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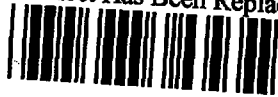
Lighting strip and method for production

The invention relates to a lighting strip having a multicore conductor strip which is fitted with LED elements which are arranged in a row one behind the other.

A lighting strip of the type mentioned above is disclosed in EP-0 669 492 A1. In the case of this known lighting strip, a conductor strip is provided which is composed of a so-called "Kaplan film". This is a plastic strip which is provided with a metal coating and in which the conductor tracks are exposed by etching away regions of the metal coating. Lighting means, called LED elements for short in the following text, are soldered onto this conductor strip at predetermined intervals. The production of the conductor strip is based on a relatively costly technology, requires a large number of process steps, and is dependent on the use of high-quality materials. Although, as a rule, the film strip which is provided with conductor tracks is provided with a coating, sealing problems have occurred in practice and it has been found that the film strip is difficult to lay, particularly in corner regions (risk of kinking), and is also highly sensitive to scratching.

Based on a lighting strip of the type mentioned initially, the invention relates to the object of equipping this lighting strip with a conductor strip which is intended to be simple and cost-effective to manufacture, assemble and install, and which can be characterized by high functional reliability.

The lighting strip which is intended to achieve this object and has a multicore conductor strip which is fitted with LED elements which are arranged in a row one behind the other, is distinguished according to the invention by the fact that the conductor strip is composed of a large number of conductor strip sections which



are cut to length and are arranged in a row in the axial direction, a printed circuit board is in each case arranged between two axially adjacent conductor strip sections and is electrically conductively connected to them, and in that each printed circuit board is fitted with an LED element.

These measures according to the invention provide a lighting strip having a conductor strip which can be manufactured and marketed considerably more economically than the known prior art. Laying of the conductor strip or illumination strip within the corresponding channels in the lighting strip is now simplified, particularly in the region of sharp corners.

The invention provides, in an preferred manner, in the case of the lighting strip according to the invention that the individual cores of the conductor strip are sheathed with insulation, that the insulation is removed at the end regions of each conductor strip section, and that the connection between the respective end of a conductor strip section and the respective printed circuit board is produced by electrically conductive contact elements, a crimped joint being provided in each case between the contact elements and the cores of the conductor strip section, and a rivetted joint being provided in each case between the contact elements and the conductor tracks on the printed circuit board. As trials have shown, an electrical connection between the stripped end regions of the conductors and the conductor tracks on the printed circuit board can be produced particularly easily and economically by means of metallic contact elements, and, in particular, above all by an extremely reliable process.

According to one particular development of the invention, the end regions of the conductor sections, the contact elements, the printed circuit boards and the LED elements are in each case encapsulated in a coloured plastic housing which leaves exposed only the light outlet side of the LED elements and is formed by direct overmoulding. This measure additionally protects the

electrical junction points but, above all, a reliable seal is achieved so that the lighting strip can be laid even in humid rooms or even under water, to be precise without any risk of a short circuit.

Another preferred refinement of the invention consists in that the end regions of the conductor strip sections, the contact elements, the printed circuit boards and the LED elements are in each case encapsulated in a plastic housing which is formed by direct over-moulding with a transparent plastic material, such as polycarbonate. In the case of this method, it is unnecessary to leave the light outlet side of the LED elements free. Furthermore, this allows a development to be achieved in that each plastic housing has, on the light outlet side of the LED elements, an integrally formed material attachment for fitting engagement in a cover of the lighting strip, which cover is provided with corresponding retaining openings. This makes it possible to provide a cover of a lighting strip from the start with openings, such as holes, which can be arranged in a row one behind the other, or else to re-equip already existing strips, such as skirting, staircase strips or the like, in that the covers of these strips are provided with any required hole pattern.

The invention provides various development measures in an effort to achieve economic manufacture of the conductor strip or illumination strip. A first measure provides that the conductor strip is composed of individual wires which each have insulation, while a second measure provides that the conductor strip is designed in the manner of a flexible ribbon cable. Commercially available wires or ribbon cable can be used in both cases, it being possible to lay these without any problems whatsoever, even at difficult junction points or in corner regions, because of their high flexibility.

Another refinement of the invention provides, instead of this, that the conductor strip is composed of an extruded, relatively dimensionally stable, profiled strip having wires incorporated in it. In this case, it

is now possible for the profiled strip to be designed as a clip-on strip and/or a stick-on strip. These measures are worthwhile with relatively rigid systems, and then provide the particular advantage that the conductor strips can be fitted or attached without any additional aids, and require no additional cover.

A further contribution to simplifying the fitting of the conductor strip results according to a refinement of the invention in that the plastic housing has an approximately rectangular contour with clip-on strips, clip-on tabs or the like, which are integrally formed on the longitudinal edges, for clip-on mounting of the conductor strip in a retaining channel which is designed within the lighting strip.

The lighting strip according to the invention is furthermore characterized in that the conductor strip is arranged in a retaining channel of a covering strip composed of opaque material, which covering strip has holes arranged one behind the other in a row for the LED elements to pass through, in that the conductor strip and the covering strip are a prefabricated flush-mounted unit for arrangement in a retaining channel in the lighting strip, and in that this flush-mounted unit is covered, and is held in the correct position, by a sealing profiled strip which likewise engages in the retaining channel, is in this case held in a force-fitting and/or positively-locking manner, and is composed of a transparent plastic material.

In the case of a lighting strip having a multi-core conductor strip which is fitted with LED elements which are arranged in a row one behind the other, the invention can also be implemented in that the conductor strip is composed of a copper strip whose cores are separated from one another by punched slots and cut-free sections, and in that the conductor strip, including the surface-mounted LED elements, resistors and the like, is surrounded by a flexible sheath profile which is extruded thereon and is formed from a transparent plastic material. Such a conductor strip or illumination strip

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provides absolute sealing, of course, which is alternatively provided in another embodiment according to the invention, according to which, in the case of a lighting strip having a multicore conductor strip which is fitted with LED elements which are arranged in a row one behind the other, it is provided that the conductor strip is composed of a plastic film strip, copper strips coated on to it and surface-mounted LED elements, resistors and the like, and of a flexible sheath profile which is extruded thereon and is formed from a transparent plastic material. In both cases, the flexible sheath profile can be equipped on the underneath with a double-sided adhesive tape, provided with a protective film, in order to make it easier to fit the conductor strip in the corresponding retaining channel in the lighting strip.

The lighting strip according to the invention can be designed, in particular, as a handrail, staircase, baggage compartment, skirting or escape route marking strip.

A method for manufacturing an insulated, multicore conductor strip having LED elements which are arranged in a row one behind the other, for a lighting strip, is characterized according to the invention in that a conductor strip of finite length is split into conductor strip sections of predetermined length, and in that those end regions of the conductor strip sections which are axially adjacent each have a printed circuit board connected to them, which printed circuit board is fitted with an LED element and, possibly, with a resistor. In this case, the operations of cutting a conductor strip section to length and of connecting a printed circuit board are in each case carried out intermittently.

In particular, a method is provided, with the following method steps, which are in each case repeated intermittently:

1. a conductor strip of finite length is drawn off a supply roll and is fed to a cutting station,
2. a conductor strip section of predetermined length is

cut to length from the conductor strip of finite length, and the conductor strip section is held firmly by a holding device,

3. the mutually adjacent end regions of the conductor strip and the conductor strip section are stripped of insulation,
4. the stripped end regions are positioned,
5. a printed circuit board which is fitted with at least one LED element is supplied,
6. an electrical connection is produced between the stripped end regions and the conductor tracks on the printed circuit board,
7. the conductor strip section which is connected via the printed circuit board to the conductor strip again is passed on to a spool drum.

Method steps two, three and four are preferably carried out simultaneously in the cutting station.

It is furthermore preferably provided that, between the sixth and the seventh method step, the printed circuit board is fed to an overmoulding station and, in the same way as the end regions of the conductors which are connected to the printed circuit board, is overmoulded here with a plasticized coloured plastic material, the light outlet side of the LED element being kept free of the overmoulding material. This measure is particularly advantageous with respect to precluding sealing problems and for lighting strips which are provided with a coloured cover which leaves only the light outlet side of the LED elements free.

Alternatively, it can advantageously be provided that between the sixth and the seventh method step, the printed circuit board is fed to an overmoulding station and, in the same way as the end regions of the conductors which are connected to the printed circuit board, is overmoulded here with a plasticized transparent plastic material. This measure is likewise particularly advantageous with respect to avoiding sealing problems and for lighting strips having a covering strip which has a row of holes.

It can furthermore be provided that the seventh method step is preceded by a method step in which the conductor strip is supplied with a flexible covering strip from a supply roll, and said flexible covering strip is connected to the conductor strip and/or to the printed circuit boards.

A measure which is particularly worthy of recommendation is that a functional test is carried out after the sixth method step and/or after each printed circuit board has been overmoulded.

Exemplary embodiments of the invention will be explained in more detail in the following text, and:

Fig. 1 shows a first embodiment of a lighting strip,

Fig. 2 shows a second embodiment of a lighting strip,

Fig. 3 shows a conductor strip having lighting means,

Figs. 4 - 6 show various embodiments of a conductor strip,

Fig. 7 shows a plan view of a connecting region between conductor strips and a printed circuit board,

Fig. 8 shows a section roughly along the line VIII - VIII in Fig. 7,

Fig. 9 shows a section roughly along the line IX - IX in Fig. 7,

Fig. 10 shows a section roughly along the line X - X in Fig. 7,

Fig. 11 shows a section through a printed circuit board - covering strip connection,

Fig. 12 shows a schematic illustration of the production method,

Figs. 13 - 15 show another embodiment of a conductor strip having lighting means, and

Figs. 16 - 17 show yet another embodiment of a conductor strip having lighting

means.

Fig. 1 shows a lighting strip for use as a floor strip 1. Alternatively, the lighting strip can be designed as a handrail, staircase, baggage compartment, skirting or escape route marking strip. The lighting strip is in general composed of aluminium or an aluminium alloy, but can, of course, also be manufactured from a plastic material. A multicore conductor strip 3, which is fitted with LED elements 4 which are arranged in a row one behind the other, is arranged in a retaining channel 2 in the lighting strip. The retaining channel 2 is closed at the top by a sealing profiled strip 5 composed of a transparent material. The sealing profiled strip 5 is composed, for example, of polycarbonate.

Fig. 2 shows a lighting strip for use as a skirting or wall strip 6. This strip also has a retaining channel 2 and a multicore conductor strip 3, which is fitted with LED elements 4 which are arranged in a row one behind the other. The skirting or wall strip 6 is in this case also composed of aluminium, an aluminium alloy or plastic, and this also applies to the sealing profiled strip 7, which is provided with openings 8 for light to emerge from.

Fig. 3 shows a multicore conductor strip 3, which is composed of a large number of conductor strip sections 9 which are cut to length and are arranged in a row in the axial direction and printed circuit boards 10 which are arranged between the conductor strip sections 9, are electrically conductively connected to said conductor strip sections 9 and are provided in a conventional manner with conductor tracks, which are not illustrated in more detail, for example in the manner of a printed circuit, said printed circuit boards 10 also being fitted with an LED element 4 connected to them, and possibly with a resistor 12 (cf. Fig. 7). The conductor strip 3 may have any required number of cores depending on the respectively desired type of illumination, such as permanent illumination or, possibly, moving light.

While the conductor strip 3 according to Fig. 3

is designed with five cores, the conductor strip 3 in Figs. 4 and 5 is composed of three cores in each case. In this case, as is shown in Fig. 4, the conductor strips 3 may be formed from individual wires 13 each having insulation or, as is shown in Fig. 4, like a flexible ribbon cable 14. In both cases, the conductor strip 3 is split into conductor strip sections 9, and their end regions are in each case connected to a printed circuit board 10 which is fitted with at least one LED element 4.

It is also possible to form a conductor strip 3 from an extruded, relatively dimensionally stable, profiled strip 15 having insulated or uninsulated conductor wires incorporated therein, and then to split it into conductor strip sections 9. This option, which is shown in Fig. 6, has the advantage that clip-on tabs 16 can be integrally formed on the conductor strip 3 for simple clip-on mounting of the conductor strip 3 in the retaining channel 2 in the respective lighting strip. Furthermore, the profiled strip 15 can be equipped on the bottom with a double-sided adhesive tape 17, so that the profiled strip 15 can be stuck to the bottom of the retaining channel 2 after a protective film 18 has been pulled off. Furthermore, in the example according to Fig. 6, profiled strip sections 15 and printed circuit boards 10 which are fitted with LED elements 4 alternate with one another.

Fig. 7 shows the cable assembly with a printed circuit board 10. The example shows three wires 13 of various colours, for example red for the positive terminal, black for the negative terminal and white for the neutral conductor, and these wires are electrically conductively connected to the printed circuit board 10. A ribbon cable 14 according to Fig. 5, or a profiled strip 15 according to Fig. 6, can also be provided instead of the individual wires 13 of each conductor strip section 9. In the example according to Fig. 7, the printed circuit board 10 is fitted with an LED element 4 and a resistor 12.

The cable assembly is preferably manufactured by

means of electrical contact elements 19, a crimped joint 20 being provided in each case - see also Fig. 8 - between the contact elements 19 and the cores of the wires 13, and a rivetted joint 21 being provided in each case between the contact elements 19 and the conductor tracks on the printed circuit board 10 - see also Fig. 9. The said joints 20, 21 can also clearly be seen in the longitudinal section illustration according to Fig. 10.

After the production of the cable assembly between a large number of conductor strip sections 9 and a large number of printed circuit boards 10 which are fitted with LED elements 4, this unit is mated with a covering strip 22 according to Fig. 11, in order to produce a simple embodiment of a lighting strip which does not require waterproof sealing of the electrical junction points. The covering strip 22 has a channel 24 which is constricted by latching tabs 23 and makes it possible to clip in the printed circuit board 10. The covering strip 22 furthermore has openings 25, which are arranged in a row one behind the other, for the LED elements 4 to pass through. The subject of Fig. 11 can now be introduced into a retaining channel 2 in, for example, a floor strip 1 and can be supported and held therein by the self-locking sealing profiled strip 5, as is shown in Fig. 1.

For lighting strips in which there must be no sealing problems, it is preferably provided that the end regions of the conductor strip sections 9, the contact elements 19, the printed circuit boards 10 and the LED elements 4 are in each case encapsulated in a coloured plastic housing 26 which leaves exposed only the light outlet side of the LED elements 4 and is formed by direct overmoulding. The plastic housing 26 is shown in Figs. 7 to 10, and can also be designed with integrally moulded clip-on strips 27 for a mounting arrangement in a covering strip 22 (see also Fig. 11).

The plastic housing 26 may also be composed of a transparent material and may also encapsulate the light outlet side of the LED elements 4 as well, it being

recommended that a material attachment, which is not illustrated in more detail, be integrally formed in each case on the light outlet sides of the individual LED elements 4, for fitting engagement in the retaining openings 8 in the sealing profiled strip 7 (Fig. 2).

A manufacturing apparatus, which is shown in a schematic illustration in Fig. 12, may be used to carry out the method for manufacturing an illumination strip for a lighting strip of the type illustrated by way of example in Figs. 1 and 2. In this case, a conductor strip 3 of finite length is drawn off a supply roll 30 and is fed to a cutting station 31. The cutting station 31 is equipped with tools which divide the conductor strip 3 into conductor strip sections 9 by cutting in each case, in order then to strip the insulation off the mutually adjacent end regions of the conductor strips 3 and the conductor strip section 9. The tools hold the stripped end regions firmly and move so far apart from one another that, in a feedstation 32, the contact elements 19 can firstly be forced against the stripped end regions in order to produce a crimped joint 20, and can be forced against the supplied printed circuit board 10 in order to produce a rivetted joint 21. Depending on the tool design, the cutting station 31 and the feed station 32 may physically coincide, or else be physically separated from one another. The respectively supplied printed circuit board 10 is equipped at least with a premounted LED element 4, and possibly also with a premounted resistor 12. The printed circuit board 10, which is electrically conductively connected to the cable ends, is transported onward, and is fed to an overmoulding station 33. In the overmoulding station 33, the printed circuit board 10 is then overmoulded, together with the contact elements 19 and the end regions of the conductors connected to the printed circuit board 10, with plasticized plastic material. If a coloured plastic material is used, the light outlet side of the LED element 4 is kept free of plastic material, while complete overmoulding and encapsulation are provided if a transparent, translucent

plastic material is to be used. The overmoulding station 33 is followed by an inspection station 34, in which a 100% light inspection is carried out. After the light inspection, a covering strip 22 is fed to the illumination strip from a supply roll 35. Latching takes place at the same time, for example with the clip-on strips 27 of the plastic housing 26. After this, the complete illumination strip is wound onto a magazine roll 26, and is kept ready for laying in the retaining channel 2 of a lighting strip. The overmoulding may be omitted in the case of illumination strips whose requirement profile with regard to sealing is less stringent, while the supply of a separate covering strip 22 can be dispensed with in the case of illumination strips having conductor strip sections 9 which are formed from profiled strips 15. The form of implementation for manufacturing a conductor strip 3 according to Figs. 13 to 15 is based on a stamped copper strip 40 having punched openings 41. LED elements 4 and, possibly, resistors 12 are connected in a conventional manner at predetermined intervals on the centre conductor, which is formed by the punched openings 41, of the copper strip 40, an intermittent flow method being envisaged. The unit prepared in this way is passed through a tool of an extrusion device and is sheathed here with a flexible sheath profile 42, which is composed of crystal-clear or transparent plastic material, the copper strip 40 actually being cut away in the regions 43 before sheathing, in order to separate the cores of the copper strip 40 from one another. The flexible sheath profile 42 is composed of a material which closely encloses the copper strip 40 and the lighting means and has shrinking characteristics. The illustration in Fig. 14 shows the conductor strip 3 before sheathing, and that in Fig. 15 after sheathing.

Figs. 16 and 17 show yet another form of implementation of the illumination strip. In this case, three or more copper strips 51 are coated on a film strip 50 and are fitted, such that they are electrically conductively connected, with LED elements 4 and,



possibly, resistors 12. The film strip 50 is subsequently sheathed, together with the copper strip 51 and the lighting means, with a flexible sheath profile 52 in an extrusion process, the flexible sheath profile 52 being composed of a transparent plastic material having shrinking characteristics.

With regard to the electrical circuits and the conductor routing, use is made of the prior art which is conventional to this extent, so that there is no need for any explanation relating to this. The same applies to the possible embodiments and refinements of the lighting strip as well as end, corner and cross-pieces. Reference should be made to the subject matter of EP 0 669 492 A1, mentioned initially, as an example for the configurations of the lighting strip.

The measures as per Claim 2, to make the connection between the ends of the strip section 9 and the printed circuit board 10 in each case by means of electrically conductive contact elements 19 and to provide a crimped joint 20 in each case between the contact elements 19 and a rivet connection 21 between the conductors of the strip section 9 and between the contact elements 19 and the conductor tracks of the circuit board 10, have proven to be advantageous. As trials have demonstrated, however, a particularly efficient, dependable and economical electrical connection between the ends of the strip section 9 and the printed circuit board 10 in each case can be made up by soldering, brazing or in particular by welding, with the advantage that the numbers of construction components and operations are reduced.



Claims:

1. Lighting strip having a multicore conductor strip (3) which is fitted with LED elements (4) which are arranged in a row one behind the other, characterized in that the conductor strip (3) is composed of a large number of conductor strip sections which are cut to length and are arranged in a row in the axial direction, a printed circuit board (10) is in each case arranged between two axially adjacent conductor strip sections (9) and is electrically conductively connected to them, and in that each printed circuit board (10) is fitted with an LED element (4).

2. Lighting strip according to Claim 1, characterized in that the individual cores of the conductor strip (3) are sheathed with insulation, in that the insulation is removed at the end regions of each conductor strip section (9), and in that the connection between the respective end of a conductor strip section (9) and the respective printed circuit board (10) is produced by electrically conductive contact elements (19), a crimped joint (20) being provided in each case between the contact elements (19) and the cores of the conductor strip section (9), and a rivetted joint (21) being provided in each case between the contact elements (19) and the conductor tracks on the printed circuit board (10).

3. Lighting strip according to Claim 1 or 2, characterized in that the end regions of the conductor strip sections (9), the contact elements (19), the printed circuit boards (10) and the LED elements (4) are in each case encapsulated in a coloured plastic housing (26) which leaves exposed only the light outlet side of the LED elements (4) and is formed by direct overmoulding.

4. Lighting strip according to Claim 1 or 2, characterized in that the end regions of the conductor strip sections (9), the contact elements (19), the printed circuit boards (10) and the LED elements (4) are in each case encapsulated in a plastic housing (26) which





is formed by direct overmoulding with a transparent plastic material, such as polycarbonate.

5. Lighting strip according to Claim 4, characterized in that each plastic housing (26) has, on the light outlet side of the LED elements (4), an integrally formed material attachment for fitting engagement in a cover (7) of the lighting strip, which cover (7) is provided with corresponding retaining openings (8).

6. Lighting strip according to at least one of Claims 1 to 5, characterized in that the conductor strip (3) is composed of individual wires (13) which each have insulation.

7. Lighting strip according to at least one of Claims 1 to 5, characterized in that the conductor strip (3) is designed in the manner of a flexible ribbon cable (14).

8. Lighting strip according to at least one of Claims 1 to 5, characterized in that the conductor strip (3) is composed of an extruded, relatively dimensionally stable, profiled strip (15) having wires incorporated in it.

9. Lighting strip according to Claim 8, characterized in that the profiled strip (15) is designed as a clip-on strip and/or a stick-on strip.

10. Lighting strip according to at least one of Claims 1 to 9, characterized in that the plastic housing (26) has an approximately rectangular contour with clip-on strips, clip-on tabs (16) or the like, which are integrally formed on the longitudinal edges, for clip-on mounting of the conductor strip (3) in a retaining channel (2) which is designed within the lighting strip.

11. Lighting strip according to one or more of the preceding claims, characterized in that the conductor strip (3) is arranged in a retaining channel (24) of a covering strip (22) composed of opaque material, which covering strip (22) has holes (25) arranged one behind the other in a row for the LED elements (4) to pass through, in that the conductor strip (3) and the covering strip (22) are a prefabricated flush-mounted unit for





arrangement in a retaining channel (2) in the lighting strip, and in that this flush-mounted unit is covered, and is held in the correct position, by a sealing profiled strip (5) which likewise engages in the retaining channel (2), is in this case held in a force-fitting and/or positively-locking manner, and is composed of a transparent plastic material.

12. Lighting strip having a multicore conductor strip (3) which is fitted with LED elements (4) which are arranged in a row one behind the other, characterized in that the conductor strip (3) is composed of a copper strip (40) whose cores are separated from one another by punched-slots and cut-free sections (41, 43), and in that the conductor strip (3), including the surface-mounted LED elements (4), resistors (12) and the like, is surrounded by a flexible sheath profile (42) which is extruded thereon and is formed from a transparent plastic material.

13. Lighting strip having a multicore conductor strip (3) which is fitted with LED elements (4) which are arranged in a row one behind the other, characterized in that the conductor strip (3) is composed of a film strip (50), copper strips (51) coated onto it and surface-mounted LED elements (4), resistors (12) and the like, and of a flexible sheath profile (52) which is extruded thereon and is formed from a transparent plastic material.

14. Lighting strip according to at least one of the preceding claims designed as handrail, staircase, baggage compartment, skirting or escape route marking strip.

15. Method for manufacturing an insulated multicore conductor strip (3) having LED elements (4), which are arranged in a row one behind the other, for a lighting strip, characterized in that a conductor strip (3) of finite length is split into conductor strip sections (9) of predetermined length, and in that those end regions of the conductor strip sections (9) which are axially adjacent each have a printed circuit board (10) connected to them, which printed circuit board is fitted with an





LED element (4) and, possibly, with a resistor (12).

16. Method according to Claim 15, characterized in that the operations of cutting a conductor strip section (9) to length and of connecting a printed circuit board (10) are in each case carried out intermittently.

17. Method according to Claims 15 and 16 with the following method steps, which are in each case repeated intermittently:

1. a conductor strip (3) of finite length is drawn off a supply roll (30) and is fed to a cutting station (31),
2. a conductor strip section (9) of predetermined length is cut to length from the conductor strip (3) of finite length, and the conductor strip section (9) is held firmly by a holding device,
3. the mutually adjacent end regions of the conductor strip (3) and the conductor strip section (9) are stripped of insulation,
4. the stripped end regions are positioned,
5. a printed circuit board (10) which is fitted with at least one LED element (4) is supplied,
6. an electrical connection is produced between the stripped end regions and the conductor tracks on the printed circuit board (10),
7. the conductor strip section (9) which is connected via the printed circuit board (10) to the conductor strip (3) again is passed on to a spool drum (36).

18. Method according to Claim 17, characterized in that method steps two, three and four are carried out simultaneously in the cutting station (31).

19. Method according to Claim 17 or 18, characterized in that, between the sixth and the seventh method step, the printed circuit board (10) is fed to an overmoulding station (33) and, in the same way as the end regions of the conductors which are connected to the printed circuit board (10), is overmoulded here with a plasticized coloured plastic material, the light outlet side of the LED element (4) being kept free of the overmoulding material.





20. Method according to Claim 17 or 18, characterized in that, between the sixth and the seventh method step, the printed circuit board (10) is fed to an overmoulding station and, in the same way as the end regions of the conductors which are connected to the printed circuit board (10), is overmoulded here with a plasticized transparent plastic material.

21. Method according to one or more of the preceding claims, characterized in that the seventh method step is preceded by a method step in which the conductor strip (3) is supplied with a flexible covering strip (22) from a supply roll (35), and said flexible covering strip (22) is connected to the conductor strip (3) and/or to the printed circuit boards (10).

22. Method according to one or more of the preceding claims, characterized in that a functional test is carried out after the sixth method step and/or after each printed circuit board (10) has been overmoulded.

23. In particular illumination strips corresponding to Claim 1, characterized by the individual conductors of the conductor strip (3) being jacketed with insulation, the insulation being removed at the ends of each strip section (9) and a soldered, brazed or welded connection being provided between the end of the strip section (9) and the conductor tracks of the printed circuit board (10).



**Abstract:**Lighting strip

A lighting strip is described having a multicore conductor strip (3) which is fitted with LED elements (4) which are arranged in a row one behind the other. The invention provides that the conductor strip (3) is composed of a large number of conductor strip sections (9) which are cut to length and are arranged in a row in the axial direction, a printed circuit board (10) is in each case arranged between two axially adjacent conductor strip sections (9) and is electrically conductively connected to them, and in that each printed circuit board (10) is fitted with an LED element (4).

Fig. 3

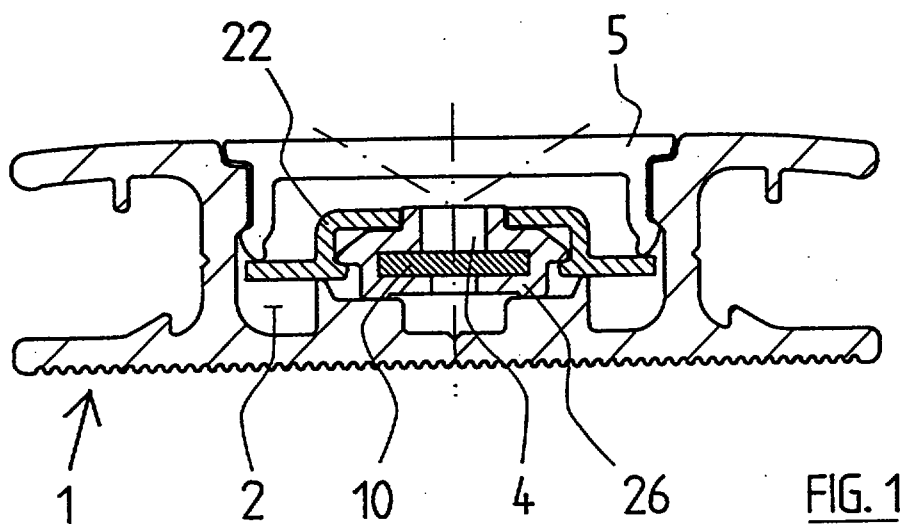


FIG. 1

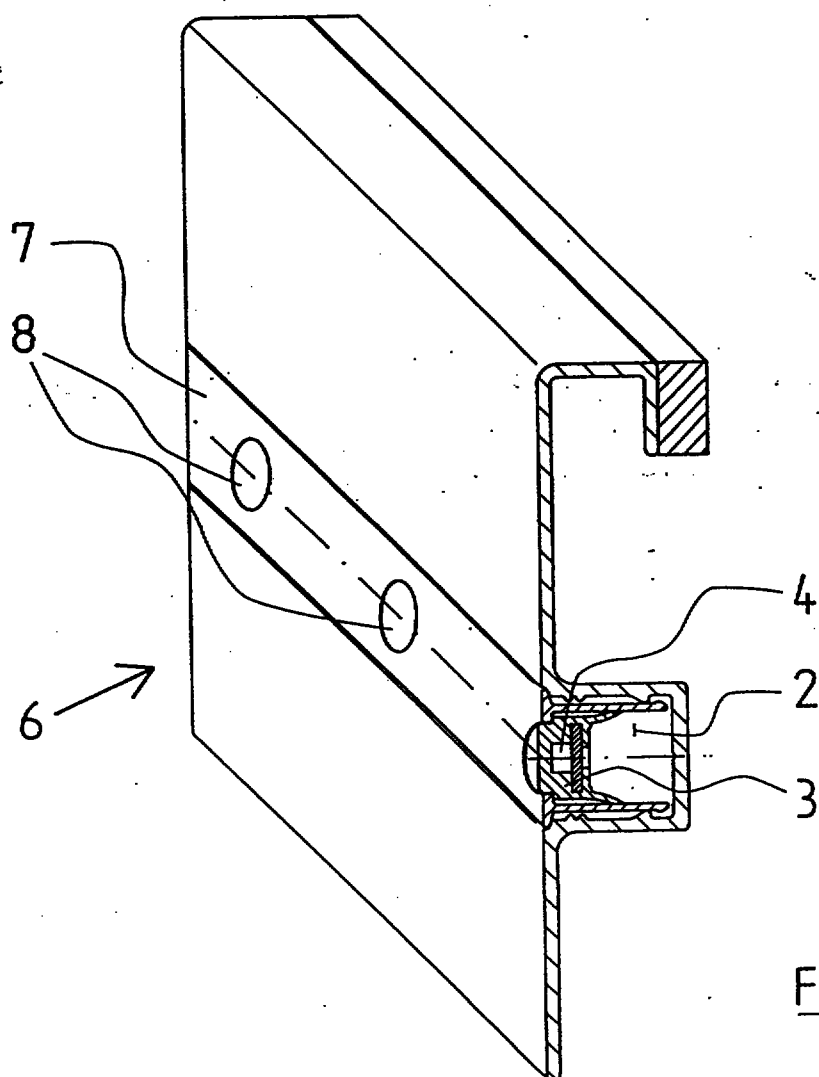
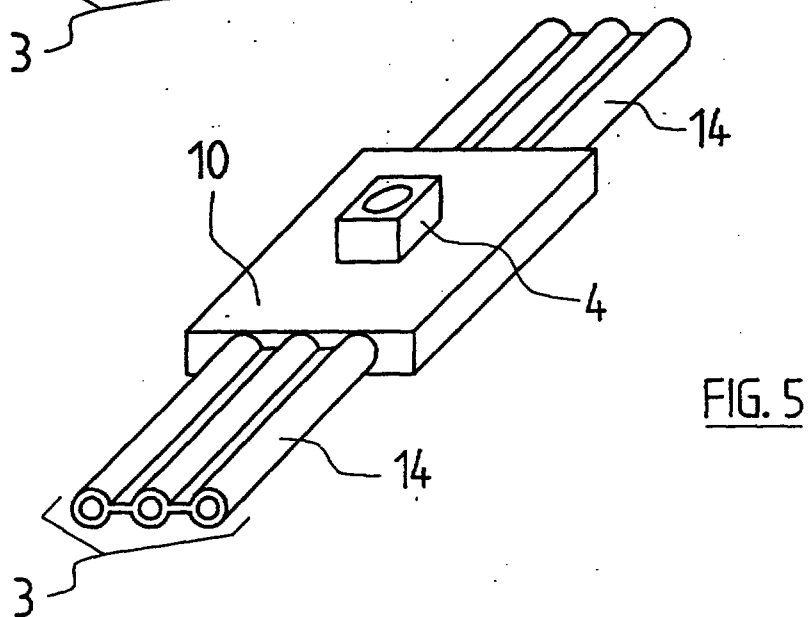
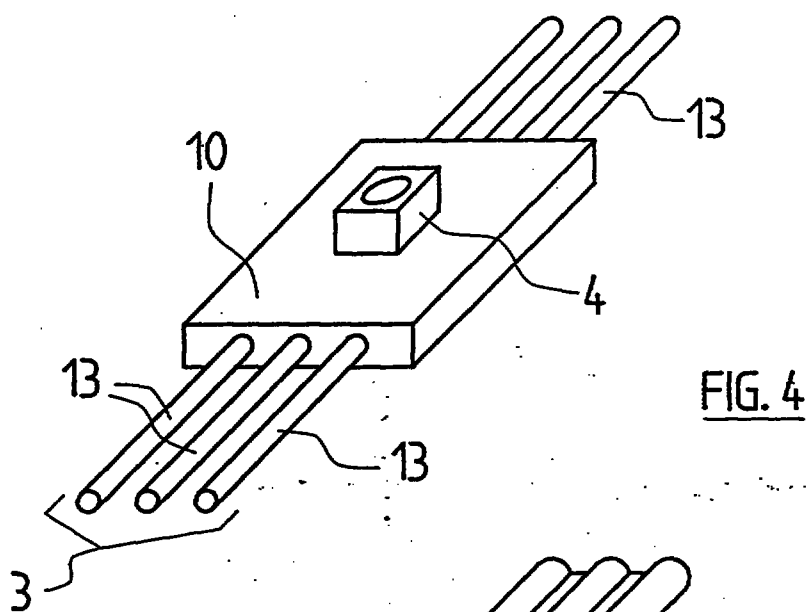
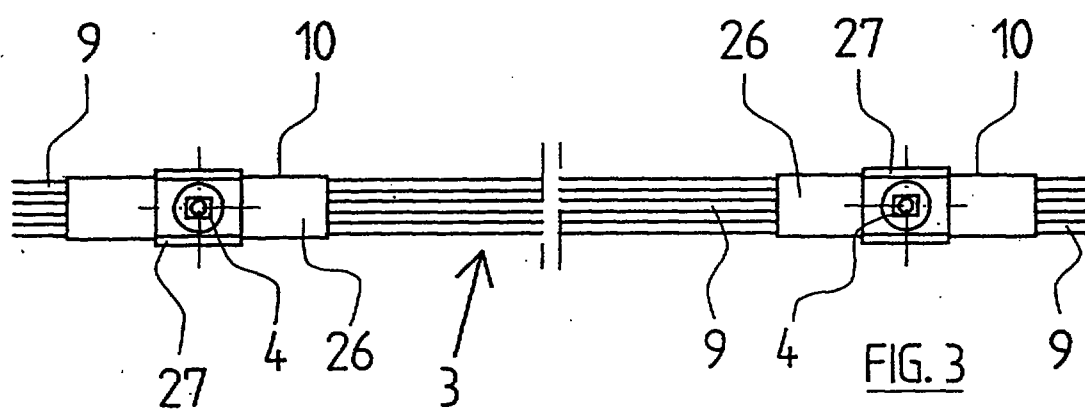


FIG. 2



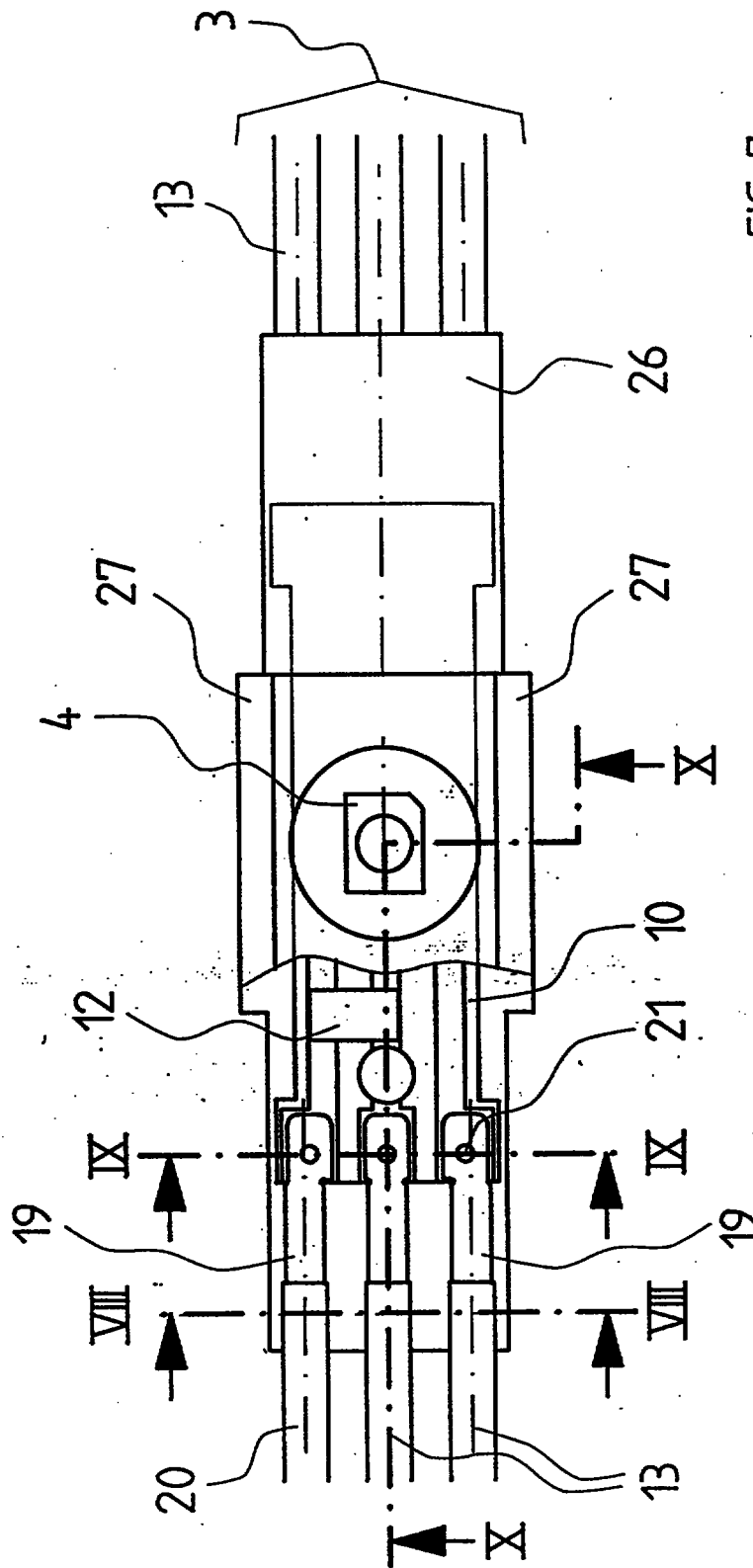


FIG. 7

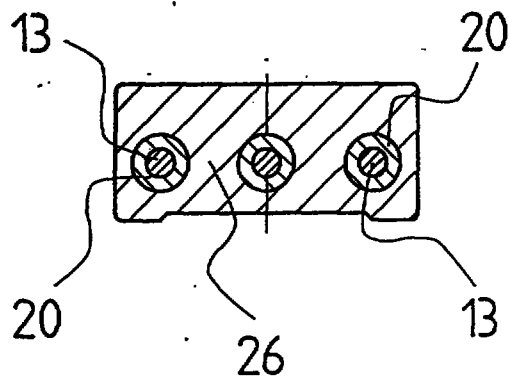


FIG. 8

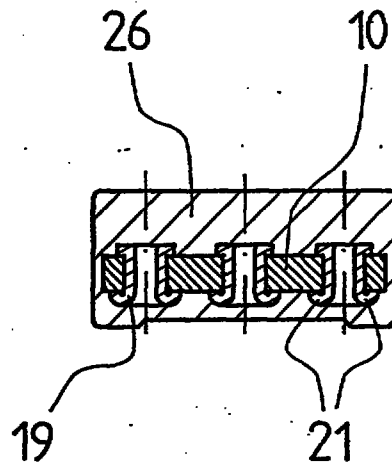


FIG. 9

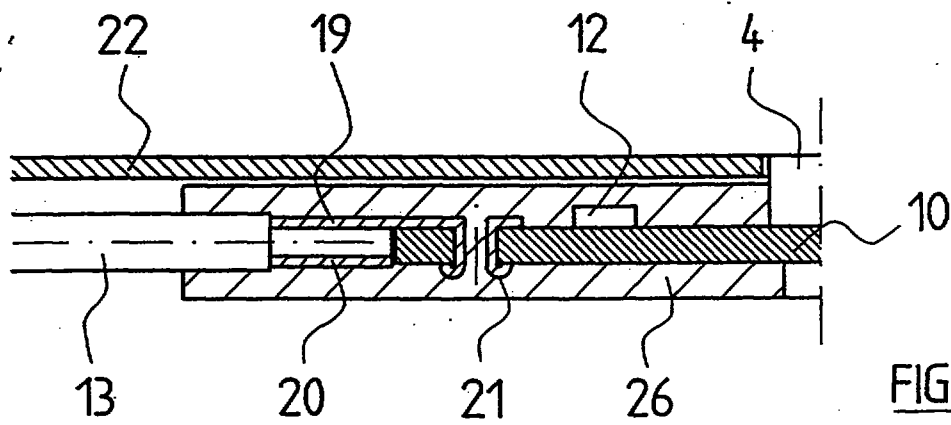
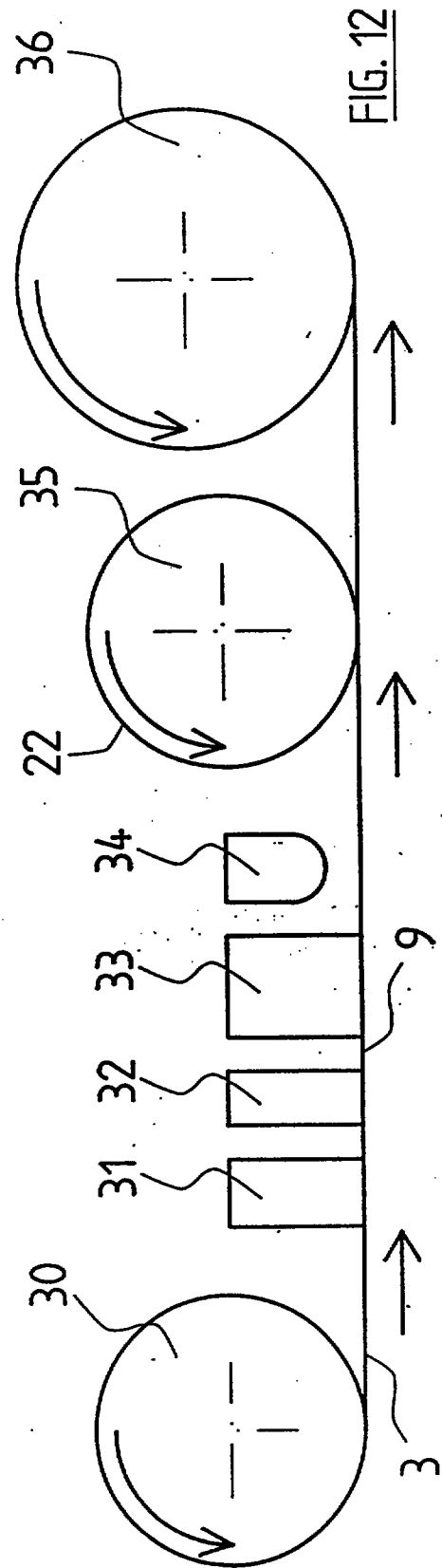
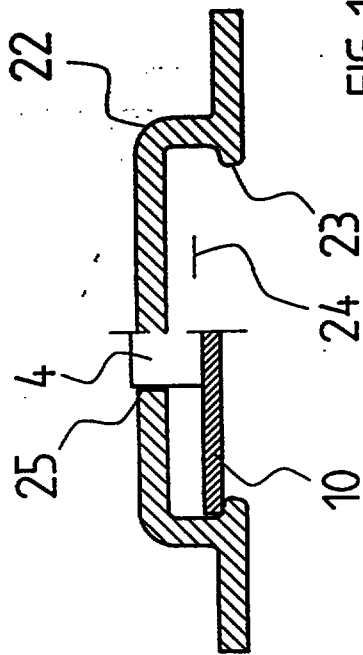
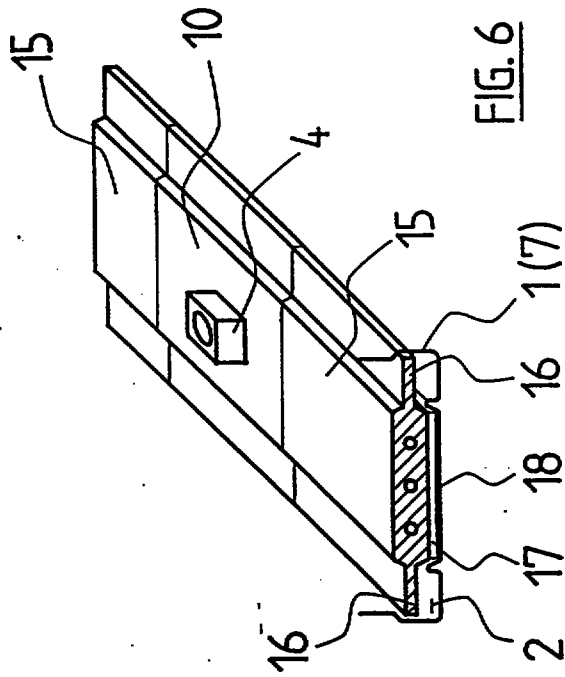


FIG. 10



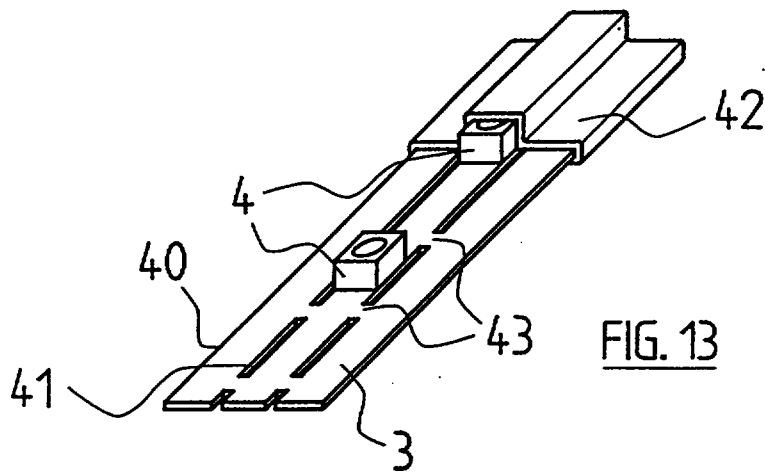


FIG. 13

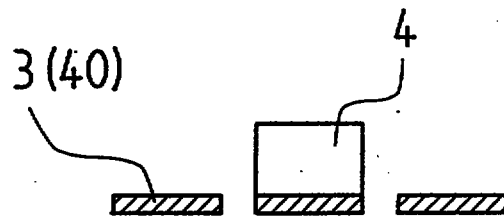


FIG. 14

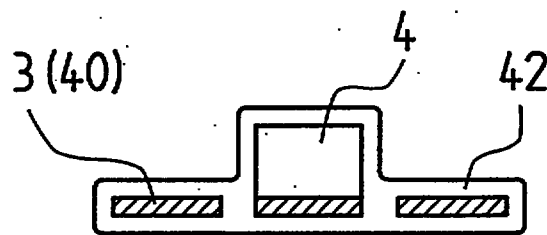


FIG. 15

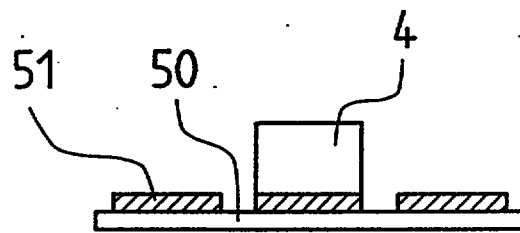


FIG. 16

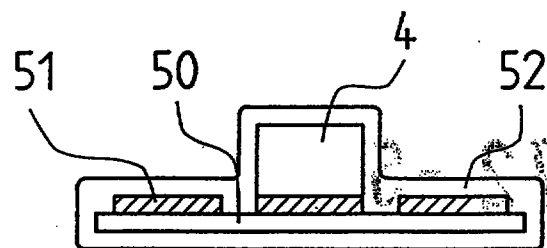
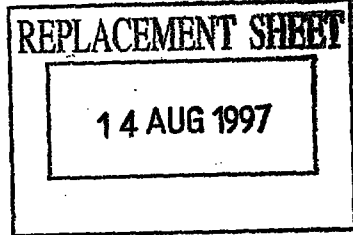


FIG. 17



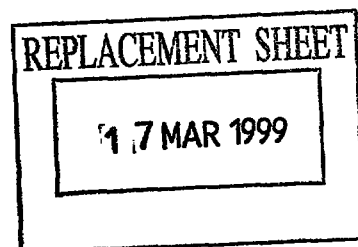
Abstract:

LIGHTING STRIP AND METHOD FOR PRODUCTION

A lighting strip is described having a multicore conductor strip (3) which is fitted with LED elements (4) which are arranged in a row one behind the other. The invention provides that the conductor strip (3) is composed of a large number of conductor strip sections (9) which are cut to length and are arranged in a row in the axial direction, a printed circuit board (10) is in each case arranged between two axially adjacent conductor strip sections (9) and is electrically conductively connected to them, and in that each printed circuit board (10) is fitted with an LED element (4).

Fig. 3

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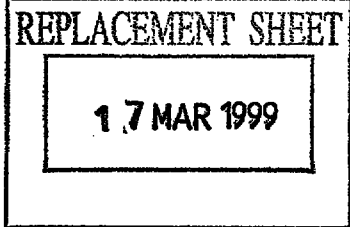
Lighting strip and method for production

The invention relates to a lighting strip having a multicore conductor strip which is fitted with LED elements which are arranged in a row one behind the other.

A lighting strip of the type mentioned above is disclosed in EP-0 669 492 A1. In the case of this known lighting strip, a conductor strip is provided which is composed of a so-called "Kaplan film". This is a plastic strip which is provided with a metal coating and in which the conductor tracks are exposed by etching away regions of the metal coating. Lighting means, called LED elements for short in the following text, are soldered onto this conductor strip at predetermined intervals. The production of the conductor strip is based on a relatively costly technology, requires a large number of process steps, and is dependent on the use of high-quality materials. Although, as a rule, the film strip which is provided with conductor tracks is provided with a coating, sealing problems have occurred in practice and it has been found that the film strip is difficult to lay, particularly in corner regions (risk of kinking), and is also highly sensitive to scratching.

Based on a lighting strip of the type mentioned initially, the invention relates to the object of equipping this lighting strip with a conductor strip which is intended to be simple and cost-effective to manufacture, assemble and install and which can be characterized by high functional reliability.

The lighting strip which is intended to achieve this object has a multicore conductor strip that is fitted with LED elements which are arranged in a row one behind the other. The conductor strip is composed of a large number of conductor strip sections which are cut to length and are arranged in a row in

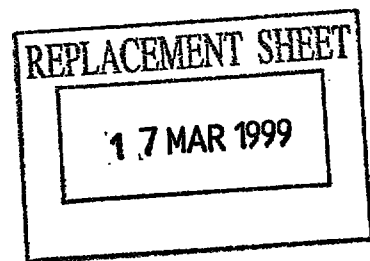


the axial direction. A printed circuit board is in each case arranged between two axially adjacent conductor strip sections and is electrically conductively connected to them, and each printed circuit board is fitted with an LED element.

These measures provide a lighting strip having a conductor strip which can be manufactured and marketed considerably economically. Laying of the conductor strip or illumination strip within the corresponding channels in the lighting strip is now simplified, particularly in the region of sharp corners.

The invention provides, in accordance with claim 1, that the individual cores of the conductor strip are sheathed with insulation, that the insulation is removed at the end regions of each conductor strip section, and that the connection between the respective end of the conductor strip section and the respective printed circuit board is produced by electrically conductive contact elements, a crimped joint being provided in each case between the contact elements and the cores of the conductor strip section, and a rivetted joint being provided in each case between the contact elements and the conductor tracks on the printed circuit board. As trials have shown, an electrical connection between the stripped end regions of the conductors and the conductor tracks on the printed circuit board can be produced particularly easily and economically by means of metallic contact elements, and, in particular, above all by an extremely reliable process.

According to one particular development of the invention, the end regions of the conductor sections, the contact elements, the printed circuit boards and the LED elements are in each case encapsulated in a coloured plastic housing which leaves exposed only the light outlet side of the LED elements and is formed by direct overmoulding. This measure additionally protects the



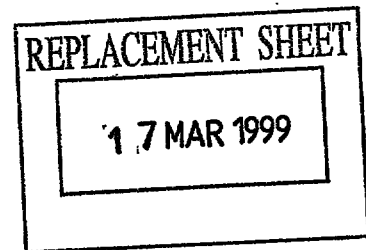
provides absolute sealing, of course, which is alternatively provided in an arrangement wherein, in the case of a lighting strip having a multicore conductor strip which is fitted with LED elements which are arranged in a row one behind the other, it is provided that the conductor strip is composed of a plastic film strip, copper strips coated on to it and surface-mounted LED elements, resistors and the like, and of a flexible sheath profile which is extruded thereon and is formed from a transparent plastic material. In both cases, the flexible sheath profile can be equipped on the underneath with a double-sided adhesive tape, provided with a protective film, in order to make it easier to fit the conductor strip on the corresponding retaining channel in the lighting strip.

The lighting strip according to the invention can be designed, in particular, as a handrail, staircase, baggage compartment, skirting or escape route marking strip.

In a method for manufacturing an insulated, multicore conductor strip having LED elements which are arranged in a row one behind the other, for a lighting strip, a conductor strip of finite length is split into conductor strip sections of predetermined length, and in that those end regions of the conductor strip sections which are axially adjacent each have a printed circuit board connected to them, which printed circuit board is fitted with an LED element and, optionally, with a resistor. In this case, the operations of cutting a conductor strip section to length and of connecting a printed circuit board are in each case carried out intermittently.

In particular, a method is provided, with the following method steps, which are in each case repeated intermittently:

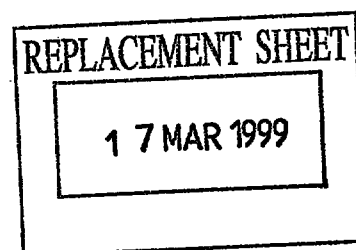
1. a conductor strip of finite length is drawn off a supply roll and is fed to a cutting station;
2. a conductor strip section of predetermined length is



possibly, resistors 12. The film strip 50 is subsequently sheathed, together with the copper strip 51 and the lighting means, with a flexible sheath profile 52 in an extrusion process, the flexible sheath profile 52 being composed of a transparent plastic material having shrinking characteristics.

With regard to the electrical circuits and the conductor routing, use is made of the prior art which is conventional to this extent, so that there is no need for any explanation relating to this. The same applies to the possible embodiments and refinements of the lighting strip as well as end, corner and cross-pieces. Reference should be made to the subject matter of EP 0 669 492 A1, mentioned initially, as an example for the configuration of the lighting strip.

The measures of making the connection between the ends of the strip section 9 and the printed circuit board 10 in each case by means of electrically conductive contact elements 19 and to provide a crimped joint 20 in each case between the contact elements 19 and a rivet connection 21 between the conductors of the strip section 9 and between the contact elements 19 and the conductor tracks of the circuit board 10, have proven to be advantageous. As trials have demonstrated, however, a particularly efficient, dependable and economical electrical connection between the ends of the strip section 9 and the printed circuit board 10 in each case can be made up by soldering, brazing or in particular by welding, with the advantage the numbers of construction components and operations are reduced.

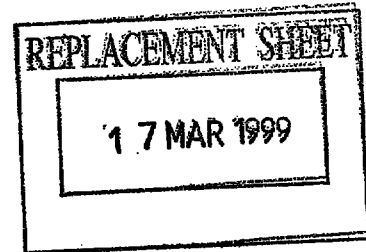


CLAIMS

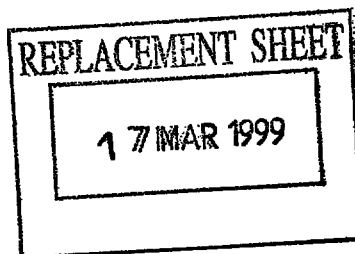
1. Lighting strip having a multicore conductor strip (3) which is fitted with LED elements (4) which are arranged in a row one behind the other, the conductor strip (3) is composed of a large number of conductor strip sections which are cut to length and are arranged in a row in the axial direction, a printed circuit board (10) is in each case arranged between two axially adjacent conductor strip sections (9) and is electrically conductively connected to them, and each printed circuit board (10) is fitted with an LED element (4), characterized in that the individual cores of the conductor strip (3) are sheathed with insulation, in that the insulation is removed at the end regions of each conductor strip section (9), and in that the connection between the respective end of a conductor strip section (9) and the respective printed circuit board (10) is produced by electrically conductive contact elements (19), a crimped joint (20) being provided in each case between the contact elements (19) and the cores of the conductor strip section (9), and a rivetted joint (21) being provided in each case between the contact elements (19) and the conductor tracks on the printed circuit board (10).

2. Lighting strip according to claim 1, characterized in that the end regions of the conductor strip sections (9), the contact elements (19), the printed circuit boards (10) and the LED elements (4) are in each case encapsulated in a coloured plastic housing (26) which leaves exposed only the light outlet side of the LED elements (4) and is formed by direct overmoulding.

3. Lighting strip according to claim 1, characterized in that the end regions of the conductor strip sections (9), the contact elements (19), the printed circuit boards (10) and the LED elements (4) are in each case encapsulated in a plastic housing (26) which is formed by direct overmoulding with a transparent plastic material, such as polycarbonate.



4. Lighting strip according to claim 3, characterized in that each plastic housing (26) has, on the light outlet side of the LED elements (4), an integrally formed material attachment for fitting engagement in a cover (7) of the lighting strip, which cover (7) is provided with corresponding retaining openings (8).
5. Lighting strip according to any one of claims 1 to 4, characterized in that the conductor strip (3) is composed of individual wires (13) which each have insulation.
6. Lighting strip according to any one of claims 1 to 4, characterized in that the conductor strip (3) is designed in the manner of a flexible ribbon cable (14).
7. Lighting strip according to any one of claims 1 to 4, characterized in that the conductor strip (3) is composed of an extruded, relatively dimensionally stable, profiled strip (15) having wires incorporated in it.
8. Lighting strip according to claim 7, characterized in that the profiled strip (15) is designed as a clip-on strip and/or a stick-on strip.
9. Lighting strip according to any one of claims 1 to 8, characterized in that the plastic housing (26) has an approximately rectangular contour with clip-on strips, clip-on tabs (16) or the like, which are integrally formed on the longitudinal edges, for clip-on mounting of the conductor strip (3) in a retaining channel (2) which is designed within the lighting strip.
10. Lighting strip according to any one of the preceding claims, characterized in that the conductor strip (3) is arranged in a retaining channel (24) of a covering strip (22) composed of opaque material, which covering strip (22) has holes (25)

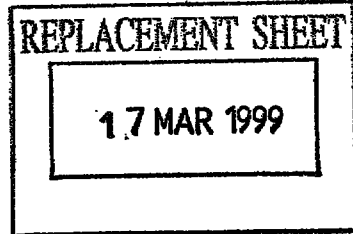


arranged one behind the other in a row for the LED elements (4) to pass through, in that the conductor strip (3) and the covering strip (22) are a prefabricated flush-mounted unit for arrangement in a retaining channel (2) in the lighting strip, and in that this flush-mounted unit is covered, and is held in the correct position, by a sealing profiled strip (5) which likewise engages in the retaining channel (2), is in this case held in a force-fitting and/or positively-locking manner, and is composed of a transparent plastic material.

11. Lighting strip having a multicore conductor strip (3) which is fitted with LED elements (4) which are arranged in a row one behind the other, characterized in that the conductor strip (3) is composed of a copper strip (40) whose cores are separated from one another by punched-slots and cut-free sections (41, 43), and in that the conductor strip (3), including the surface-mounted LED elements (4), resistors (12) and the like, is surrounded by a flexible sheath profile (42) which is extruded thereon and is formed from a transparent plastic material.

12. Lighting strip according to any one of the preceding claims designed as handrail, staircase, baggage compartment, skirting or escape route marking strip.

13. Method for manufacturing an insulated multicore conductor strip (3) having LED elements (4), which are arranged in a row one behind the other, for a lighting strip, a conductor strip (3) of finite length which is split into conductor strip sections (9) of predetermined length, and those end regions of the conductor strip sections (9) which are axially adjacent each have a printed circuit board (10) connected to them, which printed circuit board is fitted with an LED element (4) and, optionally, with a resistor (12), characterized in that the operations of cutting a conductor strip section (9) to length and of connecting a printed circuit board (10) are in each case carried out intermittently.

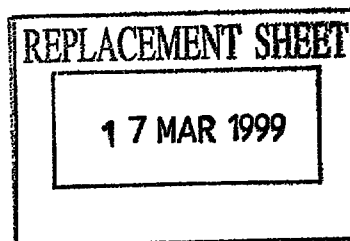


14. Method according to claim 13 with the following method steps, which are in each case repeated intermittently:

1. a conductor strip (3) of finite length is drawn off a supply roll (30) and is fed to a cutting station (31);
2. a conductor strip section (9) of predetermined length is cut to length from the conductor strip (3) of finite length, and the conductor strip section (9) is held firmly by a holding device;
3. the mutually adjacent end regions of the conductor strip (3) and the conductor strip section (9) are stripped of insulation;
4. the stripped end regions are positioned;
5. a printed circuit board (10) which is fitted with at least one LED element (4) is supplied;
6. an electrical connection is produced between the stripped end regions and the conductor tracks on the printed circuit board (10);
7. the conductor strip section (9) which is connected via the printed circuit board (10) to the conductor strip (3) again is passed on to a spool drum (36).

15. Method according to claim 14, characterized in that method steps 2, 3 and 4 are carried out simultaneously in the cutting station (31).

16. Method according to claim 14 or claim 15, characterized in that, between the method steps 6 and 7, the printed circuit board (10) is fed to an overmoulding station (33) and, in the same way as the end regions of the conductors which are connected to the printed circuit board (10), is overmoulded here with a plasticized coloured plastic material, the light outlet side of the LED element (4) being kept free of the overmoulding material.



17. Method according to claim 14 or claim 15, characterized in that, between the method steps 6 and 7, the printed circuit board (10) is fed to an overmoulding station, and in the same way as the end regions of the conductors which are connected to the printed circuit board (10), is overmoulded here with a plasticized transparent plastic material.

18. Method according to any one of claims 13 to 17, characterized in that the method step 7 is preceded by a method step in which the conductor strip (3) is supplied with a flexible covering strip (22) from a supply roll (35), and said flexible covering strip (22) is connected to the conductor strip (3) and/or to the printed circuit boards (10).

19. Method according to any of claims 13 to 18, characterized in that a functional test is carried out after the method step 6 and/or after each printed circuit board (1) has been overmoulded.

20. Lighting strip having a multicore conductor strip (3) which is fitted with LED elements (4) which are arranged in a row one behind the other, the conductor strip (3) is composed of a large number of conductor strip sections which are cut to length and are arranged in a row in the axial direction, a printed circuit board (10) is in each case arranged between two axially adjacent conductor strip sections (9) and is electrically conductively connected to them, and each printed circuit board (10) is fitted with an LED element (4), characterized by the individual conductors of the conductor strip (3) being jacketed with insulation, the insulation being removed at the ends of each strip section (9) and a soldered, brazed or welded connection being provided between the end of the strip section (9) and the conductor tracks of the printed circuit board (10).