

Description

Field of the invention

[0001] The present invention relates to a lighting device comprising a fitting and a plurality of lighting modules which can be mounted therein. The invention likewise relates to a fitting for use in such a device and to a lighting module for use in such a device.

Background

[0002] Lighting devices of the type described in the preamble, such as so-called track lighting, where lighting modules can be mounted in a rail or track, are known. Such lighting devices are limited in respect of the design of the fitting (typically a straight profile). Such lighting devices further often have the drawback that the electrically conductive tracks in the fitting are clearly visible or that complex solutions are necessary in order to make them less visible.

Summary

[0003] The present invention has for its object to provide a lighting device which is simple and robust, which allows the fitting of the lighting device to take many different forms, and which allows modular use.

[0004] The lighting device has for this purpose the features of claim 1. The lighting device comprises a fitting and one or more lighting modules which can be mounted therein. The fitting comprises a profile and a carrier. The carrier has an inner side and an outer side. The inner side is mounted against the profile. The outer side is provided with at least one first electrically conductive track of a first material. Each first electrically conductive track is covered (coated) with a second electrically conductive track which is manufactured from a second material. The one or more lighting modules each comprise a light source and at least one electrical contact element connected thereto. The one or more lighting modules can be coupled to the fitting such that the at least one electrical contact element makes contact with the at least one second electrically conductive track. The first material has a greater electrical conductivity than the second material.

[0005] By using a flexible carrier, this carrier can be mounted on or in different types of fitting, wherein the profile of the fitting may optionally have a curvature. By providing a second electrically conductive track on the first electrically conductive track, wherein the second electrically conductive track can be manufactured from a second material with a lower conductivity, this second track can be given a colour which is not very noticeable on the profile. The invention is based inter alia on the insight that the conductivity of the second electrically conductive track only makes a substantial contribution over a limited length, i.e. there where the contact element makes contact with the second electrically conductive

track. This is because the resistance between two lighting modules will be substantially determined by the first electrically conductive track with the highest conductivity. On the other hand, the class of materials with a lower conductivity allows for the colour of the second material to be chosen from a much wider range of colours, and the second electrically conductive track can thus be given a suitable colour in accordance with the desired colour of the profile.

[0006] Advantageous embodiments of the lighting device are described in the dependent claims.

[0007] The first material is preferably a metal or a metal alloy, typically copper. The first conductive track can thus be a standard copper track on a flexible PCB.

[0008] The second material preferably comprises a binder such as a paint or an ink, and electrically conductive particles such as graphite. The second material can for instance be one of the following: an electrically conductive paint or varnish; an electrically conductive ink; an electrically conductive coating. The second electrically conductive track is for instance a printed, sprayed or dispersed electrically conductive flexible layer.

[0009] The surface resistance of the second electrical track is preferably smaller than 100 ohm/square, still more preferably smaller than 80 ohm/square and most preferably smaller than 60 ohm/square. The surface resistance is measured with a four-point probe measurement at 20°C. The contact resistance is preferably smaller than 6 ohm, still more preferably smaller than 5 ohm and most preferably smaller than 4 ohm. The second electrical track is for instance an electrically conductive graphite layer.

[0010] The thickness of the second electrical track is preferably smaller than 1.0 mm, preferably smaller than 0.5 mm, more preferably smaller than 0.1 mm.

[0011] In an advantageous embodiment the carrier and the at least one first electrically conductive track form part of a flexible PCB. This track can then be covered with the second material in simple manner for the purpose of forming the second electrically conductive track.

[0012] In an advantageous embodiment the profile has a curvature with a radius of curvature R lying between 5 cm and 5 m, preferably between 10 cm and 2.5 m, still more preferably between 20 cm and 1.5 m. The profile can describe a line or arcuate segment or a closed periphery. When a closed periphery is described, the at least one first and second electrically conductive track is preferably arranged along at least 70% of the periphery of the profile, more preferably along at least 90% of the periphery of the profile, still more preferably along the whole periphery of the profile.

[0013] According to another variant, the profile is elongate with a length. The at least one first and second electrically conductive track is then preferably arranged along at least 70% of the length of the profile, more preferably along at least 90% of the length of the profile, still more preferably along substantially the whole length of the profile.

[0014] According to a preferred embodiment, the profile has at least on the side on which the carrier is arranged a colour corresponding substantially to the colour of the at least one second electrically conductive track. The whole surface of the profile preferably has a colour corresponding substantially to the colour of the at least one second electrically conductive track. More particularly, the colour difference expressed in R,G,B values is preferably no more than 20%, i.e. the difference in R value is preferably no greater than 20%, the difference in G value no greater than 20%, and the difference in B value no greater than 20%.

[0015] When a graphite layer is used for the second electrically conductive track, the profile preferably has at least on the side on which the carrier is arranged a colour with R,G,B values in the following range: R value between 00 and 90; G value between 00 and 90; B value between 00 and 90; wherein preferably at least one of the R value, the G value and the B value is smaller than 50, still more preferably smaller than 30.

[0016] In an advantageous embodiment the carrier is mounted on the profile by means of an adhesive layer such as a double-sided adhesive tape.

[0017] In an advantageous embodiment the plurality of lighting modules each comprise: a housing with an opening or light-transmitting part; and a PCB mounted in the housing, wherein the at least one contact element and the light source connected thereto are mounted on opposite sides of this PCB, and the light source is mounted so as to emit light through the opening or the light-transmitting part in the housing. This PCB can optionally be a flexible PCB. In a further developed embodiment the flexible PCB can be mounted on a curved surface with a curvature corresponding to the curvature of the profile, such that the contact elements can connect properly to the second electrically conductive track.

[0018] In an advantageous embodiment the housing of the lighting module takes the form of a holder with an open side in which or against which the PCB is mounted, wherein the opening or the light-transmitting part is provided in a wall of the holder lying opposite the open side.

[0019] In an advantageous embodiment the profile is an optionally curved channel-like profile, and the lighting modules are dimensioned to be received in the channel-like profile. The lighting modules are preferably configured to be received removably and/or slidably in the channel-like profile.

[0020] The invention further relates to a light fitting for use in a lighting device according to any of the above described embodiments, and a lighting module for use in any of the above described embodiments.

Brief description of the figures

[0021] The present invention will be further elucidated on the basis of a number of by no means limitative exemplary embodiments of assemblies according to the invention with reference to the accompanying drawings,

in which:

Figure 1A illustrates a schematic view of a first embodiment of a lighting device according to the invention;

Figure 1B illustrates a detail of the view of part 1B in figure 1A;

Figure 1C illustrates a perspective detail view of part 1B in figure 1A;

Figure 1D shows schematically a section along D-D of the lighting device of figure 1C;

Figures 2A and 2B illustrate respective cut-away perspective views of a first embodiment of a lighting module, as seen from a front side and a rear side;

Figure 3 illustrates schematically a cross-section of a second embodiment of a lighting module;

Figures 4A-4C illustrate schematic views of three variants of a fitting of a lighting module according to the invention.

Detailed description of exemplary embodiments

[0022] Figures 1A-1D illustrate a first embodiment of a lighting device according to the invention. The lighting device comprises a fitting 100 and one or more lighting modules 200 which can be mounted therein. Fitting 100 comprises a profile 110 on which a carrier 120 is mounted. In this embodiment profile 110 is annular and has a substantially U-shaped cross-section, with an open side which is directed inward. Carrier 120, for instance a flexible PCB, is mounted against an inner side 111 of profile 110. In the embodiment of figure 1A three lighting modules 200 are mounted in fitting 100.

[0023] Carrier 120 has an inner side 121 and an outer side 122. The inner side 121 of the carrier is mounted against profile 110. The outer side 122 is provided with two first electrically conductive tracks 140a, 140b of a first material with good conductivity, preferably a metal or a metal alloy, and typically copper. Each first electrically conductive track 140a, 140b is covered with a second electrically conductive track 130a, 130b which is manufactured from a second material. The first material has a greater electrical conductivity than the second material. The second material is preferably a material with a suitable colour. The second material comprises for instance a binder and electrically conductive particles or components. Carrier 120 and the at least one first electrically conductive track 140a; 140b can form part of a flexible PCB. Carrier 120 is for instance mounted on profile 110 by means of a double-sided adhesive tape 150. Provided on carrier 120 between electrically conductive layer 130a and electrically conductive layer 130b is an insulating layer 160 which preferably has substantially the same colour as electrically conductive layer 130a and electrically conductive layer 130b.

[0024] The second material is for instance one of the following materials or a combination thereof: an electrically conductive paint or varnish; an electrically conduc-

tive ink; an electrically conductive coating; an electrically conductive plastic material such as an electrically conductive polymer material. In a preferred embodiment which is particularly suitable for relatively dark profiles 111, and particularly black profiles 111, the second material is a graphite material, such as an electrically conductive graphite paint or varnish; an electrically conductive graphite ink; an electrically conductive graphite coating. The second electrically conductive track 130a; 130b is for instance a printed, sprayed or dispersed electrically conductive flexible layer.

[0025] The one or more lighting modules 200 each comprise a light source 210 and at least one electrical contact element 220a, 220b connected thereto. In the illustrated variant, see figure 1D and figure 2A, two resilient electrical contact elements 220a, 220a'; 220b, 220b' are provided for each second electrically conductive track 130a, 130b. The skilled person will appreciate that it is also possible to provide one or more than two contact elements per second electrically conductive track 130a, 130b. The one or more lighting modules 200 can be coupled to the fitting 100 such that contact elements 220a, 220a' make contact with the second electrically conductive track 130a and that contact elements 220b, 220b' make contact with the second electrically conductive track 130b. In order to further improve the contact the contact elements 220a, 220a'; 220b, 220b' can take a resilient form. Contact elements 220a, 220a' are connected to an electrically conductive track 245a on PCB 240, this being connected via one or more feedthroughs 246a to a connection of light source 210. Contact elements 220b, 220b' are connected to an electrically conductive track 245b on PCB 240, this being connected via one or more feedthroughs 246b to another connection of light source 210. In this way light source 210 can thus be fed via the first and second electrically conductive tracks 130a, 140a; 130b, 140b, the electrically conductive tracks 245a, 245b and the contact elements 220a, 220a'; 220b, 220b'. Additional conductive tracks which are optionally carried through opening 235 to a position outside housing 230 can optionally be provided on side 242 of PCB 240 so that light source 210 can be placed at a distance from wall 232.

[0026] Profile 110 preferably has a curvature with a radius of curvature R lying between 5 cm and 5 m, more preferably between 10 cm and 2.5 m, still more preferably between 20 cm and 1.5 m. Carrier 120 with the first and second electrically conductive layers 130a, 130b; 140a, 140b take a flexible form such that carrier 120 can be given the necessary curvature.

[0027] Profile 110 describes a closed periphery, and the at least one first and second electrically conductive track 130a; 130b is preferably arranged along at least 70% of the periphery of profile 110, preferably along at least 90% of the periphery of the profile, still more preferably along the whole periphery of the profile as shown in figure 1A.

[0028] Profile 110 preferably has at least on the side

111 on which the carrier is arranged a colour corresponding substantially to the colour of the at least one second electrically conductive track 130a; 130b. When a graphite layer is for instance used for the second electrically conductive track 130a, 130b, profile 110 preferably has at least on the side 111 on which the carrier is arranged a colour with R,G,B values in the following range: R value between 00 and 90; G value between 00 and 90; B value between 00 and 90; wherein preferably at least one of the R value, the G value and the B value is smaller than 50, still more preferably smaller than 30. When a conductive polymer or a conductive paint is used, many different colours can be chosen for the second electrically conductive layer 130a, 130b, and a colour can thus be chosen which corresponds to the colour of profile 110.

[0029] The skilled person will appreciate that, instead of two first and second electrically conductive tracks, it is also possible to provide three or more first and second electrically conductive tracks on carrier 120.

[0030] An embodiment of a lighting module is shown in detail in figures 2A-2B. Lighting module 200 comprises a housing 230 with an opening 235 and a PCB 240 mounted in housing 230. Contact elements 220a, 220a'; 220b, 220b' and the light source 210 connected thereto are mounted on opposite sides 241, 242 of this PCB 240, and light source 210 is mounted so as to emit light through the opening 235 in housing 230. Housing 230 of lighting module 200 takes the form of a holder with an open side 231 in which or against which the PCB 240 is mounted. Holder 230 has a bottom wall 232 and four upright side walls 233, 234. Opening 235 is provided in the wall 232 lying opposite the open side 231. The side 242 on which light source 210 is mounted is directed toward the interior of holder 230, and the side 241 on which contact elements 220a, 220a'; 220b, 220b' are mounted is directed toward the area outside holder 230. Lighting module 200 is configured to be received removably and/or slidably in the channel-like profile 110. The edge 236 of side walls 233 can have a curvature corresponding to the curvature of profile 110, such that holder 230 can connect properly to the inner side 111 of profile 110. Further provided in side walls 233 are recesses 237 through which tiltable arms 238 are movable. Tiltable arms 238 can be adjusted to protrude to greater or lesser extent from recesses 237 for the purpose of fixing/removing lighting module 200 in/from profile 110. A handle 250 which is connected to tiltable arms 238 in order to rotate tiltable arms 238 can further be provided.

[0031] Figure 3 illustrates a second embodiment of a fitting 100 with a profile 110 on which two carriers 120a, 120b are mounted at a mutual distance. Profile 110 can be annular or straight, and has a substantially U-shaped cross-section, with an open side. Each carrier 120a, 120b is mounted against an inner side 111 of profile 110, wherein the inner side 111 lies opposite the open side. Each carrier 120a, 120b has an inner side which is mounted by means of an adhesive layer 150a, 150b against profile 110. The outer side of carrier 120a, 120b is pro-

vided with a first electrically conductive track 140a, 140b of a first material with good conductivity, preferably a metal or a metal alloy, and typically copper. The first electrically conductive track 140a, 140b is covered with a second electrically conductive track 130a, 130b which is manufactured from a second material. The first material has a greater electrical conductivity than the second material, and these materials can be chosen as described above for the variant of figures 1A-1D. The carrier 120a, 120b and the associated first electrically conductive track 140a, 140b can form part of a flexible PCB.

[0032] The skilled person will appreciate that, instead of two carriers 120a, 120b, it is also possible to provide three or more carriers with associated electrical tracks on profile 110. It is further also possible to provide only one carrier 120a on profile 110, wherein profile 110 itself can function as second conductor. In such an embodiment a lighting module 200 will be provided with at least one contact element which makes contact with the second conductive track on carrier 120a, and with at least one additional contact element which makes contact with profile 110 itself.

[0033] Figures 4A-4C illustrate different variants of fitting 100. In the variant of figure 4A profile 110 is elongate and has a length L. Carrier 120 with a first and second electrically conductive track 130, 140 is preferably arranged along at least 70% of the length L of profile 110, preferably along at least 90% of the length L of profile 110, still more preferably along substantially the whole length L of profile 110. In the drawn variant the profile has a U-shaped cross-section. It is however also possible to give the profile for instance an H-shaped cross-section, wherein a carrier 120 with a first and second electrically conductive track 130, 140 can then be provided on either side of the central wall of the profile.

[0034] In the variant of figure 4B profile 110 describes a circular arc. Carrier 120 with a first and second electrically conductive track 130, 140 is preferably arranged along at least 70% of the length L of profile 110, preferably along at least 90% of the length L of profile 110, still more preferably along substantially the whole length L of profile 110. In the drawn variant the profile has a U-shaped cross-section, but the skilled person will appreciate that the cross-section can also be H-shaped, as described above. Figure 4C shows yet another variant with a curved profile 110 which describes an S shape. Profile 110 has an H-shaped cross-section here, and a carrier 120; 120' with respective first and second electrically conductive tracks 130, 140; 130', 140' is provided on either side of central wall 111 of profile 110.

[0035] The skilled person will appreciate that many modifications and variants can be envisaged within the scope of the invention, which is defined solely by the following claims.

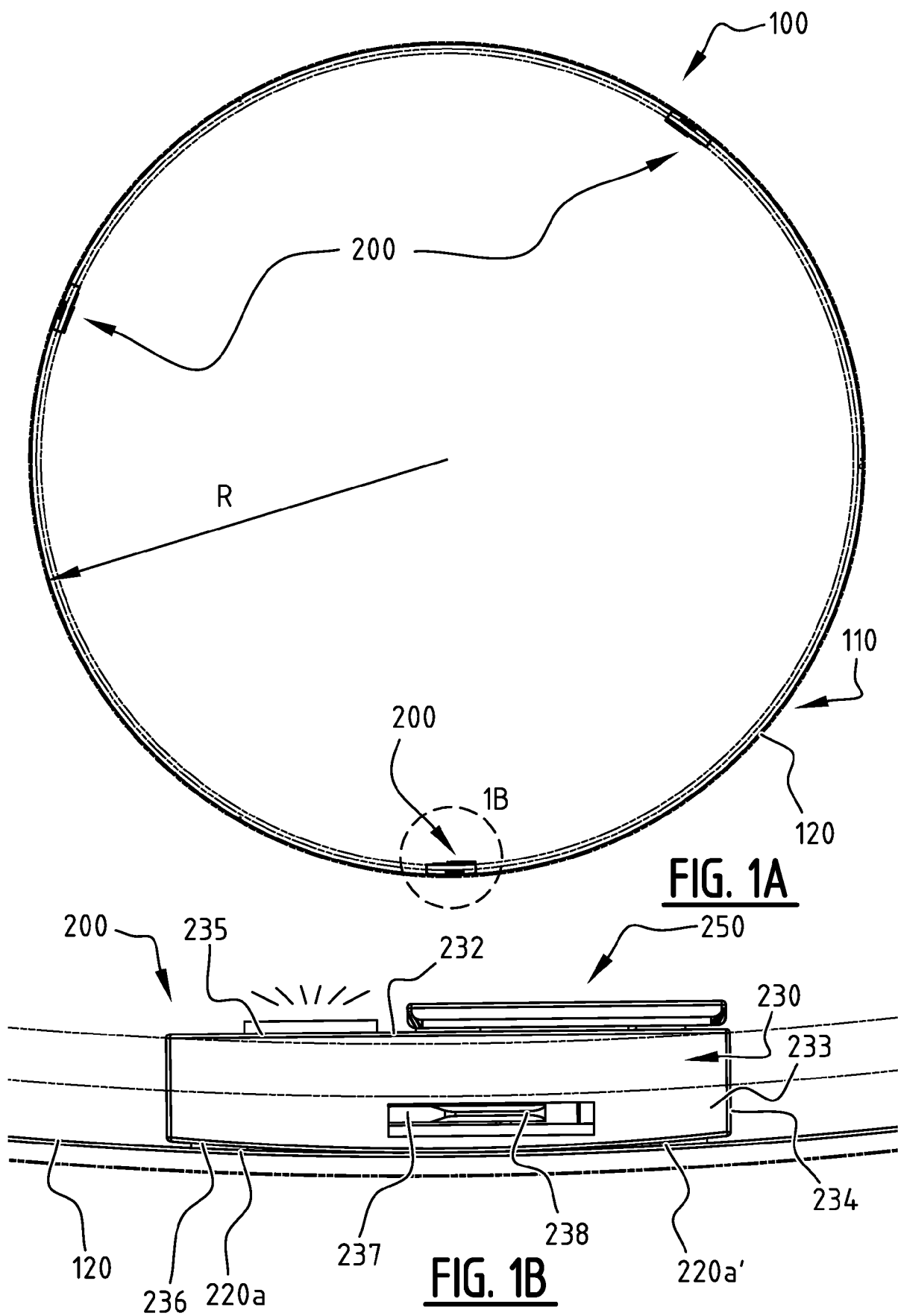
Claims

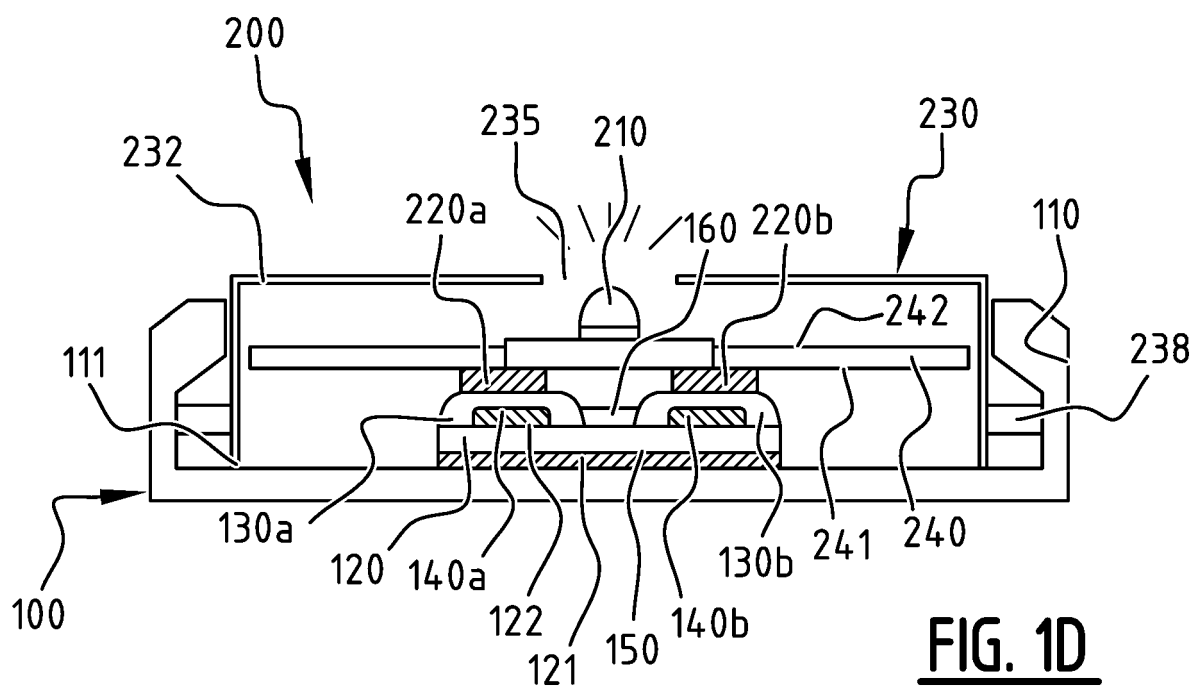
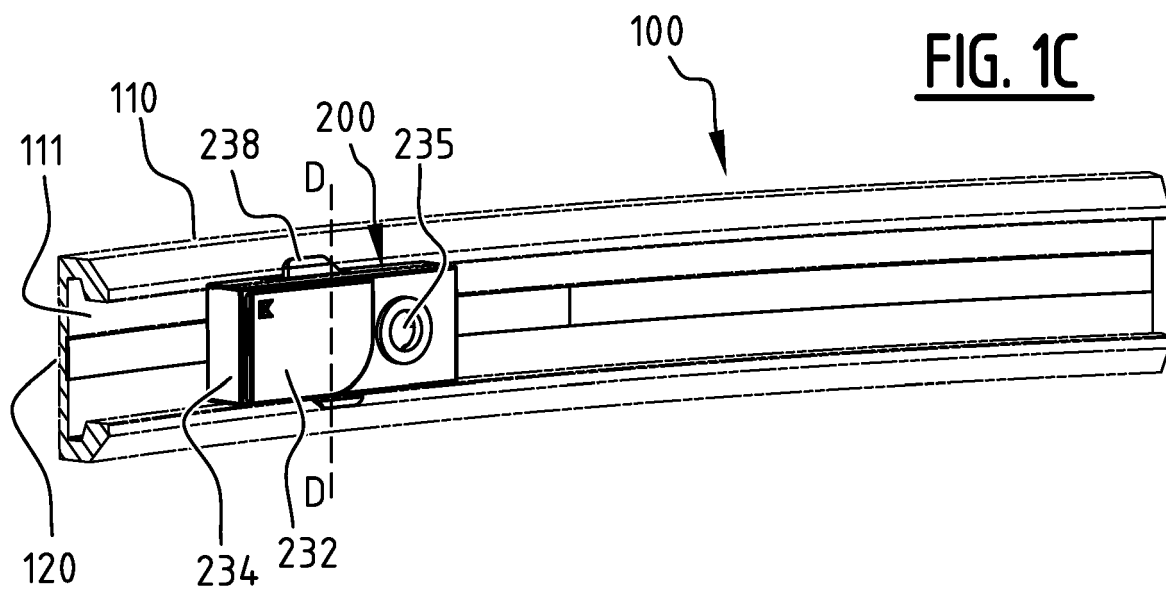
1. Lighting device comprising a fitting (100) and one or more lighting modules (200) which can be mounted therein; wherein the fitting (100) comprises a profile (110) and a carrier (120); wherein the carrier (120) has an inner side (121) and an outer side (122), wherein the inner side (121) is mounted against the profile (110); wherein the outer side (122) is provided with at least one first electrically conductive track (140a; 140b) of a first material and each first electrically conductive track is covered with a second electrically conductive track (130a; 130b) which is manufactured from a second material; wherein the one or more lighting modules (200) each comprise a light source (210) and at least one electrical contact element (220a; 220b) connected thereto; wherein the one or more lighting modules (200) can be coupled to the fitting (100) such that the at least one electrical contact element (220a; 220b) makes contact with the at least one second electrically conductive track (130a; 130b); wherein the first material has a greater electrical conductivity than the second material at 20°C.
2. Lighting device according to claim 1, wherein the first material is a metal or a metal alloy.
3. Lighting device according to claim 1 or 2, wherein the second material comprises a binder and electrically conductive particles.
4. Lighting device according to any of the foregoing claims, wherein the second material is a graphite material.
5. Lighting device according to any of the foregoing claims, wherein the surface resistance of the second electrically conductive track is smaller than 100 ohm/square, preferably smaller than 80 ohm/square and more preferably smaller than 60 ohm/square.
6. Lighting device according to any of the foregoing claims, wherein the second material is one of the following: an electrically conductive paint or varnish; an electrically conductive ink; an electrically conductive coating.
7. Lighting device according to any of the foregoing claims, wherein the second electrically conductive track (130a; 130b) is a printed, sprayed or dispersed electrically conductive flexible layer.
8. Lighting device according to any of the foregoing claims, wherein the carrier and the at least one first electrically conductive track form part of a flexible PCB.

9. Lighting device according to any of the foregoing claims, wherein the profile (110) has a curvature, and the carrier (120) with at least one first electrically conductive track (140a; 140b) and with at least one second electrically conductive track (130a; 130b) is flexible such that it can be bent against the profile and follows the curve. 5
10. Lighting device according to any of the foregoing claims, wherein the profile (110) has a radius of curvature (R) lying between 5 cm and 5 m, preferably between 10 cm and 2.5 m, still more preferably between 20 cm and 1.5 m. 10
11. Lighting device according to any of the foregoing claims, wherein the profile (110) describes a closed periphery and wherein the at least one first and second electrically conductive track (130a; 130b) is arranged along at least 70% of the periphery of the profile (110), preferably along at least 90% of the periphery of the profile, still more preferably along the whole periphery of the profile. 15 20
12. Lighting device according to any of the foregoing claims, wherein the profile is elongate and has a length, and wherein the at least one first and second electrically conductive track (130a; 130b) is arranged along at least 70% of the length (L) of the profile (110), preferably along at least 90% of the length of the profile, still more preferably along substantially the whole length of the profile. 25 30
13. Lighting device according to any of the foregoing claims, wherein the profile (110) has at least on the side (111) on which the carrier is arranged a colour corresponding substantially to the colour of the at least one second electrically conductive track (130a; 130b) and/or wherein the profile (110) has at least on the side (111) on which the carrier is arranged a colour with R,G,B values in the following range: 35 40
- R value between 00 and 90;
G value between 00 and 90;
B value between 00 and 90;
wherein preferably at least one of the R value, the G value and the B value is smaller than 50, still more preferably smaller than 30. 45
14. Lighting device according to any of the foregoing claims, wherein the carrier (120) is mounted on the profile (110) by means of a double-sided adhesive tape (150); and/or wherein the plurality of lighting modules (200) each comprise: 50
- a housing (230) with an opening or light-transmitting part (235); 55
a PCB (240) mounted in the housing, wherein the at least one contact element (220a; 220b)

and the light source (210) connected thereto are mounted on opposite sides (241, 242) of this PCB (240), and the light source (210) is mounted so as to emit light through the opening or the light-transmitting part (235) in the housing (230); and/or wherein the housing (230) of the lighting module (200) takes the form of a holder with an open side (231) in which or against which the PCB (240) is mounted, wherein the opening (235) or light-transmitting part is provided in a side (232) of the holder lying opposite the open side (231); and/or wherein the at least one contact element (220a, 220b) comprises at least one resilient element which makes contact by spring action with the at least one second electrically conductive track (130a; 130b); and/or wherein the profile (110) is an optionally curved channel-like profile, and wherein the lighting modules (200) are dimensioned to be received in the channel-like profile (110); and/or wherein the lighting modules (200) are configured to be received removably and/or slidably in the channel-like profile (110).

15. Light fitting for use in a lighting device according to any of the foregoing claims, wherein the fitting comprises a profile and a carrier; wherein the carrier has an inner side and an outer side; wherein the inner side is mounted against the profile; wherein the outer side (122) is provided with at least one first electrically conductive track (140a; 140b) of a first material and each first electrically conductive track is covered with a second electrically conductive track (130a; 130b) which is manufactured from a second material; wherein the at least one first and second electrically conductive track is intended to be connected to a power supply; wherein one or more lighting modules can be coupled to the fitting such that at least one electrical contact element of each lighting module makes contact with the at least one second electrically conductive track; wherein the first material has a greater electrical conductivity than the second material.





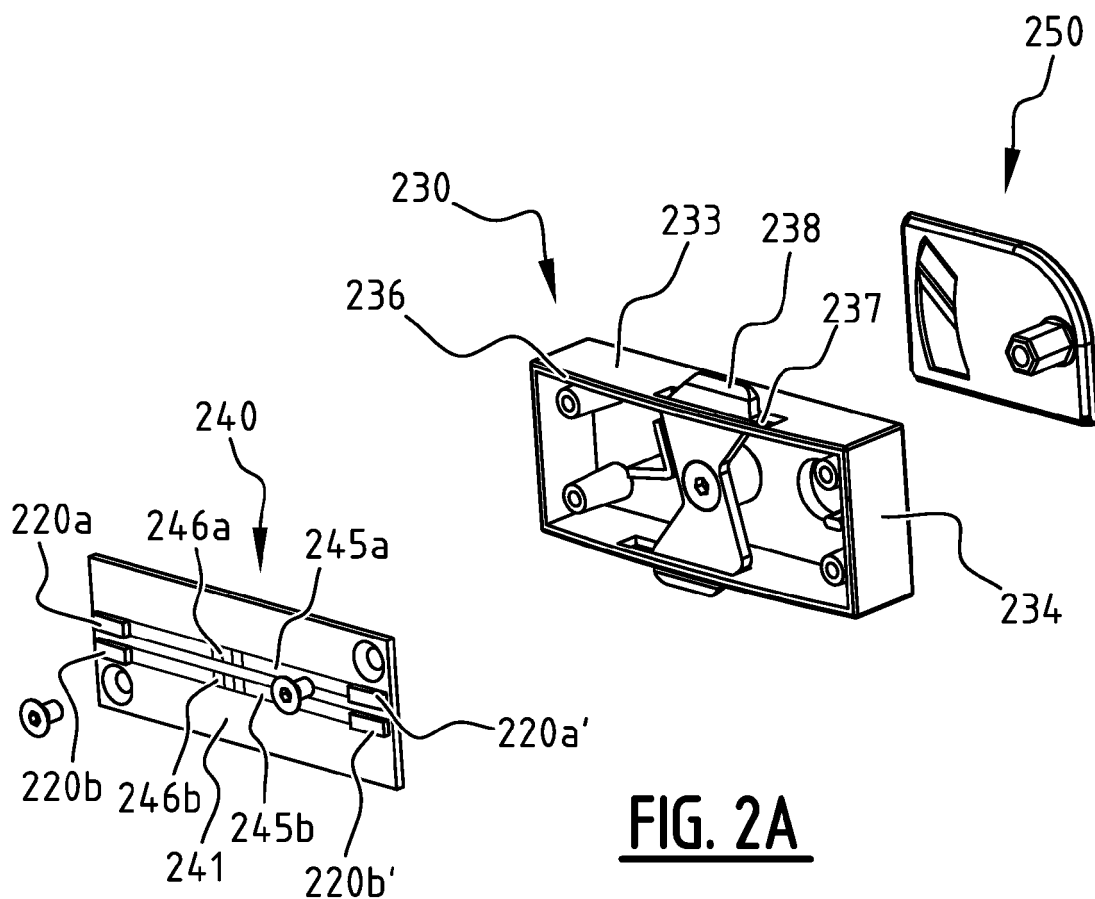


FIG. 2A

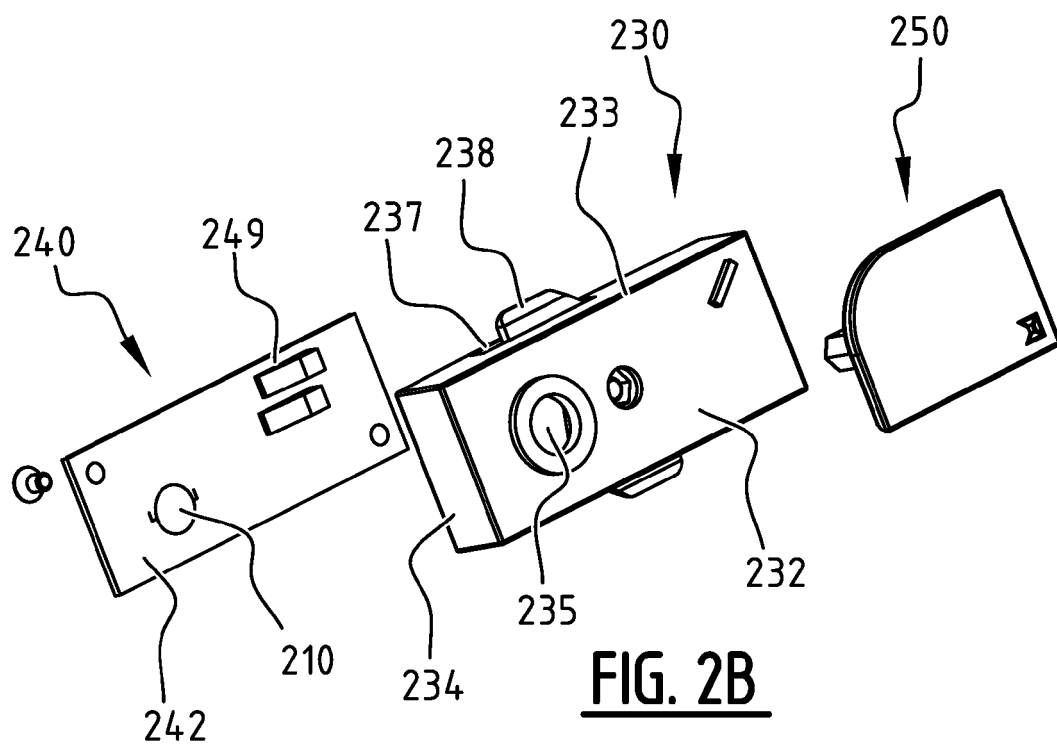


FIG. 2B

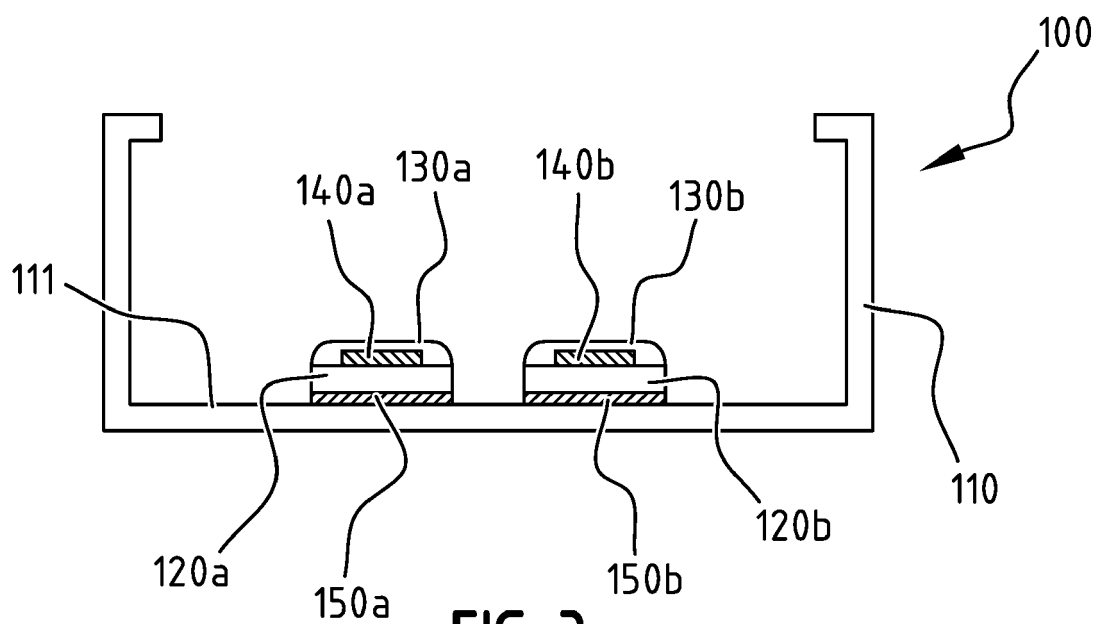


FIG. 3

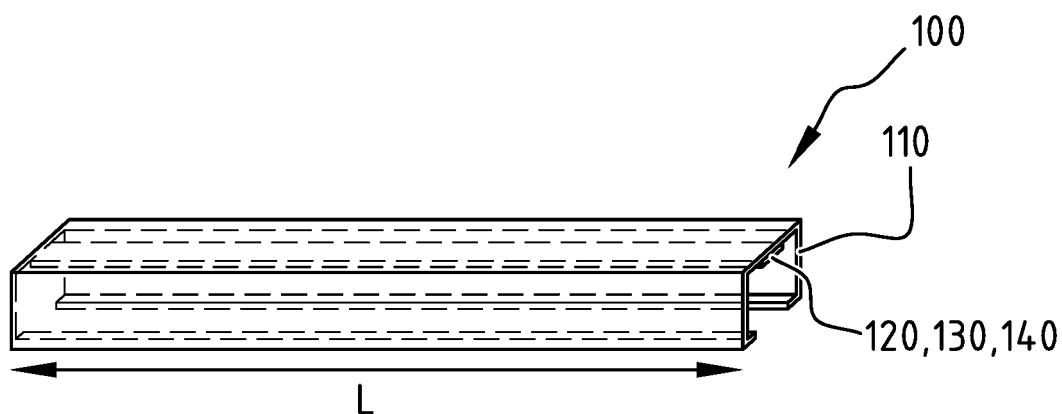


FIG. 4A

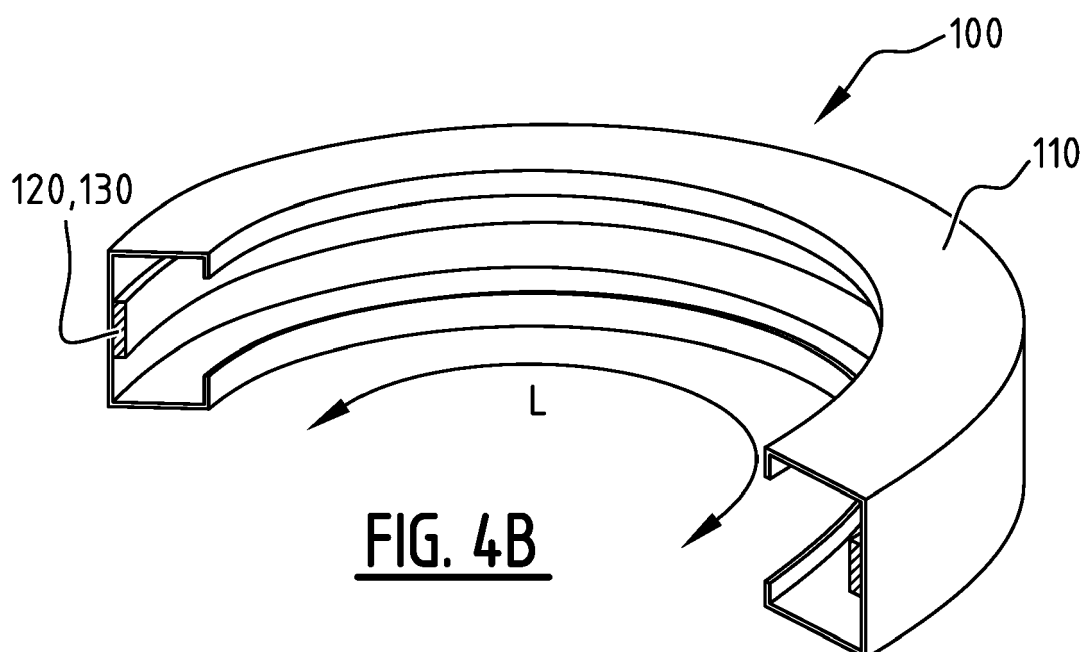


FIG. 4B

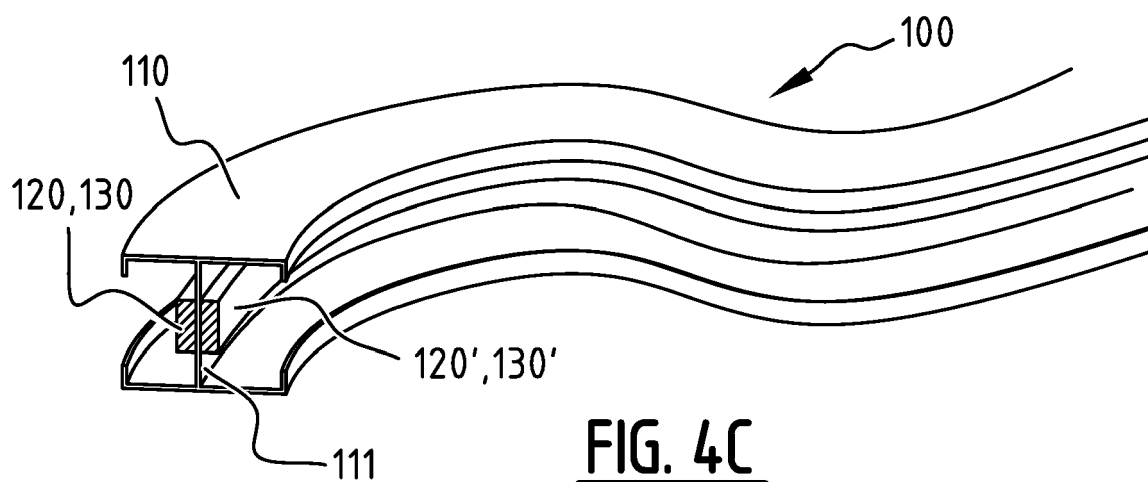


FIG. 4C



EUROPEAN SEARCH REPORT

Application Number
EP 18 16 2448

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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	US 2015/300613 A1 (ZADEREJ VICTOR [US] ET AL) 22 October 2015 (2015-10-22) * paragraph [0021] - paragraph [0031] * * figures 1-12 *	1-15	INV. F21V21/35 F21V23/00 F21S2/00
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			TECHNICAL FIELDS SEARCHED (IPC)
			F21V F21S F21Y
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 7 September 2018	Examiner Demirel, Mehmet
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			

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EPO FORM 1503 03.02 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 18 16 2448

5 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
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07-09-2018

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