

LIGHT FIXTURE, OPERATING UNIT, POWER RAIL,
CIRCUIT, AND POWER-RAIL ADAPTER

The invention to start with relates to a light fixture according to the preamble of the claim 1.

Such light fixtures are well known and quite common. They have as well been fabricated by applicant for decades. As an example, reference is here made to a focal flood fixture that is described in the current catalogue of applicant in the 2004/2005 edition on page 486 and the following and that has several differently colored light sources. The light sources are connected to power-supply lines that provide line voltage or operating voltage for the light sources. Furthermore, the fixture has three electronic ballasts so that the three light sources can be controlled individually. The ballast can for example be a ballast functioning according to the DALI protocol that can be addressed individually and that is connected to a signal line. The light fixture can be integrated into a lighting system and can receive control information from a central controller via the signal line. For example, it is possible to transmit the information from the central controller to one of the light sources of the light fixture to switch to a particular dimming state, e.g. for the purpose of mixing colors, to blink, to switch on, to switch off, or the like.

The power-supply line, which generally is associated with a phase conductor and a null conductor, is typically connected to the light fixture via a first conductor and transfers for example an operating voltage AC of 230 V or 110 V. For connection of the signal line, a second connection is provided on the light fixture or on the operating unit

assigned to the light fixture, that is, e.g. the electronic ballast. The signal line typically is a two-conductor line that transfers voltages up to 25 V for example. The signal line is normally offset from the power-supply lines.

Starting from a light fixture according to the preamble of claim 1, it is an object of the invention to provide a light fixture that offers a much safer installation with respect to mounting errors.

The invention attains this object with the features of claim 1, in particular of its characterizing clause, and is thus characterized in that the second connection provides protection against excess voltage and can be exchanged or switched.

The principal of the invention thus is essentially that a cutout is provided that operates when voltage exceeds a threshold voltage. If an incorrect mounting occurs, that is, an incorrect connection of the lines, so that the far higher operating voltage is accidentally applied to the second connection for the signal line, the cutout is actuated. If the cutout is advantageously of the fusible type, the fusible filament overheats and melts so as to protect the downstream light fixture or operating unit of the light fixture and any of its electronics against an excess voltage by interrupting the circuit. Otherwise, if the high operating voltage of for example 230 V met e.g. a 12 V low voltage transformer, copper could be vaporized, which beside direct health damage affecting the installer would also involve in a disadvantageous manner an damage to the electric and electronic parts of the light fixture, in case insulating parts or areas are made conductive after a precipitation of the copper on them, which can entail further consequential

damage. Other damage to parts of the light fixture or of the operating unit are possible.

The cutout is in most cases a sacrificial part, as for example a melt-type fuse, and is replaceable. A fusible fuse is advantageously mounted in an accessible location on the light fixture and can be held by standard spring clips so that once it is blown it can be replaced by a new fuse. Alternatively the cutout can be resettable so that it automatically, once it detects a voltage exceeding the threshold voltage, is triggered and subsequently is either reset manually from its tripped state interrupting the circuit into a conductive state or can automatically switch back, for example after a predetermined interval.

It is particularly important that the cutout respond very quickly and when open protect permanently against voltages up to 400 V. This high level of protection of the tripped cutout is necessary when instead of two signal lines two phase lines of different potential are connected to the second connection.

The cutout is particularly advantageous when the light fixture is mounted on a power rail. The cutout can in this case react when there is a mistaken connection of the conductors in the power rail and thereby protect the light fixture or the operating unit.

The provision of an replaceable cutout or a manually resettable cutout in an accessible location can for example mean that only one portion of the housing of the light fixture of the operating unit need be opened, so that when it is opened for example a holder of the fusible cutout is accessible so that the fuse can be taken out and replaced with a new fuse.

According to an advantageous embodiment of the invention, an operating unit is assigned to the light fixture on which the first and/or the second connection is mounted. As operating unit of the light fixture can for example be cited an electronic ballast, a transformer or another device that is directly assigned to the light fixture by means of which the function of the light fixture can be controlled. The operating unit typically is mounted directly in close proximity to the light fixture and can for example be in the housing of the light fixture or in a separate operating unit housing. In the case that the light fixture is connected via an adapter to a power rail, the operating unit can also be within a housing of the power-rail adapter.

According to a preferred embodiment of the invention the second connection has two terminals for signal lines that can be short circuited by an electronic element, in particular a varistor, so that when a voltage is applied to the terminals that exceeds a threshold voltage a larger current passes through the cutout. This larger current will actuate the cutout.

While with reduced voltages, in the case of a standard hookup, the electronic circuit element is effectively inactive, for example its electrical resistance is extremely high, virtually no current flows through the electronic circuit element, but when the threshold voltage is exceeded, namely in case of an improper installation, a sufficient current flows through the circuit element because as a result of the large voltage, e.g. above a threshold voltage of 60 V, the electrical resistance of the element is significantly decreased. Such a known circuit element is a varistor (variable resistor).

In case of an incorrect installation instead of the signal like a pair of phase conductors are connected with the second connection, as a result of the larger current flowing through the electronic part a corresponding current flows through the cutout. In the case of a fusible cutout this larger current causes resistive heating that melts the filament and actuates the fuse. Once the fuse is tripped and the circuit is interrupted, the downstream electronic parts of the operating unit and of the light fixture are protected from the excess voltage so that there is no damage to these parts.

Once the fuse has been operated it is merely necessary to replace or reset it, not the much more expensive light fixture or operating unit.

According to a preferred embodiment of the invention the cutout is triggered at a voltage of 30 V to 50 V, in particular above 230 V and further in particular above 300 V.

This embodiment of the invention takes into account to start with the control information moving through the signal line are typically signals of voltages less than 30 V, in any case less than 230 V. In case that instead of two signal lines being connected to the second connection mistakenly two phase lines are connected, voltages of more than 400 V can be applied so that the fuse and the varistor must be correspondingly rated. The voltage above which the cutout is triggered should be so selected according to the invention that it is above the voltage used to transmit control information plus something for compensating for tolerance variations, for example in the neighborhood of a few volts or about 10 V.

According to a further advantageous embodiment of the invention, the control information corresponds to the DALI

protocol (Digital Addressable Lighting Interface). This protocol that has been elaborated by the Arbeitsgemeinschaft DALI beim Zentralverband der deutschen Elektrotechnik- und Elektronikindustrie e. V. (ZVEI) (working committee at the umbrella association of German electrical engineering and electronics industry) is for example described in detail in the previously published handbook DALI of the DALI AG, 2nd edition, 2001, editor Richard Pflaum Verlag Munich.

The invention also relates to an operating unit for a light fixture, in particular an electronic supply unit according to the preamble of claim 6.

Such an operating unit can be part of a light fixture or can be mounted separately from the light fixture, preferably in direct proximity to the light fixture. In addition to electronic ballast devices also other devices can be possible operating units of the light fixture by means of which the light fixture can be dimmed, switched on or off or by means of which the radiation behavior or the color of the light fixture can be influenced in another manner or by means of which a light source of the light fixture can be controlled.

The operating unit according to the prior art typically has a first connection for connecting with a power-supply line by means of which the supply voltage for operating the light source of the light fixture is transmitted. The operating unit furthermore has a second connection for a signal transmission by means of which the control information for controlling the light fixture is transmitted. The control information can for example be designed according to the DALI protocol.

An output of the operating unit is typically connected to the light source so that the operating unit can control the light source or the light sources according to the received control information or control commands of the operating unit.

Starting with this state of the art it is an object of the invention to modify the operating unit of the preamble of claim 6 such that it provides greater protection against installation errors.

The invention attains this object with the features of claim 6, in particular its characterizing clause and is thus characterized in that in that the second connection is provided with a cutout that protects against excess voltage and that is replaceable or resettable.

In order to avoid repetition, reference is made to the features of claims 1 to 5 and the features, descriptions, and advantageous of the light described there are also applicable in an analogous manner to the operating unit.

The cutout complies with the one described above with reference to a light fixture. It is either replaceable or resettable. The cutout can be incorporated in the operating unit or mounted upstream of it.

In addition the invention relates to a power rail according to the preamble of claim 10.

Such a power rail is known for example from DE 100 25 646 A1. The known power rail has voltage-supply lines (standard phases 1, 2, and 3), phase conductors, that supply a light fixture with operating voltage. In addition the known power rail also has control lines that serve to control the light fixture and thus form signal lines as defined in the

preamble of claim 10, over which control information is transmitted to the light fixture.

The light fixture has a first connection by means of which it is connected to the phase conductors of the power rail and at least one second connection by means of which it is connected to the signal line of the power rail. The two connections of the light fixture naturally are formed as terminals engageable with the conductors in the power bar. The light fixture can also have an operating unit that receives the control information and operates the light source. Instead of providing the operating unit in the light fixture, the operating unit can simply be connected to the two connections of the light fixture.

Based on the known power rail it is an object of the invention to modify a power rail according to the preamble of claim 10 that it better protects the light fixture or an operating unit for the light fixture against damage caused by incorrect mounting or incorrect wiring of the power rail.

The invention attains this object with the features of claim 10, in particular with those of its characterizing clause, and is thus characterized in that the second connection is provided with a cutout that protects against excess voltage and that is replaceable or resettable.

In order to avoid repetition the above is referred to as regards claims 1 to 5, it being noted that the features, description, and advantageous that there refer to a light fixture can in an analogous manner be applied to the power rail according to the invention on which the light fixture of the operating unit is mounted.

A substantial advantage of the power rail according to the invention is that a standard power rail having fro

example three phase conductors and a null conductor can not only be connected to a light fixture that receives signal information via a signal line without any installation error having serious consequences. The provision of an excessive-voltage cutout that can be replaced or reset makes it possible to protect the valuable operating unit or the light fixture in case of an excess voltage resulting from an incorrect installation. Replacing or resetting the cutout from the tripped condition into a rest position in which it is conductive can be done after the installation is fixed without substantial costs to the operability of the light fixture or of the operating unit.

The cutout can thus for example be provided on the power rail or directly or indirectly on an adapter or the like that is mounted on the power rail.

The invention relates further to a circuit according to the preamble of claim 14.

The object of the invention here is to make a circuit for a light fixture or for an operating unit or for a power rail nonresponsive to an error in installation.

The invention attains the object with the feature of claim 14, in particular of its characterizing clause and is thus characterized in that the second connection has a cutout that protects against excess voltages and that is replaceable or resettable.

The principle and the advantages of this invention are best understood with reference to the principles of the invention described with reference to a light fixture and as defined in claims 1 to 5, so that to avoid repetition reference is made to the above which also applies to a circuit.

The circuit according to the invention can also be made separate from a light fixture or operating unit or power rail and can be connected as a separate element to a light fixture, to an operating unit, or to a power rail.

The invention furthermore relates to a power rail according to the preamble of claim 18.

The known power rail has been fabricated for example for decades under the denomination three-phase power rail by applicant. It typically comprises three phase conductors and one null conductor by means of which a light fixture or several light fixtures can be supplied with operating voltage.

Here typically a power-rail adapter is set in a generally U-shaped power rail and mechanically and electrically locked with the power rail. The various phase conductors can be selectively contacted in order to control the light fixture or a group of light fixtures.

The object of the invention consists in further developing the power rail such that the control of the light fixtures is simplified.

The invention resolves this object with the features of claims 18, in particular with those of the characterizing part and accordingly is characterized in that wiring is provided that connects one of the two conductors as signal conductor for transferring control information to the light fixture.

The principle of the invention substantially consists in the fact that a common power rail, e.g. a three phase conductor power rail is connected by wiring such that one or several of the existent conductors, preferably two conductors are used in the standard way for supplying power to the light fixture, at least one, advantageously two of the

present conductors being used in a new manner for signal transmission for transferring control information to the light fixture.

Due to the arrangement of the wiring, also existing power rails that are installed in a building in a fixed manner can be used for controlling light fixtures that e.g. have a DALI ballast or a DALI operating unit. The DALI light fixtures can receive their control information via the existing power rail without the need of installing additional lines. Thus, there is very little installation expense, since it solely requires a modification of the wiring of the power rail. Existing three-phase power rails can thus be easily retrofitted.

The novel wiring can preferably comprise a wiring part that connects an end of the power rail with a central controller for a network of light fixtures.

The invention enables one to have recourse to existing power rail systems that solely have to be connected in a way different of the common connecting way, the power rail not being connected with three phase conductors and one null conductor but with one null conductor and one phase conductor and with an operating unit of the DALI network or of another network.

According to an advantageous embodiment of the invention, a tag is mounted on the power rail that indicates that one of the conductors is used for transmitting control information.

This enables a particular easy way of indicating in which mode the power rail is operated or how the power rail is being operated. The person who wants to connect a light fixture to the power rail can in this manner verify very

quickly if the power rail is operated as a common three-phase power rail or in the manner according to the invention as a one-phase power rail that has two control lines.

Further, the tag can advantageously be attached to the power rail in a removable manner so that it can be used as an additional element or as accessory element. It is further advantageous that the tag can be clipped to the power rail so that without separate means, the tag can be mounted on the power rail.

In conclusion, the invention relates to a power-rail adapter according to the preamble of claim 25.

Such a power-rail adapter is for example known from DE 103 12 012 A1 of applicant that is referred to herein for the purpose of avoiding repetitions and whose content is included herewith also for the purpose of recourse to particular features or groups of features into the content of the present patent application.

The known power-rail adapter serves for the mechanical and electric connection of a light fixture with a power rail. In the same manner, the adapter can also serve for providing the mechanical and electric connection of the operating unit with the power rail, if an operating unit is present, as well as possibly for providing the connection for the light fixture. The operating unit can for example also be incorporated in the housing of the power-rail adapter.

The known power-rail adapter of applicant functions in an advantageous manner with only few components and enables particularly easy mounting. The known power-rail adapter therefore has a first and a second switch shaft that on the one hand has a phase-conductor contact and on the other hand

has a null-conductor contact by means of which the conductor bars in the power rail can be contacted.

On the basis of this prior art, the object of this invention consists in further developing a power-rail adapter according to the preamble of claim 1 such that also a light fixture that has a first connection for connection with a power-supply line and a second connection for connection with a signal line and having a simple structure can be connected to the power rail.

The invention resolves this object with the features of claim 25, in particular with those of the characterizing part and accordingly is characterized in that each switch shaft has two contact elements that are connected to the switch shaft in a rotary manner.

The principle of the invention substantially consists in the fact that two contact elements are assigned to both switch shafts. All contact elements can be placed in the switch shafts due to an advantageous positioning despite of the limited space. Each contact element has a plug element, preferably a plug terminal. The plug element can be connected to a line conductor that has a mating plug element. The mating plug element can for example be a flat pin bushing.

The plug element, preferably each plug element, is disposed near the pivot axis of the switch shaft. Moreover, the plug element, preferably each plug element, is substantially oriented next to the pivot axis of the related switch shaft, that is, parallel to the pivot axis. Due to this arrangement, the bending load of the line conductors is minimized as a result of a pivotal or rotational movement of the switch shaft. Damaging of the conductors is thus practically excluded.

Due to the fact that two contact elements are assigned to each switch shaft, recourse can be made to the common structure of the adapter described in DE 103 12 012 A1.

Each switch shaft has a rotational axis that in the mounted stated is oriented substantially perpendicular to the longitudinal axis of the power rail. The operating surfaces for performing a rotational movement upon the respective switch shaft accordingly are situated out of the inner space of the power rail and enable comfortable access for a user with the possibility of transmitting high torque. Typically, the operating surfaces are disposed on a broad axial portion of the respective switch shaft or on a separate operating lever.

The pairwise distribution of the in total four required contact elements for the contacting of a null conductor, of a phase conductor and of two signal lines to two separate switch shafts enables applying little operating forces for rotating the switch shafts. In contrast to a power-rail adapter of applicant that is known from prior use in which by means of an operating wheel that is pivotable about a rotational axis that is situated in the longitudinal axis of the power rail and in which as a result of the rotation of the operating wheel, four contacts can be simultaneously extended, the operating forces are practically halved in the construction according to the invention providing two switch shafts for two respective contact elements, which facilitates operation. Furthermore, with two switch shafts, there is the possibility of locking the switch shafts against each other so that a first switch shaft can be actuated when a second switch shaft has already been actuated,

as it is already provided in the known power-rail adapter according to DE 103 12 012 A1 of applicant.

Advantageously, the power rail has a common outlet for all four or more conductors. This way, it is furthermore advantageous if a switch shaft on which two contact elements are disposed has an opening for at least two further conductors, these two conductors contacting the plug element of the contact elements of the respective other switch shaft.

Furthermore, it is advantageous if the plug elements of one switch shaft, for example of the switch shaft that has the contact elements for contacting the signal lines is oriented in the mounted state of the power-rail adapter to the bottom of the power rail, while the plug elements of the contact elements of the other switch shaft are spaced away from the bottom of the power rail. This enables a particularly advantageous guiding of conductors within the power-rail adapter as well as the easy possibility of providing a common outlet for all conductors on the power-rail adapter.

Due to the arrangement of the plug elements on the contact elements, the mounting of the power-rail adapter can easily be effected. Moreover, the power-rail adapter can be fabricated with only small number of components. It is surprising that despite of the limited space for the contacts in the power rail due to the dimensions that are determined by the inlet slot in the power rail, an arrangement of two contact elements on one switch shaft is possible. Advantageously, the two contact elements are separated from each other by a plastic or another electrically insulating material.

Further advantages of the invention result from the non-cited subclaims as well as from the following description of examples of embodiments shown in the figures. Therein:

FIG. 1 is a schematic partially sectional view of a common three-phase power rail of the prior art that can be operated according to the invention also for transmitting control information;

FIG. 2 shows in schematic view a sample of a tag according to the invention;

FIG. 3 is a very schematic block-diagram representation of a first example of embodiment of a light fixture according to the invention;

FIG. 4 is a schematic block-diagram representation of a circuit according to the invention connected at the inlet side of a common operating unit;

FIG. 5 shows in a perspective, schematic view an example of an embodiment of a power-rail adapter according to the invention having two housing shells in an open position;

FIG. 6 shows the power rail according to FIG. 5 in perspective exploded view;

FIG. 7 shows an altered perspective exploded view in a representation according to FIG. 6 with other parts;

FIG. 8 shows a contact element for a switch shaft in a sectional view;

FIG. 9 shows the contact element of FIG. 8 in perspective view;

FIG. 10 shows with respect to FIG. 6 the switch shaft on the right in bottom view, generally according to arrow A in FIG. 6;

FIG. 11 shows the switch shaft according to FIG. 10 in a schematic partially sectional view, generally according to section line XI-XI in FIG. 10;

FIG. 12 shows the switch shaft according to FIG. 10 and 11 in a perspective angular view; and

FIG. 13 shows with respect to FIG. 6 the switch shaft on the left in a schematic sectional view in a representation according to FIG. 11.

First, starting from FIG. 3 an embodiment of a light fixture according to the invention referenced 10 in its entirety will be explained. It will be noted that in the following description of figures for the sake of clarity like or comparable parts or elements are referred to with same reference numbers some times with the addition of lower-case letters.

The light fixture 10 according to the invention comprises in common design a housing 11 in whose interior 12 a light source 13 is fixed. The light source, such as a light bulb, is supplied with operating voltage through two schematically indicated supply lines 14a and 14b. The supply lines connect the light source 13 with a schematically indicated operating unit 15 for the light source, such as according to type an electronic ballast. The electronic ballast 15 also has an output 16 for connecting the supply lines 14a and 14b to a first connection 17 for connecting to power-supply lines 19a and 19b and a second connection 18 for connecting the operating unit 15 and thus the light fixture 10 to signal lines 20a and 20b. The second connection 18 belongs to both the operating unit 15 and the light fixture 10.

The light fixture shown in FIG. 3 corresponds with respect to the basic structure to the prior art, however it

contains a removable fuse described below. It is not critical for the invention how many light sources 13 or how many operating units 15 are assigned to the light fixture 10. It is also conceivable that different or differently colored light sources are provided in a light fixture and that they are operable by one or more operating units. Likewise, the light fixture 10 according to the invention or the operating unit 15 according to the invention also can have several first connections 17 and several second connections 18.

FIG. 4 shows as a schematic block diagram a common operating unit 15' functioning as an electronic ballast that can be used in the light fixture 10 according to FIG. 3 as an operating unit 15 according to the invention supplemented with a circuit 21. Thus, the operating unit referred to with 15' in FIG. 4 is an operating unit of the prior art that has an output 16 for the supply lines 14a and 14b to the light source 13, a first connection 17 with two connection points 23a and 23b for connecting to the power-supply lines 19a and 19b as well as a second connection 18' with two connection points 22a and 22b that serve in the case of the common operating unit 15' for connecting to the signal lines 20a and 20b. Thus, the connection points 22a and 22b represent the inputs of common electronic ballast 15'.

Upstream of the connection 18' of the common ballast 15' is the circuit 21 on the input side that has a removable fuse 25 between the connection points 24b and 22b and a varistor 26 connected in parallel with the two connection points 22a and 22b, i.e. a variable fuse. Connected to the connection points 24a and 24b of the circuit 21 are in case of the light fixture 10 according to the invention or in case of

an operating unit 15 according to the invention the signal lines 20a and 20b.

While operating voltage, such as 230 V alternating current, is supplied through the power-supply lines 19a and 19b of the light fixture 10 the control information is modulated as signals onto the signal lines 20a and 20b with low power amplitudes, such as up to 20 or 30 V. Normally, i.e. when the light fixture 10 or the operating unit 15 is appropriately connected to the signal lines 20a and 20b through the second connection 18, only the lower power that transmits the control information is applied at the connection points 24a and 24b. Accordingly, only the lower power is also applied at the connection points 22a and 22b.

If it so happens due to an incorrect installation whose occurrence will be discussed below that a higher power, such as the operating voltage at the level of e.g. 230 V or in case of an incorrect mounting at two phase conductors a power at a level of 400 V transmitted by the power-supply lines 19a and 19b, is applied at the connection points 24a and 24b the varistor 26 that normally disables current flow between the connection points 22a and 22b can switch into a conductive state. Namely, a varistor 26 has the specific feature that below a threshold voltage it is not conductive for current and above a threshold it becomes conductive for current. If a threshold voltage is chosen, e.g. 60 V, such that the voltage region for transferring the control information is below the threshold and the voltage region that commonly serves the power supply of the light fixture 10 is above the threshold the varistor 26 becomes conductive for current in the case of an incorrect connection such that a high current flows through

the varistor 26. This high current flows at the same time also through the fuse 25 and actuates it.

Advantageously the fuse 25 is designed as lead fuse and has for example a metal thread disposed in a quartz glass capillary tube filled with sand that melts when a threshold current is exceeded and separates electrically the connection points 24b and 22b securely, i.e. puncture-proof and permanently from each other after melting thoroughly.

If actuating of the fuse 25 results in the case of an incorrect connection of the connection points 24a and 24b the electronics 27 of the operating unit 15 connected downstream of the connection points 22a and 22b and incompletely illustrated in FIG. 4 as well as the light sources disposed downstream are protected against excess voltage. After actuating the fuse 25 it is sufficient to switch the fuse 25 with a new fuse after correction of the connection of the signal lines 20a and 20b of the respective power-supply lines 19a and 19b without it being necessary to switch the operating unit 15 or parts of the electronics 27. Also the varistor 26 can remain in the circuit 21.

Instead of a common fusible cutout as used widely in electrical apparatuses and held for example by means of metal spring legs such that it is removable by manual actuation a circuit breaker can also be used which is not shown. It can be designed in a manually resetting way such that a user can reset it after actuation of the fuse 25 and correction of the conductors. Alternatively the fuse also can be designed in an automatically resetting way and return to its conducting state for example after elapse of a certain time of for example 10 or 20 minutes.

It is important that in case of applying an excess voltage to the connection points 24a and 24b the chosen fuse 25 actuates very quickly such that any damage to the downstream electronics is prevented. For example an FF315mA 700 V fuse can be considered as fuse 25. The varistor can be for example be an SO5K60 varistor of Siemens. The operating unit referred to with 15' in FIG. 4 can be a common DALI ballast that can process control information corresponding to the DALI protocol. In this way, the circuit 21 with the fuse 25 and the varistor 26 can be upstream of the common DALI ballast 15' and also connected to the input 18' of the common operating unit 15' through for example plug-in connections or other electrical connections.

Alternatively there is also the possibility of incorporating the circuit 21 into an operating unit 15 according to the invention. FIG. 3 indicates this and shows the common operating unit 15 with the second connection 18 together with the circuit 21 as a single unit.

The second connection 18 of the operating unit 15 according to FIG. 3 and 4 corresponds at the same time also to the second connection 18 of the light fixture 10 according to the invention because the operating unit 15 is part of the light fixture 10 or belongs to the light fixture 10.

In addition to an electronic ballast also any other arrangement of a light fixture 10 comes into consideration as operating unit that can at least address a light source 13 and is preferably addressable.

The fuse 25 and/or the circuit 21 can be mounted in or on a light fixture 10 separately from an operating unit 15 and for example also form a separate component. Alternatively, also a direct mounting of the fuse 15 or of the

circuit 21 into or on the housing of the operating unit 15 or into or on the housing of the light fixture 10 can be carried out. Similarly, the fuse 25 and/or the circuit 21 can be mounted in or on a power-rail adapter described later.

For the sake of clarity, the functional principle of an operating unit 15 will not be discussed further and in FIG. 4 the structure of the common operating unit 15' will be merely shown very schematically and incomplete with respect to the electronics and circuit. It is important that the operating unit 15 typically has a first connection 17 for power-supply lines, a second connection 18 for signal lines and an output 16 for connecting with at least one light source 13, the control information received through the signal lines 20a and 20b being able to address, for example dim or switch, the at least one light source.

Additionally, it will be noted that although not illustrated in the figures there is also the possibility of associating the fuse 25 and/or the circuit 21 with a power rail and even mounting it on the power rail, for example.

A common three-phase power rail 28 will be described with reference to FIG. 1 in the following that can be used in the manner of the invention as power rail for transmission of the operating voltage of a light fixture and for transmission of control information.

The known three-phase power rail 28 consists of a substantially U-shaped profile 29 especially consisting of aluminum that has an inlet slot 30 for the head region 72 of a power-rail adapter 39 (FIG. 5). With respect to the basic function of a power rail 28 and to the mechanical and electrical connection to a power-rail adapter 39 or with a light fixture 10 herewith reference is made to German patent

application DE 103 12 012 A1 of applicant the content of which also for the purpose of reference to individual features is herewith incorporated into the content of the present patent application.

In the side flanks of the profile 28 [translator's note: should read 29] four conductor bars 31, 32, 33 and 34 are disposed electrically isolated from each other. The power rail 28 of the prior art has one null conductor and three phase conductors. With a common power-rail adapter, for example according to DE 103 12 012 A1, in case of wiring as three-phase power rail a user can select which of the three-phase conductors the respective light fixture will be connected to. This way, three groups of light fixtures can be fixed at a power rail and addressed group-wise in the known manner.

According to the invention the common three-phase power rail can be wired such that two of the four conductors, e.g. the conductors 33 and 34 or alternatively the conductors 32 and 34 or alternatively the conductors 31 and 33 are wired as a signal line through which control information can be transmitted to the light fixture 10. Assuming the first-mentioned example, both remaining conductors 31 and 32 are still used as power-supply lines for the light fixture and are wired accordingly as a phase conductor and as a null conductor. While the power-supply lines 31 and 32 that thus correspond to the power-supply lines 19a and 19b of FIG. 3 transmit a high operating voltage of e.g. 230 V only control information of a lower voltage of for example 25 V is transmitted through the conductors 33 and 34 that correspond to the signal lines 20a and 20b of FIG. 3.

The wiring according to the invention of the known power rail provides on the one hand that the signal lines 33 and 34 of the power rail 28 are connected to a not illustrated controller of a network of the light fixtures, the not illustrated control supplying the control information to the signal lines 33 and 34. If bidirectional transmission of control information is provided then the information can be also decoupled from the signal line 33 and 34 if necessary.

The wiring according to invention of the known power rail 28 provides further that the light fixture 10 to be connected to the power rail 28 and/or an operating unit 15 for the light fixture assigned to the light fixture and/or a power-rail adapter 39 for connecting the light fixture 10 to the power rail 28 provides a second connection 18 or corresponding connection points 24a and 24b that can be connected to the conductors 33 and 34 of the power rail 28, control information being transmitted through this connection 18 or through these connection points 24a and 24b.

FIG. 2 shows a tag 35 indicated merely schematically and constituted as a clip that has a cover plate 37 and two spring legs 36a and 36b. In the installation direction of arrow E the tag 35 can be fitted into the support 30 of the power rail 28 and firmly clipped there, with introduction of the tag 35 the two free ends of the spring legs 36a, 36b moving together and then slightly expanding again after achieving a resting position preferably arrested by means of an abutment such that a secure fit of the tag 35 in the power rail 28 is attained.

The cover plate 37 is provided on its bottom side with an indicia region 38 that can be written on and can contain for example indicia that indicates that the power rail

28 is wired a certain way. Preferably the tag 35 indicates that due to the wiring according to the invention the common power rail 28 is in a state in which the conductors 33 and 34 are wired as signal lines.

Due to the tag 35 the wiring of the power rail 28 is indicated to the user in a simple way, a conceivably simple way of indication being provided through the clippable design of the tag 35.

In this way a user can obtain an information from the tag 35 whether a light fixture provided for example with a DALI ballast can be inserted into this power rail or not.

In the following the power-rail adapter according to the invention will be described with reference to FIG. 5 to 13:

FIG. 5 shows the power-rail adapter according to the invention in a perspective view that is referred to with 39 in its entirety. Both housing halves 40a and 40b are open. The housing corresponds with regard to its basic structure substantially to the housing of the power-rail adapter according to DE 103 12 012 A1 the content of which is herewith incorporated into the content of the present application to avoid repetition and for the purpose of reference to individual features.

As with the known power-rail adapter, two switch shafts 41 and 42 are pivotally arranged around their respective longitudinal axis as shown in FIG. 6 and referred to there with 43 and 44, respectively, in one of the two housing halves, namely in the housing half 40a on the left with respect to FIG. 5. The first switch shaft 41 can be actuated in a simple way by manual actuation of an operating

lever 70 and the second switch shaft 42 can be actuated by an actuation at a broad edge 71 provided with a knurl.

For mounting the power-rail adapter 39 the two housing halves 40a and 40b are pivoted against each other around an axis of a membrane hinge and clipped with each other. The head region of the power-rail adapter 39 generally referred to at 72 in FIG. 5 is introduced into the inlet opening 30 of the power rail 28 according to FIG. 1 for mounting at the power rail 28.

In the mounted state the first switch shaft 41 is first turned about 90° so that contact terminals 73a and 73b, holding terminals 65a and 65b as well as a provided coding stud 66 to be described later project from slits in the housing halves 40a and 40b and enter into the respective grooves in the power rail and can contact the respective conductors 31 and 32. Then also the second switch shaft 42 can be pivoted about 90° so that corresponding contact terminals 73c and 73d project from corresponding slits or openings in the housing and contact the conductors 33 and 34.

Due to a rotation of the first switch shaft 41 a mechanical and electrical connection takes place at the same time. By rotation of the second switch shaft 42 an electrical connection is effected.

Both switch shafts 41, 42 can be locked with each other through a locking arrangement such as already in the case of the known power-rail adapter such that the second switch shaft 42 can be only turned into its contacting or installing state when the first switch shaft 41 is in a contacting or installing state. Such a locking arrangement possibly can be also omitted in the case of the power-rail adapter according to the invention.

FIG. 7 indicates in an exploded view that two contact elements 48a and 48b are assigned to the second switch shaft 42 that can be plugged into the hollow switch shaft 42 in the inlet direction x. The switch shaft 42 is shown in FIG. 11 in a longitudinal section and comprises a head 51, an axle 50 and a foot 52 that is clearly expanded with respect to the head 51. The switch shaft 42 is hollow along its entire length and comprises two chambers 54a and 54b that are separated from each other by a partition 53. The partition 53 and the switch shaft 42 are made of an electrically insulating material preferably of plastic and are manufactured as die-cast components. The foot 52 has a plate 55 that is provided with two apertures 56a and 56b such that the switch shaft 42 is provided with a continuous passage along its total axial longitude.

A contact element 48 to be fitted in the second switch shaft 42 is illustrated in FIG. 8 in cross section. It comprises a region 58 for the formation of the contact terminal that contacts the corresponding conductor bar (e.g. conductor 33 according to FIG. 1) in the power rail 28 and that is bent substantially perpendicularly from a middle region 59. An end region 60 of the contact element is bent over and forms a plug element 61 constituted as a plug terminal at its free end. An offset 62, i.e. a step, shifts the plug element 61 with respect to the end region 60 slightly parallel. A nose 64 is provided on the side of the middle region 59 not facing the plug element 61.

The two contact elements 48a and 48b are now plugged in from the left with respect to FIG. 11 into the two chambers 54a and 54b of the second switch shaft 42 in the inlet direction x until the respective locking nose 64 engages the

back side 57 of the plate 55 and axially fixes the contact element 48, 48a and 48b in the second switch shaft 42 in this way. During the inlet movement the free end 61 of the end region 60 is clamped at the middle region 59 of the contact element 48 such that a locking resilient fit of the contact element 48 can be achieved at the switch shaft 42. When the locking nose 64 engages the plate 55, the contact region 58 rests on the corresponding holding terminal 49a and 49b of the switch shaft 42 imparting high stability.

In the mounted state the two contact elements 48a and 48b are separated from each other by the partition 53 in an electrically safe way. The line connections for the two contact elements 48a and 48b leading to the second connection 18 of the operating unit 15 or of the light fixture 10 and not illustrated in FIG. 11 each have a flat pin bushing at their end that can be brought into connection with the plug terminal 61. Mounting of the flat pin bushing at the plug terminal 61 can also be carried out before the contact element 48 is plugged into the second switch shaft 42. In this case the contact element 48 and the flat pin bushing are mounted at the switch shaft 42 together with the end of the line connection.

In the mounted state the plug terminal 61 is slightly spaced from the partition 53 due to the bend 62 such that there is sufficient space for the not illustrated flat pin bushing. Basically, this also allows mounting the line connection to the flat pin bushing at the contact element 48, 48a, or 48b when the contact element is already fixed at the switch shaft 42.

It is important that the plug terminal 61 extends both substantially along the pivot axis 44 of the second switch shaft 42 and is directed in the direction to the base

of the profile 29 of the conductor bar 28 in the mounted state of the contact element 48. Thus, connection of the plug terminal 61 through the line connection takes place from the above direction with respect to FIG. 8. This allows as only illustrated in outline in FIG. 5 feeding of the two associated line connections 69c and 69d into the switch shaft 42 from this direction. Altogether, this leads to a very space-saving structure of the power-rail adapter 39 that actually does not have to differ externally from the power-rail adapter of the prior art.

It will be noted such as especially results from FIG. 7 that a cover 63 is provided that closes the foot region 52 of the second switch shaft 42 and thus also covers the contact elements 48a and 48b completely.

In the following the first switch shaft 41 will be described with reference to FIGS. 6 and 13. FIG. 6 shows that the contact elements 45a and 45b are substantially perpendicular and have respective plug elements 47a and 47b, according to the type of plug terminal at their lower free end. The plug terminal serves for connecting to a mating plug element according to the type of flat pin bushing provided on one end of a line connection 69a or 69b. At the opposite end of the contact elements 45a and 45b there are contact terminals 73a and 73b that in turn serve for connecting to the conductor bars (e.g. conductors 32 and 31 according to FIG. 1) of the power rail 28.

The contact element 45a or 45b virtually identically corresponds to the contact element described in FIG. 9 to 12 in DE 103 12 012 A1. Also the mounting of such a contact element 45a and 45b is described in this patent application such that reference is made thereto to avoid repetition.

A specific feature of the arrangement is now shown by FIG. 5 from which it can be seen that the two line connections 69c and 69d for the second switch shaft 42 are fed through the first switch shaft 41. Additionally, a ground conductor not illustrated in FIG. 5 can be passed through the switch shaft as a further line connection such as shown in FIG. 2 of DE 103 12 012 A1.

Consequently, the first switch shaft 41 is now provided with a first outlet channel 68a and a second outlet channel 68b for at least two line connections 69c and 69d. The line connections 69a and 69b assigned to the contact elements 45a and 45b leave the foot region 52 of the first switch shaft 41 together with the line connections 69c and 69d such that the power-rail adapter 39 has a shared outlet 74 for all of the four line connections for a ground conductor a shared outlet for five line connections. This shared outlet facilitates the connection of the line connections to the light fixture to be connected to the power-rail adapter.

As indicated in FIG. 13 and in FIG. 7 a partition 46 can be provided in the interior of the hollow first switch shaft 41. However, this can be possibly omitted when the line connections 69c and 69d are sufficiently insulated and have for example double insulation.

In addition the first switch shaft 41 differs from the second switch shaft 42 with respect to the retaining tongues 65a and 65b and the coding stud 66. Altogether, the first switch shaft 41 has a structure that basically identically corresponds to the structure of a switch shaft illustrated in FIG. 8 of DE 103 12 012 A1. An additional coding tongue 66 is actually provided but its function is not further discussed here.

It will be noted that the contact elements 45a and 45b are fitted into associated chambers 67a and 67b in the first switch shaft 41 and can be axially secured by means of corresponding locking noses 75 (FIG. 6) that engage corresponding wall regions 76 of the first switch shaft 41.

The power-rail adapter 39 according to the invention has two contact elements 45a and 45b at the first switch shaft 41 that can be brought into contact with the null conductor 31 of the power rail 28 and the phase conductor 32 of the power rail.

The second switch shaft 42 has two contact elements 48a and 48b that can be brought into contact with the signal lines 33 and 34 of the power rail 28. In this way a light fixture 10 according to FIG. 3 with a single power-rail adapter 39 can be connected to the power rail 28. Thus, the contact terminal 73a corresponds for example to a null-conductor contact, the contact terminal 73b corresponds to a phase-conductor contact and the contact terminals 73c and 73d correspond to the signal line contact terminals.

Claims

1. A light fixture (10) with at least a first connection (17) for a supply-voltage line (19a, 19b) in particular for powering a light source (13), and with at least one second connection (18) for a signal line (20a, 20b) for receiving control information, characterized in that the second connection (18) has a cutout that protects against excess voltage and that is replaceable or resettable.

2. The light fixture according to claim 1, characterized in that the light fixture has an operating unit (15) that is associated with the first and/or the second connection (17, 18).

3. The light fixture according to claim 1 or 2, characterized in that the second connection (28) has two connection points (22a, 22b; 24a, 24b) for signal lines that are both connected to an electronic circuit element (26), in particular a varistor, such that when a voltage exceeding a threshold voltage is applied to the two connection points (22a, 22b) a large current passes through the cutout (25).

4. The light fixture according to one of the preceding claims, characterized in that the cutout (25) is tripped only above a voltage of 30 V, in particular above 50 V, in particular above 230 V, and further in particular above 300 V.

5. The light fixture according to one of the preceding claims, characterized in that the control information corresponds to the DALI protocol.

6. An operating unit (15) for a light fixture, in particular an electronic ballast, with at least a first connection (17) for a supply-voltage line (19a, 19b) in particular for powering a light source (13) of the light fixture, and with at least one second connection (18) for a signal line (20a, 20b) for receiving control information, characterized in that the second connection (18) has a cutout that protects against excess voltage and that is replaceable or resettable.

7. The operating unit according to claim 6, characterized in that the second connection (28) has two connection points (22a, 22b; 24a, 24b) for signal lines that are both connected to an electronic circuit element (26), in particular a varistor, such that when a voltage exceeding a threshold voltage is applied to the two connection points (22a, 22b) a large current passes through the cutout (25).

8. The operating unit according to claim 6 or 7 characterized in that the cutout (25) is tripped only above a voltage of 30 V, in particular above 50 V, in particular above 230 V, and further in particular above 300 V.

9. The light fixture according to one of claims 6 to 8, characterized in that the control information corresponds to the DALI protocol.

10. A power rail (28) for powering a lighting fixture (10) through at least one phase conductor (31, 32, 19a, 19b) with supply voltage and for supplying the lighting

fixture (10) with control information via at least one signal line (33, 34, 20a, 20b), the light fixture (10) being connectable with the power rail 28) by at least a first connection (17) for the phase conductors (19a, 19b, 31, 32) and by at least one second connection (18) with the signal line (29a, 29b, 33, 34), characterized in that the second connection (18) has a cutout that protects against excess voltage and that is replaceable or resettable.

11. The power rail according to claim 10, characterized in that the second connection (28) has two connection points (22a, 22b; 24a, 24b) for signal lines that are both connected to an electronic circuit element (26), in particular a varistor, such that when a voltage exceeding a threshold voltage is applied to the two connection points (22a, 22b) a large current passes through the cutout (25).

12. The power rail according to claim 10 or 11, characterized in that the cutout (25) is tripped only above a voltage of 30 V, in particular above 50 V, in particular above 230 V, and further in particular above 300 V.

13. The power rail according to one of the claims 10 to 12, characterized in that the control information corresponds to the DALI protocol.

14. A circuit (21) for a light fixture according to the preamble of claim 1 or for an operating unit (15) according to the preamble of claim 6 or for a power rail (28) according to the preamble according to claim 10, characterized in that the second connection (18) has a cutout that protects against excess voltage and that is replaceable or resettable.

15. The circuit according to claim 14, characterized in that the second connection (28) has two connection points (22a, 22b; 24a, 24b) for signal lines that are both connected to an electronic circuit element (26), in particular a varistor, such that when a voltage exceeding a threshold voltage is applied to the two connection points (22a, 22b) a large current passes through the cutout (25).

16. The circuit according to claim 14 or 15, characterized in that the cutout (25) is tripped only above a voltage of 30 V, in particular above 50 V, in particular above 230 V, and further in particular above 300 V.

17. The circuit according to one of claims 14 to 16, characterized in that the control information corresponds to the DALI protocol.

18. A power rail (28) comprising at least a first conductor (31) and at least a second conductor (33, 34) that are both with connected one or two light fixtures (1) for supplying them with line voltage, characterized in that a circuit is provided that connects one of the two conductors (33, 34) as a signal line (20a, 20b) for feeding control information to the light fixture (10).

19. The power rail according to claim 1, characterized in that the power rail (28) is a standard power rail in particular a three-phase power rail.

20. The power rail according to claim 18 or 19, characterized in that the light fixture (10) with the power

rail (28) can be connected through at least a first connection (17) to the phase conductor (31, 32, 19a and 19b) and through at least a second connection (18) to the signal line (33, 34, 20a and 20b).

21. The power rail according to one of claims 18 to 20, characterized in that the second connection (18) has a cutout (25) that protects against excess voltage and that is replaceable or resettable.

22. The power rail according to one of claims 18 to 21, characterized in that a tag (35) is provided on the power rail (28) that indicates that at least one of the conductors (33, 34) is used for transmitting control information.

23. The power rail according to claim 22, characterized in that the tag (35) can be removably fixed to the power rail (28).

24. The power rail according to claim 22 or 23, characterized in that the tag (35) can be clipped to the power rail (28).

25. A power-rail adapter (39) for mechanical and electrical connection of a light fixture (10) and/or of an operating unit (15) of the light fixture with a power rail (28), comprising a first switch shaft (41) and a second switch shaft (42), characterized in that each switch shaft has two respective contact elements (48, 48a, 48b, 45a, 45b) rotationally connected to the switch shaft.

26. The power-rail adapter according to claim 25, characterized in that a null-conductor contact (73a) and a phase-conductor contact (73b) are assigned to the first switch shaft (41).

27. The power-rail adapter according to claim 25 or 26, characterized in that two signal line contact terminals (73c, 73d) are assigned to the second switch shaft (42).