Translated from the GERMAN
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(19) Federal Republic of Germany

German Patent Office

(12) **Unexamined Patent Specification**

(10) **DE 41 29 094 A 1**

(21) File Number: P 41 29 094.1
(22) Filing Date: September 2, 1991
(43) Date laid open: March 4, 1993

(51) Int. Cl.[5]:
F 21 Q 1/00
F 21 Q 3/00
G 09 F 9/33
B 60 Q 1/26
F 21 V 8/00
F 21 V 5/00

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[TrN: DE-Z = German publication]

(54) # Signal lamp for motor vehicles

(57) To create a signal lamp for motor vehicles, which has a high luminosity and a high signal- and warning effect, which guarantees an even illumination at low current consumption, and which is developed flat and in an optimally space-saving fashion, a signal lamp for motor vehicles having a housing and/or a fastening means to be attached to or installed into a motor vehicle body has at least one transparent end plate and a number of light sources that are developed as light-emitting diodes; each light-emitting diode has an associated elongated light guide element; at least one face of each light guide element is developed as a light-coupling surface for the light of a light-emitting diode; the side of each light guide element facing away from the light-emitting surface has light-deflecting means, and at least two light guide elements are arranged in parallel side by side behind the end plate.

Description

The invention relates to a signal lamp for motor vehicles having a housing and/or a fastening means to be installed into or attached to a motor vehicle body, with at least one transparent end plate, and with a number of light sources that are developed as light-emitting diodes.

The German published patent application DE 40 03 807 A 1 discloses a motor vehicle warning lamp that is used as a brake light. The signal lamp has a housing and a fastening means so that the signal lamp can be attached to the body of a motor vehicle or installed into a motor vehicle. The housing is developed in such a fashion that it has a transparent end plate in the direction of radiation of the light. To generate light, a number of light sources are arranged in the housing, which are developed as light-emitting diodes.

With the known embodiment, it is disadvantageous that a large number of light-emitting diodes are required to generate a sufficiently high signal- and warning effect of the signal lamp. This leads to an expensive and high-effort construction, which furthermore has a high current consumption. With the known embodiment of the signal lamp, it is especially disadvantageous that because of the known radiating characteristics, the light-emitting diodes have to be arranged in a short distance to one another to obtain an even illumination of the transparent end plate, and a large radiating surface that also has a high signal- and warning effect can be obtained only if a large number of light-emitting diodes are arranged in the signal lamp, which increases the production cost and the current consumption.

The invention is based on the task of creating a signal lamp for motor vehicles, which is simple and economical, has a high luminosity and a high signal- and warning effect, ensures an even illumination at a low current consumption, and is developed in an optimally flat and space-saving fashion.

According to the invention, this task is achieved in that each light-emitting diode has an associated elongated light guide element; in that at least one face of each light guide element is developed as a light-coupling surface for the light of a light-emitting diode; in that the side of each light guide element facing away from the light-emitting surface has light-deflecting means; and in that at least two light guide elements are arranged in parallel side-by-side behind the end plate.

It is advantageous that each light-emitting diode has an associated elongated light guide element because in this way, the light generated by each light-emitting diode can be converted in a simple and economical fashion via an elongated light guide element into a desired light distribution with a wide radiating area.

In this context, it is advantageous that at least one face of each light guide element is developed as a light-coupling surface for the light of a light-emitting diode because this ensures the optimum utilization of the light provided by each light-emitting diode.

The fact that the side of each light guide element facing away from the light-emitting surface has light-deflecting means results in the advantage that the light of the light-emitting diode coupled into the light guide element can be deflected into a specific light-radiating direction.

Here, it is advantageous that at least two light guide elements are arranged in parallel side by side behind the end plate, which ensures a simple and economical construction and producibility; a large-surface signal lamp with high luminosity and a high signal- and warning effect can be constructed, which furthermore has only a low current consumption at an even illumination because due to the good utilization of the light of the light-emitting diodes, only a small number of light-emitting diodes are required. It is especially advantageous here that the signal lamp can be developed in a flat and especially space-saving fashion.

It is advantageous if the light guide elements are developed cylindrically because this leads to a simple and economical producibility of the light guide elements and furthermore, an especially favorable light distribution for signal lamps can be achieved because on the one hand, an especially favorable distribution of the light is achieved in the light guide element because of the reflections occurring in the light guide element, and on the other hand, an especially large even distribution is obtained during the radiation when the light radiates across the face because the cylindrical form leads to a magnifying glass effect.

It is advantageous that the light-deflecting means at the side of each light guide element facing away from the light-emitting surface are prisms because on the one hand, this leads to a simple and economic producibility because the prisms can be introduced into the body of the light guide element at the same time that the light guide element is produced, for example in an injection molding process, and on the other hand, the scattering angle and/or the deflection of light emitted by the light guide can be influenced in an especially simple fashion by varying the prism angles and/or the prism division and/or the prism depth, which means that depending on the required light radiation, varying light-radiating characteristics can be achieved in an especially simple and economical fashion.

The fact that the light-emitting surface of each light-emitting diode protrudes into the light guide element, and that the form of the light-coupling surface of each light guide element is adapted to the form of the light-emitting surface and the light-radiating characteristics of the light-emitting diode, leads to the advantage that the light radiated by the light-emitting diode via its light-emitting surface is optimally coupled into the light guide element, depending on the type of the light-emitting diode being used, which means that the loss of light is kept relatively low.

In this context, it is advantageous that each light guide element has a light-coupling area with a diameter that tapers toward the light-coupling surface because in this way, for example with light-emitting diodes that have a small light-emitting surface but radiate the light widely, the light that hits the walls of the light-coupling area cannot leave the light guide element because of the effective total reflections and is reflected at a favorable angle into the light guide element, which results in a particularly good utilization of the light made available and furthermore increases the even distribution of the light in the light guide element.

The fact that all light-emitting diodes are arranged at one side of the light guide elements arranged in parallel leads to the advantage of an especially simple and economical structure of the signal lamp.

It is advantageous that with adjacent light guide elements arranged in parallel, the light-emitting diodes are alternately arranged on both sides, which results. in particular with a large longitudinal expansion of the light guide elements and their parallel arrangements. in an especially even illumination.

In this context, it is especially advantageous that the surface opposite the light-coupling surface is mirrored, which increases the evenness of the illumination with light coupled only at one side.

It is advantageous that the light-emitting diodes are arranged on both sides of the light guide elements, which especially with light guide elements of a large length leads to an especially even illumination.

An embodiment of the signal lamp that is especially simple and economical to produce is obtained when the light-emitting diodes are arranged in rows on at least one common printed circuit board.

It is advantageous if the end plate has light-deflecting means; on the one hand, this increases the evenness of the illumination and on the other hand, specified and desired light distributions can be generated in a simple and economical fashion.

Because a number of light guide elements arranged in parallel with light-emitting diodes of the same color forms a group that generates a uniform signal light, a

signal lamp that is especially space-saving and has a flat structure can be produced, which has a specified illumination surface with especially even illumination and therefore a high signal- and warning effect.

In this context, it is advantageous that the signal lamp has at least two groups with light-emitting diodes of the same or different color to produce especially space-saving and flat signal lamps that can display signal light of the same or different color, either at the same time or separately.

The fact that the parallel light guide elements of one group are developed in one piece leads to the advantage that they can be produced in an especially simple and economical fashion.

If the signal lamp is used as tail light and/or brake light and and/or blinker and/or rear backing up light in motor vehicles, it is advantageous if the signal lamp is constructed in a space-saving and especially in a flat fashion, has a low weight and has a low current consumption.

According to the characteristics of Claim 16, the resulting advantages are that the light generated by the light-emitting diodes has a high intensity and a wide, conical radiation, which means that the number of light-emitting diodes can be kept low, and a wide, large-area radiation of light is obtained.

An embodiment of the object of the invention is shown in the illustrations and explained below using the figures.

The same or similar components have the same reference symbols in all figures.

They show in

Fig. 1 a signal lamp according to the invention,

Fig. 2 the detail Y according to **Fig**. 1,

Fig. 3 a light guide arrangement of the signal lamp,

Fig. 4 and **Fig.** 5 an example of an arrangement of a signal lamp with light guide elements,

Fig. 6 a light guide arrangement with ray paths,

Fig. 7 the detail X according to **Fig.** 6,

Fig. 8 a light guide arrangement with prisms,

Fig. 9 a section through the light guide arrangement according to **Fig.** 8.

Fig. 10 an embodiment of a light-emitting diode.

Fig. 1 shows an embodiment of a signal lamp according to the invention. It has a housing (G) with which the signal lamp can be installed into a motor vehicle body or attached to a motor vehicle body. With the embodiment shown here, the signal lamp has four groups (GP) that can generate light of the same or a different color at the same time or at different times. One of the groups can be a taillight, for example, whereas another one can be a brake light, another one can be a blinker, and another group (GP) represents a backing up light. As shown here, the individual groups can be covered by individual transparent end plates (A) of the same or different colors. However, in another embodiment, the signal lamp can have only one transparent end plate (A) that can be the same or a different color. The color of the end plate (A) may differ from the color of the light emitted by the respective group (GP) so that when the light generation by the respective group (GP) is turned off, the color may be a different color than when the light generation is turned on.

In another embodiment of the invention, where the signal lamp is inserted into the opening of a car body, for example, a housing (G) is not necessary. In that case, the housing (G) can be replaced by a fastening means (B).

As shown in the area designated Y in **Fig.** 1, each group (GP) has a number of light sources that are developed as light-emitting diodes (LED). Each light-emitting diode (LED) has an associated elongated light guide element (L) into which the light generated by the respective light-emitting diode (LED) is coupled. To obtain an even illumination, at least two light guide elements (L) are arranged in parallel side by side behind the end plate (A). With the embodiment shown here, ten light guide elements (L) per group (GP) and the associated light-emitting diodes (LED) are

arranged in parallel behind the respective transparent end plate (A). In this way, a large-area even light signal source is generated, which has a space-saving and flat construction and a large signal- and warning effect.

Fig. 2 shows the detail Y corresponding to **Fig.** 1 in an enlarged scale. The light-emitting diodes (LED) are arranged in rows and attached on a common printed circuit board (LP) with electrical contact. Here, each light-emitting diode (LED) has an associated elongated light guide element (L) that is developed in conical shape. The light guide elements (L) are arranged in parallel side by side, with the light being fed in on one side in such a way that with adjacent light guide elements (L) arranged in parallel, the light is fed in from different sides. In other embodiments, the light-emitting diodes (LED) can all be arranged at one side or at both sides.

To fasten and securely space the light guide elements (L) arranged in parallel, they are mounted on a fastening means (B), as shown in the present example. In another example, the light guide elements (L) of a group (GP) can also be developed in one piece.

Fig. 2 furthermore shows that the side of each light guide element (L) facing away from the light-emitting surface shown here has light-deflecting means which, for example, is developed here as prisms (P) that are arranged transversely to the main light-radiating direction.

Fig. 3 shows, in an enlarged scale, a section through an embodiment of a light guide arrangement according to **Fig.** 2. The light-emitting diode (LED) has a base and a lensoid light-emitting surface. Said light-emitting surface protrudes into the light guide element (L). For an optimal utilization of the light emitted by the light-emitting diode (LED), the form of the light-coupling surface (LK) of the light guide element (L) is adapted to the form of the light-emitting surface and the light-radiating characteristic of the light-emitting diode (LED). With the embodiment shown here, the light guide element (L) has a light-coupling area (LB) with a diameter that tapers toward the light-coupling surface (LK). Depending on the development of the light-emitting surface and the light-radiating characteristic of the light-emitting diode (LED) being used, the light-coupling area (LB) can have a different shape than the conical shape shown here; for example, it can also be spherical. In another exemplary embodiment, a light-coupling area (LB) may not be needed at all, depending on the light-emitting diode (LED) being used. As already described under **Fig.** 2, each light guide element (L) has prisms (P) at the side facing away from the light-emitting surface, some of which are shown here as examples. Depending on the desired light scattering and the light distribution to be generated, the scattering angle of the radiated light can be changed by changing the prism angles and/or the prism division and/or the prism depth. **Fig.** 3 shows examples of a few prisms (**P**). To elaborate on the path of the rays in the light guide (L), two light rays are drawn [in the figure] as examples, which are reflected by the prisms (P) in the direction of radiation and leave the light guide element (L). In the embodiment shown here, [they] are coupled into the light guide element (L) only at one side. To improve the even distribution of the light, the surface (F) opposite the light-coupling surface (LK) is therefore mirrored. The light guide element (L) is shown in a shortened fashion in **Fig.** 3. The required length of the light guide elements (L) can differ between different applications, as can the diameter of the light guide elements (**4**).

Fig. 4 shows an example of an arrangement for a signal lamp according to the invention. With the arrangement shown here, the light guide elements (L) are arranged horizontally in parallel behind a transparent end plate (A). The end plate (A) can be part of a housing (G) and/or a fastening means (B).

Fig. 5 shows a section through a signal lamp according to the invention corresponding to **Fig.** 4. Examples of the paths of the rays of the six light guide elements (L) shown here, which are arranged in parallel vertically behind the

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