IN THE UNITED STATES DISTRICT COURT
FOR THE WESTERN DISTRICT OF TEXAS
WACO DIVISION

RETROLED COMPONENTS, LLC, Plaintiff,	§	Civil Case No. 6:18-cv-55-ADA
v.	§	JURY TRIAL DEMANDED
PRINCIPAL LIGHTING GROUP, LLC Defendant.	§	EXHIBIT TO RETROLED COMPONENTS, LLC'S INITIAL DISCLOSURES OF INVALIDITY

German utility patent DE 299 00 320 U 1 to InfoSystems GmbH Visuelle und akustiksche (Translation)

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(73) Patent holder:
InfoSystems GmbH Visuelle und akustische
Systeme für die Verkehrstechnik [Visual and Acoustics System for Traffic Technology], 42109 Wuppertal,

DE

(74) Representative:

Christiansen, H., Grad. Eng., patent attorney, 14195 Berlin

(54) Assembly set for a lighting device

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InfoSystems GmbH

Visuelle und akustische Systeme

für die Verkehrstechnik

42109 Wuppertal

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Kit for an Illumination Device

12 pages of description
4 pages with 16 Claims

7 pages of drawings

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Description

The invention relates to a replacement kit for an illumination device according to the preamble of Claim 1.

A dot matrix display device is known, which is used for example for displaying the destination of busses or trains in local public transport. It is implemented as a passive information display device, wherein each of the individual display elements has display platelets, which may be electromagnetically switched between two stable rotary positions. In the first rotary position, a light reflecting, usually yellow-coloured surface faces towards the viewer and in the second rotary position a more or less light absorbent, usually black surface faces towards the viewer.

During times without daylight, an additional illumination device is required in order to make the light reflecting surface of the indicator platelets effective and thus make the destination display visible.

In the known information displays, illumination devices having one or several fluorescent lamps are used as a source of light for illuminating the display surfaces.

Further disadvantages of the known devices are the relatively high-energy consumption and the relatively low expected service life of the fluorescent lamps used, so that relatively high operating and maintenance costs ensue as a result of the frequent replacement of the fluorescent lamps.
For these reasons, plans for converting the information displays on buses and trains are contemplated by the enterprises involved in local public transport, wherein more modern, in particular relatively energy-

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efficient and low maintenance illumination means will be used as a source of light instead of the fluorescent lamps.

So far, such projects have failed, particularly because each type of illumination means has a different, system-specific connection technology and a formal replacement of a fluorescent lamp by another illumination means is therefore not possible. Rather, the intended replacement of the illumination means requires a large amount of installation work and further structural adaptations, which result in substantial costs.

On the basis of the deficiencies of the prior art, the invention is based on solving the problem of providing a replacement kit for an illumination device of the kind mentioned above, which can be installed as a replacement for an existing fluorescent lamp without any great expenditure in terms of installation work.

The problem is solved by means of the features indicated in the characterising portion of Claim 1.

The invention includes the recognition that would benefit the business financially when converting vehicles by installing more efficient electrical assemblies which are particularly more economical in operation, for example in illumination devices, if the pre-existing connection technology may - at least partially - be maintained, so that no labour-intensive installation and adaptation works for replacing the electrical assemblies are required.

According to the invention, the replacement kit comprises an LED lamp designed as a plug-in device and for replacing existing fluorescent lamps, as well as a set of cables or another device for bridging or bypassing the pre-

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existing ballast, so that the plug-in socket may be immediately connected to the on-board DC voltage.

The plug-in device includes a source of light formed from electric illumination means and substantially corresponds, with regard to the external dimensions as well as the layout and the size or geometry of the electrical terminals for the illumination means, to a conventional fluorescent lamp and can therefore readily be used in the mountings of an existing and conventional small fluorescent lamp, which has the electrical terminals.

The cable set is used for connecting the connection sockets of the fluorescent lamp mounting to the vehicle battery, whilst at the same time, the ballast connected between the fluorescent lamp to be replaced and the voltage source for the electrical system of the vehicle is electrically bridged. According to the preferred embodiment of the invention, the lamp has a plurality of super bright light-emitting diodes as the source of light, which are arranged in at least one row on a board, which extends essentially parallel to the longitudinal axis of the lamp.

The use of light-emitting diodes also has the advantage that due to their relatively low space requirement as well as their low electric power consumption, whilst at the same time the outside dimensions of the lamp, which are adapted to a certain size of fluorescent lamp, remain the same, the desired illumination may be adjusted simply by varying the number and/or layout type of the light-emitting diodes on the board. Advantageously, no further structural adaptations to the pre-existing plug-in sockets or modifications to the

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voltage supply are required when replacing fluorescent lamps. Also, LEDs have a substantially longer life, whilst at the same time power consumption is lower. For example, in the illustrated arrangement the power consumption is substantially lower than in the case of a display where the LEDs form the display elements themselves, which means they will also have to operate during daytime.

In accordance with a preferred embodiment of the invention, the illumination device includes reverse pole protection means, in order to preclude destruction of the light-emitting diodes as a result of an accidental confusion of the polarity when plugging the diodes into the pre-existing fluorescent lamp mountings. A diode is provided as the reverse pole protection means, which is connected in the same flow direction and in series with the source of light formed by the light-emitting diodes.

In accordance with one variant of the invention, the diode provided as reverse pole protection means is arranged on the circuit board of the lamp, which carries the light-emitting diodes.

In order to be able to increase the illumination intensity of the illumination device according to the invention in a simple manner by providing a larger number of light-emitting diodes, the light-emitting diodes according to one variant are connected parallel on the circuit board.

According to one variant of the invention, the illumination device includes switching means in order to switch the light-emitting diodes arranged in one or several rows on or off either individually, in pairs or in groups. This advantageously provides the possibility to adapt the

light level of the illumination device to the respective demand and thus to operate the entire information display in a more energy-efficient manner.

The lamp includes an essentially concave reflector as an illumination carrier having a preferably U-shaped cross-sectional profile, on the faces of which one end piece is respectively arranged.

The board is formed as a printed circuit board and is retained within the space encircled by the illumination carrier by fixing in a clamped manner between the end pieces.

In order to impart to the lamp sufficient mechanical stiffness for handling, the circuit board carrying the light-emitting diodes advantageously has a width, which corresponds to the internal clearance width of the illumination carrier. As a result, the lateral edges of the circuit board rest positively against the internal wall of the illumination carrier.

According to the preferred embodiment of the invention, two contact pins, which are preferably cylindrically formed, are provided on each end piece, of which respectively one is electrically connected to the light-emitting diodes arranged on the circuit board.

With regard to the formation of the lamp, which conforms to the fluorescent lamp, the equally sized contact pins are arranged in the end pieces in such a way that they are respectively located on the same diameter and extend on the same plane. This plane extends transversely to the light emergence plane of the lamp, so that this may, when installing it as a replacement for a fluorescent lamp, be plugged into the pre-existing mountings in the same way as

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the fluorescent lamp and may be locked therein by rotating it by 90°.

According to an advantageous improvement of the invention, the illumination carrier is formed from sheet metal and it has on the inside a polished surface or a reflective coating to enhance the light yield in an advantageous manner with the same radiation power of the light-emitting diodes.

In a further adaptation to the shape of a fluorescent lamp, the end pieces are essentially formed in a circular cylindrical manner. They are made from an insulating material and are preferably provided with a metallic jacket. As a result, the end pieces may be easily connected by welding them onto the illumination carrier and will impart additional mechanical stability to the illumination carrier, which is made from a relatively thin sheet metal.

The replacement kit according to the invention is particularly suitable for use as an illumination device to display the destination in means of transport.

Further advantageous improvements of the invention are characterised in the dependent claims or will be shown in more detail below together with the description of the preferred embodiment of the invention by means of the figures, wherein:

Fig. 1 shows a top view of a preferred embodiment of the replacement kit according to the invention,

Fig. 2 shows a sectional view along the line A...A in Fig. 1,

Fig. 3 shows a sectional view along the line B...B in Fig. 2,

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Fig. 4 shows a lateral view of the embodiment of a replacement kit element, which is shown in Fig. 1,

Fig. 5 shows a view of the end face of the embodiment of the replacement kit element according to Fig. 4,

Fig. 6 shows a preferred circuit layout for the illumination means shown in Figs. 1, 2 and 3,

Fig. 7 shows a perspective view of the destination display of a bus or train having an illumination device formed from the replacement kit according to the invention, and

Figs. 8a and b show a variant of the embodiment according to Fig. 1 in an exploded view and in an assembled condition.

The replacement kit 1 shown in Fig. 1 for an illumination device that may replace a fluorescent lamp and illuminate the display surface of a destination display on buses or trains has a lamp 2, which may be plugged in in the same way as a fluorescent lamp and has a set of cables 3. The set of cables 3 is used for electrically bridging the ballasts arranged between the fluorescent lamp to be replaced and the voltage source for the electric system of the vehicle and is composed of two flexible cables 4 and 5 both designed in the same way, on the ends of which cable terminals 4.1 and 5.1 are provided for an easy electrical connection.

In the lamp 2 that may be plugged into the fluorescent lamp mounting, sixteen light-emitting diodes 6 are provided as sources of light. The light-emitting diodes 6 are arranged in rows on a circuit board 7, which is arranged in a reflector 8 made from sheet metal, which has a U-shaped cross-sectional profile.

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For the purpose of clarity, an illustration of the switching means for switching the parallel connected light emitting diodes 6 on or off in pairs or in groups and the corresponding line connections between the light-emitting diodes and the connection terminals 9, 10 was omitted. The unused contacts 9' and 10' only constitute guiding means, in order to ensure that the lamp 2 can be plugged into existing fluorescent lamp mountings in a manner similar to fluorescent lamps.

In order to achieve a uniform illumination of the destination display, the light emergence openings of the light-emitting diodes 6 have to be arranged at the same level. This is achieved by using spacers 11. The spacers 11, through which the connection leads 12 of the light emitting diodes 6 are guided, are supported - as shown in Figs. 2 and 3 in a longitudinal or cross-sectional view through the lamp 2 - on one surface of the circuit board 7. On the surface, which faces away from the circuit board, the spacers have a recess into which the light-emitting diode body is inserted.

The reverse pole protection means for the light emitting diodes 6, which is disposed on the circuit board 7, is identified with 13. On each end face of the reflector 8, an end piece 14 is fastened through which the contact pins 9, 10 for the electrical connection of the light emitting diodes 6 disposed on the circuit board 7 are guided with a voltage source as well as the unused contacts 9', 10'. The reflector 8 is provided on the inside thereof with a polished surface in order to enhance the reflection of the light emitted by the light-emitting diodes.

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The end pieces 14 have a circular-cylindrical core 15 made from an insulating material, the lateral surface of which carries a metallic jacket 16. In the core 14 [sic] of the end pieces 14, a slot-shaped recess 17 of a low depth is respectively machined on the side facing the reflector 8. This recess extends respectively along the radius on which the contact pins 9, 10 (or the unused contacts 9', 10') are arranged. The recess 8.1 accommodates the edges on the narrow side of the circuit board 7 and secures in this way their stable position within the space volume surrounded by the reflector 8.

Due to the metallic jacket 16, the reflector 8 - as shown in Figs. 4 and 5 - may be connected in a simple manner by butt welding to the end faces of the end pieces 14 attached to the reflector. Moreover, the welding connection 18 at the bottom 8.1 and on the legs 8.2 of the U-shaped profiled reflector 8 ensures a higher mechanical stiffness of the entire lamp 2.

The contact pins 9, 10 and the corresponding, equally sized unused contacts 9' and 10' in the end pieces 13 are - as shown in the end view of lamp 2 according to Fig. 5 - arranged with regard to the implementation of the lamp 2 in a form conforming to a fluorescent lamp and lie respectively on the same diameter and extend in the same plane. This plane extends transversely to the light emergence plane of the lamp 2, so that this may be plugged into the pre-existing fluorescent lamp mounting when installing it as a replacement for a fluorescent lamp (compare position 19 in Fig. 6) and may be locked by rotating it about 90°.

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The light-emitting diodes 6 are - as shown in Fig. 6 - electrically connected in series on the circuit board 7 together with a diode 13 forming the reverse pole protection means. The line sections of the circuit board 7 are identified with 7.1 and 7.2 and are connected to the contact terminal 9 or 10 of the lamp 2. The diode 13 and the block of light-emitting diodes 6 which are electrically connected in series, form a series connection wherein the diodes 6, 13 are arranged in such a way that they all have the same flow direction.

The flexible cables 4 and 5 of the cable set are respectively connected in the plug-in blocks 19.1 and 19.2 of the fluorescent lamp mounting 19 in sockets receiving the contact pins and are connected – whilst electrically bridging the ballasts of the replaced fluorescent lamp - with their free ends to the poles of the vehicle battery.

In the case of a polarity reversal when plugging the lamp 2 into the fluorescent lamp mounting 19 (direction of arrow 20), the diode 13 is - as shown in Fig. 6 - operated in the reverse direction, as a result of which a flow of current in a wrong direction is prohibited in order to protect the light-emitting diodes 6. Either in order to achieve the correct polarity of the lamp 2, the connections of the cables 4 and 5 are reversed or the lamp 2 is rotated by 180° (direction of arrow 21) and is then plugged back into the fluorescent lamp mounting 19.

The destination display 100 of a bus, which is schematically shown in Fig. 7, has a dot matrix information display unit 30 radiated by the lamp 2, the individual display elements 31 of which are formed as display platelets which may be electromagnetically switched between

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two stable rotary positions. In the first stable rotary position, a light reflecting, usually yellow-coloured surface and in the second rotary position a more or less light-absorbent, black surface of the display platelets faces towards the viewer of the destination display. In their respective stable rotary position, the display platelets are slightly inclined with respect to the vertical, by which the light reflection or light absorption effect is supported.

The lamp 2 plugged into the plug-in blocks 19.1 and 19.2 of the pre-existing fluorescent lamp mounting 19 is – as viewed in the direction of travel of the bus - displayed in front of the information display device 30. As a result of the light emitted by the light-emitting diodes 6, the yellow-coloured surface of the individual display platelets 31, which faces towards the viewer, is radiated and thus optically highlighted by the light reflection in comparison to the remaining, dark display platelets. The reflector 8 having a rectangular cross-sectional profile ensures an adequate illumination of the surface of the information display device 30.

In the variant shown in an exploded view in Fig. 8a, two U-shaped guide rails 8.1 and 8.2 are inserted into the U-shaped illumination carrier 8 on each side forming a leg of the “U”, wherein the guide rails extending in the longitudinal direction form a receptacle for the board carrying the LEDs, which is not shown in this exploded view. Locking rings 16.1 and 16.2 are connected to the ends of the illumination carrier 8, which in turn accommodate rotary parts 14.1 and 14.2, which serve as a carrier for the contacts 9.1 and 9.2 or 10.1 and 10.2.

The entire arrangement is shown in Fig. 8b in the assembled condition. It can be seen that the illumination carrier 8 reaches right up to the rotary parts 14.1 and 14.2, so that almost the entire structural length may be used for the illumination means.

The implementation of the invention is not limited to the preferred embodiment examples provided above. Rather, a number of variants are conceivable which apply the presented solution even in the case of different embodiments of a principally different kind.

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Patent Claims

1. A replacement kit for replacing a fluorescent lamp for illuminating an information display, in particular a destination display device (30) in a vehicle,

characterised by

a device (2) that may be plugged into a contact socket and which has a number of light-emitting diodes (6) as electrical illumination means, including an illumination carrier (8) wherein the external dimensions as well as the arrangement and geometry of the electrical connection terminals (9, 10) thereof correspond to a usual small fluorescent lamp, and

means (3) for directly connecting the socket to the on-board voltage source whilst bypassing or bridging the ballast.

2. The replacement kit according to Claim 1, **characterised in that** the light-emitting diodes (6) are arranged in at least one row extending essentially parallel to the longitudinal axis of the plug-in device (2).

3. The replacement kit according to Claim 2, **characterised in that** the light-emitting diodes are provided on a common circuit board (7).

4. The replacement kit according to Claim 2, **characterised in that** the light-emitting diodes are diodes having great brightness.

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5. The replacement kit according to Claim 2, **characterised in that** a reverse pole protection means (13) is provided for the light-emitting diodes (6).

6. The replacement kit according to Claim 4, **characterised in that** a normal diode (13) connected in series with the light-emitting diodes (6) and being polarised in the same reverse or flow direction is provided as the reverse pole protection means.

7. The replacement kit according to any one of the preceding claims, **characterised by** the series connection of the LEDs as illumination means (6).

8. The replacement kit according to any one of the preceding claims, **characterised in that** the plug-in device (2) has an essentially concave illumination carrier (8) with a preferably U-shaped cross section and with end pieces (13) arranged on the end face thereof, between which the board (7) carrying the light-emitting diodes (6) is retained.

9. The replacement kit according to Claim 7, **characterised in that** the board is formed as a printed circuit board (7) and is fixed in a clamped manner between the end pieces (14).

10. The replacement kit according to Claim 7 or 8, **characterised in that** on each end piece (14), two preferably cylindrically formed contact pins (9, 10) are provided, which are electrically connected to the light emitting diodes (6) disposed on the circuit board (7).

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11. The replacement kit according to Claim 9, **characterised in that** the circuit board (7) has a width which essentially corresponds to the clear internal width of the illumination carrier (8).

12. The replacement kit according to Claim 9, **characterised in that** the plane on which the contact pins (7) are arranged extends essentially transversely to the light emergence plane of the illumination carrier (8).

13. The replacement kit according to any one of the preceding claims, **characterised in that** the illumination carrier (8) is formed from sheet metal and/or has a light reflecting coating or a polished surface on the inside thereof.

14. The replacement kit according to Claim 7, **characterised in that** the end pieces (14) are formed essentially circular-cylindrical and have a core (15) made from an insulating material, which has a metallic jacket.

15. The replacement kit according to Claim 13, **characterised in that** the jacket (16) is preferably connected to the illumination carrier (8) by welding.

16. The replacement kit according to any one of the preceding claims, **characterised in that** the device (3) for directly connecting the socket to the on-board voltage source whilst bypassing or bridging the ballast is comprised of a cable set (3) or a terminal for bridging the ballast required for operating the fluorescent lamp with the onboard supply DC voltage of the vehicle.

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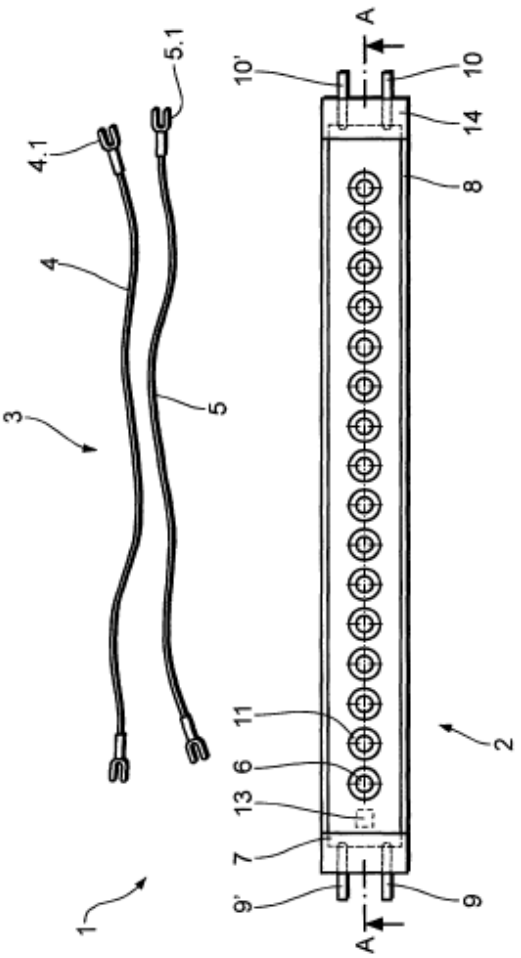

Fig.1

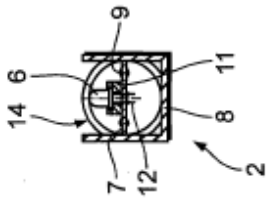

Fig.3

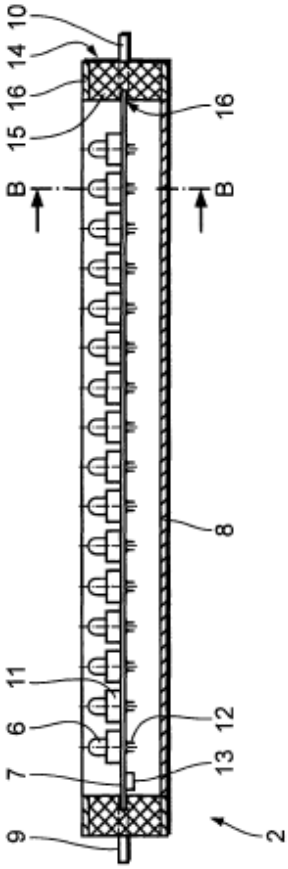

Fig.2

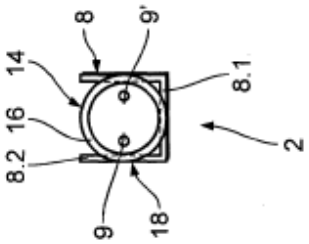

Fig.5

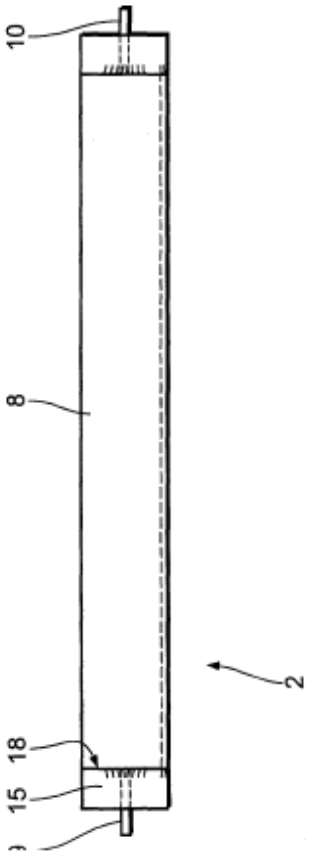

Fig.4

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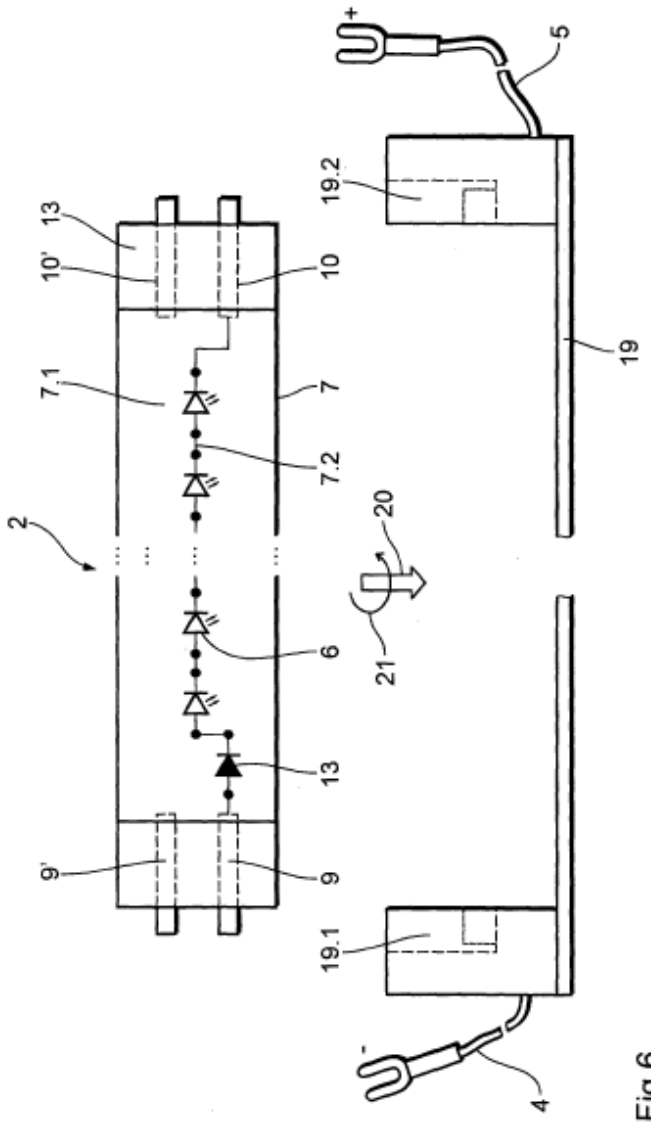

Fig.6

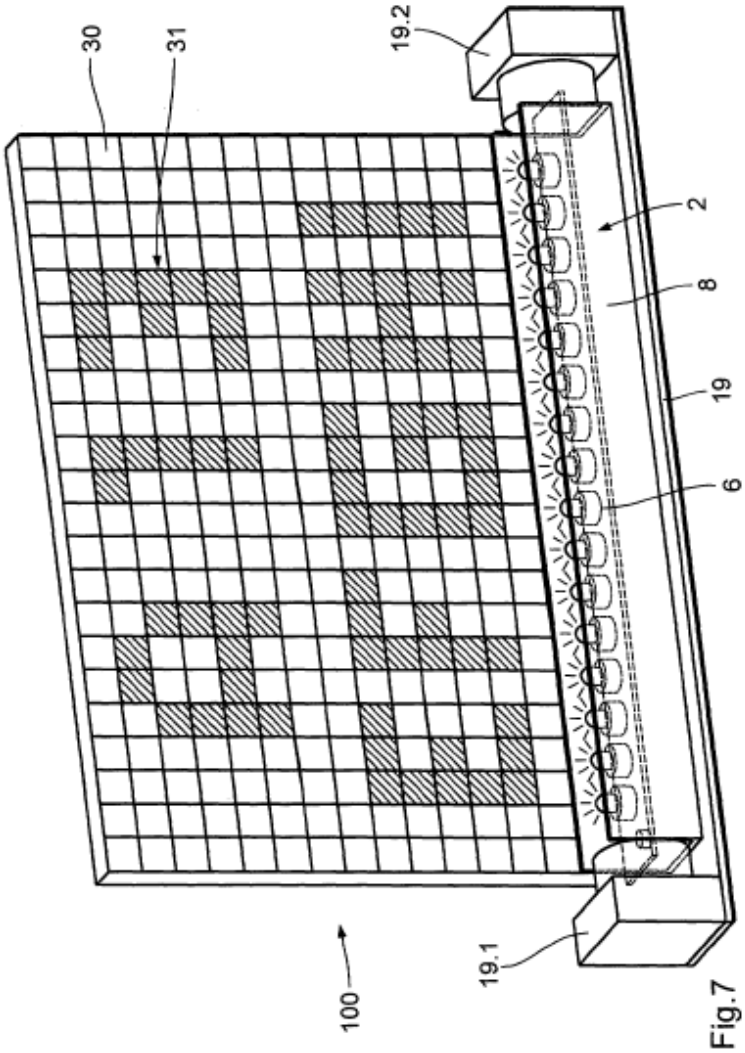

Fig.7

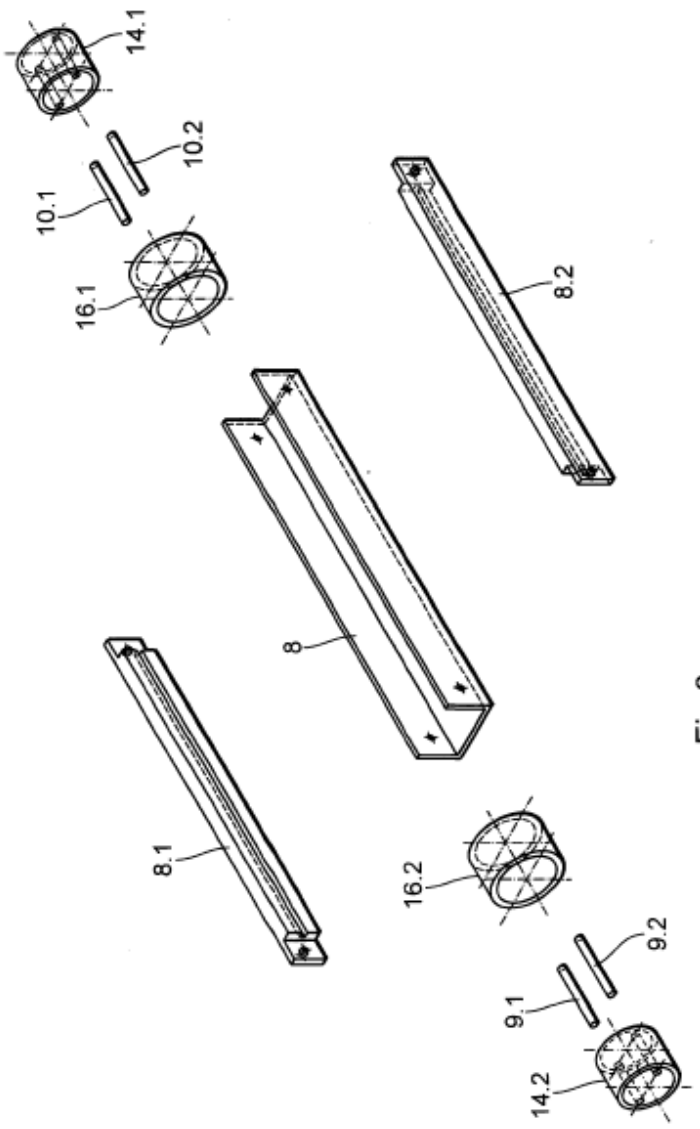

Fig.8a

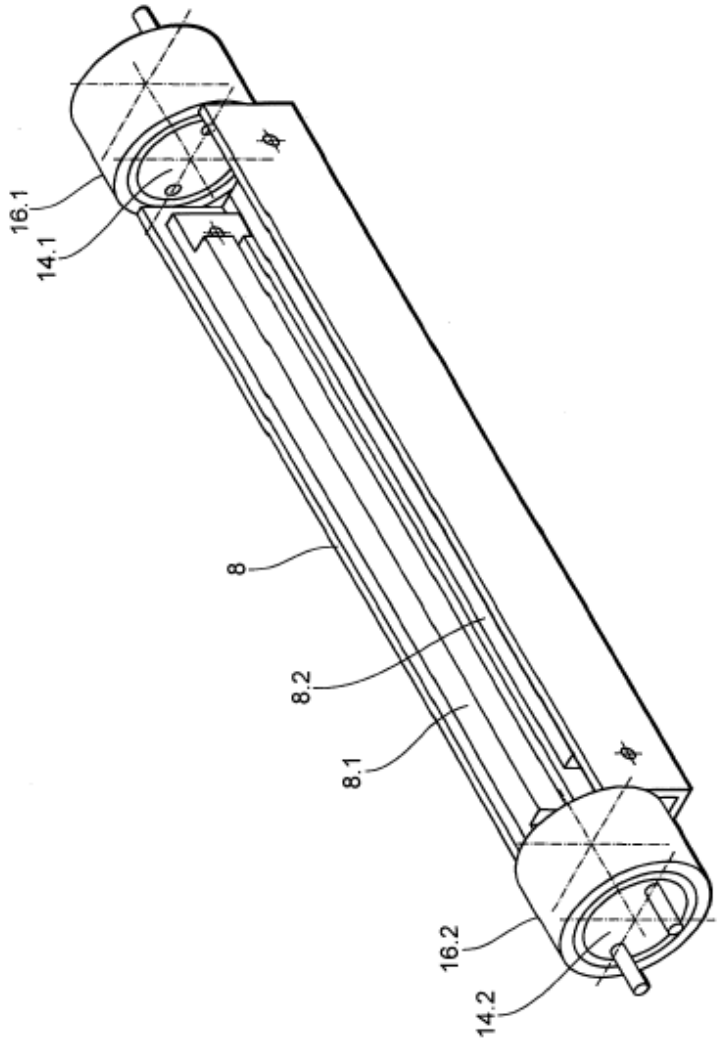

Fig.8b