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(71) Applicant: **PHILIPS LIGHTING HOLDING B.V.**
[NL/NL]; High Tech Campus 45, 5656 AE Eindhoven
(NL).

(72) Inventor: **WENDT, Matthias**; c/o High Tech Campus 45,
5656 AE Eindhoven (NL).

(74) Agent: **VERWEIJ, Petronella, Danielle** et al.; High Tech
Campus 45, 5656 AE Eindhoven (NL).

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(54) Title: DATA-LINE POWERED TRACK LIGHTING SYSTEM

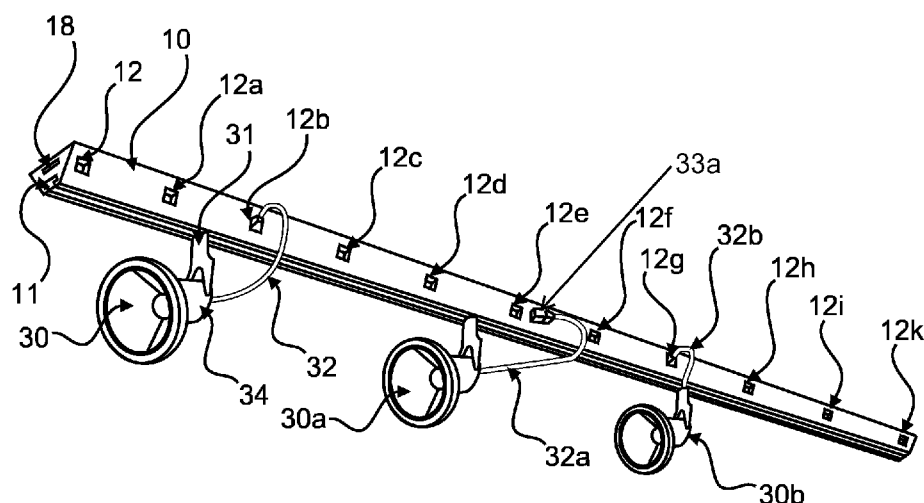


FIG. 3

(57) Abstract: The present invention relates to a track lighting system in which a power sourcing equipment is integrated, wherein the track (10) comprises multiple data supply sockets (12-12k) through which power is supplied to respective spotlights (30, 30a, 30b) of the track lighting system. This allows a spotlight to be of a very small size, as only low voltage electronics without specific isolation requirements are required. Yet, the spotlight can still be freely positioned. The data supply sockets (12-12k) can be placed on a side wall of the track (10) such that the spotlights (30, 30a, 30b) can be mechanically attached to the track (10) and a data cable (32, 32a, 32b) is used to power and control it. Alternatively, the sockets (12-12k) can be placed such that the spotlights (30, 30a, 30b) can directly be attached via the sockets (12-12k).

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Data-line powered track lighting system

FIELD OF THE INVENTION

The invention relates to the field of lighting systems, such as – but not limited to – track lighting systems, for use in various different applications for home, retail and industry.

BACKGROUND OF THE INVENTION

A huge part of spotlighting systems is configured as track lighting systems. Track lighting systems are well-known for use in interior decorating, display cases, and many other uses. Typical track lighting systems use a track having an interior channel with electrical conductors within the interior channel.

Fig. 1 shows a typical conventional track lighting system in which bus-type connection systems are used for power-supply. In such track lighting systems, light fixtures 30 (such as lamp assemblies, lamps, luminaires, spotlights or other types of light sources) are fixed on at least one mounting rail or track 10 that also provides power to the lights. To achieve this, blank rail conductors are typically provided along the track 10 which are isolated by means of a rail carrier which keeps them in place inside an interior channel of the track 10. Each of the light fixtures 30 typically comprises a foot element which has a clamping mechanism that is pushed by spring loaded contacts against the rail conductors to make contact. The track 10 is typically mounted to a wall or ceiling by mounting screws or hung by a pendant. The light fixtures 30, 30a, 30b are typically fixed by a rail-type mechanism to the track 10.

However, conventionally, such tracks are configured to distribute mains voltage and hence the light fixtures are bulky and heavy. In addition, control options for tracks are rather limited, as the lighting system typically does not know about the relative position of lighting devices (e.g. on the track) nor about the direction of their light beam.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide an improved track lighting system which can be operated with light fixtures of reduced size and weight.

This object is achieved by a lighting device as claimed in claim 1, by a mounting device as claimed in claim 7, and by a lighting system as claimed in claim 10.

Accordingly, a lighting system is proposed where power is supplied to the lighting devices via data network connections, e.g., by Power over Ethernet (PoE), allowing for enhanced control, sensing and monitoring options. Moreover, lighting devices can be kept extremely compact, as the size of the remaining driver electronics part can be reduced substantially.

As an additional advantage, connection cables used in some embodiments can be unobtrusive, as they are very short and do not need a high gauge size.

According to a first option, the lighting device may further comprise a pigtail-type cable connected to the lighting device, wherein the data network plug (or socket) is connected to the lighting device via the pigtail-type cable. Thereby, the lighting devices can be manufactured with prearranged short low-power cable portions and data network plugs (or sockets) so that assembly of the lighting system is very simple and flexible.

According to a second option which can be combined with the first option, the lighting device may further comprise a fixing foot element for connecting the lighting device to the track housing by means of a fixing element. Thereby, the lighting device can be easily mounted to the track housing. As a more specific example of the second option, the fixing element may comprise at least one of a clip, a screw, a clamp, a magnet, a rolling mechanism and a sliding mechanism. These fixing measures facilitate fixation and flexibility of mounting the lighting devices to the track housing.

According to a third option which can be combined with the above first or second option, the data network plug (or socket) may be integrated to the fixing foot. This provides the advantage that connecting and mounting of the lighting device can be done in one step and thus further simplified.

According to a fourth option which can be combined with any one of the above first to third options, the data network plug may comprise an RJ45 plug. Thus, available standardized plugs, sockets and other elements for PoE systems can be used for powering the lighting system.

According to a fifth option which can be combined with any one of the above first to fourth options, the track housing may comprise a plurality of track segments each comprising at least one end connector for connecting to another track segment via an intermediate connecting piece. Thereby, the length of the track can be varied by serially connecting the track segments.

According to a sixth option which can be combined with the above fifth option, the end connector may be connected to a supply connecting piece which provides a data connection and a power connection. Thus, power supply as well as data exchange for control and monitoring purposes can be provided via a single connection.

5 According to a seventh option which can be combined with any one of the above first to sixth options, an identification may be allocated to network ports of the data network sockets (or plugs), wherein the lighting system is adapted to estimate the position of a corresponding lighting device on the track housing of the mounting device based on the identification. Thereby, enhanced control of the lighting system based on known positions of
10 individual lighting devices can be provided.

 According to an eighth option which can be combined with the above seventh option, the lighting system may be adapted to cluster neighboring ones of the data network sockets (or plugs) by allocating a single logical port to them at the power supply unit, wherein a blocking mechanism can be provided on the track housing to block a neighboring
15 one of an occupied network socket (or plug). Thereby, the number of logical ports can be reduced to facilitate network control.

 According to a ninth option which can be combined with any one of the above first to eighth options, the data network sockets and the data network plugs may be arranged to allow rotation of installed data network plugs. This allows directing light beams of the
20 lighting devices without requiring any mechanical axis at the lighting device.

 According to a tenth option which can be combined with the above ninth option, the lighting system may be adapted to monitor a rotation angle of an installed data network plug (or socket) and to provide an information about the monitored rotation angle via a network connection. Thereby, pointing directions of directional lighting devices can be
25 monitored and controlled.

 The integrated power supply unit of the mounting device of claim 7 may allow the mounting device to operate as a Power-over-Ethernet compliant Power Sourcing Equipment (PSE) or Midspan. Thus, the mounting device may receive, e.g. over an Ethernet cable, data for controlling any lighting devices coupled to the mounting device (i.e. attached
30 to the track) and may further receive power over said Ethernet cable or source power from another power source (e.g. the mounting device may source the power from an AC grid and the integrated power supply may comprise a converter for converting AC power to DC power). The mounting device may further receive data, e.g. via a wired, such as an Ethernet, or wireless interface. This received data can comprise control commands that determine the

light output of the lighting devices connected to the mounting device (the track). The mounting device, e.g. via the integrated power supply, may then control the amount of power outputted to the various lighting devices (together or individually) based on the data received.

According to an eleventh option which can be combined with the above tenth option, the lighting system may comprise actuator elements for rotating or tilting at least some of lighting devices, wherein the actuator elements can be controlled via the network connection. Thus, the lighting devices can be steered via network control.

It shall be understood that the lighting device of claim 1, the mounting device of claim 7, and the lighting system of claim 10 may have similar and/or identical preferred embodiments, in particular, as defined in the dependent claims.

It shall be understood that a preferred embodiment of the invention can also be any combination of the dependent claims or above embodiments with the respective independent claim.

These and other aspects of the invention will be apparent from and elucidated with reference to the embodiments described hereinafter.

BRIEF DESCRIPTION OF THE DRAWINGS

In the following drawings:

Fig. 1 shows a conventional track lighting system;

Fig. 2 shows a schematic architecture of a PoE lighting system;

Fig. 3 shows a PoE powered track lighting system according to a first embodiment;

Figs. 4a to 4c respectively show end or middle connectors elements for connecting track segments in various embodiments; and

Fig. 5 shows a PoE powered track lighting system according to a second embodiment.

DETAILED DESCRIPTION OF EMBODIMENTS

Embodiments of the present invention are now described based on a connected lighting system where flexible fixing of lamps or spotlights (lighting devices) along a mounting track is desirable, as in retails and museums, for example.

According to the following embodiments, it is therefore suggested using data network connections for supplying power to the lighting devices (such as Power over Ethernet (PoE)) as well as for providing a connectivity solution for track lighting

applications. Thereby, an active track system can be implemented, where a power supply entity (PSE) is integrated with the rail and data network sockets (e.g., Ethernet (RJ45) sockets) are arranged at certain distances along the rail.

In the following embodiments, PoE is used as an example for power distribution which allows parallel use of the same network cable for power supply and connectivity control. Of course, other types of network connections (e.g. Universal Serial Bus (USB) or the like) with integrated power supply functionality can be used. The upcoming PoE standard 802.3bt will allow for a huge span in power ranging from smaller 5W up to 90W. These power levels also allow spotlight applications to be powered by PoE.

Fig. 2 shows a schematic architecture of a PoE lighting system according to various embodiments using twisted pair Ethernet cables 23 for connecting lighting devices 24 and switching or other lighting control elements 26, 28 to a PoE control unit 20 with integrated PSE 21. The PoE control unit 20 is connected via a conventional power supply cable 22 to an external power supply. The proposed data-line based power and data supply to the lighting devices 24 is essentially based on a star wiring rather than a bus-type wiring. As PoE is using twisted pair Ethernet cables 23, it is also based on star wiring rather than busses which are typically used in conventional track lighting systems.

In the following embodiments, PoE data and power processing is done in the track housing where the track rail is limited to flexible positioning and fixing of the lighting devices. Integrated with the rail are Ethernet (RJ45) sockets at certain distances along the rail. The PoE PSE can be placed in one central place at the rail, e.g., at one end or it can be directly at each socket.

Fig. 3 shows a PoE track lighting system according to a first embodiment, wherein a PSE (not shown in Fig. 3) is integrated in a track housing 10 (or rail) and wherein the track housing 10 comprises multiple RJ45 sockets 12, 12a-k. This allows spotlights 30, 30a, 30b to be of a very small size, as only low voltage electronics without specific isolation requirements are required. Yet, the spotlights 30, 30a, 30b can still be freely positioned.

As can be gathered from Fig. 3, the lighting devices (i.e. spotlights 30, 30a, 30b) can be provided with a short pigtail connector 32, 32a, 32b fixed at them. The pigtail length can be adjusted to the typical distance between the POE sockets 12, 12a-k on the track housing 10.

The RJ45 sockets 12, 12a-k can be placed on the side (as shown in Fig. 3) of the track housing 10, so that each spotlight 30, 30a, 30b is mechanically attached to the track housing 10 via a foot element 31 and the cable of the pigtail connector 32, 32a, 32b is used

for supplying power and control signals to the spotlights 30, 30a, 30b. A clamp feature on the foot element 31 allows to fix the spotlights 30, 30a, 30b to a rail 11 which is integrated with the track housing 10.

Optionally, the track housing 10 can be extendable, such that, for example, a
5 passive track (not comprising a PSE) can be added to an active track (comprising a PSE).

A driver of the spotlights 30, 30a, 30b can fit into a small housing 34, as only low voltage electronics without specific isolation requirements is required.

As already mentioned above, the spotlights 30, 30a, 30b can be manufactured with short cables of a pigtail connectors 32, 32a, 32b fixed or may be adapted to allow
10 attachment of short patch cables. At their ends, the cables carry RJ45 Ethernet connectors or plugs 33a that can be plugged into the nearest PoE socket 12, 12a-k. The cables used in the embodiments can be unobtrusive as they are very short and do not need a high gauge size.

The spotlights 30, 30a, 30b can be fixed to the rail 11 by means of e.g. clips, screws, clamps, magnets or as rolling sliding device.

15 Furthermore, the track housing 10 may be comprised of track segments that can have an end connector element 18 allowing to serially connect them by means of an intermediate connecting piece 50 as shown in Figs. 4a and 4c.

Figs. 4a to 4c respectively show end and middle connector elements 18, 58, 68
for connecting track segments, intermediate pieces or end pieces in various embodiments.

20 Fig. 4a shows a partial view of a segment of the track housing 10 with an end connector element 18 is provided for connecting power supply and data lines for a PoE connection. Additionally, a RJ45 socket 13 is mounted under a different angle at the bottom side of the track housing 10.

Fig. 4b shows an end piece 60 with an end connector element 68 which is
25 adapted to be connected to the end connector element 18 of the track housing 10 so as to provide an interface for an external power connection line 61 and data connection line 62.

Fig. 4c shows an intermediate connecting piece 50 which can be used for connecting segments of the track housing 10 to each other by respective middle connector elements 58.

30 Fig. 5 shows a PoE powered track lighting system according to a second embodiment.

In the second embodiment, the PoE (e.g. RJ45) plug 33 of the spotlight 30 is directly integrated with the foot element 31 as depicted in Fig. 5. A track housing 10 having an integrated PSE which has PoE (e.g. RJ45) sockets 12, 12a, 13, 13a and 13b distributed

along the track. The PoE sockets 12, 12a, 13, 13a and 13b may be mounted under different angles (here shown as PoE sockets 12x and PoE sockets 13x). The spotlight 30 can be positioned at any free PoE socket and plugged in. The PoE plug 33 is integrated in the foot element 31 of the spotlight 30 and can be rotatably mounted to allow free lamp aiming. A manual lock button 331 may be provided to release a socket latch which holds the PoE plug 33 in place under operational conditions.

Also other lighting system components may be placed in the PoE sockets 12, 12a, 13, 13a and 13b, such as e.g. a PIR sensor 40 used for presence detection.

The PoE sockets 12, 12a, 13, 13a and 13b may be enumerated or otherwise identified by an identification (e.g., address or the like) by allocating a port to which a spotlight or sensor is connected, so that the lamp or sensor position can be estimated.

In a further developed embodiment, PoE plugs or sockets near to each other may have allocated only one logical port at the PSE and mechanical means may be used to block the neighboring PoE plug or socket when respectively a PoE socket or plug is occupied. This reduces the number of PSE ports required. Alternatively, ports may be adapted to detect that a lamp is placed and deactivate related neighboring ports belonging to the same logical port.

In a further developed embodiment, the PoE plugs may be installed in a way that they can rotate. That would allow aiming without any mechanical axis at the lamp side. Then, the rotation angle could be monitored and read through IP connectivity via the data connections allowing to automate lighting controls and scene setting. This may be done in a very rough resolution, e.g., simply allowing to detect whether a lamp points down or to the ceiling or to a wall.

In a further developed embodiment, spotlights may be integrated with actuators for rotation and tilt actuation, which are controlled and monitored via the data connections, e.g., over IP (Internet Protocol). In embodiments where the PoE sockets are configured to be rotatable, they may be rotated by an actuator.

In a further developed embodiment, other PoE appliances like speakers, cameras, access points etc. can be connected via the PoE sockets.

To summarize, a track lighting system has been described in which a power sourcing equipment is integrated, wherein the track comprises multiple data supply sockets through which power is supplied to respective spotlights of the track lighting system. This allows a spotlight to be of a very small size, as only low voltage electronics without specific isolation requirements are required. Yet, the spotlight can still be freely positioned. The data

supply sockets can be placed on a side wall of the track such that the spotlights can be mechanically attached to the track and a data cable is used to power and control it.

Alternatively, the sockets can be placed such that the spotlights can directly be attached via the sockets.

5 While the invention has been illustrated and described in detail in the drawings and foregoing description, such illustration and description are to be considered illustrative or exemplary and not restrictive. The invention is not limited to the disclosed embodiments. The proposed power supply and data control can be established by other data network connections in other types of networks and lighting systems where flexible fixing and control
10 of lamps is desirable.

 Other variations to the disclosed embodiments can be understood and effected by those skilled in the art in practicing the claimed invention, from a study of the drawings, the disclosure and the appended claims. In the claims, the word “comprising” does not exclude other elements or steps, and the indefinite article “a” or “an” does not exclude a
15 plurality. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to advantage.

 The foregoing description details certain embodiments of the invention. It will be appreciated, however, that no matter how detailed the foregoing appears in the text, the invention may be practiced in many ways, and is therefore not limited to the embodiments
20 disclosed. It should be noted that the use of particular terminology when describing certain features or aspects of the invention should not be taken to imply that the terminology is being re-defined herein to be restricted to include any specific characteristics of the features or aspects of the invention with which that terminology is associated.

 A single unit or device may fulfill the functions of several items recited in the
25 claims. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to advantage.

CLAIMS:

1. A mounting device for mounting a plurality of lighting devices (30), the mounting device comprising a track housing (10) with an integrated power supply unit (21) for supplying power via a plurality of data lines (23) to a plurality of data network sockets (12) or plugs (33) arranged on the track housing (10).

5

2. The mounting device of claim 1, wherein the track housing (10) comprises a plurality of track segments each comprising at least one end connector (18) for connecting to another track segment via an intermediate connecting piece (50).

10 3. The mounting device of claim 2, wherein the end connector (18) is adapted be connected to a supply connecting piece (60) which provides a data connection (61) and a power connection (62).

15 4. A lighting system comprising at least one mounting device of claim 1 and the plurality of lighting devices (30), wherein the data network plug (33) or socket (12) of each of the plurality of lighting devices (30) are adapted to be plugged into respectively a data network socket (12) or plug (33) of the at least one mounting device, and wherein each of the plurality of lighting devices (30) comprises a data network plug (33) or socket (12) used for supplying power to said lighting device (30) and adapted to be connected to respectively a
20 data network socket (12) or plug (33) provided on the track housing (10).

5. The lighting system of claim 4, wherein the lighting device (30) further comprises a pigtail-type cable (32) connected to the lighting device (30), and wherein the data network plug (33) is connected to the lighting device (30) via the pigtail-type cable (32).

25

6. The lighting system of claim 4, wherein the lighting device (30) further comprises a fixing foot element (31) for connecting the lighting device (30) to the track housing (10) by means of a fixing element.

7. The lighting system of claim 6, wherein the fixing foot element (31) comprises at least one of a clip, a screw, a clamp, a magnet, a rolling mechanism and a sliding mechanism.

5 8. The lighting system of claim 6, wherein the data network plug (33) or socket (12) is integrated to the fixing foot (31).

9. The lighting system of claim 4, wherein the data network plug (33) comprises an RJ45 plug.

10

10. The lighting system of claim 4, wherein an identification is allocated to network ports of the data network sockets (12) or plugs (33), and wherein the lighting system is adapted to estimate a position of a lighting device on the track housing (10) of the mounting device based on the identification of the network socket (12) or plug (33) to which
15 the lighting device is plugged into.

11. The lighting system of claim 10, wherein the lighting system is adapted to cluster neighboring ones of the data network sockets (12) or plugs (33) on the track housing (10) by allocating a single logical port to them at the power supply unit (21), and wherein a
20 blocking mechanism is provided on the track housing (10) to block a neighboring one of an occupied network socket or plug on the track housing (10).

12. The lighting system of claim 4, wherein the data network sockets (12) and the data network plugs (33) are arranged to allow rotation of data network plugs (33) plugged
25 into data network sockets (12).

13. The lighting system of claim 12, wherein the lighting system is adapted to monitor a rotation angle of an installed data network plug (33) or socket (12) and to provide an information about the monitored rotation angle via a network connection.

30

14. The lighting system of claim 13, wherein the lighting system comprises actuator elements for rotating or tilting at least some of lighting devices, and wherein the actuator elements are controlled via the network connection.

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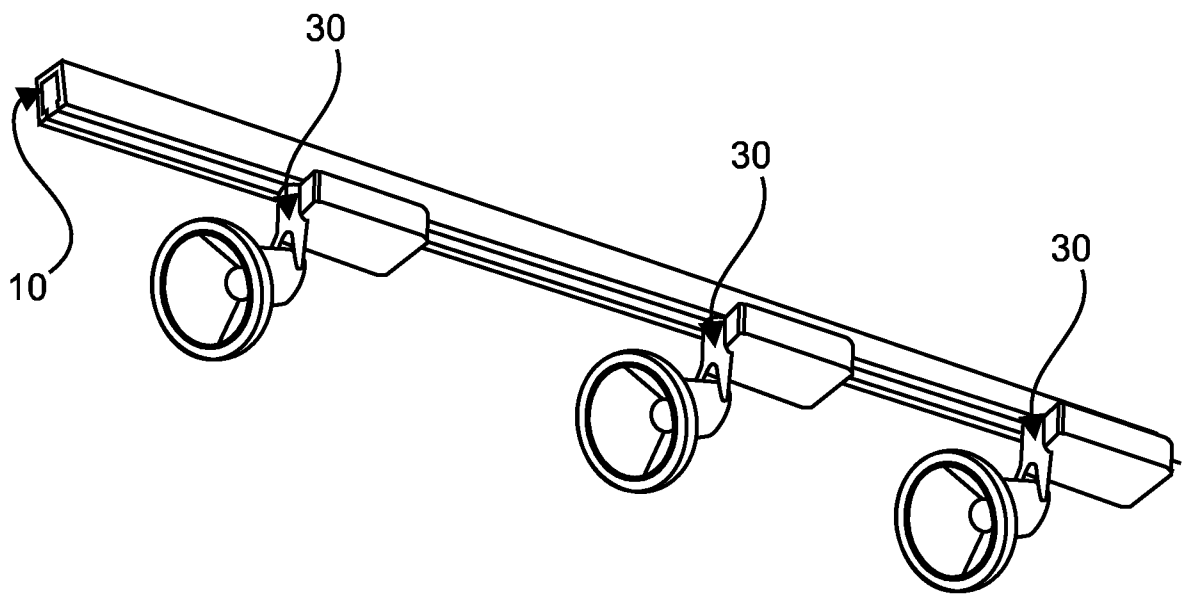


FIG. 1

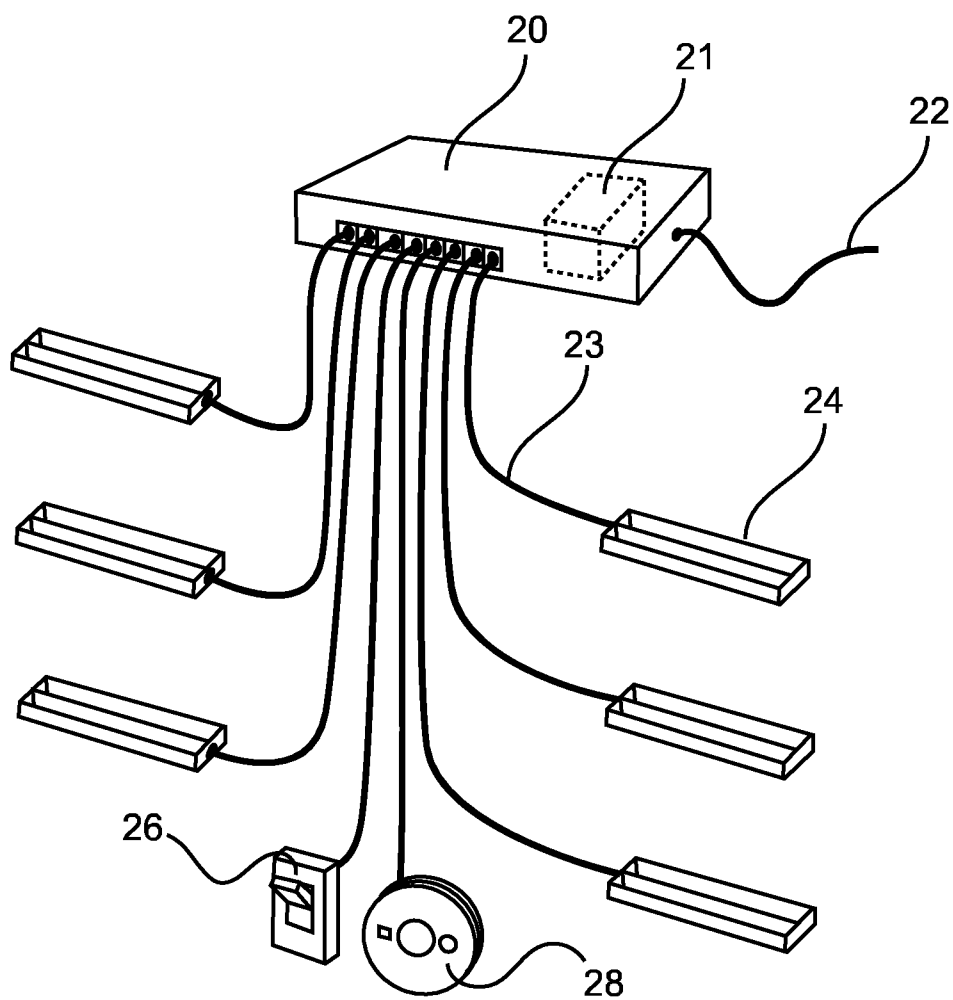


FIG. 2

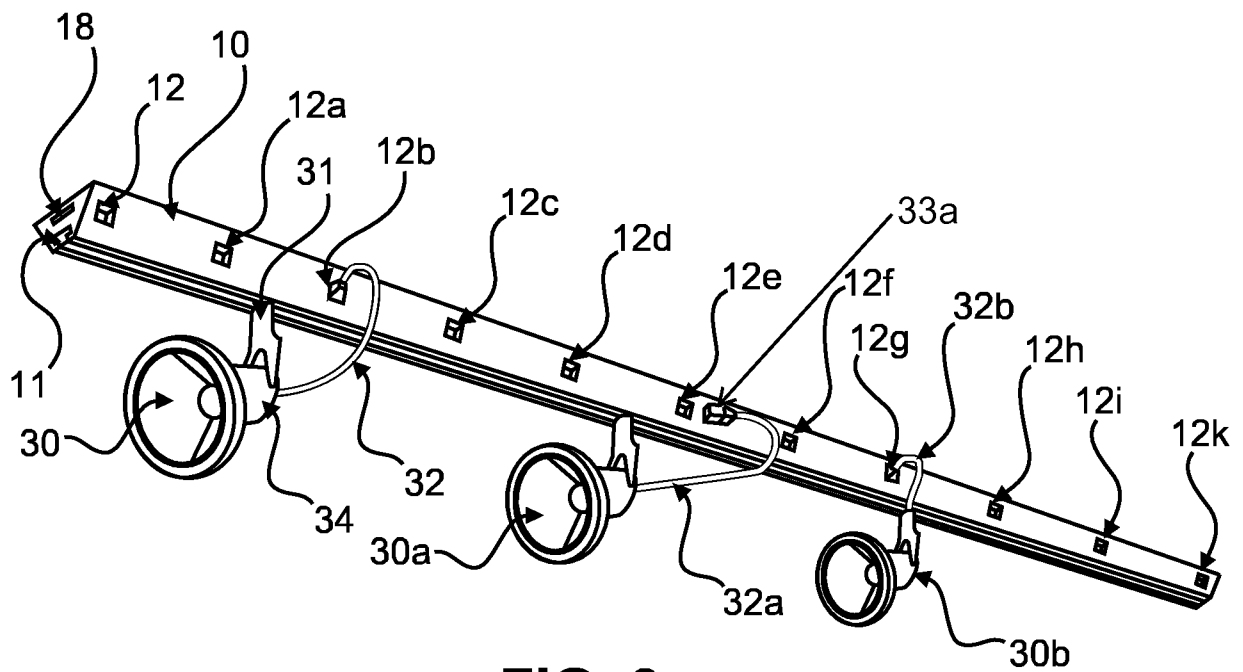


FIG. 3

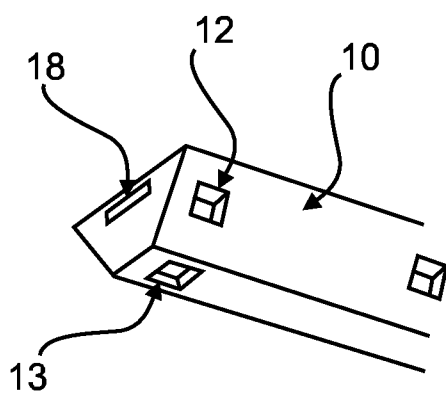


FIG. 4a

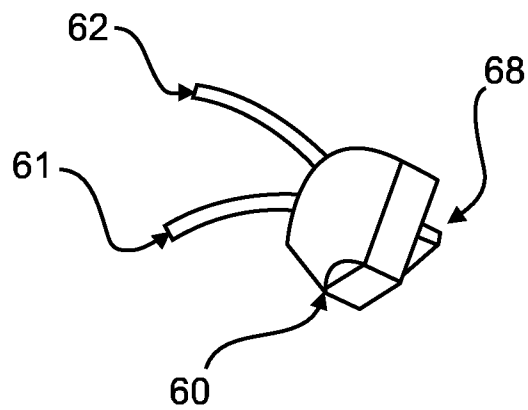


FIG. 4b

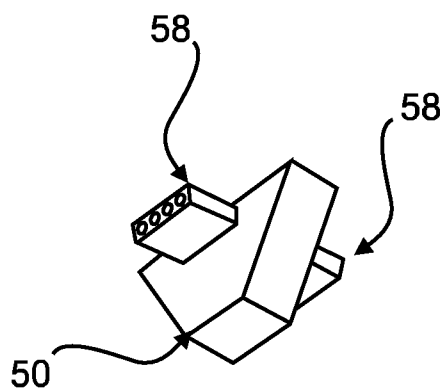


FIG. 4c

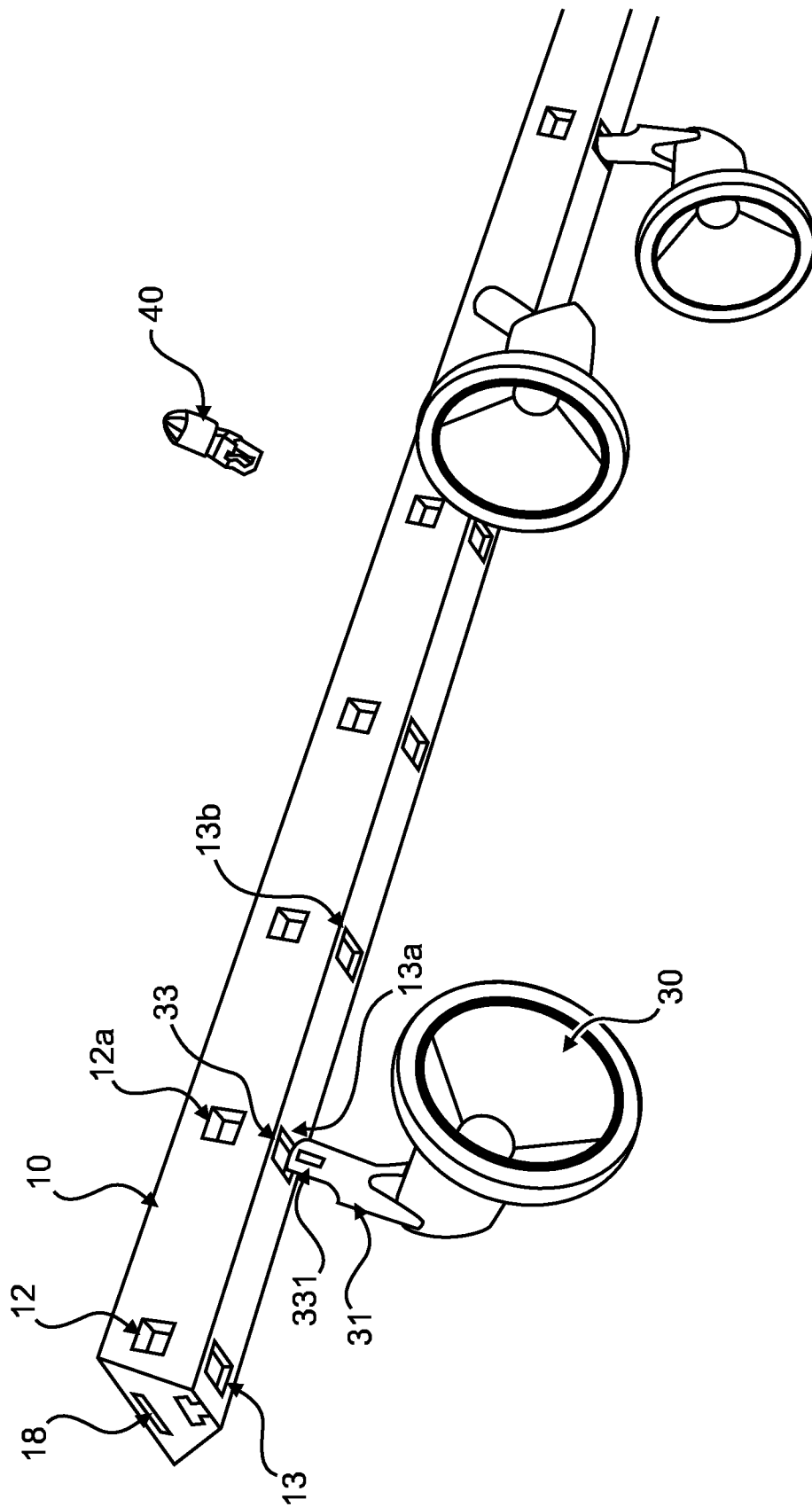


FIG. 5

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2017/075146

A. CLASSIFICATION OF SUBJECT MATTER		
INV.	H05B37/02	F21S8/00
	F21V21/34	H01R25/14
ADD.		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols)		
H05B F21S F21V H01R		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
EPO-Internal, WPI Data		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2011/181200 A1 (LUK JOHN F [US] ET AL) 28 July 2011 (2011-07-28) figures 1,9, 20 paragraph [0029] - paragraph [0031] paragraph [0116] -----	1-10, 12-14
Y	US 8 011 794 B1 (SIVERTSEN CLAS GERHARD [US]) 6 September 2011 (2011-09-06) figures 1, 3A, 3B, 4, 5 column 1, line 17 - line 59 column 2, line 46 - column 3, line 54 column 5, line 54 - column 6, line 14 -----	1-10, 12-14
Y	US 2013/063963 A1 (RIESEBOSCH SCOTT A [CA]) 14 March 2013 (2013-03-14) figures 1, 2 paragraph [0019] - paragraph [0022] ----- -/-	1-10, 12-14
☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
* Special categories of cited documents : "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search		Date of mailing of the international search report
14 December 2017		22/12/2017
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016		Authorized officer Alberti, Carine

INTERNATIONAL SEARCH REPORT

International application No
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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2015/159840 A1 (LIU IVAN [TW]) 11 June 2015 (2015-06-11) figure 4 paragraph [0020] - paragraph [0022] -----	2
Y	US 2016/192461 A1 (MINSKY HENRY BOWDOIN [US]) 30 June 2016 (2016-06-30) paragraph [0027] -----	10
Y	EP 1 483 534 B1 (REMOTE CONTROLLED LIGHTING LTD [GB]) 28 June 2006 (2006-06-28) claim 15 paragraph [0007] paragraph [0030] paragraph [0041] -----	12-14
A	WO 2014/033575 A1 (KONINK PHILIPS ELECTRONICS NV) 6 March 2014 (2014-03-06) page 2, line 8 - line 24; figure 1 -----	1-14
A	US 2006/039168 A1 (MIER-LANGNER ALEJANDRO [US] ET AL) 23 February 2006 (2006-02-23) figures 1, 2, 10a, 15, 16, 17 paragraph [0035] paragraph [0042] - paragraph [0047] -----	1-14
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INTERNATIONAL SEARCH REPORT

Information on patent family members

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