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(54) Explosion-proof lighting device

(57) The invention provides an explosion-proof lighting device (1) comprising a light source (3) and a luminaire (4) provided with a supply source for providing the light source with a supply voltage, wherein the light

source is provided with connection means by which the light source is non-detachably connected to the supply source for receiving the supply voltage, said connection means being encapsulated in an electrically insulating moulding compound.

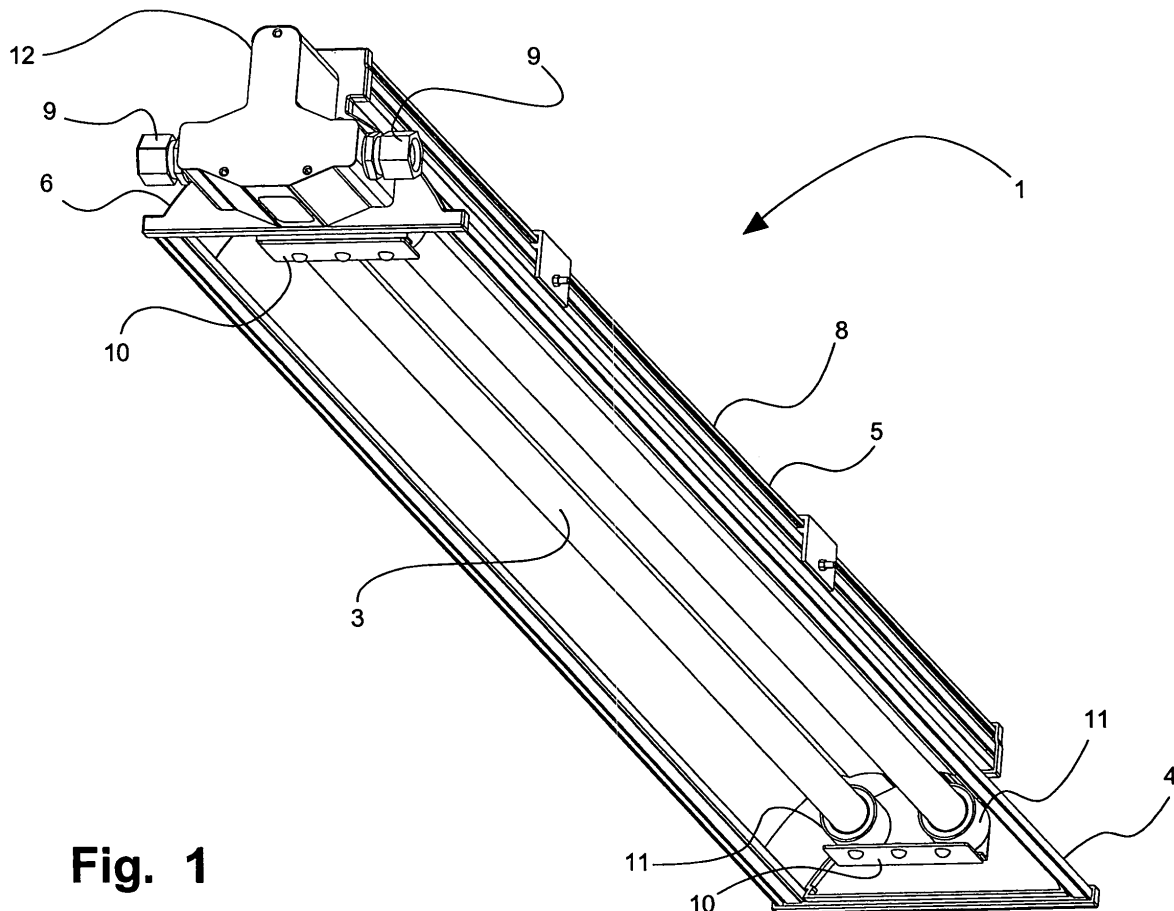


Fig. 1

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Description

[0001] The present invention relates to an explosion-proof lighting device comprising a light source and a luminaire provided with a supply source for providing the light source with a supply voltage.

Background of the invention

[0002] Explosion-proof lighting devices are widely used in industrial applications, especially in locations where fire safety is of major importance such as oil refineries, drilling platforms, etc. Electrical installations in such applications should often comply with the ATEX guidelines issued by the European Union. The ATEX guideline applies to all locations where there is a risk of explosions; it has been in force since 1996. The guideline relates not only to the risk of gas explosions, but also, for example, to the risk of dust explosions, and applies to apparatuses and other electrical systems. The object of these guidelines is to safeguard the health and safety of personnel working in such locations. ATEX is short for the French expression "atmosphère explosive" and refers to explosive atmospheres, the definition of which is: a mixture of combustible substances in the form of gases, vapours, mists and dust under atmospheric conditions in which a combustion process after ignition will spread over the entire as yet not combusted mixture.

[0003] Explosion protection techniques are classified into Ex and EEx classes under the ATEX guidelines. Among the Ex classes that can be distinguished there is, for example, Ex e, which is a classification for equipment that is designed such that its components cannot cause any sparks or high temperatures in normal use and that it is insulated from its surroundings. The equipment should in addition be impact-resistant so as to be able to withstand as much as possible any external forces released in the case of an emergency.

[0004] Another explosion protection is classified sub Ex d, wherein a device is provided with a pressure-resistant envelope such that components that cause sparks or high temperatures in normal use and that may come into contact with the explosive atmosphere inside the device cannot cause combustion or explosion outside the pressure-resistant envelope.

[0005] The explosion safety techniques classified under Ex m serve to ensure that potentially flammable components are encapsulated or encased in a moulding compound. The flammable atmosphere is thus separated from the flammable components while at the same time the surface temperature of the encapsulated components can be kept under control.

[0006] Industrial lighting devices usually comprise an (explosion-proof) luminaire provided with a light source, which luminaire is provided with a supply source for providing the light source with a supply voltage. The light source in the luminaire can be replaced when it becomes defective. A disadvantage of a lighting device according

to the prior art is that the luminaire itself is indeed explosion-proof, but the (replaceable) light source still present an explosion risk.

[0007] In order to make the lighting device explosion-proof in spite of this, it may be considered to place the luminaire in an explosion-proof housing (Ex d or Ex p), but this will make the lighting device expensive.

Brief description of the invention

[0008] It is an object of the present invention to counteract the problems inherent in the prior art and to provide an explosion-proof lighting device that is of a simple construction.

[0009] According to the invention, this object is achieved in that it offers an explosion-proof lighting device comprising a light source and a luminaire provided with a supply source for providing the light source with a supply voltage, wherein the light source is provided with connection means by which the light source is non-detachably connected to the supply source for receiving the supply voltage, said connection means being encapsulated in an electrically insulating moulding compound.

[0010] The explosion-proof lighting device in its entirety, including the light source, now complies with the Ex m classification of the ATEX guideline owing to the fact that the connection means of the light source itself are encapsulated in an electrically insulating moulding compound. The simple encapsulation of the connection means of the light source in an electrically insulating moulding compound enables the luminaire to fall within the Ex m category in a simple manner, possibly without any substantial adaptations to the basic construction of the luminaire, if so desired.

[0011] In an embodiment of the present invention, the electrically insulating compound comprises a resin. The use of a resin instead of a gel is preferred especially in maintenance-free applications, where the explosion-proof lighting device is constructed such that its light source is not accessible from the outside, or cannot be replaced. Following the manufacturing process of the lighting device in which the resin is moulded for encapsulating the connection means, the resin will dry up so as to form a solid encapsulating substance that separates the connection means from the atmosphere.

[0012] The electrically insulating moulding compound may alternatively comprise a gel. The advantage of the use of a gel is that a gel does not constitute a solid substance but a liquid of usually high viscosity. A gel is usually held in place under the influence of its own surface tension. When a gel is used for encapsulating the connection means, the light source is detachably connected to the luminaire. A disadvantage is, however, that a gel is not impact-resistant and accordingly does not fully comply with the explosion safety requirements. This embodiment accordingly cannot be regarded as particularly suitable for achieving the Ex m classification. On the other hand, the encapsulation of the contact points in a gel in

itself contributes to the fire safety of the luminaire. The contact points are in fact effectively screened off from the surroundings, so that sparking and the resulting fire risk are eliminated, while at the same time the gel provides an excellent thermal conduction.

[0013] According to an embodiment of the invention, the electrically insulating moulding compound may comprise a material chosen from a group comprising polyepoxide or epoxy, polyurethane, polyethylene, polyester, polystyrene and polyamide.

[0014] In another embodiment, the explosion-proof lighting device comprises a light source housing for accommodating the light source. The electrically insulating moulding compound may then be present inside the light source housing.

[0015] According to another embodiment of the invention, the explosion-proof lighting device comprises a control circuit for controlling and adjusting the supply voltage that is fed to the light source. This control circuit may also be encapsulated in a further electrically insulating moulding compound. This further electrically insulating moulding compound may again comprise a gel or a resin. If a gel is used, the electronics of the control circuit are still accessible at a later stage, so that the lighting device can be repaired in the case of a defect. If a maintenance-free luminaire is opted for, however, in which the light source itself may be replaceable, for example through the use of a gel as the moulding compound, then it may be considered to choose a resin for the further electrically insulating moulding compound, which will become hard after drying up so as to form a solid encapsulation.

[0016] In an embodiment of this version, the further electrically insulating moulding compound may comprise a material chosen from a group comprising polyepoxide or epoxy, polyurethane, polyethylene, polyester, polystyrene, and polyamide.

[0017] In another preferred embodiment, the light source and the control circuit of the lighting device are located such that they are thermally separated from one another so as to counteract mutual temperature influences. This may be achieved, for example, in that the light source housing mentioned above is physically separated from the control circuit. The control circuit may be accommodated in a separate dedicated circuit housing. Said circuit housing may contain the further electrically insulating moulding compound and may be, for example, completely filled thereby. This not only provides a satisfactory closing-off of any ignition sources with respect to the surroundings, but it is also capable of achieving that heat originating from said ignition sources can be effectively removed. The circuit housing and the light source housing mentioned above may be integrated into a single device housing while nevertheless being located separately from one another.

[0018] For the purpose of controlling the temperature gradient in the lighting device, the lighting device may be provided with a temperature sensor which is operatively connected to the control circuit, such that the control cir-

cuit is arranged for controlling the supply voltage in dependence on a signal from the temperature sensor. This not only provides an additional protection against overheating and eliminates a potential explosion risk, but it may also achieve that the operating temperature of the lamp is influenced by the supply voltage to the extent that a long operational life of the light source can be obtained. This is especially advantageous in maintenance-free lighting devices in which the light source is non-detachably coupled to the luminaire, for example through the use of a fixed resin as described above.

Short description of the drawings

[0019] The invention will be explained in more detail below with reference to specific embodiments thereof, which are not to be regarded as implying any limitation, and with reference to the appended drawings, in which:

Figure 1 is a three-dimensional view of an explosion-proof lighting device according to the present invention;

Figure 2 is a bottom view of the lighting device shown in figure 1;

Figure 3 is a cross-sectional view of the lighting device shown in figure 1; and

Figure 4 presents an enlarged view of the connection means of the light sources of the of the lighting device shown in the figures 1 to 3.

Detailed description of the preferred embodiment

[0020] Figure 1 shows a lighting device 1 according to the invention, comprising two light sources connected to a luminaire 4. The luminaire 4 is formed by a housing 5 consisting of a light source housing or hood 6 and a housing part 8 that adjoins the hood 6.

[0021] At both ends of the hood 6 there is a fastening part 10 for fastening two light sources 3. The fastening parts 10 are provided with connection parts 11 which are constructed so as to cooperate with contact points (not visible in figure 1) of the light sources 3 for providing an electrical connection between the light sources 3 and the parts of the luminaire operational in energizing the light sources 3. A control circuit (not visible) for controlling and adjusting the supply voltage fed to the light sources 3 is present in the housing part 8 of the lighting device.

[0022] The control circuit of the luminaire 4 is supplied with current from the public mains. The mains current can be supplied to the luminaire 4 by means of cables passed through inlets 9. Connection terminals (not visible in figure 1) are situated in the interior of the housing 5, in the housing part 12 adjacent the inlets 9, for providing the mains voltage to the control circuit. According to the invention, the connection parts 11 are filled with an electrically insulating, thermally conductive resin after the connection points of the light sources have been connected, such that an explosion-proof connection comply-

ing with the Ex m standard is obtained. The connection parts 11 are shaped for this purpose such that, after their connection to the light source 3, there is still sufficient space that can be filled up with the electrically insulating resin.

[0023] Figure 2 is a bottom view of the lighting device shown in figure 1. The bottom view shows the lighting device 1 provided with light sources 3, fastening parts 10, and connection parts 11 for the light sources 3. Furthermore, the housing part 12 and the inlets 9 for the mains voltage as well as the light source housing 6 are visible in figure 2. Figure 3, which will be discussed below, is a cross-sectional view taken on the line A-A.

[0024] Figure 3 shows the luminaire and the light source of figures 1 and 2 in cross-section. The cross-sectional view shows the housing 5 comprising the housing part 8, the housing part 12, and the light source housing 6. Furthermore, a cross-section is visible of the fastening means 10 which are provided with connection parts 11. The cross-section of figure 3 also shows the light source 3.

[0025] A control circuit housing in which a control circuit 15 is present is accommodated in the housing part 8 of the housing 5. The control circuit 15 is fully encapsulated in an electrically insulating gel or resin which screens off the ignition-sensitive parts of the control circuit from the surroundings in an explosion-proof manner. The control circuit is supplied from the public mains by means of power cords, so that a connection can be established via inlet 9 to connection terminals of the luminaire for supplying the mains voltage to the luminaire. This mains voltage is passed on to the control circuit 15 via mains voltage connections present in a space 17 of the housing. Both the space 17 and the housing part 12 are preferably filled up with an electrically insulating moulding compound, such as a resin or a gel, for separating the ignition-sensitive lines from the (explosive) atmosphere in accordance with the Ex m standard.

[0026] The luminaire 4 further comprises suspension elements 18 for fastening the luminaire to a ceiling. The elements 18 are mounted to the housing 5 of the luminaire 4 in such a manner that they can be steplessly shifted so as to fit the location where these elements 18 are to be fastened in the local situation. The elements are suitably shaped for this purpose and cooperate with the housing 5 (not shown), said housing forming a rail over which the elements 18 can glide. Other solutions for adapting the locations of the elements 18 to the local situation will readily suggest themselves to those skilled in the art.

[0027] Figure 4 shows on an enlarged scale a fastening part 10 provided with connection parts 11 for connecting the light sources 3 to the luminaire. It is apparent from figure 4 that the connection parts 11 are cup-shaped and that a lampholder unit 20 is present inside the cup shape of each connection part 11 for connecting contact points 21 of the light source 3. The lampholder units 20 are slightly smaller than the diameter of the cup of the

connection part 11, so that the lampholder units 20 and the contact points 21 can be fully enveloped by the electrically insulating moulding compound in the form of a resin. A light source is provided in this manner which complies with the explosion safety standard Ex m in accordance with the ATEX guideline. If a gel is used for the moulding compound that encloses the contact points 21 instead of a resin, the luminaire no longer meets the requirements as to explosion safety according to Ex m, but a fire-resistant solution is nevertheless obtained that is still quite suitable for application in an industrial environment.

[0028] Those skilled in the art will understand that the ideas and the operational principle as described above may be implemented in manners different from what has been specifically indicated in the figures and description. The scope of the invention is accordingly limited only by the ensuing claims.

Claims

1. An explosion-proof lighting device comprising a light source and a luminaire provided with a supply source for providing the light source with a supply voltage, wherein the light source is provided with connection means by which the light source is non-detachably connected to the supply source for receiving the supply voltage, said connection means being encapsulated in an electrically insulating moulding compound.
2. An explosion-proof lighting device according to claim 1, wherein the electrically insulating compound comprises a gel.
3. An explosion-proof lighting device according to any one of the preceding claims, wherein the electrically insulating compound comprises a resin.
4. An explosion-proof lighting device according to any one of the preceding claims, wherein the electrically insulating moulding compound comprises a material chosen from a group comprising polyepoxide or epoxy, polyurethane, polyethylene, polyester, polystyrene, and polyamide.
5. An explosion-proof lighting device according to any one of the preceding claims, further comprising a light source housing for accommodating the light source.
6. An explosion-proof lighting device according to claim 5, wherein the electrically insulating moulding compound is present inside the light source housing.
7. An explosion-proof lighting device according to any one of the preceding claims, further comprising a

control circuit for controlling the supply voltage fed to the light source.

8. An explosion-proof lighting device according to claim 7, wherein the control circuit is encapsulated in a further electrically insulating moulding compound. 5
9. An explosion-proof lighting device according to claim 8, wherein the further electrically insulating compound comprises a gel or a resin. 10
10. An explosion-proof lighting device according to any one of claims 8 and 9, wherein the further electrically insulating moulding compound comprises a material chosen from a group comprising polyepoxide or epoxy, polyurethane, polyethylene, polyester, polystyrene, and polyamide. 15
11. An explosion-proof lighting device according to at least one of claims 7 to 10, wherein the control circuit and the light source are located such that they are thermally separated from one another so as to counteract mutual temperature influences. 20
12. An explosion-proof lighting device according to one of claims 7 to 11, further comprising a circuit housing for accommodating the control circuit. 25
13. An explosion-proof lighting device according to claim 12 and at least one of claims 8 to 11, wherein the further electrically insulating moulding compound is present inside the circuit housing. 30
14. An explosion-proof lighting device according to claim 13, wherein the entire circuit housing is filled up with the further electrically insulating moulding compound. 35
15. An explosion-proof lighting device according to one of the preceding claims insofar as dependent on at least one of claims 5 and 6 and on at least one of claims 12 to 14, wherein the circuit housing and the light source housing are integrated into a single device housing. 40
16. An explosion-proof lighting device according to any one of claims 7 to 15, further comprising a temperature sensor which is operatively connected to the control circuit, such that the control circuit is arranged for controlling the supply voltage in dependence on a signal from said temperature sensor. 45 50

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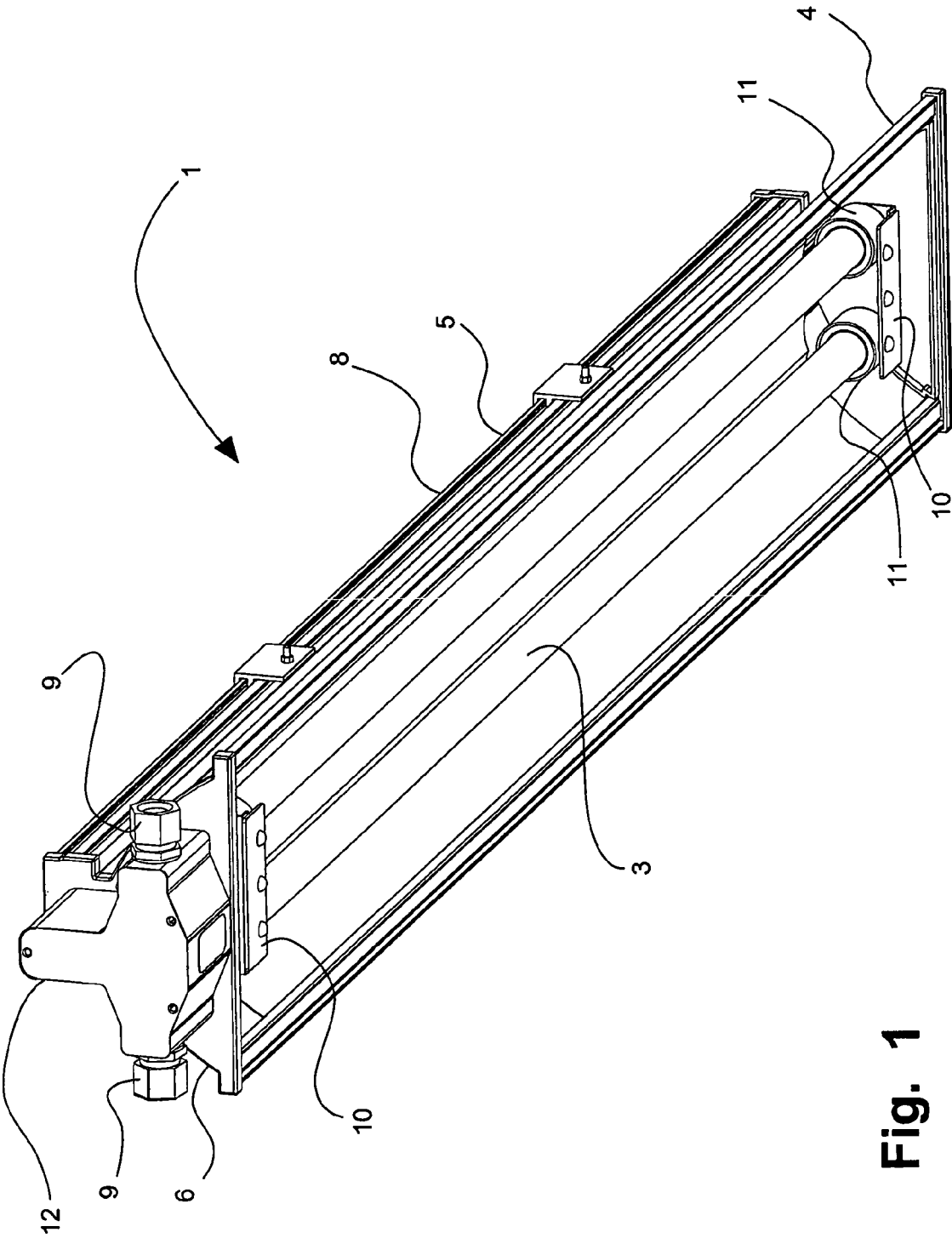


Fig. 1

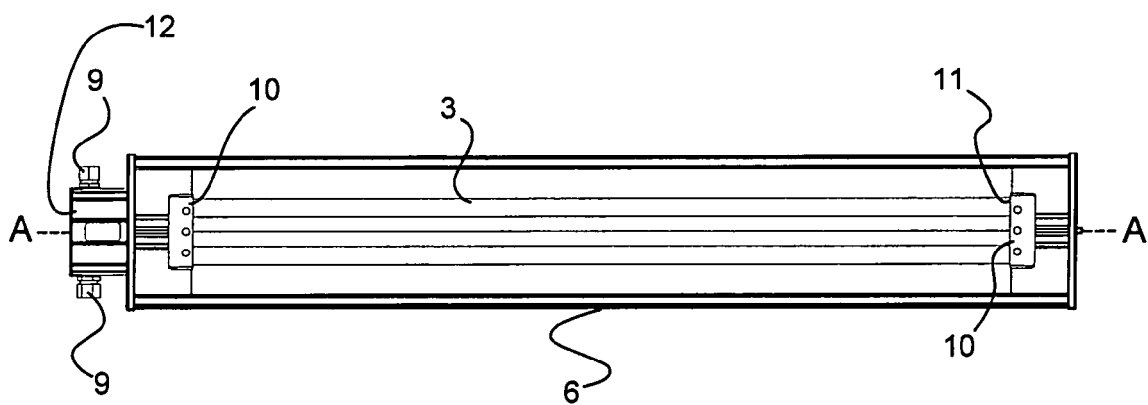


Fig. 2

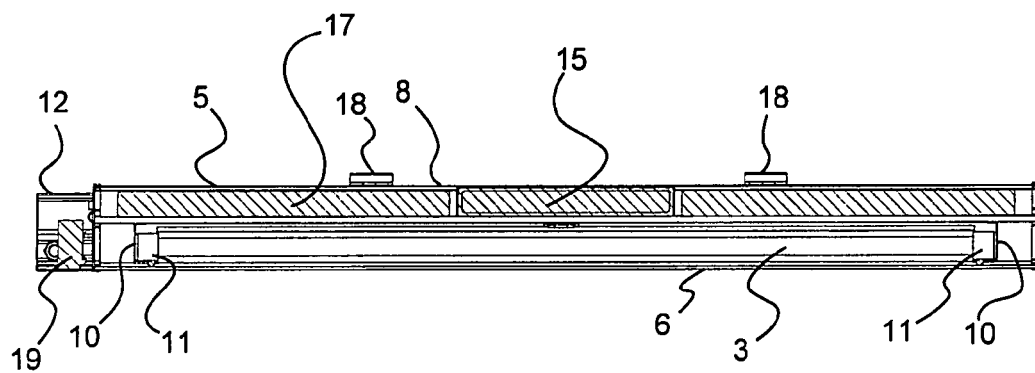


Fig. 3

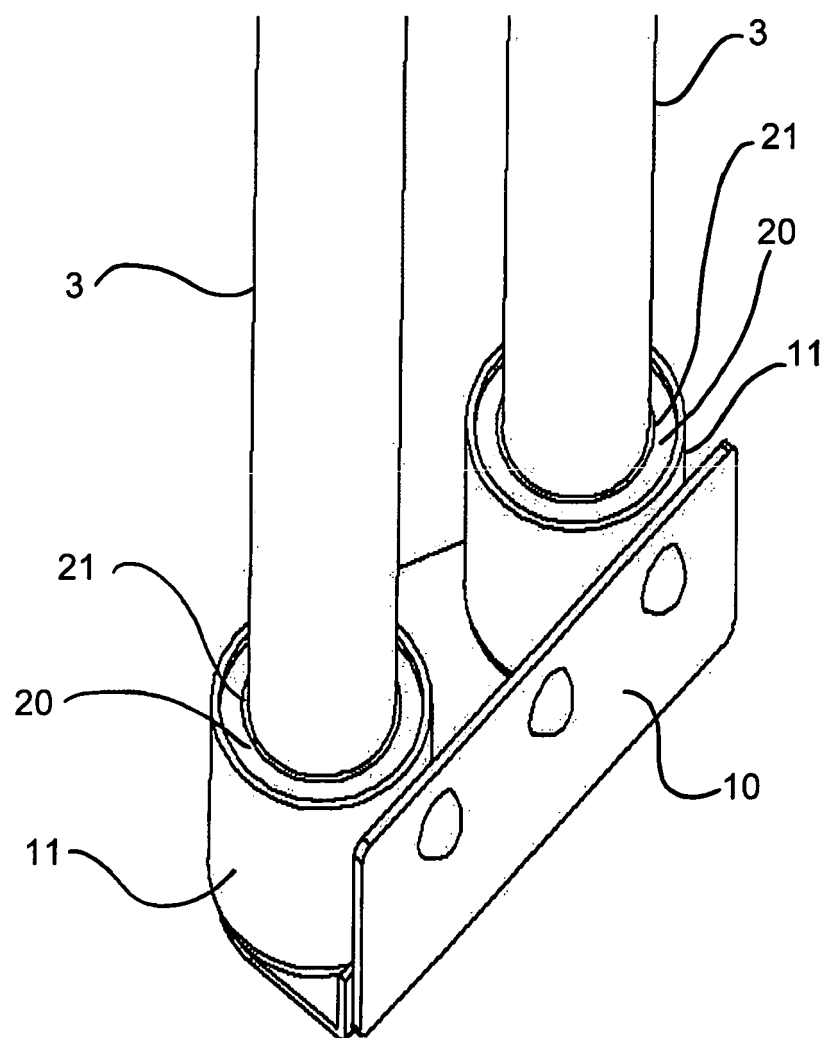


Fig. 4



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Place of search The Hague		Date of completion of the search 12 June 2009	Examiner Blokland, Russell
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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