body of an LED, or the primary optical body of a gas discharge lamp or a bulb, and similarly a lighting glass designed in the form of a flat glass, all have optically active surfaces and/or they form such surfaces; and these surfaces affect, for example reflect, refract, break or completely reflect the light from the light emission formation point of the light to the point at which it leaves the vehicle light. Optically active surfaces where an optical transition between the environments with different optical refractive index occurs are also referred herein as optical interfaces.

[0035] Here, each optical element, each optical surface, and each one of the other optically active surfaces contribute to the desired and/or legally defined light distribution in a way to ensure the light distribution of the respective lighting function such that most, or a less significant part of the light used will be emitted independent of the predetermined light distribution of the vehicle light, upon the light passing through the lighting glass of the vehicle light, from the light emission formation point of the light to the point at which it leaves the vehicle light from the lighting glass on the beam path

[0036] Any interaction of the beam path with an optically active surface causes a loss, in which case a part of the light interacting with the optically active surface upon hitting thereto cannot contribute to the formation of the desired light distribution, the reason for which may be the undesired absorption and/or transmission and/or reflection.

[0037] Thus, any interaction of the beam path with the optically active surface has a negative effect on the optical quality.

[0038] Apart from these, the optical quality also depends on the optical elements on the beam path, starting from at least one light source until leaving the vehicle light through the lighting glass, which is required for the sensitivity of the relative direction during the formation of a desired light distribution. The optical quality, for example, decreases as the sensitivity of the directions of the parts, which are required for obtaining the desired light distribution, relative to one another starting from the light source decreases.

[0039] If light conducting elements are used, it will be possible to reduce the number of optical elements required for providing light distribution. Said optical elements may be the ones which combine various characteristics of more than one different optical elements. The LEDs, in particular those in the form of a point, thereby forming the light sources allowing the calculation of the light emitted thereby in a sensitive manner according to the beam path, provide an improvement in the optical quality, with respect to the plurality of optical elements arranged consecutively using light conducting elements.

[0040] A light conducting element is made up of at least one light coupling portion and at least one light decoupling portion. By means of total internal reflection, the light movement within the light conducting element occurs virtually, although not totally, with no loss. Thus, the other optical elements may be no longer required. Mostly, transparent plastic materials are used for producing light conducting elements. It is thus possible to produce light conducting elements by injection molding method with lower costs and in an automated manner.

[0041] The light coupling portion comprises at least one light coupling area provided for coupling the light from the at least one light source of the lighting apparatus.

[0042] The light decoupling portion, on the other hand, comprises a light output area which is configured for decoupling the light coupled inside the light conducting element, which is preferably located in front of the light conductor, and which differs from the light coupling portion; and when necessary, it comprises a light deflection area which is assigned to at least one light output area, which differs from this assigned light output area, and is, for example, located at the back side of the light conductor of the light output area.

[0043] At least the light coupling area, the light output area, and when necessary the light deflection area, form the optically active surface of the light conducting element. The light coupling area and light output area may be optical interfaces, i.e. optically active surfaces, herein. The remaining surfaces of the light conducting element may also be optically active surfaces provided that they contribute to the beam path such that unwanted light decoupling is almost absent via total internal reflection.

[0044] It is known from the documents DE 10 2006 034 070 A1 and EP 1 881 258 A1 that, in order to achieve a high optical quality, a light distributing body is directly applied to an LED by injection method as the primary optical body, thereby aligning the LED and the light distributing body in a sensitive manner, and at the same time reducing the number of optical interfaces.

[0045] As a result, the optical quality is also dependent on the sensitivity of all the optically active surface along the beam path until leaving the lighting glass through the light emission point, wherein said optical elements including, for example, light conducting elements and/or the light source itself, as well as the optical interfaces. Hence, the quality of the surfaces of the light coupling area and light output area, and when required the light deflection area, of a light conducting element also contributes to the optical quality since a light coupled in a light conducting element leaves the light conducting element in a sensitive manner and with no loss such that it will contribute to the determined light distribution as much, in proportion to the sensitivity of these surfaces. This may be the case when an optically active surface is formed inside the light conducting element. If said surface is smooth, an unwanted light decoupling at a lower ratio occurs in the optically active surface which deflects the light, when compared to a rough surface.

[0046] Providing a projection module for high-beam function is known from the document WO 2013/075157 A1; wherein the projection module comprises two or more light sources, each one comprising at least one LED. Each light source couples light into a light guide, which is typically in rectangular form, via a light coupling point assigned thereto, both in a perpendicular longitudinal section and a perpendicular transverse section. Here, the light exits the light guides via a light decoupling point of the light guide. The exiting light is projected into the outside space by means of a projection lens to form at least one light distribution for a high-beam function. Here, the light exiting the light guide contributes to a partial light distribution of the high-beam function. The light guides for the individual light sources are arranged laterally side by side in a horizontal line and directly adjoin one another, thereby forming a common light guide for overall light. It is used for allowing a part of the light coupled in the light guide pass from the light guide side to another light guide adjacent, i.e. light can pass between the adjoining light guides. Each individual light exit surfaces are arranged adjacent one another and form a light exit surface for overall light. One or more recesses are provided in the light exit surface for overall light between the individual light exit surfaces, each of which extends at least over a portion of the vertical extent of the light exit surface for overall light. Here, a low-beam function is obtained via at least one LED light source, wherein said light source reflects the light thereof to a reflector assigned thereto in upward direction, starting from a plane covering the upper portion of the light guide. The reflector refracts the light provided for low-beam function in the direction of the projection lens. The edge formed by the light exit area is provided along the beam path from the reflector to the projection lens, said edge defines the low-beam function as the lightness-darkness limit.

[0047] The disadvantage of the aforementioned application is that a multiple interaction exists between the optically active surfaces of the light guides along the beam path of the light sources, outside the light guides arranged side by side in at least horizontal plane while forming the high-beam function. Moreover, the beam paths, which are provided for the high-beam function from the light sources, are also subject to multiple interaction with the optical interfaces along the beam path by means of the light passing each one of the light guides. The light exit area of the light guide extending in the horizontal plane provided with recesses also causes the beam paths, coming from the light sources provided for the high-beam function to additionally interact with the optically active surfaces of the beam path. This further disadvantage results from the rectangular form of the light guide in longitudinal section, the upper and lower limits thereof not being suited for focusing the light to the focal point of the projection lens. Instead of this, the flat upper and lower sides of the light guide are suitable for keeping the light therein. Providing a sensitive lightness-darkness limit further requires reflecting the upper portion of the light guide, for which an additional process step, and thus additional costs are required.

[0048] A projection headlight for vehicles, comprising a first projection light unit for generating a sufficient first light distribution for a first high-beam function and a second projection light unit for generating a sufficient second light distribution for a low-beam function, is known from the document DE 102009049458 A1. The projection headlight is provided with a common lens, for both the projection light units, positioned in front in the main irradiation direction. The first projection light unit comprises a first reflector device, a first light source device associated with the first reflector device, and a first light shield arranged close to a rear focal point of the lens. The second projection light unit, on the other hand, comprises a second reflector device, a light source device associated with the second reflector device and a second light shield arranged close to the rear focal point of the lens. The first light source is located at a first side on the central plane intersecting the optical axis of the lens such that an interval will be provided with respect thereto, and the second light source is located at a second side. The first reflector is disposed at the first side of the central plane while the second reflector is disposed at the second side of the central plane such that an interval will be provided with respect thereto. The first light shield and the second light shield are arranged in front of the first reflector and the second reflector in the main light direction. Said first light shield and second light shield have a common light shield end at the side facing the lens.

[0049] The disadvantage herein is that the optical quality of a reflector arrangement is lower than that of a light conducting element or a lens, because loss of light is reduced in a transparent solid-state collimator with respect to a reflection to a surface having light reflecting characteristics, or to a reflected surface. Said disadvantage is especially prominent when high-beam function is taken into consideration.

[0050] It is known from the document DE 10 2012 106 483 A1 that the light emitted from the first light unit is projected on the lens for generating a first light function and the light emitted on the second light unit is projected over a deflection reflector on the lens to produce a second light function. Here different units are assigned for different functions. Both of the light sources are arranged at different sides of the same cooling body.

[0051] The disadvantage of the above application, however, is the limited optical quality as the light sources irradiate without focusing, and so too much light loss occurs apart from the light distribution to be performed.

[0052] In summary, the optical quality of the lighting apparatuses having light sources configured for high-beam function and low-beam function known from the state of the art is not sufficient; although many approaches have been used in the experiments conducted for solving the problem of obtaining a high optical quality, these approaches ranging from the attempts for directing sensitive light thanks to multiple interactions with the optically active surfaces, to the approaches in which the interaction with optically active surfaces is substantially omitted, it was not possible to achieve a proper optical quality.

[0053] The object of the invention is to develop a lighting apparatus which is suited for fulfilling a low-beam function and a high-beam function in a vehicle front headlight, wherein said lighting apparatus has an optical quality. Another object of the invention is to develop a vehicle front headlight which is provided with such a lighting apparatus.

[0054] This object is achieved by the characteristics of the independent claims. Advantageous embodiments are described in the claims, drawings, and the following description written with reference to the drawings.

[0055] The first aspect of the invention relates to a lighting apparatus for a vehicle front headlight.

[0056] The lighting apparatus is provided with at least one first projection unit for forming a sufficient first light distribution for the low-beam function and at least one second projection unit for forming a sufficient second light distribution for the high-beam function.

[0057] The limitation considering the fact that the projection light units are each provided for forming a sufficient light distribution for at least a part of the lighting function is relevant to the possibility of arranging two or more projection light units for performing a lighting function, and lack of the necessity of each one of them performing the complete light distribution of the projection light unit, instead performing said task jointly by means of the projection light unit which contributes to said light distribution. However, this does not exclude the possibility that each projection light unit, on its own, may be sufficient for performing a complete light distribution determined for said lighting function.

[0058] Each projection light unit has at least one light source. LEDs are envisaged as the light sources of the projection light unit.

[0059] The lighting apparatus is provided with a common lens, for the first and second projection light units, positioned in front in the main irradiation direction.

[0060] A light shield extends from the lens along the optical axis, or parallel to said optical axis, at the side facing the projection light unit at the focal point of the lens.

[0061] Said light shield is also a component of the lighting apparatus.

[0062] It is used for forming a precise lightness-darkness limit in the desired geometry, for example in an asymmetric form.

[0063] At least one first projection light unit provided for a sufficient first light distribution for forming at least a part of the low-beam function is disposed on the central plane which extends in parallel to the light shield and encloses the same.

[0064] At least one projection light unit provided for a sufficient first light distribution for forming the low-beam function reflects its light towards the focal point over the light shield.

[0065] Accordingly, the at least one first projection light unit may be arranged over the light shield, or one or more part/s of the first projection light unit may protrude to the lower portion of the opposite central plane, or may even be accommodated therein.

[0066] The at least one LED of the first projection light unit is, for example, disposed perpendicular to the central plane and the light emitted thereby is reflected, for example, outwards from the central plane in upward direction to the first axis, which normally extends over the central plane.

[0067] The at least one first projection unit further comprises a first optical element which is used as a light deflection unit, which, in turn, protrudes from the side of the LED facing outward from the lens, thereby rising by again protruding from the central plane at the side of the lighting apparatus arranged on the central plane, and extends along the at least one LED of the at least first projection light unit over the first axis.

[0068] The first optical element deflects the first projection light element via said at least one LED, upwards from the central plane and also deflects the light scattered around the first axis to the focal point of the lens.

[0069] Preferably, the light shield is disposed between the at least one first projection unit and the focal point of the lens.

[0070] The second projection light unit provided for a sufficient second light distribution for forming at least a part of the high-beam function is assigned to a side under the central plane which extends in parallel to the light shield and encloses the same.

[0071] The first projection light unit provided for a sufficient first light distribution for forming the low-beam function reflects its light towards the focal point under the light shield.

[0072] The at least one second projection light unit is arranged under the light shield.

[0073] The at least one LED of the second projection light unit is oriented to the focal point of the lens and reflects the light emitted thereby along a second axis intersecting the focal point of the lens and extending from the LED. In this case, the at least one LED of the second projection light unit reflects its light in the directions around the second axis.

[0074] The at least one second projection light unit further comprises a second optical element which is assigned to at least one LED of the second projection light unit and designed as a collimation unit.

[0075] The second optical element aligns the light distributed around the second axis and in the focal point direction of the lens from the at least one LED thereof.

[0076] The second optical element is a light conducting element designed in the form of a refractor or a light refracting body; wherein the light coupling surface of said element faces the at least one LED of the second projection light unit, and the light emitting area thereof faces towards the focal point of the lens. The light emitted by the at least one LED of the second projection light unit within the light conducting element is subject to one light deflection at most via total internal reflection (TIR). A light deflection via total internal reflection leads to less loss, thereby presenting a higher optical quality, with respect to a reflection on a mirror surface, or to a reflection on a surface having mirror characteristics. Said at most once interaction of the optically active surface within the light conducting element for light deflection further causes less loss on the beam path when compared to the multiple interaction. This, in turn, contributes to higher optical quality.

[0077] The light conducting element, which may be designed as a refractor or a light refracting body, is provided with a surface with a continuous, parabolic geometry. Thus, the lights emitted by an LED in any direction are collected in a very efficient manner and oriented towards the light output area.

[0078] The light output area of the light conducting element of the second projection light unit may be in flat form. In this case, the second axis normally extends on a plane enclosing the light output area.

[0079] The light output area of the light conducting element of the second projection light unit is designed preferably with a curved form. In such a case, the second axis normally extends along an imaginary tangent plane formed with the light output area of the light conducting element at the punching point of the second axis on the light output area.

[0080] The curved light output area of the light conducting element of the second projection light unit may, for example, be designed in the form of spherical segment.

[0081] As an alternative or in addition to this, the light output area of the light conducting element of the second projection light unit may be curved in convex form.

[0082] Instead of the convexly curved light output area of the light conducting element of the second projection light unit, a curved design in concave form can also be configured.

[0083] Diffraction of light may occur while the light enters and/or exits the light conducting element.

[0084] The light conducting element may be directly connected to at least one LED of the second projection light unit by injection method. Thus, it will be possible to omit the optical interfaces from the formation point of the light to the point it leaves the light output area.

[0085] The light distribution formed by the at least one projection light unit may comprise a part of the light distribution formed by at least one second projection light unit.

[0086] Preferably, an aspherical optical lens is used as a lens.

[0087] Preferably, the lighting apparatus comprises one first projection light unit and two second projection light units. Thanks to aligning both the second axis of both of the second projection light units, said second projection light units are arranged with an angle towards the light shield and one another. Here, two identical second optical elements are used for both second projection light units, which, in turn, facilitates the manufacturing process; at the same time preventing complexities during assembly, and as a result of this, error ratio is minimized to such an extent that costs will be lowered.

[0088] The first optical element may rise outwards from the central plane at the side of the lighting apparatus which is disposed on the central plane from the side of the LED facing outwards from the lens, and may, at least, extend towards the first projection light unit over the at least one LED until the plane which is in normal state with respect to the optical axis and enclosed the first axis.

[0089] The first optical element of the first projection light unit is preferably a reflector assigned to at least one LED of the first projection light element, said reflector extending at least until the first axis over the LED starting from the back side of the LED when viewed from the lens of the central plane and being designed in an open form towards the lens.

[0090] The reflector may be designed as a multiple elliptical reflector and it may have more than one elliptical reflecting portions.

[0091] The light emitted by at least one LED of the first projection light unit is deflected by reflection from the multiple elliptical reflector into the focal point of the lens.

[0092] Alternatively, the first optical element of the first projection light unit may be an additional light conducting element, the light coupling area of which faces towards at least one LED of the first projection light unit and the light output area of which faces towards the focal point of the lens. A light deflection via total internal reflection (TIR) occurs inside the other light conducting element. Such a light deflection leads to less loss, thereby presenting a higher optical quality, with respect to a reflection on a mirror surface, or to a reflection on a surface having mirror characteristics, as the second optical element of the second projection light unit embodied as the light conducting element.

[0093] The light conducting element may be directly connected to at least one LED of the second projection light unit by injection method. Thus, it will be possible to omit the optical interfaces from the formation point of the light to the point it leaves the light output area.

[0094] The advantages over the state of the art include the following: allowing minimum interaction of the optical elements with the optically active surface which is required for forming the respective light distributions, and thus obtaining a higher optical quality.

[0095] A second aspect of the invention relates to a vehicle front headlight equipped with the lighting apparatus described above.

[0096] The vehicle front headlight generally comprises a lamp housing and a lamp internal portion which is at least partially covered by a lighting glass, the lighting apparatus being accommodated therein.

[0097] The lamp internal portion may be at least partially covered by the lens or a lighting glass.

[0098] In such a case, the lens of the lighting apparatus may at least partially form the lighting glass, partially enclose, or may be at least partially enclosed or formed by the same.

[0099] For the visibility of the vehicle itself, the vehicle front headlight may additionally have a parking light function, or said function may be provided in a separate vehicle light located in front of the vehicle. The parking light function is always available along with other functions and guarantees that the vehicle is recognized by the vehicles on the other side of the road in case other functions fail to work.

[0100] The vehicle light may comprise some properties of the above described lighting apparatus, or any combination of two or more properties of the of the above described lighting apparatus; at the same time, the lighting apparatus also comprises some properties of the above described vehicle light, or any combination of two or more properties of the above described vehicle light.

[0101] As an alternative or in addition to these, the lighting apparatus and/or vehicle light may have the characteristics of the embodiments individually or in combination with the state of the art, and/or the characteristics of the embodiments described in the state of the art in one or more documents and/or in the following description illustrated with drawings.

[0102] Again, all advantages of the vehicle light can be made use of by utilizing the advantages of the lighting apparatus to an extent permitted by the vehicle light.

[0103] It is clear that the invention can be realized by deflecting each one of the irradiations emitted by two individual light sources adapted as LEDs, contributing to a high-beam function, and each one of which is assigned to a corresponding LED, to a focal point of the lens from a light conducting element designed as a light refracting body. The light conducting elements, each one of which is assigned to an LED, designed as a refractor or a light refracting body, are provided with a surface with a continuous, parabolic geometry. Thus, the lights emitted by an LED in any direction may be collected in a very efficient manner and oriented towards the light output area.

[0104] The invention will be described in detail with reference to the embodiments illustrated by the drawings. Here, the same reference numbers refer to the same elements, or to the elements having the same function. For the sake of clarity, only the reference numbers which are necessary to describe the respective drawings. The size ratios of each element with respect to one another do not necessarily correspond to their real size ratios, because the drawings are simplified and shown in an enlarged scale with respect to the other elements for a better illustration. The following figures are shown schematically:

Fig. 1 shows a first embodiment of the lighting apparatus when viewed from a longitudinal section extending perpendicularly with respect to the central plane.

Fig. 2 is the partial cross-sectional view of a vehicle front headlight, over the end of the light shield of the lighting apparatus in Fig. 1.

Fig. 3 is a partial cross-sectional illustration of the lighting apparatus in Fig. 1, where second projection light units under the light shield along the orthogonal optical axis with respect to the central plane through the vehicle front headlight, are not shown.

Fig. 4 is the longitudinal sectional view of a second embodiment of a lighting apparatus, extending perpendicularly with respect to the central plane along the optical axis of the lens.

Fig. 5 is a partial cross-sectional view of a vehicle front headlight, over the end of the light shield of the lighting apparatus in Fig. 4.

[0105] The lighting apparatus (100), shown partially or as a whole in Figs. 1 to 5, which is provided, for example, for at least low-beam function or a high-beam function of a vehicle front headlight for providing night vision comprises the following:

- at least one first projection light unit (700) provided for forming a sufficient first light distribution for at least a part of the low-beam function,
- at least one second projection light unit (500, 600) provided for forming a sufficient second light distribution for at least a part of the high-beam function, and
- a light shield (4) disposed in a central plane (40) and stretched between said at least one first projection

light unit (700) and at least one second projection light unit (500, 600).

[0106] The limitation considering the fact that the projection light units (500, 600, 700) are each provided for forming a sufficient light distribution for a lighting function is relevant to the possibility of arranging two or more projection light units (500, 600, 700) for performing a lighting function, and lack of the necessity of each one of them performing the complete light distribution of the projection light unit (500, 600, 700), instead performing said task jointly by means of the projection light units (500, 600, 700) which serve for fulfilling the respective lighting function. This, however, does not exclude the possibility that each projection light unit (500, 600, 700), on its own, may be sufficient for performing a complete light distribution provided for said lighting function.

[0107] Thus, the light distribution formed by, for example, at least one first projection light unit (700) may comprise a part of the light distribution formed by at least one second projection light unit (500, 600).

[0108] The light shield (4) may have the desired geometry, e.g. an asymmetric geometry, and it is used for defining lightness-darkness limit.

[0109] Each projection light unit (200, 300, 700) has at least one LED (5, 6, 7) as the light source.

[0110] The lighting apparatus (100) is provided with a common lens (1), for the first and second projection light units (700, 500, 600), positioned in the front.

[0111] The light shield (4) faces outwards from the focal point (10) of the lens (1) disposed at the side facing the projection light unit (500, 600, 700), along the optical axis (101) of the lens (1) or parallel to the same.

[0112] In the following, only focal point the term focal point (10) will be used when referring to the focal point (10) at the side of the lens (19) facing the projection light unit (500, 600, 700).

[0113] The first projection light unit (700) which is configured for forming at least a part of the light distribution of the low-beam function is assigned to the central plane (40) extending in parallel to the light shield (4), for example enclosing the light shield (4), and reflects its light towards the focal point (10) of the lens (1) over the light shield (4).

[0114] The at least one LED (7) of the first projection light unit (700) is, for example, disposed perpendicular to the central plane (40) and reflects the light emitted thereby, for example, outwards from the central plane (40) in upward direction along the first axis (70), which normally extends over the central plane (40).

[0115] The at least one first projection light unit (700) further comprises a first optical element (800) used as a light deflection element. First optical element (800)

[0116] The at least one first projection unit (700) further comprises a first optical element (800) used as a light deflection unit. Said first optical element (800) protrudes from the side of the LED (7) facing outward from the lens (1) of the first projection light element (700), thereby rising by again protruding from the central plane (40) at the side of the lighting apparatus (100) arranged on the central plane (40), and extends along the at least one LED (7) of the at least first projection light unit (700) over the first axis (70).

[0117] The first optical element (800) deflects the light emitted by at least one LED (7) of the first projection light element (700) along the first axis (70) and upwards from the central plane (40), and also deflects the light scattered around the first axis (70) to the focal point (10) of the lens (1).

[0118] The at least one first projection light unit (700) may be arranged on the light shield (4). In addition or as an alternative to this, one or more parts of the first projection light unit (700) may protrude until the lower opposite portion of the central plane (40), or may be accommodated therein.

[0119] The light shield (4) preferably disposed between an LED (7) of the at least one first projection light unit (700) and the focal point (10) of the lens (1).

[0120] The first optical element (800) may rise upwards from the central plane (40) at least one side of the LED (7) of the first projection light unit (700) facing outwards from the lens, and may, at least, extend outwards over the at least one LED (7) of the first projection light unit (700) from the plane covering the first axis (70) which is in normal state with respect to the optical axis (101).

[0121] The first optical element of the first projection light unit (700) preferably has a focal point (701), at which point the LED (7) of the first projection light unit (700) being disposed.

[0122] The light sources of the lighting apparatus (100) designed as LED (5, 6, 7) have properties close to those of a point-formed light source, thereby permitting a quite more sensitive positioning with respect to the one or more focal points (701, 501, 601) of the optical elements (800, 200, 300).

[0123] Preferably, as the first optical element (800) of the first projection light unit (700), a reflector (8) is used which is assigned such that the LED (7) of the first projection light unit (700) will be at the focal point (701) of the reflector (8), with respect to the first LED (7) of the first projection light unit (700). The reflector (8) extends outwards from the central plane (40) and at least until the first axis over the LED (7) at the back side of the LED (7) when viewed from the lens (1) and is designed in open form towards the lens (1).

[0124] Preferably, the reflector (8) is designed as a multiple elliptical reflector and it may have more than one elliptical reflecting portions.

[0125] The light emitted by at least one LED (7) of the first projection light unit (700) is deflected by reflection from the multiple elliptical reflector into the focal point (10) of the lens (1).

[0126] The second projection light unit (500, 600) configured for a sufficient second light distribution for fulfilling at least a part of the high-beam function is arranged under the light shield (4), and thus assigned to a central plane

(40), for example covering the light shield (4) at the side extending in parallel under the light shield (4). The at least one second projection light unit (500, 600) then reflects its light towards the focal point (10) of the lens (1) under the light shield (4).

[0127] The at least one LED (5, 6) of the second projection light unit (500, 600) is oriented towards the focal point (10) of the lens (1). The at least one LED (5, 6) of the second projection light unit (500, 600) distributes the light emitted thereby along the second axis (50, 60) which extends outwards from the LED (5, 6) and intersects the focal point (10) of the lens (1).

[0128] The at least one second projection light unit (500, 600) further comprises a second optical element (200, 300) which is assigned to at least one LED (5, 6) of the second projection light unit (500, 600) and designed as a collimation unit; wherein said element provides alignment in the focal point (10) direction of the lens (1) from at least one LED (5, 6) of the second projection light unit (500, 600), as well as in the focal point (10) direction of the lens (1) around the second axis (50, 60).

[0129] The second optical element (200, 300) is a light conducting element (2, 3) designed in the form of a refractor or a light refracting body.

[0130] The light coupling area (21, 31) of the light conducting element (2, 3) faces towards at least one LED (5, 6) of the second projection light unit (500, 600).

[0131] The LEDs (5, 6) of the second projection light units (500, 600) are preferably assigned to the focal points (501, 601) of each one of the light coupling areas (21, 31) belonging to the light conducting elements (2, 3) and having a lens geometry each.

[0132] The light coupling area (21, 31) may extend alongside the reflective light coupling side areas (22, 23, 32, 33) concentrically disposed around the second axis (50, 60).

[0133] Preferably, the light coupling area (21, 31) may similarly have light coupling side areas (22, 23, 32, 33) concentrically disposed around the second axis (50, 60) and used for light coupling purposes.

[0134] The light coupling area (21, 31) may be convexly curved when viewed from the side of the light conducting element (2, 3) and may be concentrically enclosed by the light coupling side areas (22, 23, 32, 33) that are reflective and/or used for light coupling again. The convex curved form of the light coupling area (21, 31) constitutes an optical lens, in the focal point (501, 601) of said lens, at least one LED (5, 6) of the second projection light unit (500, 600) being arranged.

[0135] The light coupling side areas (22, 23, 32, 33) may be arranged parallel to the second axis (50, 60), or they may have a diverging and/or converging from the LED (5, 6) by extending therefrom.

[0136] The light output area (25, 35) of the light conducting element (2, 3) faces towards the focal point (10) of the lens (1).

[0137] The light output area (25, 35) of the light conducting element (2, 3) of the second projection light unit (500, 600) is preferably designed in a curved form, particularly in a convexly curved form, which is seen in the exemplary embodiment shown in Figs. 4 and 5.

[0138] In such a case, the second axis (50, 60) normally extends along an imaginary tangent plane formed with the light output area (25, 35) of the light conducting element (2, 3) of the second projection light unit (500, 600) at the punching point (50, 60) of the second axis (50, 60) on the light output area (25, 35).

[0139] In case of an embodiment with the convexly curved light output area (25, 35) of the light conducting element (2, 3) second projection light unit (500, 600), the light output area (25, 35) of the light conducting element (2, 3) of the second projection light unit (500, 600) may, for example, be configured in a curved form as a spherical segment, or preferably in a convexly curved form.

[0140] The light output area (25, 35) of the light conducting element (2, 3) of the second projection light unit (500, 600) may be designed in a flat form, which is seen in the exemplary embodiment shown in Figs. 1 and 2. In this case, the second axis (50, 60) normally extends on a plane enclosing the light output area (25, 35).

[0141] The light emitted by the at least one LED (5, 6) of the second projection light unit (500, 600) within the light conducting element (2, 3) is subject to one light deflection at most via total internal reflection (TIR), at the coating side surfaces (20, 24, 30, 34) of the light conducting element (2, 3).

[0142] The light conducting element (2, 3), designed as a refractor or a light refracting body, is provided with a coating surface with a continuous, parabolic geometry, formed by the coating side surfaces (20, 24, 30, 24) resulting from light deflection.

[0143] A light deflection via total internal reflection leads to less loss, thereby presenting a higher optical quality, with respect to a reflection on a mirror surface, or to a reflection on a surface having mirror characteristics. Said at most once interaction of the optically active surface within the light conducting element (2, 3) for light deflection further causes less loss on the beam path when compared to the multiple interaction. This, in turn, contributes to higher optical quality.

[0144] Since the light conducting element, which is designed as a refractor or a light refracting body, is provided with a surface with a continuous, parabolic geometry; the beams emitted by a LED (5, 6) by means of a coating surface in any direction are collected quite efficiently and oriented to the light output area (25, 35) direction.

[0145] Diffraction of light may occur while the light enters and/or exits the light conducting element (2, 3).

[0146] The light conducting element (2, 3) of the second projection light unit (500, 600) may be directly connected to at least one LED of the second projection light unit (500, 600) by injection method. Thus, it will be possible to omit the optical interfaces from the formation point of the light to the point it leaves the light output area (25, 35).

[0147] Here, the light coupling area (21, 31) is directly formed in the LED chip of the LED (5, 6) of the light conducting element (2, 3) or in the capsule area boundary surrounding the LED chip.

[0148] Preferably, an aspherical optical lens is used as a lens (1). The aligned light of the second projection light unit(s) (500, 600) enters to the side facing one of the projection light units (500, 600, 700), e.g. to the lens (1) by means of the flat surface (11), and then leaves said lens from the opposite surface (12) designed in an aspherical form.

[0149] Particularly preferably, the lighting apparatus (100) has a first projection light unit (700) and a second projection light unit (500, 600) as shown in Figs. 1, 2, 3, 4, and 5. With both the second axis (50, 60) of the second projection light units (500, 60) being oriented towards the focal point (10) at the side of the lens (1) facing the projection light units (500, 600, 700), both of said second projection light units (500, 600) are located with an angle towards the light shield (4) and one another. Here, both optical elements (200, 300) are used for both of the second projection light units (500, 600), which, in turn, facilitates the manufacturing process; at the same time preventing complexities during assembly, and as a result of this, error ratio is minimized to such an extent that costs will be lowered.

[0150] As an alternative to the described design in relation to the first optical element (800) of the first projection light unit (700), another light conducting element may be used as the reflector (8), the light coupling area of which faces towards at least one LED (7) of the first projection light unit and the light output area of which faces towards the focal point (10) of the lens (1). A light deflection via total internal reflection (TIR) occurs inside the other light conducting element. Such a light deflection leads to less loss, thereby presenting a higher optical quality, with respect to a reflection on a mirror surface, or to a reflection on a surface having mirror characteristics, applied as the second optical element (200, 300) of the second projection light unit (500, 600) embodied as the light conducting element. The other light conducting element may be directly connected to at least one LED (7) of the first projection light unit (700) by injection method in order to further increase the optical quality. Thus, it will be possible to omit the optical interfaces from the formation point of the light to the point it leaves the light output area.

[0151] The lighting apparatus (100) described above may be used in a vehicle front headlight (900) referred by a lighting glass (901) in Figs. 2, 3, and 5.

[0152] The vehicle front headlight (900) comprises a lamp housing and a lamp internal portion (902) which is at least partially covered by a lighting glass (901), a lighting apparatus (100) being accommodated in said portion.

[0153] The lens (1) of the lighting apparatus (100) may at least partially form or cover the lighting glass (901) and/or the lens (1) of the lighting apparatus (100) may be at least partially enclosed or formed by the lighting glass (901).

[0154] For the visibility of the vehicle itself, the vehicle front headlight (900) may additionally have a parking lamp, or said parking lamp may be provided separately in vehicle light located in front of the vehicle. The parking light function is always available along with other functions and guarantees that the vehicle is recognized by the vehicles on the other side of the road in case other functions fail to work.

[0155] The lens (1) constitutes a first optical element for both lighting functions performed by the lighting apparatus (100) and the vehicle front headlight (900) equipped therewith, while the first optical elements are formed by the optical elements (200, 300, 800) of the projection light units (500, 600, 700).

[0156] It is to be noted that the invention can be realized by deflecting each one of the irradiations emitted by two individual light sources adapted as LEDs (5, 6), contributing to a high-beam function, and the beams of which being assigned to a corresponding LED (5, 6), to a focal point (10) of a lens (1) from the light conducting elements (2, 3) each one of which is designed as a refractor or light refracting body. Each light conducting element (2,3), each one being assigned to an LED (5, 6) and each one being designed as a refractor or a light refracting body is provided with a surface with a continuous, parabolic geometry. Thus, the lights emitted by an LED (5, 6) in any direction are collected in a very efficient manner and oriented towards the light output area (25, 35) of the corresponding light conducting element (2, 3).

[0157] As an alternative or in addition to these, the lighting apparatus and/or vehicle light may have the characteristics of the embodiments individually or in combination with the state of the art, and/or the characteristics of the embodiments describing the state of the art in one or more documents and/or in the above description illustrated with drawings.

[0158] The invention is not limited to the embodiments in the description which are given only for illustrative purposes. Instead, the invention includes any novel property and any combination of characteristics, which particularly include any combination of the characteristics in the claims; moreover, said property or combination will be within the scope of the invention even if not clearly stated in the claims or the exemplary embodiments.

[0159] The invention is in particular industrially applicable in the field of the production of vehicle lights.

Reference Numerals

[0160]

1	Lens
2	Light conducting element
3	Light conducting element
4	Light shield
5	LED
6	LED

7	LED
8	Reflector
10	Focal point
11	Surface
12	Surface
20	Coating side surface
21	Light coupling area
22	Light coupling side areas
23	Light coupling side areas
24	Coating side surface
25	Light output area
30	Coating side surface
31	Light coupling area
32	Light coupling side areas
33	Light coupling side areas
34	Coating side surface
35	Light output area
40	Central plane
50	Second axis
60	Second axis
70	First axis
100	Lighting apparatus
101	Optical axis
200	Second optical element
300	Second optical element
500	Second projection light unit
501	Focal point
600	Second projection light unit
601	Focal point
700	First projection light unit
701	Focal point
800	First optical element
900	Vehicle front headlight
901	Lighting glass
902	Lamp internal portion

Claims

1. A lighting apparatus (100) for a vehicle front headlight (900) which comprises at least one first projection light unit (700) for providing a low-beam function and at least one second projection light unit (500, 600) for providing a high-beam function, and a light shield (4) arranged in a central plane (40) extending between the first and second projection light units (700, 500, 600), **characterized in that**:

- each projection light unit (700, 500, 600) has at least one LED (7, 5, 6) as the light source;
- the lighting apparatus (100) is provided with a common lens (1), for the first and second projection light units (700, 500, 600), positioned in front of the main irradiation direction;
- the light shield (4) extends outwards from the focal point (10) of the lens (1) disposed at the side facing the projection light unit (700, 500, 600) in parallel to the optical axis (101) of the lens (1);
- the first projection light unit (700) is arranged at a side along the central plane (40);
- the at least one LED (7) of the first projection light unit (700) reflects the light emitted thereby outwards from the central plane (40) in upward direction along the first axis (70), which extends over the central plane (40);
- the at least one first projection light unit (700) comprises a first optical element (800), said element orienting the light distributed by at least one LED (7) of the first projection light unit (700) towards the focal point (10) of the lens (1);
- the at least one second projection light unit (500, 600) is arranged under the light shield (4);
- the LED (5, 6) of the second projection light unit (500, 600) is arranged towards the focal point (10) of the lens (1), and the light emitted thereby being distributed along and around the second axis (50, 60) which extends outwards from the LED (5, 6) and intersects the focal point (10) of the lens (1);
- the at least one second projection light unit (500, 600) comprises a second optical element (200, 300) which is designed as a collimation unit, which aligns the light emitted by at least one LED (5, 6) of the second projection light unit (500, 600) in the focal point (10) direction of the lens (1);

wherein:

- a light conducting element (2, 3) is present which is designed as a refractor or a light refracting body to serve as the optical element (200, 300), the light coupling area (21, 31) of which faces towards at least one LED (5, 6) of the second projection light unit (500, 600) and the light output area (25, 35) of which is oriented to the focal point (10) of the lens (1);
- the light emitted by at least one LED (5, 6) of the second projection light unit (500, 600) within the light conducting element (2, 3) is subject to one light deflection at most via total internal reflection (TIR);
and
- the light conducting element (2, 3) comprises a surface (20, 24, 30, 34) having a continuous, parabolic geometry.

2. The lighting apparatus according to Claim 1, **characterized in that** the light output area (25, 35) of the light conducting element (2, 3) of the second projection light unit (500, 600) is configured in a flat form, and that the second axis (50, 60) normally extends on a plane covering the light output area (25, 35).

3. The lighting apparatus according to Claim 1, **char-**

acterized in that the light output area (25, 35) of the light conducting element (2, 3) of the second projection light unit (500, 600) has a curved form.

4. The lighting apparatus according to Claim 3, **characterized in that** the light output area (25, 35) has a convexly curved form.

5. The lighting apparatus according to Claims 1 to 4, **characterized in that** the light conducting element (2, 3) of the second projection light unit (500, 600) is directly connected to at least one LED (5, 6) of the second projection light unit (500, 600) by injection method.

6. The lighting apparatus according to one of the preceding claims, **characterized in that** the light distribution formed by at least one first projection light unit (700) comprises a part of the light distribution formed by at least one second projection light unit (500, 600).

7. The lighting apparatus according to one of the preceding claims, **characterized in that** the lens (1) is an aspherical optical lens.

8. The lighting apparatus according to one of the preceding claims, **characterized in that** the lighting apparatus (100) has a first projection light unit (700) and a second projection light unit (500, 600).

9. The lighting apparatus according to one of the preceding claims, **characterized in that** the first optical element (800) rises upwards from the central plane (40) by at least one side of the LED (7) of the first projection light unit (700) facing outwards from the lens (1) thereof, and that it extends outwards over the at least one LED (7) of the first projection light unit (700) from the plane covering the first axis (70) until it extends normally with respect to the optical axis (101).

10. The lighting apparatus according to one of the preceding claims, **characterized in that** a LED (7) of the reflector (8) assigned to the first projection light unit (700) is used as a first optical element (800), which, in turn, extends at least until the first axis (70) over the LED (7), coming from the central plane (40) at the back side of the LED (7) when viewed from the lens (1) and is designed in open form towards the lens (1).

11. The lighting apparatus according to Claim 10, **characterized in that** the reflector (8) is designed as a multiple elliptical reflector and has more than one elliptical reflecting portions.

12. The lighting apparatus according to Claims 1 to 9, **characterized in that** another light conducting element is present as the first optical element (800), the light coupling area of which faces towards at least one LED (7) of the first projection light element (700) and the light output area of which faces the focal point (10) of the lens (1).

13. The lighting apparatus according to Claims 12, **characterized in that** the first projection light unit (700) of the other light conducting element is connected to the corresponding LED (7) by injection method.

14. The lighting apparatus according to one of the preceding claims, **characterized in that** the at least one first projection light unit (700) is arranged above the light shield (4), and that one or more parts of the first projection light unit (700) protrude(s) until the lower opposite portion of the central plane (40), or being accommodated therein.

15. The lighting apparatus according to one of the preceding claims, **characterized in that** the light shield is disposed between at least one LED (7) of the at least one first projection light unit (700) and the focal point (10) of the lens (1).

16. The vehicle front headlight (900) which comprises a lamp housing and a lamp internal portion (902) which is at least partially covered by a lighting glass (901), a lighting apparatus (100) being accommodated in said portion, **characterized in** comprising a lighting apparatus (100) according to one of the preceding claims.

17. The lighting apparatus according to Claim 16, **characterized in that** the lens (1) of the lighting apparatus (100) at least partially forms or covers the lighting glass (901) and/or the lens (1) of the lighting apparatus (100) is at least partially enclosed or formed by the lighting glass (901).

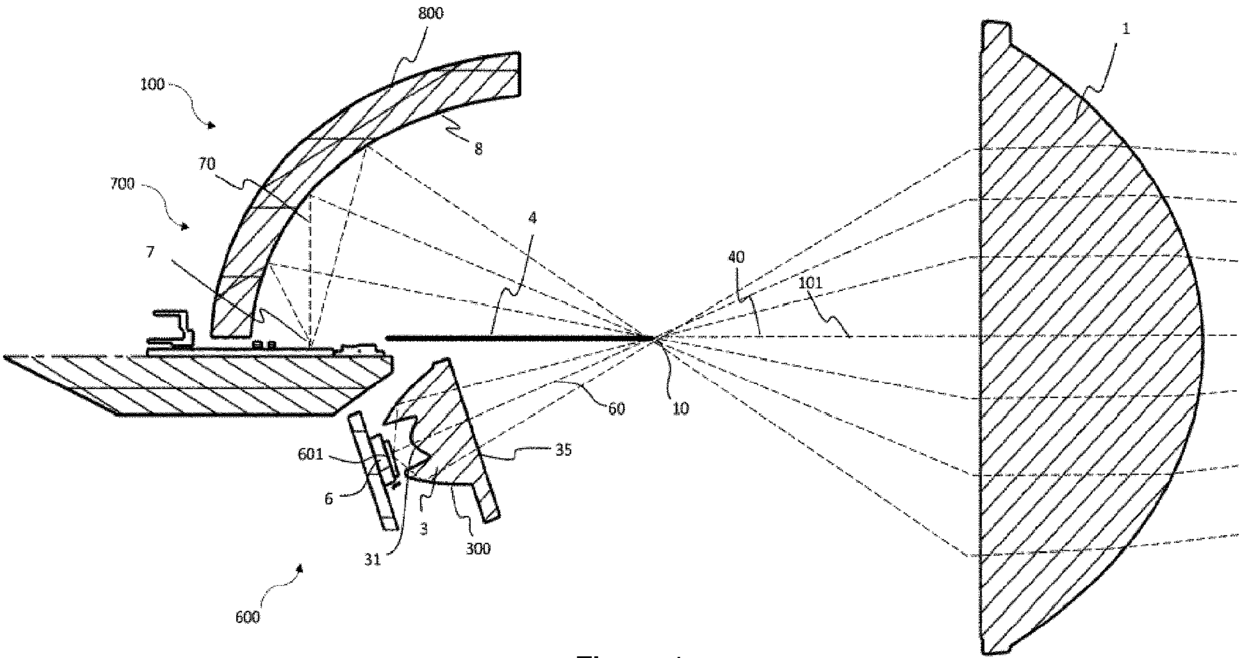

Figure 1

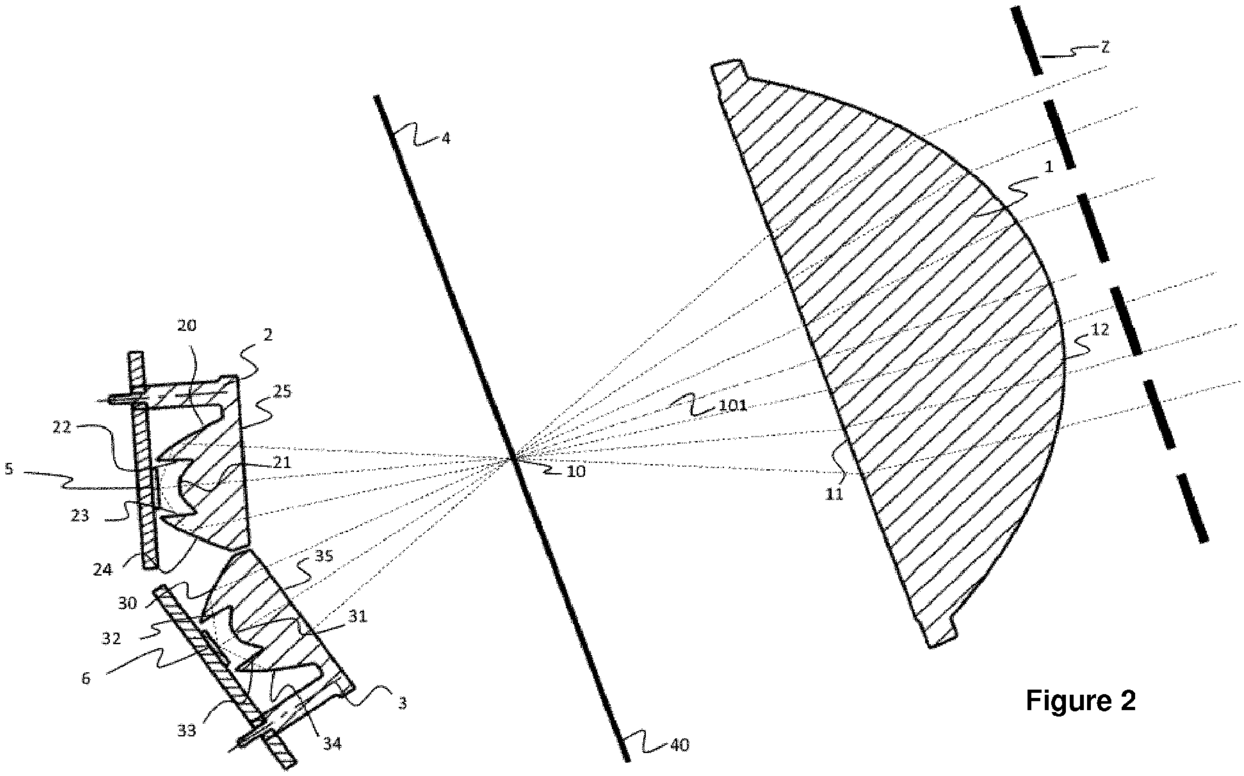

Figure 2

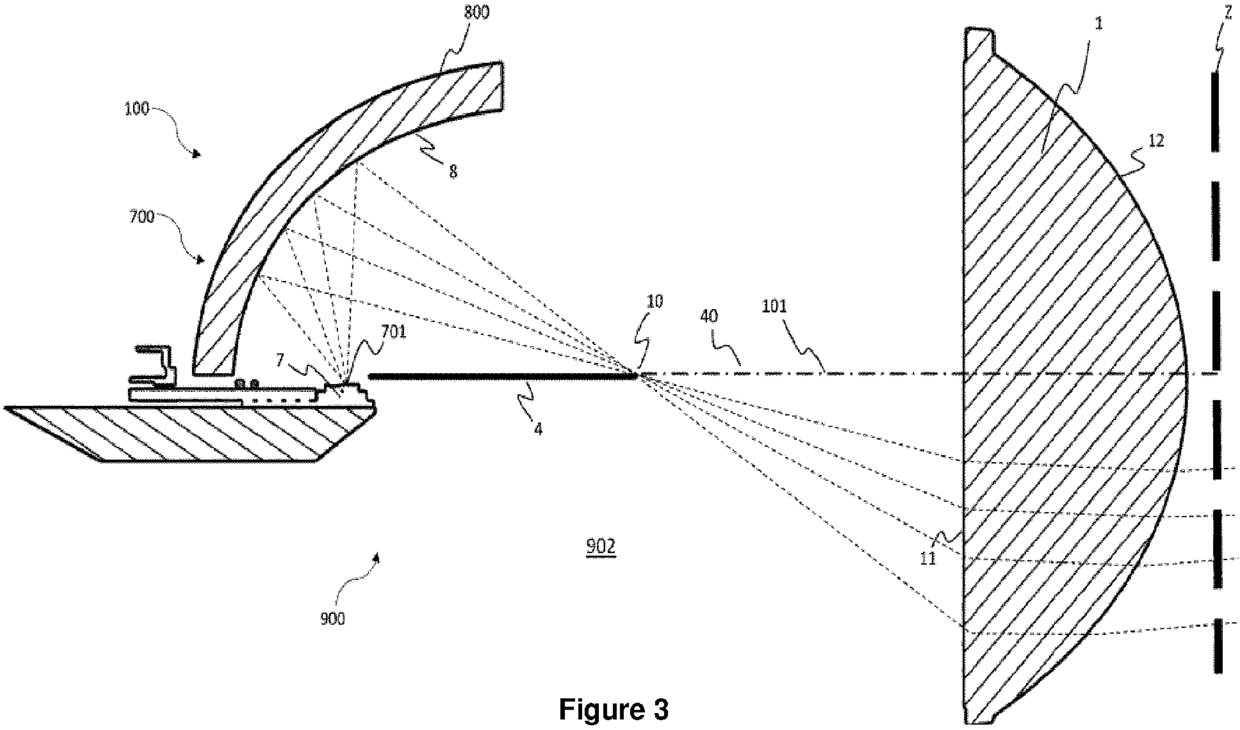

Figure 3

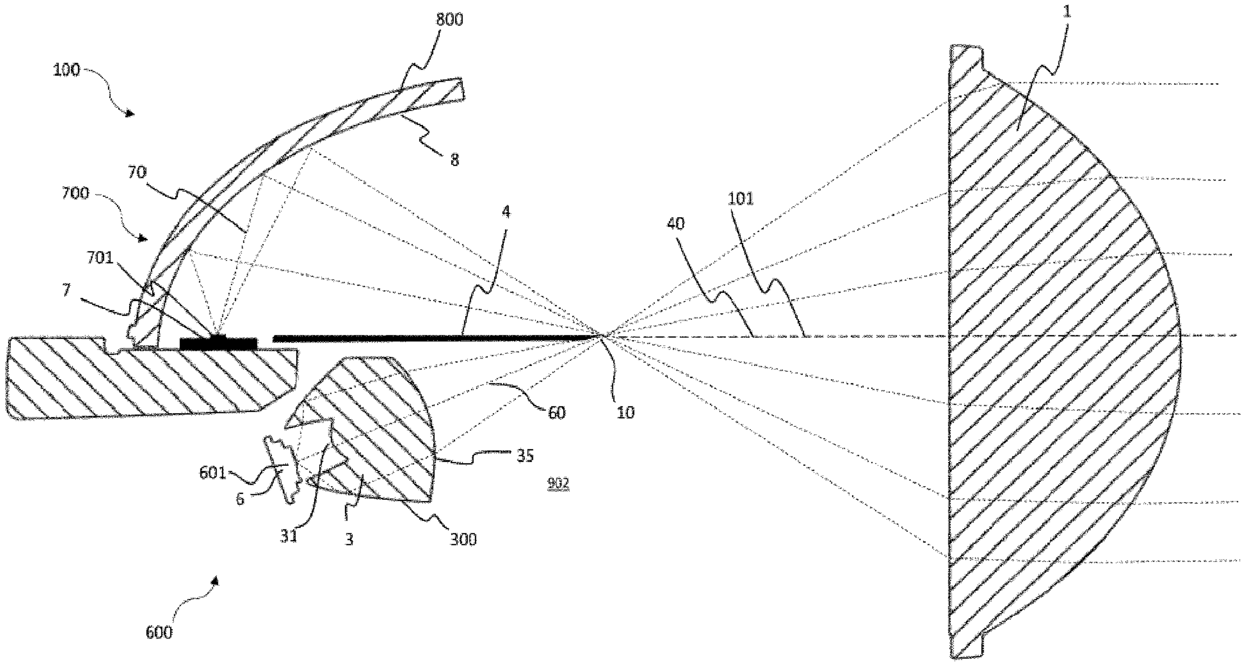

Figure 4

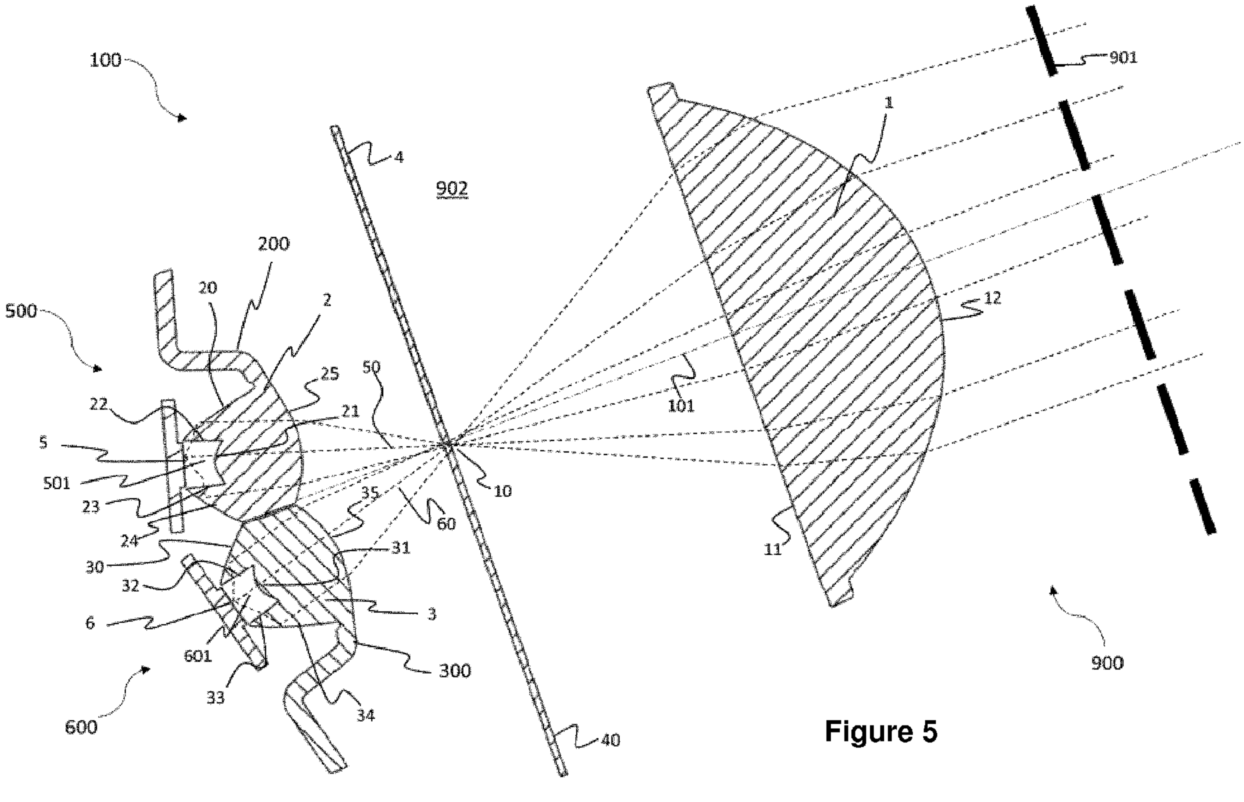
100
4
902
1
901
200
20
2
500
12
25
50
22
21
101
5
501
23
10
35
24
60
31
30
11
32
3
6
601
300
900
33
34
600
40

Figure 5

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 17 15 8273

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	KR 2015 0068141 A (SL CORP [KR]; SL SEOBONG CORP [KR]) 19 June 2015 (2015-06-19) * the whole document * -----	1-17	INV. F21S8/10 ADD. F21Y115/10
A	US 2007/201241 A1 (KOMATSU MOTOHIRO [JP]) 30 August 2007 (2007-08-30) * paragraph [0127] - paragraph [0132] * * figures 1, 10 * -----	1-17	
A,D	DE 10 2012 106483 A1 (HELLA KGAA HUECK & CO [DE]) 23 January 2014 (2014-01-23) * the whole document * -----	1-17	

TECHNICAL FIELDS SEARCHED (IPC)
F21S

1 The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	1 August 2017	Cosnard, Denis

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 17 15 8273

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

01-08-2017

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
KR 20150068141 A	19-06-2015	NONE	
US 2007201241 A1	30-08-2007	DE 102007008994 A1	20-09-2007
		JP 4663548 B2	06-04-2011
		JP 2007227228 A	06-09-2007
		US 2007201241 A1	30-08-2007
DE 102012106483 A1	23-01-2014	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- DE 102006034070 A1 **[0044]**
- EP 1881258 A1 **[0044]**
- WO 2013075157 A1 **[0046]**
- DE 102009049458 A1 **[0048]**
- DE 102012106483 A1 **[0050]**