(12) UK Patent Application (19) GB (11) 2480577 (13) A

(43) Date of Reproduction by UK Office 23.11.2011

(21) Application No: 1114971.3

(22) Date of Filing: 09.03.2010

(30) Priority Data:
(31) 102009011948 (32) 10.03.2009 (33) DE

(86) International Application Data:
PCT/EP2010/001447 De 09.03.2010

(87) International Publication Data:
WO2010/102777 De 16.09.2010

(71) Applicant(s):
GM Global Technology Operations, Inc.
(Incorporated in USA - Delaware)
PO Box 300, 300 Renaissance Center, Detroit, 48265-3000, United States of America

(72) Inventor(s):
Peter Brandt
Heiko Charle
Wilfried Schulz

(74) Agent and/or Address for Service:
Adam Opel AG
Intellectual Property Patents, IPC:A0-02, 65423 Rüsselsheim, Germany

(51) INT CL:
G02B 6/00 (2006.01) ***B60Q 3/04*** (2006.01)
G09F 13/18 (2006.01) *G02B 6/00* (2006.01)

(56) Documents Cited by ISA:
EP 1992870 A2 **EP 1840626 A1**
WO 2005/093477 A1 **US 20080297894 A1**
US 20080074902 A1 **US 20070188677 A1**
KR 1020080105873 A

(58) Field of Search by ISA:
INT CL **B60Q, G02B, G09F, G09G**
Other: **EPODOC; WPI**

(54) Title of the Invention: **Display device for a vehicle and method for producing the display device**
Abstract Title: **Display device for a vehicle and method for producing the display device**

(57) The invention relates to a display device (1-5) for a vehic le (7), and to a method for producing the display device (1-5). The display device (1-5) includes a display screen (8) and background lighting (9). Illuminated symbols (11-17) are arranged, depicted or activated on the display screen (8). The background lighting of the display screen (8) has luminous elements (18) emitting light to a light guide body (19). The light guide body (19) is arranged at a back side (20) of the display screen (8). The light guide body (19) is provided with a light guide plate (21) made of an optically transparent plastic compound (22), in which optically non-transparent partitions (23) for light guide zones (24-30) of the light guide body (19) are arranged, said light guide zones being optically shielded from one another.

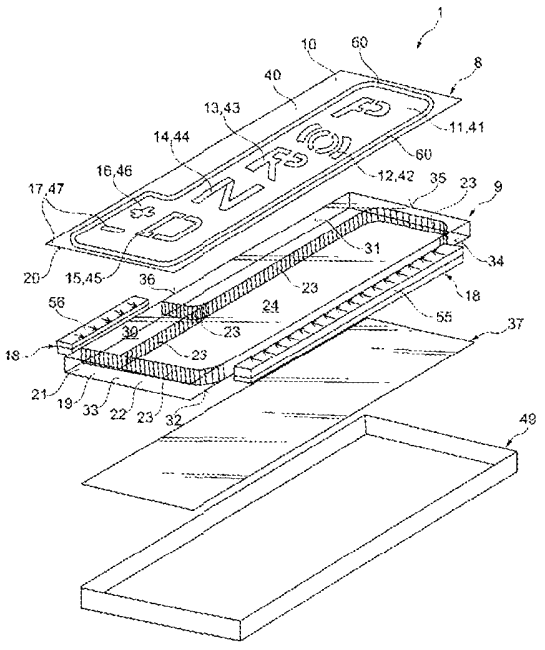

Fig. 2

GB 2480577 A

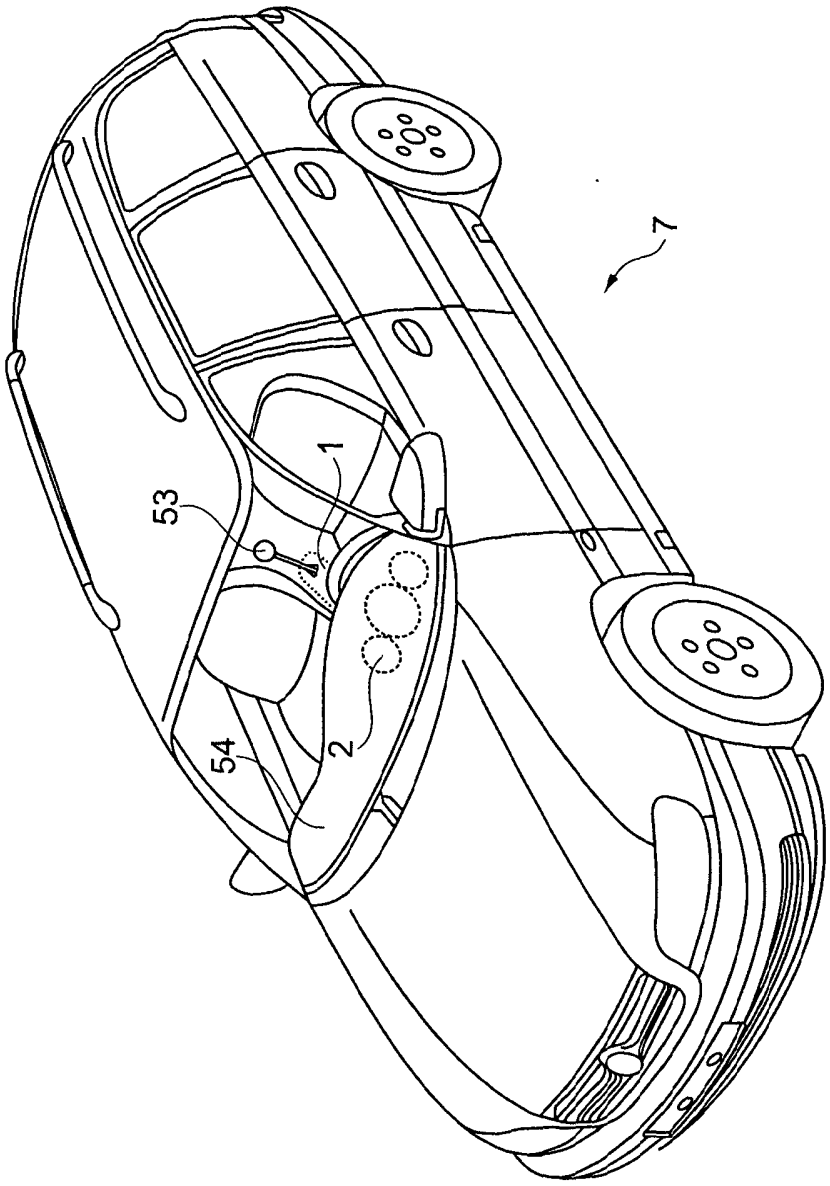

Fig. 1

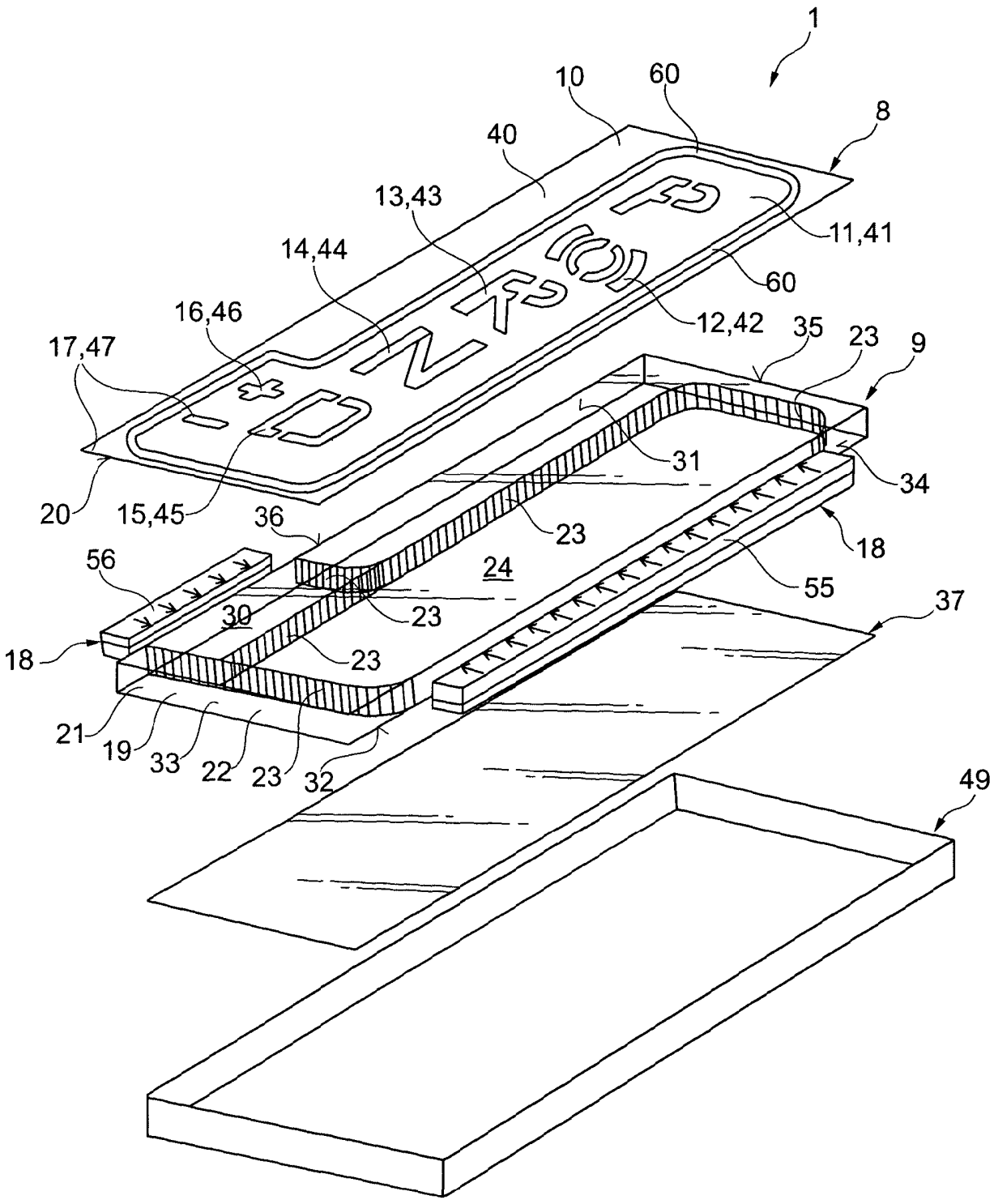
1
10
60
8
40
13,43
11,41
14,44
60
16,46
12,42
35
23
9
17,47
31
34
20
15,45
36
23
18
56
24
55
37
30
23
18
23
21
19
33
22
23
32
49

Fig. 2

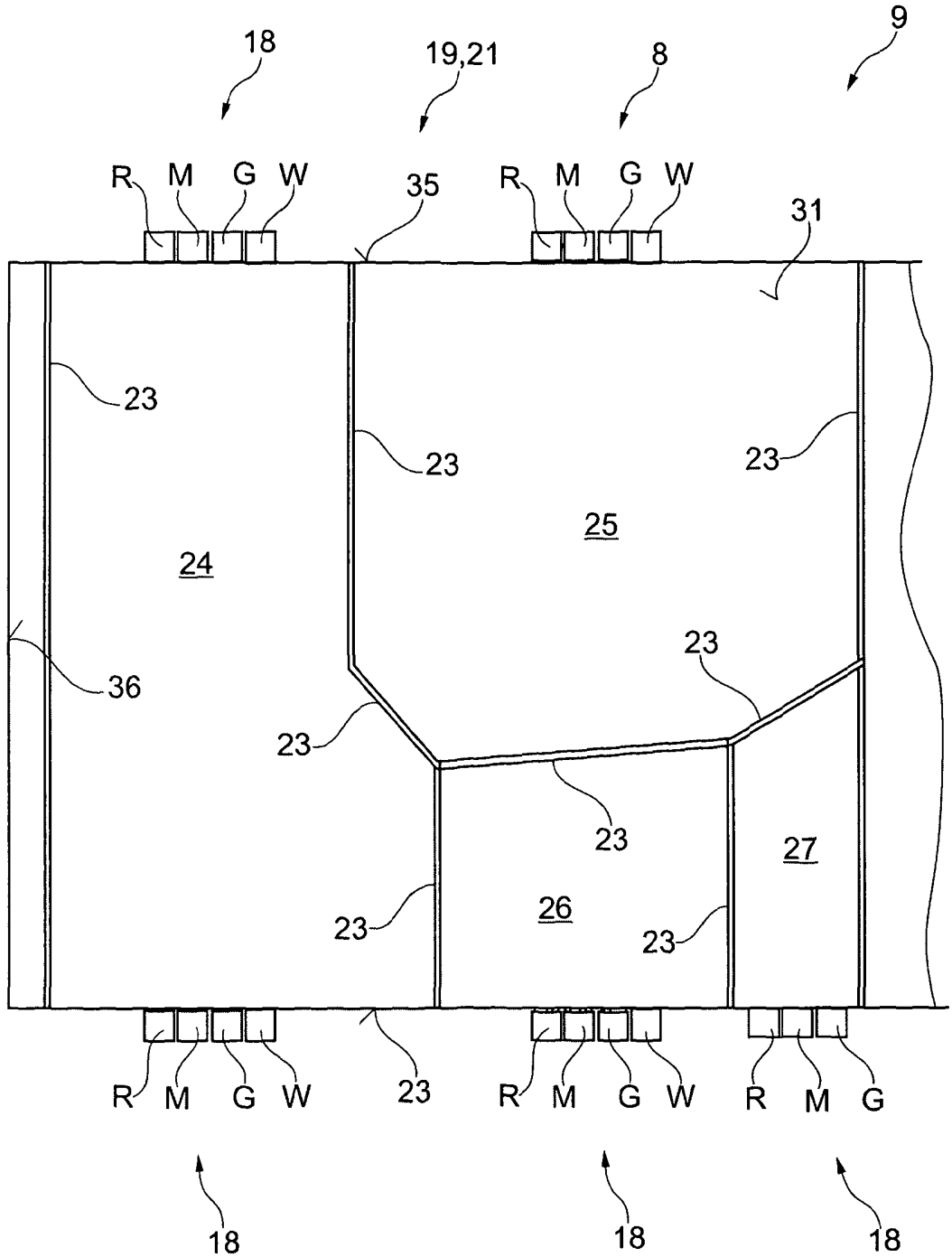
18
19,21
8
9
R M G W
35
R M G W
31
23
23
23
25
24
23
36
23
23
27
26
23
23
R M G W
23
R M G W
R M G
18
18
18

Fig. 3

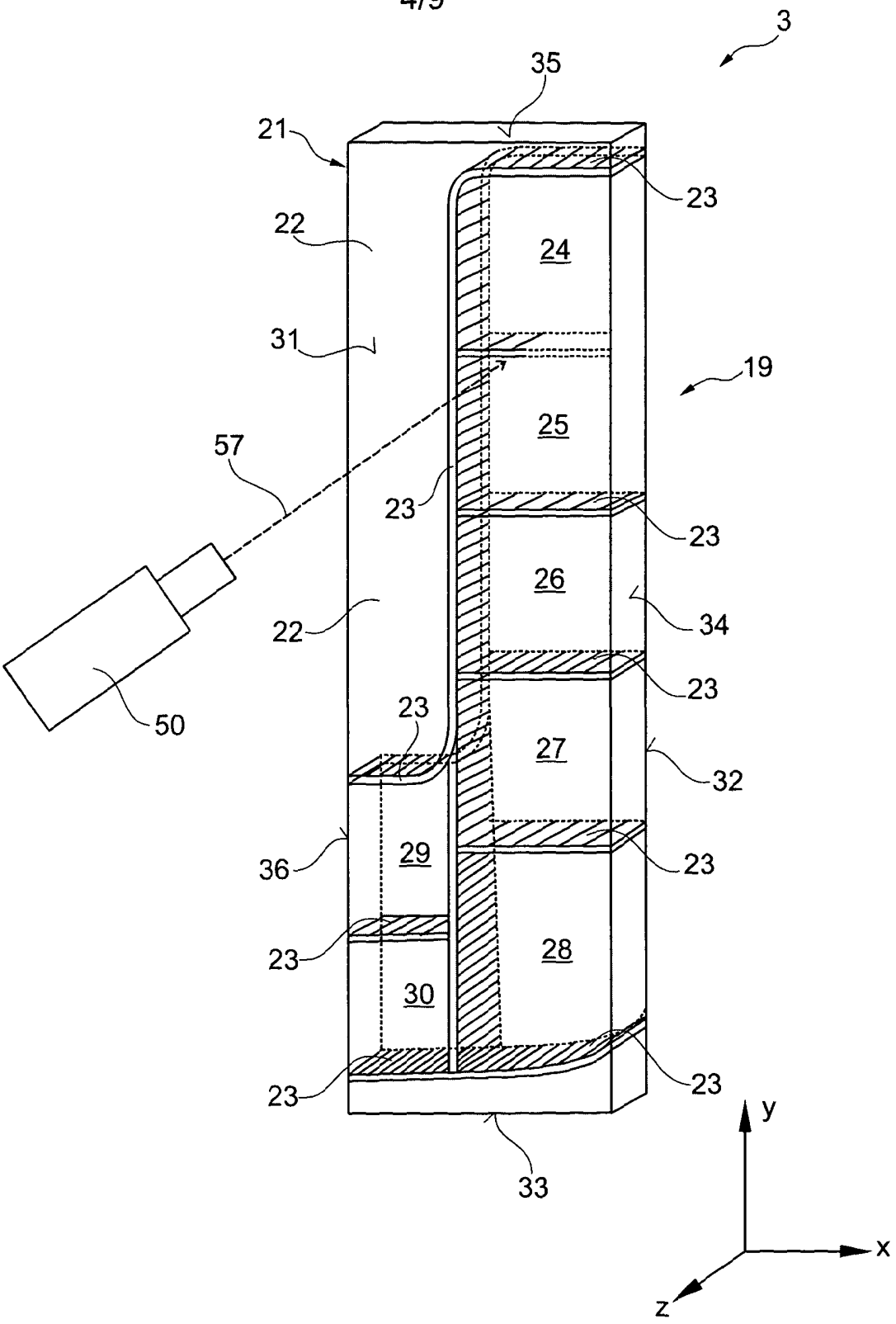
3
35
21
23
22
24
31
19
25
57
23
23
26
22
34
23
50
23
27
32
36
29
23
23
28
30
23
23
33
y
x
z

Fig. 4

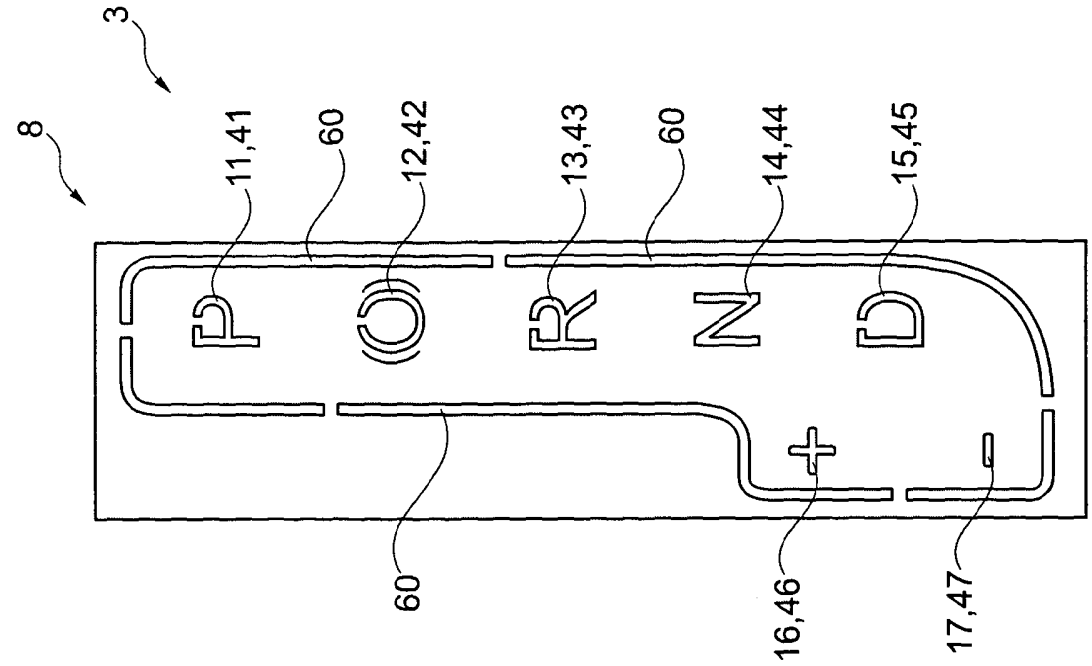
3
8
11,41
60
12,42
13,43
60
14,44
15,45
P
O
R
N
D
60
16,46
17,47

Fig. 5B

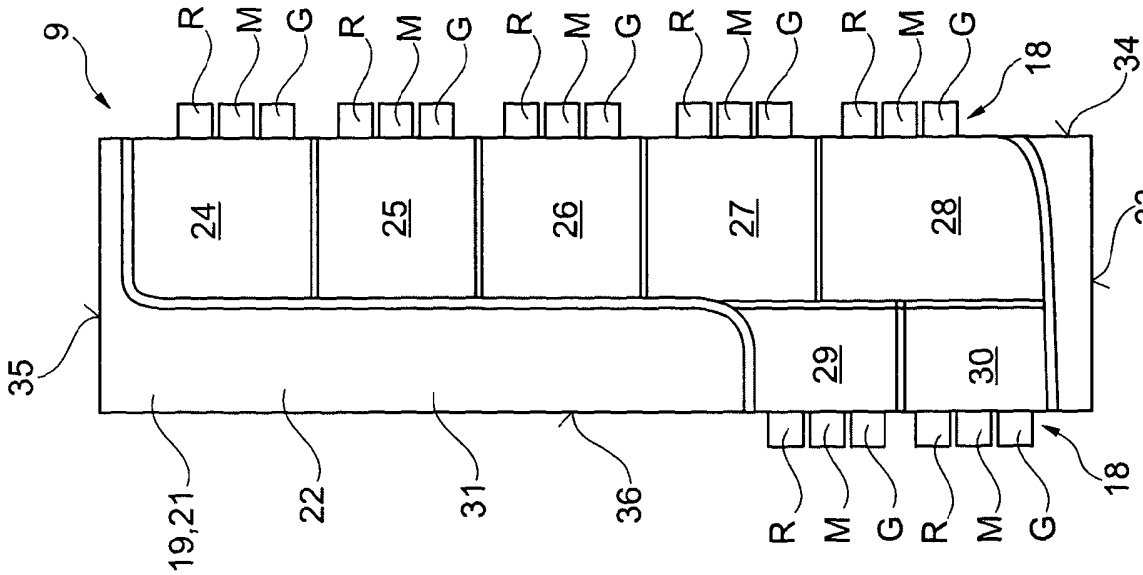
9
R
M
G
18
34
24
25
26
27
28
33
35
29
30
19,21
22
31
36
18

Fig. 5A

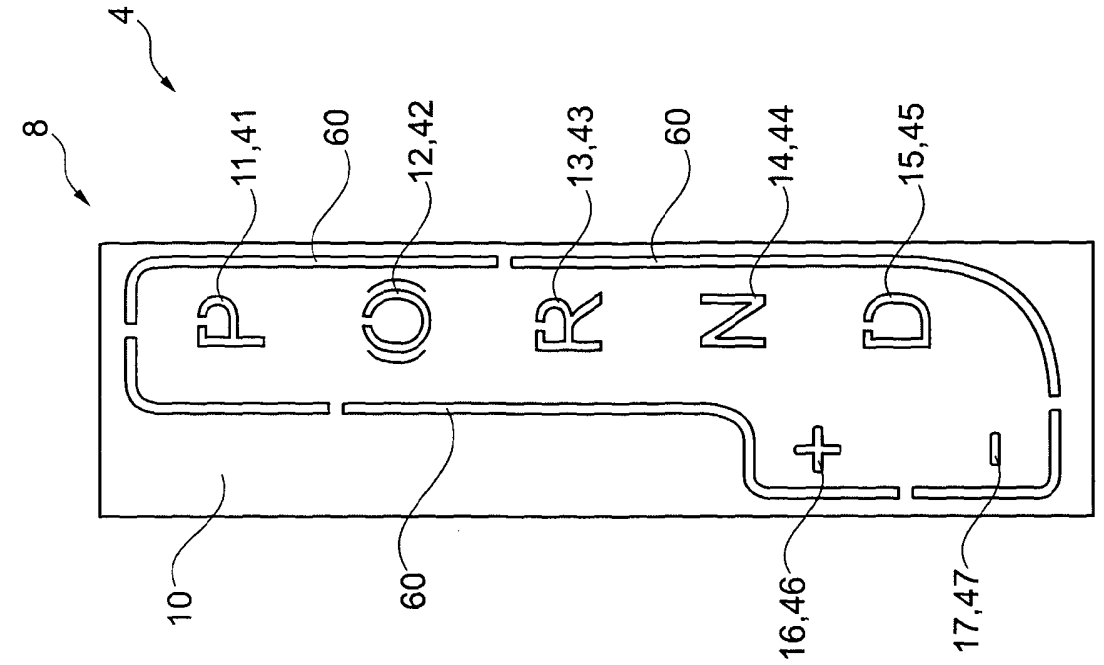
4
8
11,41
60
12,42
13,43
60
14,44
15,45
P
O
R
N
D
10
60
16,46
17,47

Fig. 6B

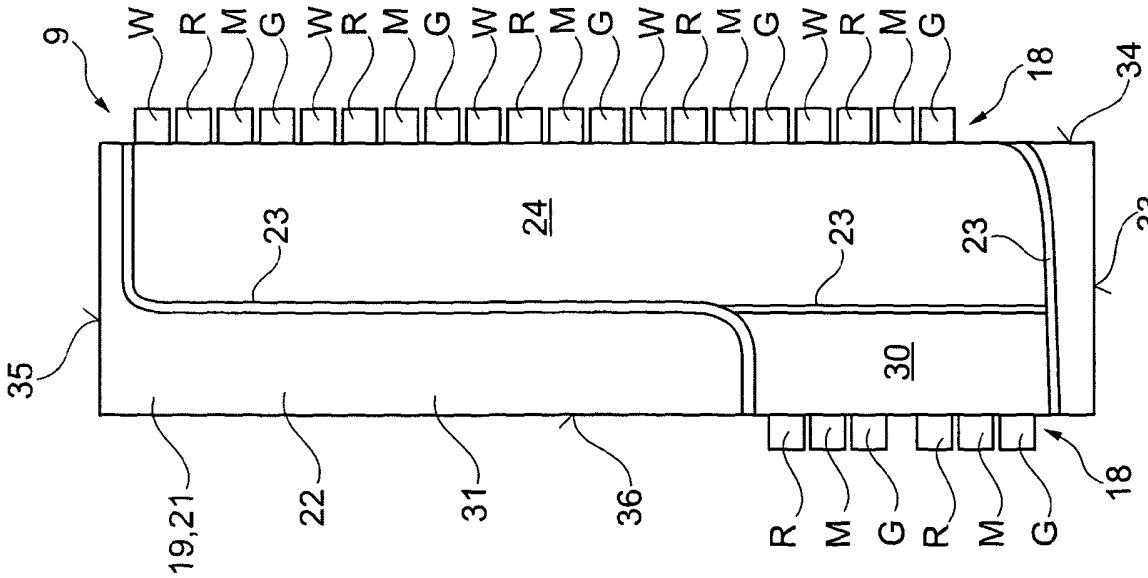
9
W
R
M
G
18
34
23
24
23
23
33
35
30
19,21
22
31
36
18

Fig. 6A

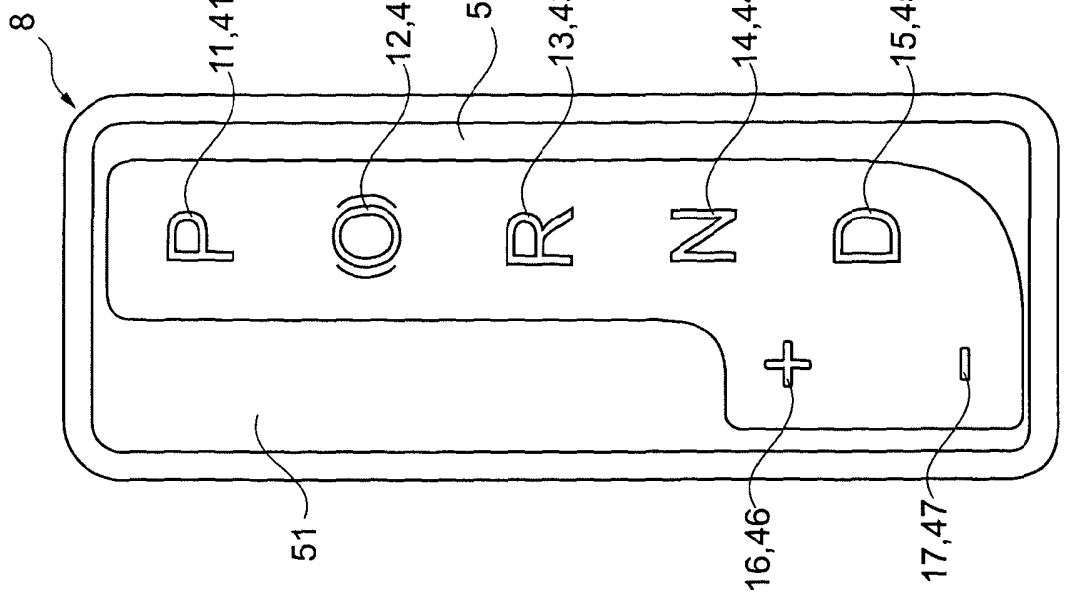

Fig. 7A

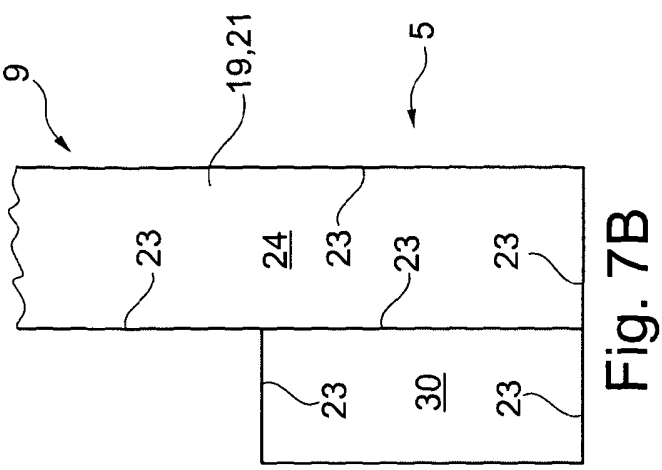

Fig. 7B

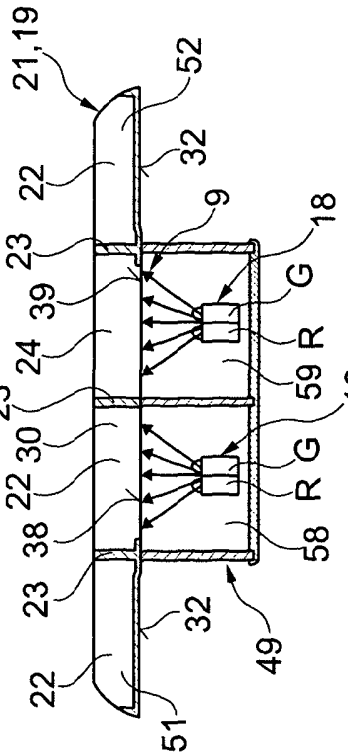

Fig. 7C

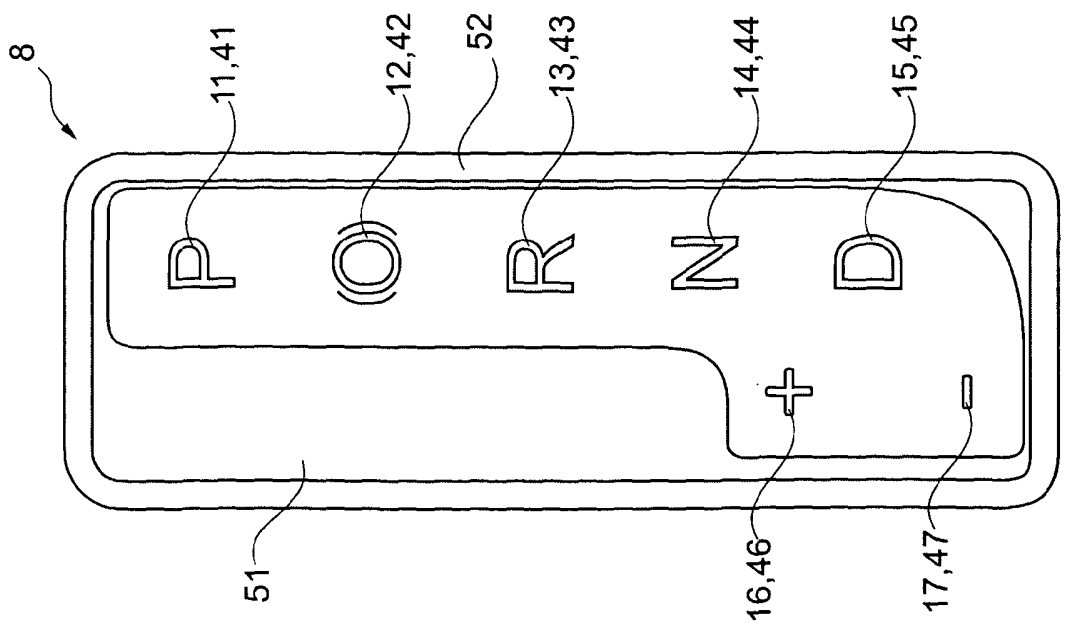

Fig. 8A

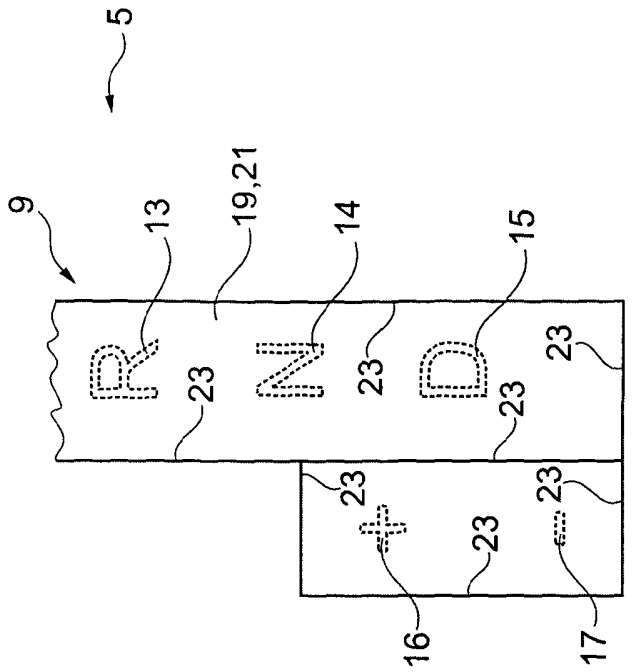

Fig. 8B

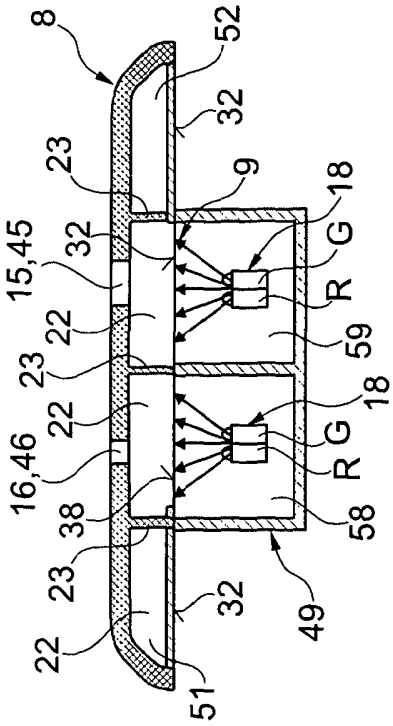

Fig. 8C

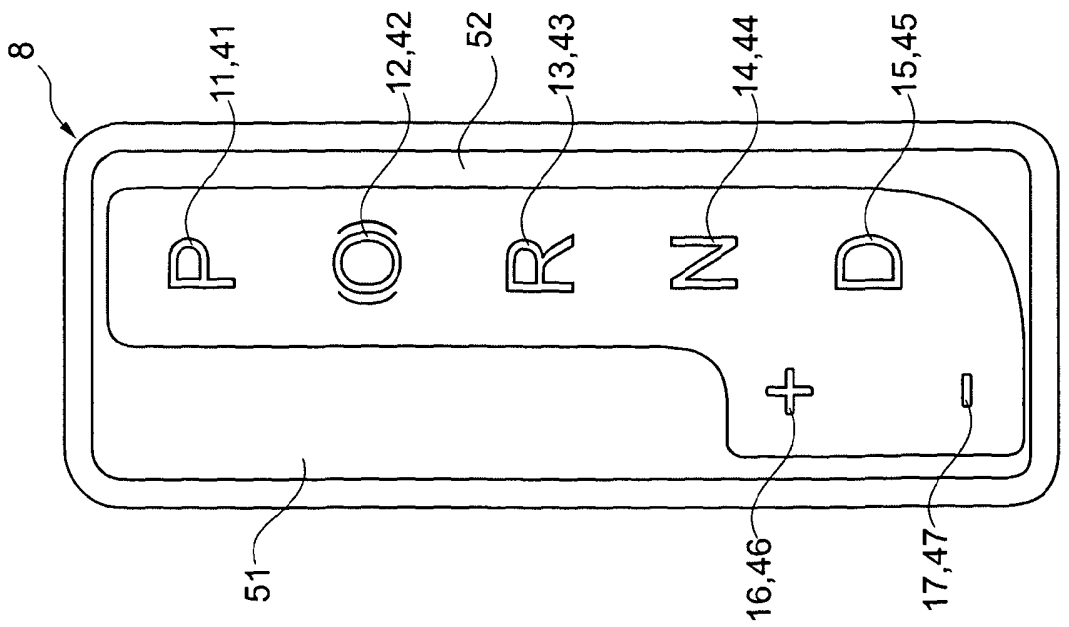

Fig. 9A

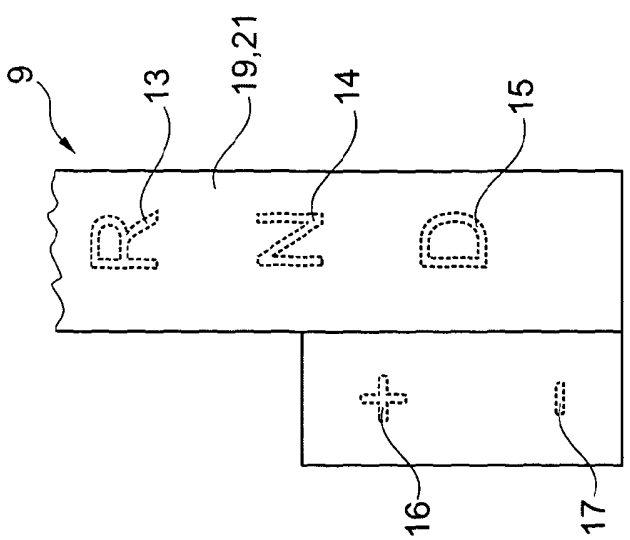

Fig. 9B

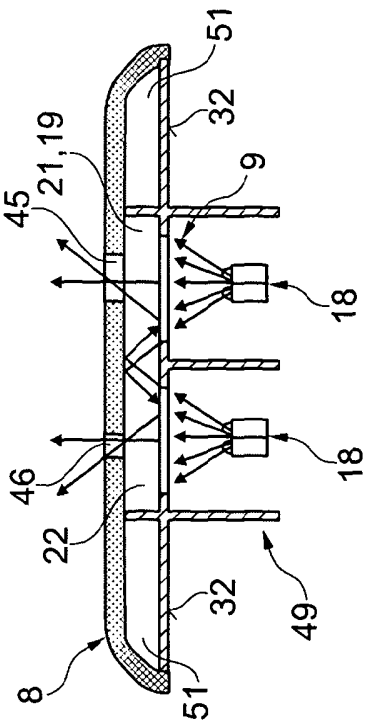

Fig. 9C

DISPLAY APPARATUS FOR A VEHICLE AND METHOD FOR MANUFACTURING THE DISPLAY APPARATUS

The invention relates to a display apparatus for a vehicle and a method for manufacturing the display apparatus. The display apparatus comprises a display screen and a background lighting. Illuminated characters are disposed, imaged, or activated on the display screen. The background lighting of the display screen comprises illuminants, which emit light into a light guide body. The light guide body is disposed on a rear side of the display screen. At the same time, the light guide body comprises a light guide plate made of an optically transparent plastic compound.

A monochrome display apparatus comprising a display screen and a backlight provided for a backlighting of the display screen is known from the document DE 10 2005 045 692 A1. The backlight comprises a light source having a first color and a light source having a second color. To this end, a first light conductor is coupled to the first light source and a second light conductor is coupled to the second light source. The two light conductors are disposed closely adjacent to one another, behind the display screen of the display apparatus in such a manner that they backlight the entire display extensively and an area of the display associated with the first light conductor with a first color and an area of the display associated with the second light conductor with the second color.

Such a display apparatus has the disadvantage that for a plurality of different-colored illuminated areas, a plurality of individual light conductors is required, which are to be connected to light sources having the corresponding colors or color filters. This arrangement of a plurality of light conductors is cost-intensive and results in a complex structure of closed adjacently disposed light conductors, which can then be illuminated with a respectively different color. The separation of the individual lighting areas or the individual light conductors requires a minimum width to prevent overlighting of the respectively other color. At the same time, these separations must project as close as possible onto the underside of the display screen in order to partition off the individual areas in a lightproof manner. It is disadvantageous here that the separations are possibly visible on the display screen.

Figures 9A, 9B and 9C show such a display apparatus 6 known from the prior art. Figure 9A shows a schematic view of a display screen 8 having structured transparent openings 41 to 47, where the structured transparent openings 41 to 45 are the positions of a gear shift lever in automatic mode as backlit characters 11 to 15. In automatic shifting mode, these characters disposed in the transparent openings 41 to 45 light up green, for example, whereas the characters 16 and 17, which are characterized with the backlit character 16 for a manual shift of the gears into the next higher gear or by the backlit character 17 for a manual shift into the next lower gear, light up red. However, if the shift lever is not operated in automatic mode but in the manual shift mode, the characters 16 and 17 in the display screen 8 light up green whilst the automatic characters 11 to 15 emit red.

Figure 9B shows schematically a partial area of a light guide plate 21 of a backlight 9, where the positions of the characters 14 to 17 are indicated by dashed lines. In order to explain the different coloring and also the switching of the colors, Figure 9C shows a schematic section through the display apparatus 6 according to the prior art. The light guide plate 21 is delimited laterally by metal-coated lateral regions 51 and 52 and is covered by the display screen 8, which has structured openings 45 and 46 filled with a transparent plastic compound 22, through which light can emerge. The light guide plate 21 is made of a transparent plastic compound 22, which can be illuminated in different colors from the rear side 32 by appropriate illuminants 18.

These illuminants 18 are disposed in chambers of an illuminating box or light box 49 and irradiate the light guide plate 21 from the rear side 32, where the colors mix partially in the transparent openings 46 and 47 due to multiple reflections inside the light guide plate 21, so that the color assignment as provided for manual and automatic mode is not unique. In order to avoid this mixing of colors, according to the prior art two separate light guide plates would need to be produced and provided with appropriate partitions, which however involves increased costs and complex production steps.

It is the object of the invention to provide a display apparatus and a method for producing the same, which enables a considerable cost saving with a simultaneously improved display image. In addition, it is the object of the invention to prevent coupling of light into neighboring light conductor areas and to avoid any color mixing between neighboring light conductors.

This object is achieved according to the invention by the subject matter of the independent claims. Advantageous further developments of the invention are obtained from the dependent claims.

According to the invention, a display apparatus for a vehicle and a method for manufacturing the display apparatus is provided. The display apparatus comprises a display screen and a background lighting. Illuminated characters are disposed, imaged, or activated on the display screen. The background lighting of the display screen comprises illuminants, which emit light into a light guide body. The light guide body is disposed on a rear side of the display screen. At the same time, the light guide body comprises a light guide plate made of an optically transparent plastic compound, in which optically non-transparent partitions for light guide zones of the light guide body, which are optically shielded from one another, are introduced by means of laser irradiation of the plastic compound. This display apparatus has the advantage that there is no need to position a plurality of light guide bodies or light guide plates adjacent to one another and provide appropriate partitions in between but the display apparatus according to the invention comprises a plurality of adjacently disposed light guide zones in a single light guide plate, which are merely screened optically from one another by dividing surfaces introduced thermally into the light guide body or the light guide plate, where the light guide zones can have different, also curved, contours since, by introducing the partitions into the transparent plastic compound by means of energy conversion of the plastic compound, a high design freedom is possible with simultaneously low costs for designing the light guide plate. At the same time, the partitions preferably extend through the light guide body from an upper side disposed on the rear side of the display screen as far as a rear side of the light guide body. Consequently, the color mixing shown in Figure 9 is prevented by these continuous optically screening partitions.

In a preferred embodiment of the invention, the edges of the light guide body are largely kept free of partitions and the illuminants emit a bright light over the partition-free edges as background lighting into the edges for homogeneous illumination of the light guide body or the light guide zones. If a light guide zone does not lie on one of the edges of the light guide plate, these zones can be illuminated separately from the rear side of the light guide plate individually with different colors.

Preferably light sources having different colors are disposed on the edges of the light guide plate, where respectively one light guide zone that can be illuminated from one

edge is illuminated by one of the light sources. The rear side of the light guide plate can comprise a reflection layer or a reflection film, where this reflection layer and/or the reflection film can also be assigned to a light box, in which the light guide plate is disposed.

The rear side of the light guide plate can have reflection-layer-free areas to light guide zones, where differently colored light can be coupled into the light guide zones via the reflection-layer-free areas. It is thereby possible either to illuminate all the light guide zones of a light guide plate from the rear side and switch between different colors per light guide zone or to largely illuminate the light guide zones from the edge, where illumination from the rear side is only possible in cases in which one or more of the light guide zones does not extend as far as the edge of a light guide plate.

A display screen is located opposite the rear side of the light guide plate, which display screen preferably comprises a structured optically opaque film, where the film has structured transparent openings for the illuminated characters. Instead of a film, a structured optically opaque coating such as a chrome coating can also be applied to the transparent plastic compound, where the optically opaque coating is applied to the upper side of the light guide body in such a manner that structured transparent openings remain for the illuminated characters. In addition, it is possible to apply a correspondingly structured coating to a transparent film as a display screen. Furthermore, it is possible to provide a self-supporting display screen with appropriately introduced and structured transparent openings or to apply an LCD screen (liquid crystal display) as a display screen to the light guide body structured in the light guide zones.

In order to form the partitions, the transparent plastic compound can comprise light-absorbing spots or light-reflecting spots, which contact one another in the vertical direction through the light guide body and/or overlap one another, and thereby form an appropriate optically shielding partition.

In a preferred embodiment of the invention, the partitions are composed of burn-in spots, which contact and/or overlap one another in the vertical direction. Such burn-in spots can be introduced by high focused energy input into a corresponding transparent plastic compound, without the light guide plate or the light guide body needing to be separated into individual light guide plates, as in the prior art. In this case, the burn-in spots preferably form agglomerates of carbon precipitates of the transparent plastic

compound, which preferably comprises polycarbonate, where the carbon of the polycarbonate chains is isolated by a focused energy input and can be compacted to form carbon agglomerates.

A method for manufacturing a display apparatus of a vehicle comprises the following process steps. Firstly, a plate of a light guide material is manufactured for a plurality of light guide bodies for display apparatuses. Optically shielding partitions are introduced into the transparent light guide material to form light guide zones. The plate of light guide material is then divided into individual light guide bodies which are adapted to the size and shape of a display screen. The display apparatus comprising display screen and background lighting with light guide zones of a light guide body optically shielded from one another by optically shielding partitions which have been introduced, is then installed in a light box with illuminants for different-colored illumination of the light guide zones of the light guide body.

The display screen can be prepared as a self-supporting and shaped as well as structured optically opaque plate apart from transparent openings for the illuminated characters and can be applied to the light guide body when assembling the display apparatus or it can be vapor-deposited and structured on a preformed light guide body of the display screen made of an optically opaque material. Finally, instead of a permanent display screen, it is also possible to provide an LCD screen which is particularly suitable for instrument display devices since the characters to be imaged can be variably activated.

In relatively inexpensive LCD screens, a coarse pixel structure is provided for the DOT matrix. Since the invention provides the possibility of already achieving, instead of this coarse pixel structure of the LCD screens, finely curved, even annular structures in the light guide plate, it is possible to image curved to annular structures on the display screen since these are already provided in the light guide plate. To this end, such a character is formed by two partitions comprising an inner partition and an outer partition surrounding the inner partition as a light guide zone and for example, light is emitted from the rear side into the curved light guide zone, which can contrast in color from the shade of the background lighting.

In a preferred embodiment of the method, the introduction of the optically shielding partitions is executed by means of a three-dimensional laser scanner in such a manner that light-absorbing spots or light-reflecting spots are formed in a transparent plastic

compound, which contact one another and/or overlap one another in the vertical direction through the light guide body.

The invention is now explained in detail with reference to the appended figures.

Figure 1 shows a schematic perspective view of a vehicle with display apparatus according to the invention;

Figure 2 shows a schematic exploded perspective view of a display apparatus according to a first embodiment of the invention;

Figure 3 shows a schematic plan view of a transparent light guide body with light emission from the lateral edges for dashboard illuminations according to a second embodiment of the invention;

Figure 4 shows a schematic diagram for the method of manufacturing light guide zones in a light guide body of a display apparatus according to a third embodiment of the invention;

Figure 5 shows a schematic plan view of a light guide body with display screen according to the third embodiment of the invention;

Figure 6 shows a schematic plan view of a light guide body with display screen according to a fourth embodiment of the invention;

Figure 7 shows a schematic plan view of a light guide body with display screen according to a fifth embodiment of the invention;

Figure 8 shows schematic views of the display apparatus according to Figure 7;

Figure 9 shows schematic diagrams of a display apparatus according to the prior art.

Figure 1 shows a schematic perspective view of a vehicle 7 having display apparatuses 1 and 2 according to the invention, where the display apparatus 1 comprises illuminated characters with differently lighting-up colors of a gear shift lever 53 and

where the display apparatus 2 comprises dashboard instruments and/or symbols of the dashboard 54 of the vehicle 7.

Figure 2 shows a schematic exploded perspective view of a display apparatus 1 according to a first embodiment of the invention. This display apparatus 1 is composed of four components, a display screen 8, a background lighting 9, a reflection film 37, and a light box 49, which accommodates the reflection film 37 and the light guide body 19 with illuminants 18 and serves as a holder for these components of the display apparatus. Instead of the reflection film 37, the light box can also be fitted with a reflection coating.

The display screen 8 can be configured as a self-supporting translucent component having a structured optically opaque coating 10, where the optically opaque coating 10 has transparent openings 41 to 47 and 60, through which the transparent material is illuminated from the rear side 20 of the display screen 8 with the aid of the background lighting 9 of the light guide body 19. Instead of a self-supporting screen, an optically opaque film having transparent openings 41 to 47 and 60 can also be fixed on an upper side 31 of the light guide body. The structured transparent openings 41 to 47 thereby form indirectly illuminated characters 11 to 17.

The light guide body 19 consists of a transparent plastic material 22 in the form of a light guide plate 21 with an upper side 31 and a rear side 32. Of the edges 33 to 36, the opposite edges 34 and 36 comprise illuminants 18 which in this embodiment of the invention, form two colored light-emitting diode arrays 55 and 56, which are disposed at the edges 34 or 36 of the light guide plate 21 in the areas free from light-shielding partitions 23. In this embodiment of the invention, the light-emitting diode arrays 55 and 56 comprise two light-emitting diode arrays disposed one above the other with different colors, for example, green and red, which can selectively be activated.

Light-shielding partitions 23 are introduced into the light guide body 19, which extend from the upper side 31 to the rear side 32 of the light guide body 19 and in this embodiment of the invention, surround a light guide zone 24, which can be illuminated laterally from the edge zone of the lateral edge 34, which is free from such a light-shielding surface. In addition, the light-shielding partitions 23 surround a further light guide zone 30, which can be illuminated by the dichromatic light-emitting diode array 56, for example, either green or red. The light guide zones 24 and 30, which are shielded from one another, are illuminated relatively homogeneously by multiple and

total reflection, where the upper side 31 of the light guide body 19 has a light coupling-out structure, which can emit light emitted by the light-emitting arrays of light-emitting diodes onto the marginal sides 34 and 36 orthogonal to the marginal sides in the direction of the display screen.

Instead of a display screen 8 shown here with fixedly predefined backlit characters in an optically opaque layer 10, the display screen can also comprise an LCD matrix by which means, depending on costs, extensive selectable liquid crystal regions having dimensions in the millimeter range or small liquid crystal regions having dimensions in the micrometer range, can be switched between a transmitting and an absorbing state so that it is possible to fit any display of an instrument with the display apparatus according to the invention.

As a result of the possibility of introducing arbitrarily curved contours of light guide zones 24 and 30 into the background lighting 9 from a light guide body 19 by forming light-shielding partitions 23, it is also possible to incorporate finely structured curved characters, symbols, or company logos in instrument displays having an inexpensive LCD screen with relatively coarse pixel matrix. Then for example, the intermediate space between nested curved partitions can be illuminated from the rear side 32 of a light guide plate 21 with the aid of an additional illuminant, so that even in a coarse pixel matrix of an inexpensive LCD screen, curved and/or annular contours can be imaged with uniform and exact contours in an additional color, for example, as a warning triangle or in the form of a circular company logo.

Figure 3 shows a schematic plan view of a transparent light guide body 19 with light emission from the lateral edges 33 and 35 for dashboard illuminations of display apparatus 2 according to a second embodiment of the invention. In this embodiment of the invention, merely a partial area of the light guide body 19 is shown, which is divided into seven light guide zones 24 to 27 by introducing light-shielding partitions 23. In this case, each light guide zone 24 to 27 can be illuminated from the marginal sides 33 and 35 by a light-emitting diode array, for example, of red R, magenta M, and green G, as well as white W emitting diodes.

As a result of the multiple and total reflection within this light guide plate 21, the light of the individual light guide zones 24 to 27 can be emitted in different color combinations relatively homogeneously over a coupling-out structure on the upper side 31 of the light guide plate 21, where light-emitting diodes in red R, magenta M, green G, and white W

of the light-emitting diode array can be activated differently. For reasons of cost, only two colors such as, for example, red R and green G, can be provided as background lighting.

For example, red R can serve as a warning color and green G as an indicator color. If such a light guide plate having light guide zones 24 to 27, which can be differently shielded from one another and arbitrarily structured, is used as background lighting 9 of a display apparatus 2 of an instrument or a dashboard, for example, in an instrument panel, a more flexible and inexpensive monochromatic LCD screen having a coarse pixel matrix can be used as a display screen in order to make differently colored and variable characters and symbols light up on the instrument.

Figure 4 shows a schematic diagram for the method of manufacturing light guide zones 24 to 30 in a light guide body 19 of a display apparatus 3 according to a third embodiment of the invention. The light guide body 19 is formed by a light guide plate 21 having a rectangular shape, which has the marginal sides 33 to 36. Partitions 23 extending from the upper side 31 to the rear side 32 are introduced into the light guide body 19 by means of a three-dimensional laser scanner 50 by varying the focal point of the three-dimensional laser scanner 50. As a result of the thermal action of the three-dimensionally focusable laser beam 57, light-absorbing or light-reflecting spots are formed, which contact one another and/or overlap in the vertical z-direction and form non-shielding walls in the light guide body 19. By keeping the lateral edges 34 and 36 of the light guide plate 21 free from such light-shielding partitions, it is possible to couple light from these marginal sides 34 and 36 and from the rear side 32 into the light guide body 19.

Figure 5 shows a schematic plan view of a light guide body 19 with display screen 8 according to the third embodiment of the invention. Figure 5A shows the light guide body 19, which as a result of illuminants 18 from the marginal sides 34 and 36 forms a flexible background lighting 9 in the light guide zones 24 to 30. In this case, each light guide zone 24 to 30 is equipped with separate illuminants 18, which for example are equipped from light-emitting diode arrays comprising red R, magenta M, and green G emitting light-emitting diodes. In this embodiment of the invention, a display screen 8 as shown in Figure 5B is backlit onto such a background lighting, which can activate different colors in each of the light guide zones 24 to 30. The illuminated characters 11 to 17 can light up individually illuminable shift positions of a gear shift lever, as shown in Figure 1. In so doing, it is possible to switch over from an

automatic mode having the illuminated characters 11 to 15 into a manual shifting mode having the characters + and -.

With the aid of the background lighting 9 shown in Figure 5A it is possible to make the respective position of the gear shift lever light up green while the remaining positions of the automatic gear shift light up white and the non-actuated manual shift positions with the characters 16 and 17 of the gear shift lever light up red. If the system is switched to manual shifting, all the characters 11 to 15 provided for the automatic gear shift are switched to red and the two characters for the manual engagement of gears are displayed by green and white in the manual shift mode.

Figure 6 shows a schematic plan view of a light guide body 19 with display screen 8 according to a fourth embodiment of the invention. In this case, Figure 6A again shows the background lighting 9 in the form of a light guide body 19, which is configured as a light guide plate 21 and has merely two light guide zones 24 and 30, where the light guide zone 24 is provided for the automatic shifting and the light guide zone 30 is provided for the manual shifting possibility. At the same time, a plurality of light-emitting diodes disposed adjacently on the lateral edge 34 or 36 is provided, where these light-emitting diodes, for example, can make the three color components red R, magenta M, and green G light up as well as a brightly illuminating background color W. Figure 5B in turn shows the appurtenant display screen 8 with the shift positions of the automatic shift comprising illuminated characters 1 to 15, which as a result of the common light guide zone 24, as shown in Figure 6A, light up in one color while the characters 16 and 17 can light up simultaneously in another color. If, for example, the automatic shift is operating, the automatic shift positions can light up green, for example, with the aid of the light guide zone 24 and the manual shift positions can light up red, for example, with the aid of the light guide zone 30 and conversely.

Figure 7 shows schematic views of a display apparatus 5 according to a fifth embodiment of the invention. Components having the same functions as in the preceding figures are identified with the same reference numbers and not discussed additionally. In this embodiment of the invention, for example, the display panel of a gear shift lever is shown with differently illuminated characters 11 to 17, with Figure 7A showing a plan view of the display screen 8 and Figure 7B showing the background lighting 9, onto which the display screen 8 can be applied. The background lighting 9 comprises two light guide zones 24 and 30 in a light guide plate 21, where both the

light guide zone 30 and the light guide zone 24 are completely surrounded by partitions 23 since in this embodiment of the invention, as shown in Figure 7C, the light guide zones 24 and 30 of the light guide plate 21 are illuminated from the rear side 32 of the light guide plate 21.

In addition, as shown in Figure 7C, a light box 49 having light chambers 58 and 59 is disposed on the rear side 32, each light chamber having an illuminant 18 with two light-emitting diodes red R and green G, which illuminate the light guide body 19 shown in Figure 7B. The transparent plastic compound 22 of the light guide plate 21 is divided into lateral regions 51 and 52 and illuminated light guide zones 24 and 30, where the lateral regions 51 and 52 are shielded from the illuminated regions by light-shielding partitions 23 and the illuminated regions are partitioned off from one another by a shielding partition 23 between the light guide zones 24 and 30 so that no color mixing can occur.

Figure 8 shows schematic views of the display apparatus 5 according to Figure 7, where Figure 8A corresponds to Figure 7A and Figure 8B corresponds to Figure 7B with positions of the characters 13 to 17 which can be backlit indicated by dashed lines. In Figure 8C the assembly of display screen 8 and background lighting 9 can now be seen in cross-section, where the display screen 8 consists of an optically opaque plastic compound, which is fixed with its rear side 20 on the upper side 31 of the light guide plate 21. Through the transparent openings 45 and 46 in the optically opaque plastic compound of the display screen 8, the light of the light guide zones 24 and 30, which are shielded from one another, is incident on the rear side 20 of the display screen 8 and can be emitted through the openings 15 and 16 having a transparent plastic compound. This transparent plastic compound disposed in the openings protects the display screen 8 from accumulations of dust.

Figure 9 shows schematic diagrams of a display apparatus according to the prior art, as has already been discussed initially with its disadvantages so that this will not be repeated here.

Reference list

1	Display apparatus (first embodiment)
2	Display apparatus (second embodiment)
3	Display apparatus (third embodiment)
4	Display apparatus (fourth embodiment)
5	Display apparatus (fifth embodiment)
7	Vehicle
8	Display screen
9	Background lighting
10	Optically opaque layer
11-17	Illuminated characters
18	Illuminant or light source
19	Light guide body
20	Rear side of the display screen
21	Light guide plate
22	Plastic compound
23	Partition wall
24-30	Light guide zones
31	Upper side of the light guide body or the light guide plate
32	Rear side of the light guide body or the light guide plate
33	Edge
34	Edge
35	Edge
36	Edge
37	Reflection layer or reflection film
38	Reflection-layer-free region
39	Reflection-layer-free region
40	Film for display screen
41-47	Structured transparent openings
48	LCD screen
49	Light box
50	3-D laser scanner
51	Lateral region
52	Lateral region

53	Gear shift lever
54	Instrument panel
55	Light-emitting diode array
56	Light-emitting diode array
57	Laser beam
58	Light chamber
59	Light chamber
60	Transparent opening

G	Green
M	Magenta
R	Red
W	White

PATENT CLAIMS

1. A display apparatus for a vehicle comprising a display screen (8) and a background lighting (9), wherein illuminated characters (11-17) are disposed, imaged, or activated on the display screen (8) and wherein the background lighting (9) of the display screen (8) emits light into a light guide body (19) by means of illuminants (18) and wherein the light guide body (19) is disposed on a rear side (20) of the display screen (8) characterized in that the light guide body (19) comprises a light guide plate made (21) of an optically transparent plastic compound (22), in which optically shielding partitions (23) for light guide zones (24-30) of the light guide body (19), which are optically shielded from one another, are introduced by means of laser irradiation of the plastic compound (22).

2. The display apparatus according to claim 1, characterized in that the partitions (23) extend through the light guide body (19) from an upper side (31) of the light guide body (19) disposed toward the rear side (20) of the display screen (8) as far as a rear side (32) of the light guide body (19).

3. The display apparatus according to claim 1 or claim 2, characterized in that the optically shielding partitions (23) have differently curved contours of the light guide zones (24-30).

4. The display apparatus according to any one of the preceding claims, characterized in that the edges (33-36) of the light guide body (19) are largely kept free of partitions (23) and the illuminants (18) emit a bright light over the partition-free edges (33-36) as background lighting into the edges (33-36) for homogeneous illumination of the light guide body (19) or the light guide zones (24-30).

5. The display apparatus according to claim 4, characterized in that light sources (18) having different color are disposed on the edges (33-36) of the light guide plate (21) and that respectively one light guide zone (24-30) that can be illuminated from one edge (33-36) is illuminated by one of the light sources (18).

6. The display apparatus according to any one of claims 2 to 5, characterized in that the rear side (32) of the light guide plate (21) comprises a reflection layer or a reflection film (37) or a light box (49) for supporting a total reflection of the light coupled into the light guide zones (24 to 30).

7. The display apparatus according to any one of claims 2 to 6, characterized in that the rear side (32) of the light guide plate (21) has reflection-layer-free areas (38, 39) to light guide zones (24-30), wherein differently colored light can be coupled into the light guide zones (24-30) via the reflection-layer-free areas (38, 39).

8. The display apparatus according to any one of the preceding claims, characterized in that the display screen (1) comprises a structured optically opaque film (40), wherein the film (40) has structured transparent openings (41-47) for the illuminated characters (11-17).

9. The display apparatus according to any one of the preceding claims, characterized in that the display screen (8) is formed by a structured optically opaque layer (10), wherein the layer (10) is applied to the upper side (31) of the light guide body (19) and has structured transparent openings (41-47) for the illuminated characters (11-17).

10. The display apparatus according to any one of the preceding claims, characterized in that the display screen (8) comprises an LCD screen (48).

11. The display apparatus according to any one of the preceding claims, characterized in that the transparent plastic compound (22) comprises light-absorbing spots or light-reflecting spots, which contact one another in the vertical direction through the light guide body (19) and/or overlap one another.

12. The display apparatus according to any one of the preceding claims, characterized in that the partitions (23) are composed of burn-in spots, which contact and/or overlap one another in the vertical direction.

13. The display apparatus according to claim 12, characterized in that the burn-in spots comprise agglomerates of carbon precipitates of the transparent plastic compound.

14. A method for manufacturing a display apparatus (1-5) of a vehicle (7), wherein the display apparatus is illuminated indirectly by means of a light guide body (19) and the method comprises the process steps:

- manufacturing a plate of a light guide material for a plurality of light guide bodies (19) for display apparatuses (1-5);
- introducing optically shielding partitions (23) into the light guide bodies (19) to form light guide zones (24-30);
- dividing the plate of light guide material into individual light guide bodies (19) which are adapted to the size and shape of a display screen (8);
- assembling the display apparatus (1-5) comprising display screen (8) and background lighting with light guide zones (24-30) of a light guide body (19) optically shielded from one another by introduced optically shielding partitions (23) by installing the light guide body (19) and illuminants (18) for different-colored illumination of the light guide zones (24-30) of the light guide body 19) into a light box (49).

15. The method according to claim 14, characterized in that the introduction of the optically shielding partitions (23) is executed by means of a three-dimensional laser scanner (50) in such a manner that light-absorbing spots or light-reflecting spots are formed in a transparent plastic compound (22), which contact one another and/or overlap one another in the vertical direction through the light guide body (19).

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2010/001447

A. CLASSIFICATION OF SUBJECT MATTER
INV. G02B6/00 B60Q1/00 G09F13/18
ADD.

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G02B B60Q G09F G09G

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

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	KR 2008 0105873 A (SAMSUNG ELECTRONICS CO LTD [KR]) 4 December 2008 (2008-12-04) the whole document	1-15
Y	US 2008/297894 A1 (KIM DAE IL [US] ET AL) 4 December 2008 (2008-12-04) paragraphs [0056] - [0093]; figures 3-9,13,14	1-15
Y	EP 1 992 870 A2 (ROHM & HAAS DENMARK FINANCE AS [DK]) 19 November 2008 (2008-11-19) paragraphs [0075] - [0078]; figures 3,4	1-15

-/--

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
15 June 2010	22/06/2010

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Fax: (+31–70) 340–3016	Wolf, Steffen

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2010/001447

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 2005/093477 A1 (ALBIS PLASTIC GMBH [DE]; FLEHINGHAUS MICHAEL [DE]; TEITGE ANDREAS [DE]) 6 October 2005 (2005-10-06) page 1, line 22 - page 12, line 22; figure 1	8,9
A	US 2008/074902 A1 (OH JEONG SEOK [KR] ET AL) 27 March 2008 (2008-03-27) paragraphs [0059] - [0062]; figures 8,9	1-15
A	EP 1 840 626 A1 (GM GLOBAL TECH OPERATIONS INC [US]) 3 October 2007 (2007-10-03) paragraphs [0026] - [0037]; figure 4	1-15
A	US 2007/188677 A1 (SOUK JUN-HYUNG [KR] ET AL) 16 August 2007 (2007-08-16) paragraphs [0011] - [0063]; figures 1,2	1-15

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2010/001447

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
KR 20080105873 A	04-12-2008	NONE	
US 2008297894 A1	04-12-2008	EP 2051116 A2	22-04-2009
		KR 20080104475 A	03-12-2008
EP 1992870 A2	19-11-2008	CN 101349400 A	21-01-2009
		JP 2009043706 A	26-02-2009
		KR 20080101802 A	21-11-2008
		US 2008285310 A1	20-11-2008
WO 2005093477 A1	06-10-2005	AT 422061 T	15-02-2009
		CN 1950734 A	18-04-2007
		DE 102004015293 B3	08-12-2005
		DE 202004021432 U1	21-02-2008
		DK 1733263 T3	18-05-2009
		EP 1733263 A1	20-12-2006
		ES 2324225 T3	03-08-2009
		JP 2007530358 T	01-11-2007
		PT 1733263 E	05-05-2009
		SI 1733263 T1	30-06-2009
		US 2007159837 A1	12-07-2007
US 2008074902 A1	27-03-2008	KR 20080027599 A	28-03-2008
EP 1840626 A1	03-10-2007	DE 102006014394 A1	11-10-2007
		US 2007274102 A1	29-11-2007
US 2007188677 A1	16-08-2007	KR 20070081564 A	17-08-2007