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(54) **Title:** POWER DISTRIBUTION TRACK SYSTEM HAVING SEPARATE AC AND DC CONDUCTORS, ELECTRIC LOAD THEREFOR HAVING AC/DC CONVERTER

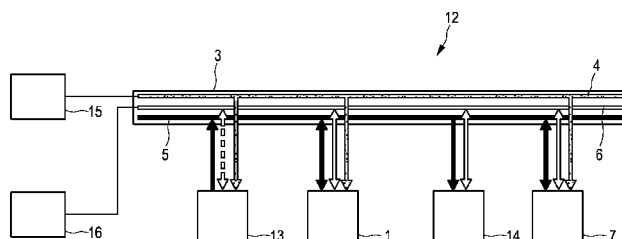


FIG. 1

(57) **Abstract:** The invention relates to an electrical load (1, 7) like a lamp for being attached to a track (3) of a power distribution track system (12) for providing power, preferentially DC power, to the electrical load. The electrical load has an integrated power converter for converting a first power, preferentially AC power, to a second power, preferentially DC power, wherein the second power is supplied to a second conductor (5) of the track. If such an electrical load is attached to the track, not only the load, but also the available second power, which can be provided by the track, is increased. The probability that a power distribution track system gets overloaded, if an additional electrical load is attached to the track, can therefore be reduced, thereby simplifying the installation of a power distribution track system.

POWER DISTRIBUTION TRACK SYSTEM HAVING SEPARATE AC AND DC CONDUCTORS,
ELECTRIC LOAD THEREFOR HAVING AC/DC CONVERTER

FIELD OF THE INVENTION

The invention relates to an electrical load for being connected to a track of a power distribution track system for providing power to the electrical load. The invention relates further to a power distribution track system and a method for setting up the power distribution track system. The invention also relates to a set of electrical loads being

BACKGROUND OF THE INVENTION

Power distribution track systems for lighting fixtures, which provide a direct current (DC) network for supplying DC power to the lighting fixtures, generally comprise a track with several conductors, which is connected to a ceiling of a room. The conductors are electrically connected to DC power supplies at different locations above the ceiling and the lighting fixtures are attached to the track such that they are electrically connected to the conductors within the track, in order to provide the DC power to the lighting fixtures via the conductors of the track.

For installers it is often difficult to select the right number of power supplies for driving the lighting fixtures such that the power limit of the power supplies is not exceeded, which may result in switching off the complete power distribution track system.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide an electrical load for being attached to a track of a power distribution track system, a power distribution track system and a set of electrical loads, which allow providing power, which fits to the electrical loads attached to the track of the power distribution track system, more easily. It is a further object of the present invention to provide a corresponding method for setting up the power distribution track system.

In a first aspect of the present invention an electrical load for being attached to a track of a power distribution track system for providing power to the electrical load is presented, wherein the electrical load has an integrated power converter for converting a first power to a second power and wherein the electrical load is adapted to be attached to the track such that the first power supplied by a first conductor of the track is convertible by the

integrated power converter to the second power and that the second power is supplied to a second conductor of the track.

Since the electrical load comprises an integrated power converter for converting the first power to the second power, wherein the first power is provided by a first conductor of the track and the second power is supplied to a second conductor of the track, with attaching such an electrical load to the track not only the load, but also the available second power, which can be provided by the track, is increased. The probability that a power distribution track system gets overloaded, if an additional electrical load is attached to the track, can therefore be reduced, thereby simplifying the installation of a power distribution track system.

The first power is preferentially alternating current (AC) power provided by an AC power source electrically connected to the first conductor. The second power is preferentially DC power, which is distributed via the second conductor. Correspondingly, the integrated power converter is preferentially an AC/DC power converter.

The electrical load is, for instance, a lamp, a sensor, a user interface device et cetera. For example, the electrical load can be a user interface device, wherein the user interface device can be adapted allow a user to control at least one other electrical device attached to the track. The user interface device may be connected to a control line of the track, to which also the at least one other electrical device may be connected, in order to allow a user to control the at least one other electrical device via the control line by using the user interface device. The at least one other electrical device can be an electrical load comprising an integrated power converter, an electrical load not comprising an integrated power converter or a power source for providing DC power, which is not integrated into an electrical load like a lamp or a sensor. For instance, the user interface device can control a lamp driver of a lamp via the control line. The user interface device can also be adapted to allow user to control one or several power sources, which may be attached to the track and which may also be connected to the control line. For instance, the user interface device can be adapted to allow a user to switch one or several power sources attached to the track on and off. The user interface device can comprise, for instance, a user interface element like a slidable element, which can be slid by a user, or a rotatable element, which can be rotated by a user, for controlling the at least one other electrical device.

The electrical load can be adapted such that, if the integrated power converter is not fully loaded, the output voltage provided by the integrated power converter is lower than or equal to a nominal voltage of the integrated power converter. Thus, the integrated

power converter can be output voltage controlled. Moreover, the electrical load can be adapted such that, if the integrated power converter delivers its maximum output current, the output voltage will be lowered for additionally drawn currents. If the different power converters are connected in parallel, the power converters in the power distribution system will therefore automatically share the total power.

In a further aspect of the present invention a power distribution track system for providing power to an electrical load is presented, wherein the power distribution track system comprises:

- a track with a first conductor for distributing a first power and with a second conductor for distributing a second power,
- an electrical load of a first kind as defined in claim 1 for being attached to the track such that the second power supplied by the first conductor of the track is converted by the integrated power converter and that the second power generated by the integrated power converter is supplied to the second conductor of the track.

The power distribution track system may further comprise a power source for providing second power to be distributed by the second conductor. The power source may be adapted to convert the first power to second power for providing the second power.

The power distribution track system can further comprise an electrical load of a second kind, without an integrated power converter for converting the first power to the second power, for being attached to the track such that the second conductor provides the second power to the electrical load. For instance, the power distribution track system can comprise several electrical loads of the first kind and several electrical loads of the second kind, wherein the electrical loads of the first kind and the electrical loads of the second kind are evenly distributed along the track. This can ensure that the second power, in particular, the DC power, is relatively homogeneously provided along the track.

The electrical loads of the first kind and the electrical loads of the second kind have preferentially different visual appearances. For instance, they can have different shapes, different colors and/or they can be made of different outer materials. This allows a user like an installer to easily determine whether the electrical loads of the first kind and the electrical loads of the second kind are distributed as desired, in particular, whether the electrical loads of the first kind and the electrical loads of the second kind are evenly distributed, by visual inspection.

In an embodiment the power distribution track system comprises several power converters for converting first power from the first conductor to second power to be

provided to the second conductor, wherein at least one of the power converters is an integrated power converter of an electrical load of the first kind, wherein the power distribution track system further comprises a control unit for controlling the power converters. The control unit can be adapted to control the power converters in accordance with a predefined power control schedule.

The power distribution track system may also comprise a control unit for controlling the electrical load, wherein the control unit for controlling the power converters and the control unit for controlling the electrical loads may be the same unit or different units.

In a further aspect of the present invention a set of electrical loads is provided, wherein the set comprises a) a first kind of electrical loads as defined in claim 1 for being attached to the track such that the integrated power converter of the respective electrical load receives the first power from the first conductor, converts the first power to the second power and supplies the second power to the second conductor of the track and b) a second kind of electrical loads, without comprising an integrated power converter for converting the first power of the first conductor to the second power for being supplied to the second conductor, for being attached to the track such that the respective electrical load receives the second power from the second conductor for powering the respective electrical load.

If such a set of electrical loads is attached to the track of the power distribution track system, the likelihood of an overload condition is reduced, because the set of electrical loads also comprises electrical loads of the first kind with the integrated power converter for providing the second power required by the electrical loads. The set may be regarded as being a kit of parts which may be ordered by an installer or an end user for allowing the installer or end user to install the power distribution track system more easily without overloading the system.

In a further aspect of the present invention a method for setting up a power distribution track system as defined in claim 6 is presented, wherein the method comprises:

- providing a track with a first conductor for distributing a first power and with a second conductor for distributing a second power,
- providing an electrical load as defined in claim 1,
- attaching the electrical load to the track such that the integrated power converter of the electrical load receives the first power from the first conductor, converts the received first power to the second power and supplies the second power to the second conductor.

It shall be understood that the electrical load of claim 1, the power distribution track system of claim 6, the set of electrical loads as defined in claim 14, and the method of claim 15 have similar and/or identical preferred embodiments, in particular, as defined in the dependent claims.

5 It shall be understood that a preferred embodiment of the invention can also be any combination of the dependent claims 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.

10 BRIEF DESCRIPTION OF THE DRAWINGS

In the following drawings:

Fig. 1 shows schematically and exemplarily an embodiment of a power distribution track system for providing power to an electrical load,

15 Fig. 2 shows schematically and exemplarily an embodiment of an electrical load of a first kind,

Fig. 3 shows schematically and exemplarily a further embodiment of an electrical load of a first kind,

20 Fig. 4 shows schematically and exemplarily an embodiment of a power source converting AC power to DC power,

Fig. 5 shows schematically and exemplarily an embodiment of an electrical load of a second kind,

Fig. 6 shows schematically and exemplarily a further embodiment of a power distribution track system for providing power to an electrical load, and

25 Fig. 7 shows a flowchart exemplarily illustrating a method for setting up a power distribution track system.

DETAILED DESCRIPTION OF EMBODIMENTS

30 Fig. 1 shows schematically and exemplarily an embodiment of a power distribution track system 12 for providing power to an electrical load. The power distribution track system 12 comprises a track 3 with a first conductor 4 for distributing a first power and with a second conductor 5 for distributing a second power. In this embodiment the first power is AC power provided by an AC power source 15 to the first conductor 4 and the second power is DC power. The power distribution track system 12 further comprises an

electrical load 1 of a first kind being attached to the track 3. The electrical load 1 is schematically and exemplarily shown in more detail in Fig. 2.

The electrical load 1 is a lamp having an integrated power converter 2 for converting AC power to DC power, wherein the electrical load 1 is adapted to be attached to the track 3 such that the AC power supplied by the first conductor 4 of the track 3 is convertible by the integrated power converter 2 to the DC power and that the DC power is supplied to the second conductor 5 of the track 3. The integrated power converter is therefore an AC/DC power converter. The electrical load 1 further comprises a lamp driver 8 receiving DC power from the second conductor 5 and/or the integrated power converter 2 and providing a driving current to a light source 9 of the electrical load 1.

The electrical load 1 further comprises an attaching unit 10 for attaching the electrical load 1 to the track 3. The attaching unit can, for instance, comprise screws for fixing the electrical load 1 at a desired position along the track 3. The attaching unit 10 can of course also comprise other attaching means for attaching the electrical load 1 at a desired position along the track 3. The attaching unit 10 is configured such that electrical contacts of the electrical load 1 contact the respective conductors within the track 3, if the electrical load 1 is attached to the track 3 via the attaching unit 10.

The power distribution track system 12 further comprises a power source 13 for providing DC power to be distributed by the second conductor 5. The power source 13, which is schematically and exemplarily shown in Fig. 4, is an AC/DC power converter for converting AC power from the first conductor 4 to DC power to be supplied to the second conductor 5. Also the power source 13 comprises an attaching unit 17 for attaching the power source 13 to the track 3. The attaching unit 17 can comprise screws or other attaching means and is configured such that, if the power source 13 is attached to the track 3, electrical connectors are electrically connected to the first conductor 4 and the second conductor 5 such that AC power can be received from the first conductor 4 and DC power, which has been generated by the power source 13, can be supplied to the second conductor 5.

The power distribution track system 12 further comprises an electrical load 14 of a second kind without an integrated power converter for converting the AC power to the DC power. The electrical load 14 of the second kind is attached to the track 3 such that the second conductor 5 provides the DC power to the electrical load 14. The electrical load 14, which is schematically and exemplarily shown in more detail in Fig. 5, also comprises a lamp driver 8 for driving a light source line. Thus, in this embodiment the electrical load 14 of the second kind is a lamp. The electrical load 14 further comprises an attaching unit 18 for

attaching the electrical load 14 to the track 3 such that electrical connections of the lamp driver 8 are in contact with the track 3, if the electrical load 14 has been attached to the track 3. The first kind of electrical loads and the second kind of electrical loads may be evenly or unevenly distributed along the track.

5 The power distribution track system 12 further comprises a control unit 16 for controlling the power converters of the electrical loads of the first kind and optionally for controlling the power source 13. The control unit 16 can further be adapted to control also the electrical load 14 of the second kind. The control unit 16 is preferentially adapted to control the different units by control signals transmitted via a third conductor 6 of the track 3 to the
10 respective units. The control unit 16 is preferentially adapted to perform the control in accordance with a predefined control schedule, which may be regarded as being a power control schedule, if the control schedule only defines how the power converters of the electrical loads of the first kind and the power source 13 should be controlled.

 The power distribution track system 12 comprises a further electrical load 7 of
15 the first kind being a user interface device. The user interface device 7 is schematically and exemplarily shown in more detail in Fig. 3.

 The user interface device 7 comprises a user interface unit 11 being adapted to allow a user to control at least one other electrical device attached to the track 3. In this embodiment, the user interface unit 11 is configured to be connected to the third conductor 6,
20 when the user interface device 7 is attached to the track 3, in order to allow the user to control, for example, the electrical load 14, in particular, the lamp driver 8 of the electrical load 14, via the third conductor 6. The user interface unit 11 can also be adapted to control other electrical devices like the power source 13 or the electrical load 1 of the first kind via the third conductor 6. The user interface unit 11 can comprise, for instance, a sliding element
25 for allowing a user to control, for instance, the lamp driver 8 of the lamp 14 by sliding the sliding element. The user interface device 11 can also comprise another user interface element like a rotatable knob, which allows a user to control, for instance, the lamp driver 8 of the electrical load 14 by rotating the rotatable knob as desired. Moreover, also the user interface device 7 comprises an attaching unit 10 for attaching the user interface device 7 to
30 the track 3. The attaching unit 10 is configured such that the user interface unit 11 is electrically connected to the third conductor 6 for providing a control signal and to the second conductor 5 for being supplied by DC voltage, when the user interface device 7 is attached to the track 3.

The integrated power converters 2 and the power converter of the power source 13 are preferentially adapted such that, if the respective power converter is not fully loaded, the output voltage provided by the respective power converter is lower than or equal to a nominal voltage of the respective power converter. Thus, the respective power converter can be output voltage controlled. Moreover, the power converters are preferentially adapted such that, if the respective power converter delivers its maximum output current, the output voltage will be lowered for additional drawn currents. The different power converters are connected in parallel such that the power converters automatically share the total power in the power distribution system.

A set of electrical loads for being connected to the track of the power distribution track system can be provided, wherein the set of electrical loads comprises a) one or several of the electrical loads of the first kind for being attached to the track such that the integrated power converter of the irrespective electrical load receives the AC power from the first conductor, converts the AC power to the DC power and supplies the DC power to the second conductor of the track and b) a second kind of electrical loads, without comprising an integrated power converter for converting the AC power of the first conductor to the DC power for being supplied to the second conductor, for being attached to the track such that the respective electrical load of the second kind receives the DC power from the second conductor for powering the respective electrical load of the second kind. Thus, a kit of parts can be provided, wherein the parts are the electrical loads of the first kind and the second kind. An installer or an end user may be provided with such a set of electrical loads for attaching the electrical loads of this set to the track. The set is preferentially configured such that the number of electrical loads of the first kind and the number of the electrical loads of the second kind do not yield an overloaded power distribution track system, if all electrical loads of this set are attached to the power distribution track system. The installer or end user can therefore just attach all electrical loads of the set to the track, without thinking about whether the power distribution track system may become overloaded.

The track of the power distribution track system is preferentially substantially U-shaped, wherein the track can be mounted to, for instance, a ceiling of a room such that the opening of the substantially U-shaped track is directed to the floor of the room. The different units can be attached to the track by fixing the units in this opening of the substantially U-shaped track via the attaching units.

Fig. 6 shows schematically and exemplarily a perspective view of a further embodiment of the power distribution track system. In this embodiment the power

distribution track system 112 comprises a track 3, to which two electrical loads of the first kind and two electrical loads 14 of the second kind are attached. The electrical loads 14 of the second kind comprise an attaching unit, a lamp driver and a light source as described above with reference to, for instance, Fig. 5. The electrical loads 1 of the first kind comprise a power converter, a lamp driver, a light source and an attaching unit as described above with reference to, for instance, Fig. 2. In this embodiment, the electrical load 1 of the first kind preferentially comprises two different units, which are attached to each other. A first unit 19 comprising the power converter and a second unit 20 comprising the lamp driver and the light source.

The electrical loads 1 of the first kind have another shape than the electrical loads 14 of the second kind, i. e. the electrical loads 1 of the first kind comprise the additional first unit 19 comprising the power converter. The electrical loads 1 of the first kind and the electrical loads 14 of the second kind have therefore different visual appearances.

Alternatively or in addition, the different appearances can be provided by, for instance, different colors and/or different materials of the electrical loads of the different kinds.

In the following an embodiment of a method for setting up a power distribution track system will exemplarily be described with reference to a flowchart shown in Fig. 7.

In step 201 a track with a first conductor for distributing a first power, in particular, AC power, and with a second conductor for distributing a second power, in particular, for distributing DC power, is provided. In step 202 the track is attached to, for instance, a ceiling of a room and the first conductor is electrically connected with a mains power source, in particular, with an AC power source. In step 203 one or several electrical loads of the first kind and one or several electrical loads of the second kind are attached to the track. The electrical loads of the first kind are attached to the track such that the respective integrated power converter of the respective electrical load of the first kind receives the first power from the first conductor, converts the received first power to the second power and supplies the second power to the second conductor. The electrical loads of the second kind are attached to the track such that the second conductor provides the second power to the respective electrical load of the second kind.

The first, second and third conductors are preferentially metallic conductors, especially copper conductors. In particular, the power distribution track systems described above with reference to Figs. 1 to 6 integrate conductors for AC power distribution with conductors for control and with conductors for DC power distribution. Since the AC power is

distributed over the length of the track, the connection to the AC mains power source to the track can be at any position on the track, substantially independently of the position of the power converters, i.e. the integrated power converters of the electrical loads of the first kind and optional further power converters like the power converter of the power source 13. The power converters connect to the AC mains rail, i.e. to the first conductor, and output the DC link voltage, i.e. the DC power, to the DC rail, i.e. to the second conductor. A connection to the control lines may be used or not dependent on the control functionality provided by the control unit.

The electrical loads of the second kind are preferentially lamps having only contacts to the DC conductor and the control conductor, i.e. to the second and third conductors. Preferentially, a lamp driver converts the DC link voltage to a lamp drive current as required by a light source of the respective lamp. Lamp parameters like the light intensity and/or the light color may be controlled by the control unit via the control conductors, i.e. via the control link. Lamp drivers of the electrical loads of the second kind may also only comprise electrical contacts to the DC conductor and the control conductor, i.e. to the second and third conductors, wherein the integrated power converter preferentially has electrical contacts to the AC conductor, the DC conductor and optionally to the control conductor, in order to allow the power converter to receive the AC power from the AC conductor, to convert the AC conductor to the DC power and to provide the DC power to the DC conductor for supplying the generated DC power to the electrical loads attached to the track.

Generally for installers and end users it is not easy to select the right power, in particular, the right number of power converters, to drive an installed number of lamps. If the power limit of the power converter gets exceeded, typically the whole power distribution track system is switched off. There might be a trial and error method used to get this problem solved, i.e. if an overload occurs, lamps may be taken off the track, until the power distribution track system is operable again. Another possible solution for overcoming the problem of a possibly exceeded power limit might be to over specify the power supply making an overload improbable. However, in order to overcome this problem the power distribution track system described above with reference to Figs. 1 to 6 uses electrical loads of the first kind with an integrated power converter, in particular, a set of electrical loads of the first kind with the integrated power converter and of a second kind without the integrated power converter, in order to provide an inherent up scaling of the supplied power, if electrical loads are attached to the track.

The electrical loads of the first kind comprise preferentially AC/DC conversion means, i.e. AC/DC power converters, as a building block. Preferentially, a set of electrical loads to be attached comprises electrical loads of the first kind and electrical loads of the second kind. For instance, if new lamps should be added to a power distribution track system, a fraction of these lamps may have a power converter integrated. The installer or end user may spread these electrical loads over the full track. This also may solve the problem of high currents in the DC conductor, because the power converters are near to the respective group of electrical loads, in particular, the respective group of lamps. The resistance in the DC conductor generally adds some voltage drop between the respective power converter and the respective electrical load, which can lead to a current split. For instance, the power converters in a system may not have a series resistance and the DC conductor may have a resistance of $1\ \Omega$ per meter. If, in this example, a lamp without an integrated power converter is 2 m from a lamp with an integrated power converter on the left and 1 m distance from a next lamp with integrated power converter on the right, the supply DC current may be split into $2/3$ from the right and $1/3$ from the left as taught by the van Kerkhoff rules. This is because in series with the power converter voltage to the left there are $2\ \Omega$ and in series to the power converter on the right there is $1\ \Omega$. The current split to either side depends therefore on the distance, if the resistance in the DC conductor is to be considered.

The integrated power converters, which may form a first unit of the respective electrical load attached to a second unit of the electrical load comprising, for instance, a lamp driver and a light source, may directly and visibly from the outside be attached to the fixture, i.e. to the track, together with the further parts of the respective electrical load, if the respective electrical load is attached to the track. The track may contain a number of copper leads forming the different conductors, two copper leads connected to the mains AC voltage forming the first conductor, two copper leads for distributing the DC voltage forming the second conductor and one or more further copper leads forming the third conductor for controlling purposes.

The installer or end user may order a number of lamps, wherein the ordered number of lamps, i.e. the ordered set of lamps, may always comprise the required number of lamps with integrated power converters. Thus, without the need for a configuration calculation the installer or end user may simply attach all lamps to the track. If the installer or end user keeps an eye on roughly evenly distributing the lamps with the integrated power converters, in particular, which the attached first units comprising the power converters, over

the length of the track, an overload of the power distribution track system can easily be prevented.

The control unit may schedule power delivery by the power converters in addition to the normal function of controlling the lights, if the electrical loads are lamps. The power converters may be adapted to communicate to the control unit the partial load condition, wherein the control unit may decide when a power converter may be switched off. For instance, if the partial load conditions communicated to the control unit indicated that it is not necessary that all power converters are switched on, one or several power converters may be switched off by the control unit.

Electrical loads of the first kind, electrical loads of the second kind and power sources, which are not integrated in an electrical load, can be combined and can cooperate with each other on a track of a power distribution track system. For instance, an electrical load of a first kind being a user interface device can be adapted to control another electrical load of the first kind, an electrical load of a second kind and/or a power source that is not integrated into an electrical load.

The power converter integrated with the electrical load can be provided in a separate housing attached to another housing of the electrical load, which includes other parts of the electrical loads like the lamp driver and the light source, or the power converter and further parts of the electrical load can be included in a common housing.

Although in the above described embodiments the electrical loads are mainly lamps, the electrical loads can also be of another kind. For instance, they can be sensors or user interface devices, wherein a power converter can be integrated in the respective sensor or user interface device. For example, a power converter may be integrated with a user interface unit in a common housing. This may lead to efficient switching on/off and dimming functions, which are easy to realize as the power converter can be provided with the user input from the user interface unit.

The power converters can be adapted such that they automatically switch off, if they are not loaded. Moreover, the power converters can communicate with a central control means, in particular, the control unit, which determines which power converters are needed for the respective load situation. For instance, the electrical loads can be adapted to provide operation information via a control line of the track to the central control means, wherein the central control means can control the electrical loads depending on the received operation information via the same or another control line. The central control means can be adapted to control the power converters depending on power control rules, which define

which power converters should be switched on based on the respective load situation. In particular, if the power distribution track system comprises several lamps and several power converters, the control rules can define how many power converters should be switched on depending on the number of lamps actually being switched on. The central control means can also be adapted to gather maintenance information from the electrical loads via the control line.

The power distribution track system can comprise a single track or several tracks, wherein to each track one or several electrical loads with integrated power converters, one or several electrical loads without integrated power converters and optionally also pure power sources can be attached. The several tracks can be electrically connected to or electrically insulated from each other.

The power distribution track system is preferentially adapted to be a rail-oriented lighting system especially for retail.

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 plurality.

A single unit or device may fulfill the functions of several items recited in the 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.

Any reference signs in the claims should not be construed as limiting the scope.

The invention relates to an electrical load like a lamp for being attached to a track of a power distribution track system for providing power, preferentially DC power, to the electrical load. The electrical load has an integrated power converter for converting a first power, preferentially AC power, to a second power, preferentially DC power, wherein the second power is supplied to a second conductor of the track. If such an electrical load is attached to the track, not only the load, but also the available second power, which can be provided by the track, is increased. The probability that a power distribution track system gets overloaded, if an additional electrical load is attached to the track, can therefore be reduced, thereby simplifying the installation of a power distribution track system.

CLAIMS:

- 5 1. An electrical load for being attached to a track of a power distribution track system for providing power to the electrical load, the electrical load (1, 7) having an integrated power converter (2) for converting a first power to a second power, wherein the electrical load (1, 7) is adapted to be attached to the track (3) such that the first power supplied by a first conductor (4) of the track (3) is convertible by the integrated power
10 converter (2) to the second power and that the second power is supplied to a second conductor (5) of the track (3).
2. The electrical load as defined in claim 1, wherein the electrical load (1, 7) is a lamp, a sensor or a user interface device.
- 15 3. The electrical load as defined in claim 2, wherein the electrical load (7) is a user interface device, wherein the user interface device is adapted allow a user to control at least one other electrical device (1, 13, 14) attached to the track (3).
- 20 4. The electrical load as defined in claim 1, wherein the electrical load (1, 7) is adapted such that, if the integrated power converter (2) is not fully loaded, the output voltage provided by the integrated power converter (2) is lower than or equal to a nominal voltage of the integrated power converter (2).
- 25 5. The electrical load as defined in claim 1, wherein the electrical load (1, 7) is adapted such that, if the integrated power converter (2) delivers its maximum output current, the output voltage will be lowered for additionally drawn currents.
- 30 6. A power distribution track system for providing power to an electrical load, the power distribution track system (12; 112) comprising:
- a track (3) with a first conductor (4) for distributing a first power and with a second conductor (5) for distributing a second power,
- an electrical load (1) of a first kind as defined in claim 1 for being attached to the track (3) such that the second power supplied by the first conductor (4) of the track (3) is

converted by the integrated power converter (2) and that the second power generated by the integrated power converter is supplied to the second conductor (5) of the track (3).

7. The power distribution track system as defined in claim 6, wherein the power distribution track system (12) further comprises a power source (13) for providing second power to be distributed by the second conductor (5).

8. The power distribution track system as defined in claim 7, wherein the power source (12) is adapted to convert the first power to second power for providing the second power.

9. The power distribution track system as defined in claim 6, wherein the power distribution track system (12; 112) further comprises an electrical load (14) of a second kind, without an integrated power converter for converting the first power to the second power, for being attached to the track (3) such that the second conductor (5) provides the second power to the electrical load (14).

10. The power distribution track system as defined in claim 9, wherein the power distribution track system comprises several electrical loads of the first kind and several electrical loads of the second kind, wherein the electrical loads of the first kind and the electrical loads of the second kind are evenly distributed along the track.

11. The power distribution track system as defined in claim 9, wherein the electrical load (1) of the first kind and the electrical load (14) of the second kind have different visual appearances.

12. The power distribution track system as defined in claim 6, wherein the power distribution track system (12; 112) comprises several power converters (2, 13) for converting first power from the first conductor (4) to second power to be provided to the second conductor (5), wherein at least one of the power converters is an integrated power converter of an electrical load (1, 7) of the first kind, wherein the power distribution track system (12; 112) further comprises a control unit (16) for controlling the power converters.

13. The power distribution track system as defined in claim 6, wherein the power distribution track system (12) further comprises a control unit for controlling the electrical load (1).

5 14. A set of electrical loads for being connected to a track of a power distribution track system as defined in claim 6, wherein the set of electrical loads comprises a) a first kind of electrical loads (1) as defined in claim 1 for being attached to the track (3) such that the integrated power converter (2) of the respective electrical load receives the first power from the first conductor (4), converts the first power to the second power and supplies the second
10 power to the second conductor (5) of the track (3) and b) a second kind of electrical loads (14), without comprising an integrated power converter for converting the first power of the first conductor (4) to the second power for being supplied to the second conductor (5), for being attached to the track (3) such that the respective electrical load (14) receives the second power from the second conductor (5) for powering the respective electrical load (14).

15 15. A method for setting up a power distribution track system as defined in claim 6, comprising:

- providing a track (3) with a first conductor (4) for distributing a first power and with a second conductor (5) for distributing a second power,

20 - providing an electrical load (1, 7) as defined in claim 1,

- attaching the electrical load (1, 7) to the track (3) such that the integrated power converter (2) of the electrical load (1, 7) receives the first power from the first conductor (4), converts the received first power to the second power and supplies the second power to the second conductor (5).

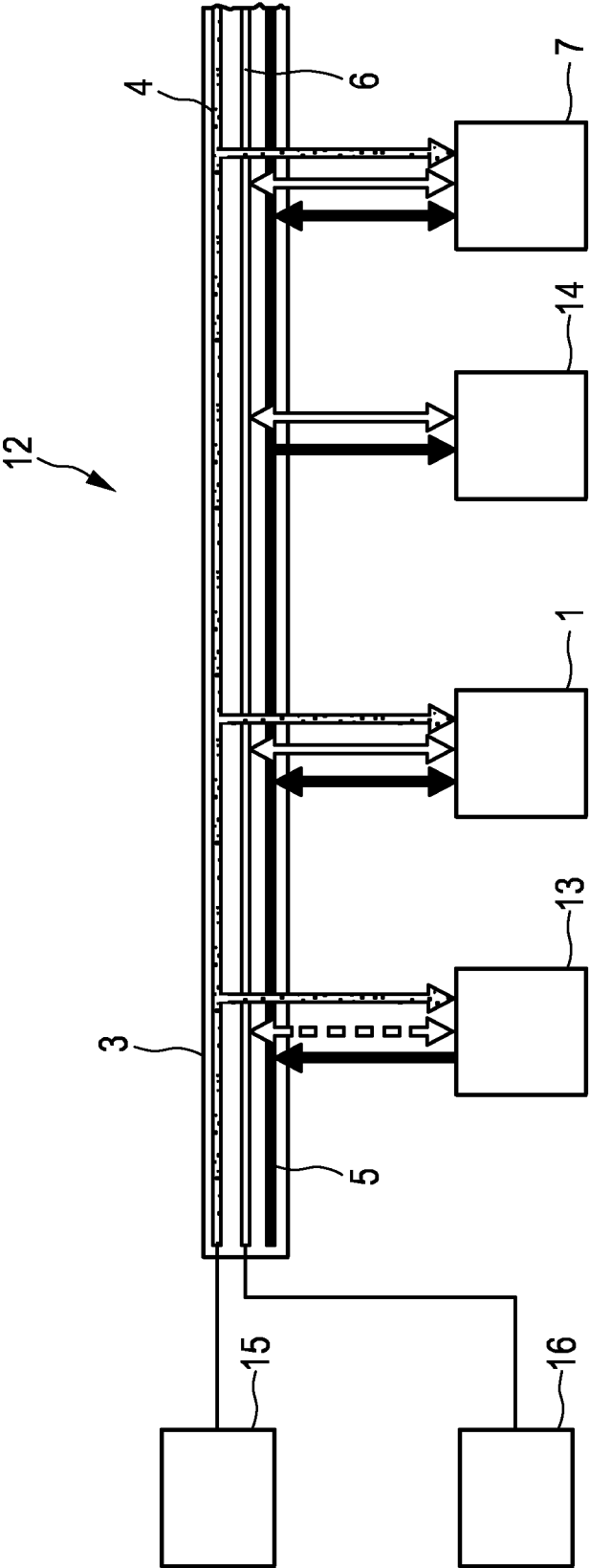


FIG. 1

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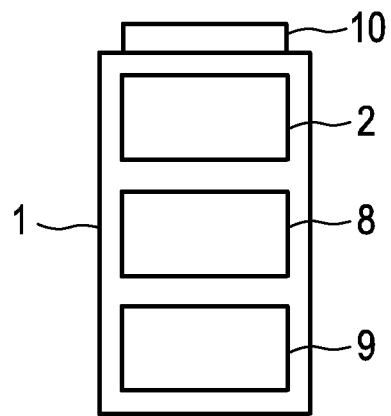


FIG. 2

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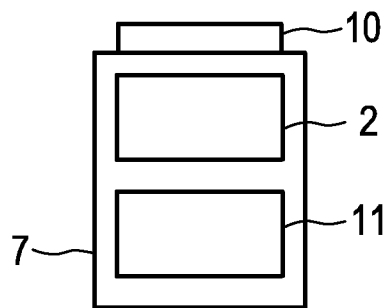


FIG. 3

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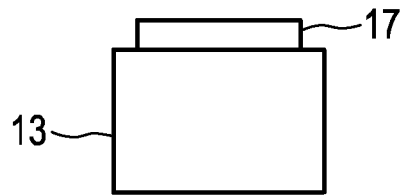


FIG. 4

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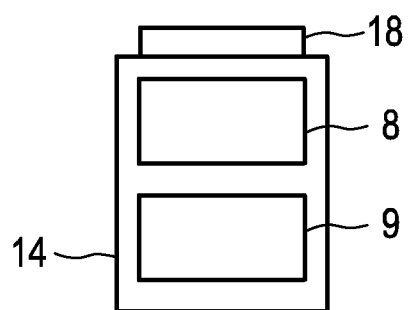


FIG. 5

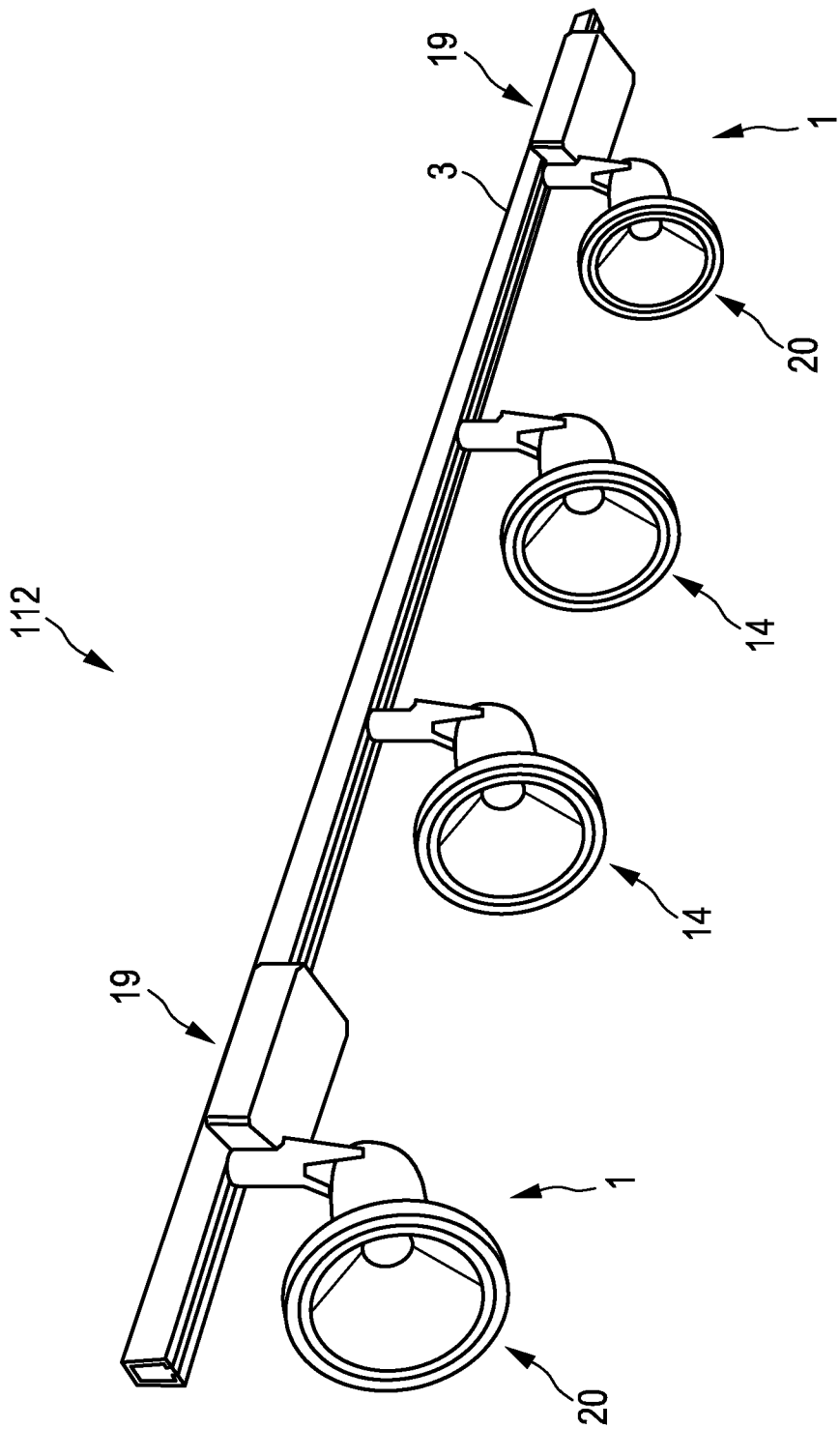


FIG. 6

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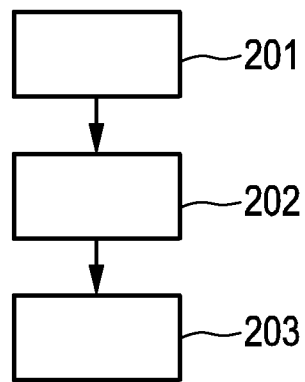


FIG. 7

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2013/051564

A. CLASSIFICATION OF SUBJECT MATTER
INV. H05B37/00 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 H01R H01F H02G

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.
X	US 2007/167043 A1 (LEHMAN GREGG ARTHUR [US] ET AL) 19 July 2007 (2007-07-19) paragraph [0103] - paragraph [0105] paragraph [0264] - paragraph [0269] paragraph [0289] - paragraph [0296] figures 35, 36, 44, 45	1-15
X	US 2012/014042 A1 (TALLAM RANGARAJAN M [US] ET AL) 19 January 2012 (2012-01-19) paragraph [0023] - paragraph [0023] paragraph [0025] - paragraph [0025] claim 19 figure 2 ----- -/-	1,6,14, 15



Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

11 July 2013

Date of mailing of the international search report

25/07/2013

Name and mailing address of the ISA/

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Authorized officer

Bagge af Berga, Hans

INTERNATIONAL SEARCH REPORT

International application No

PCT/IB2013/051564

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X,P	DE 10 2011 017702 A1 (ZUMTOBEL LIGHTING GMBH [AT]) 31 October 2012 (2012-10-31) paragraph [0001] - paragraph [0001] paragraph [0011] - paragraph [0011] paragraph [0013] - paragraph [0013] paragraph [0030] - paragraph [0032] paragraph [0035] - paragraph [0035] paragraph [0040] - paragraph [0047] figures 1, 3, 5-7 -----	1,6,14, 15
A	US 2009/236909 A1 (ALDAG PHILIP R [US] ET AL) 24 September 2009 (2009-09-24) paragraph [0007] - paragraph [0007] paragraph [0052] - paragraph [0052] paragraph [0056] - paragraph [0056] paragraph [0070] - paragraph [0071] paragraph [0074] - paragraph [0075] paragraph [0084] - paragraph [0084] paragraph [0095] - paragraph [0101] claims 10, 32 figures 1, 2, 4, 5, 11A, 13, 20 -----	1-15
A	US 2012/002356 A1 (LINNANE JENNIFER [US] ET AL) 5 January 2012 (2012-01-05) paragraph [0012] - paragraph [0012] figure 5 -----	1-15

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/IB2013/051564

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 2007167043	A1	19-07-2007	NONE	

US 2012014042	A1	19-01-2012	CN 202285365 U	27-06-2012
			EP 2407982 A2	18-01-2012
			US 2012014042 A1	19-01-2012

DE 102011017702	A1	31-10-2012	DE 102011017702 A1	31-10-2012
			WO 2012146636 A2	01-11-2012

US 2009236909	A1	24-09-2009	DE 112009000697 T5	10-02-2011
			US 2009236909 A1	24-09-2009
			US 2011237097 A1	29-09-2011
			US 2011244715 A1	06-10-2011
			WO 2009117500 A2	24-09-2009

US 2012002356	A1	05-01-2012	CA 2795625 A1	26-01-2012
			US 2012002356 A1	05-01-2012
			WO 2012011982 A2	26-01-2012
