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Applicant Nireco Co., Ltd.

54) [Title of the invention]

Slender light source wherein light emitting diodes have been used.

57) [Summary]

[Aim]

To obtain a slender light source with a long lifespan that is compatible with existing fluorescent lamps.

[Structure]

Light emitting diodes 1 are arranged in printed circuit board 2 in a linear form, this is established inside circular tube 3 with the same dimensions as a standard linear fluorescent lamp, and in both ends of circular tube 3, electric connectors 7 with the same dimensions as electric connectors of fluorescent lamps are established.

[What is claimed]

[Claim 1]

A slender light source wherein light emitting diodes have been used, with the characteristic that it has been equipped with a printed circuit board wherein light emitting diodes have been lined up in a linear form, and a light transmissive circular tube with the same dimensions as a linear fluorescent lamp with standard dimensions wherein this printed circuit board is installed in the interior, and electric connector fittings with the same dimensions as the electric connectors of a standard linear fluorescent lamp, that have been installed in both ends of the said circular tube.

[Claim 2]

The slender light source wherein light emitting diodes have been used that has been described in claim 1, with the characteristic that in the inner wall of the above mentioned circular tube, supporting materials that sandwich both sides in the width direction of the above mentioned printed circuit board from above and below, has been established.

[Claim 3]

The slender light source wherein light emitting diodes have been used that has been described in claims 1 or 2, with the characteristic that the above mentioned circular tube has been constituted by a scattering material whereby light is scattered.

[Detailed description of this invention]

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[Field of use for the industry]

This invention pertains to a slender light source wherein light emitting diodes for light beaming that are used in optical detectors that determine the edge positions of a web such as paper, foil, and strips etc., have been used.

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[Existing technology]

In the case that paper and foil etc. are successively printed, and in the case that strips are rolled in a rolling process, the edge position and central position of their web are detected, and such a control is carried out that the web comes to be forwarded correctly by rollers. Moreover, also detection of the width of the web is carried out. Figure 4 shows the method of such a detection

of edge position and width of a web. In the lower surface of travelling web 10, light beamer 11 that has a slender light source is arranged in such a way that its length direction becomes the width direction of web 10, and from the upper part of web 10, the image of the edge of web 10 is picked up by image sensor 12. The light from the light source can, because the position of the border that is covered by web 10, presents the edge, detect the edge by the fact that this position is detected by the image that has been picked up by image sensor 12. (A) shows the method of detection of the edge in this way, and (B) shows the method of detection of the width of web 10 that is the length between the edges, by the fact that both edges in the width direction of web 10 are detected.

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The detector for determination that in this way determines the edge and width of the web, and the central position of the width etc., often requires a detection length with a wide range, and consequently, also for the beamer length of the light source for beaming that is used, has to be a long one, from a number of hundreds of mm to ca. 1 m. Therefore fluorescent lamps have been widely used as light sources with a long beaming length and also a uniform brightness.

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[Problems that should be solved by the invention]

In the case that fluorescent lamps are used as a light source, the position of the edge is detected with the position that becomes darker than a fixed threshold value, as the edge position. Because in analogue detection systems the brightness of the light source deteriorates in the course of time, detection errors gradually increase. Moreover, in digital detection systems, there is no change of characteristics if, even if the light source ages, there is no difference between the level of clearness and the threshold value, and because changes can be prevented by modification of the established threshold value, the influence of deterioration in the course of time can be prevented to some degree, but it had the lifespan problem that the period wherein use is possible is short, and because in both systems lifespan is short, exchange with fixed intervals was necessary, and this brought a hindrance for maintenance. Because, however, fluorescent lamps are widely used as slender light sources, and detectors for determination of the edge etc. are manufactured in such a way that fluorescent lamps are fitted, slender light sources that can also easily be fitted in this way in existing detectors, are necessary.

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This invention has been performed by learning lessons from the above mentioned problems, and it has the aim to obtain a light source with a long lifespan by lining up light emitting diodes in a linear form and turning them into slender light sources. Moreover, by making the outer form and the electric connection fittings the same as those of fluorescent lamps, they are turned into slender light sources that can also be used in existing devices.

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[Means to solve the problems]

In order to achieve the above mentioned aim, it is, in the invention of claim 1, equipped with a printed circuit board wherein light emitting diodes have been lined up in a linear form, and a light transmissive circular tube with the same dimensions as a linear fluorescent lamp with standard dimensions wherein this printed circuit board is installed in the interior, and electric connector fittings with the same dimensions as the electric connectors of a standard linear fluorescent lamp, that have been installed in both ends of the said circular tube.

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In the invention of claim 2, supporting materials that sandwich both sides in the width direction of the above mentioned printed circuit board from above and

below, have been established in the inner wall of the above mentioned circular tube.

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In the invention of claim 3, the above mentioned circular tube has been constituted by a scattering material whereby light is scattered.

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[Action]

By the fact that by the invention of claim 1 light emitting diodes are lined up on a straight line, a slender light source is obtained. The length of the light source can be set at the desired length by increasing the number of light emitting diodes. Because light emitting diodes have a sufficiently longer lifespan than fluorescent lamps and also the brightness is stabilised, a light source with a long lifespan and a stable brightness is obtained. Because the printed circuit board wherein light emitting diodes have been lined up, is entered in a light transmissive circular tube with the same dimensions as those of linear fluorescent lamps with standard dimensions that are used in existing detectors, and the electric connection fittings are the same as those of fluorescent lamps, it can be used as a slender light source, also in existing devices with fluorescent lamps as the light source.

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Because by the invention of claim 2, supporting materials that sandwich both edges in width direction of the printed circuit board wherein light emitting diodes have been lined up in a linear form, from above and below, have been established in the inner wall of the inner tube, they become a guide when the printed circuit board is inserted in the circular tube, and they sufficiently support the printed circuit board against vibrations and become a reinforcement of the circular tube.

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Because by the invention of claim 3, the light from the light emitting diodes is scattered, the brightness is made uniform.

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[Example of execution]

Below, an example of execution of this invention is explained, referring to figures. Figure 1 shows the structure of the slender light source of the example of execution, and (A) is a longitudinal section, (B) is X-X cross section of (A), and (C) is the view of the Y-Y arrows of (A). For light emitting diode 1, often a red LED is used, but depending on the detection object, also yellow, green, blue and infrared LEDs may be used. Light emitting diodes 1 are arranged on printed circuit board 2 with the mutual distance of one row as the density. Printed circuit board 2 is arranged on the diameter of circular tube 3, made of acryl, and both ends are bound by 2 plates of supporting material 4, an upper and a lower one, that have been established in the wall of the circular tube. This supporting material 4 also is the guidance when printed circuit board 2 is inserted in circular tube 3. Moreover, it is a structure that supports printed circuit board 2 with sufficient firmness against vibrations, and also serves as a reinforcement of circular tube 3. Resistance 5 and capacitor 6 are parts that constitute a full wave rectifying and smoothing circuit of the current that is supplied to light emitting diodes 1. Electric connection fittings 7 are established in both ends of circular tube 3, and outer diameter and length of circular tube 3 and electric connection fittings 7 have the same dimensions and arrangement as the linear fluorescent lamp of JIS C7601, that is used in existing detectors, and have the same dimensions as the base of G13 or R17d of JIS C 7709. In these detectors, often fluorescent lamps with the output of 30 W, 32 W and 40 W are used, and the length only becomes longer, corresponding with the output.

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Printed circuit board 2 consists of a standard circuit board with standard dimensions, and in one standard circuit board, 33 light emitting diodes have been established. For 30 W, 3 circuit boards, for 32 W, 4 circuit boards, and for 40 W, 6 circuit boards have been arranged in longitudinal direction. As circular tube 3, a colourless transmissive one of an acryl material is used. In order to improve the uniformity of brightness in the longitudinal direction, however, it may also be a milky white non-transmissive body. Moreover, the window glass for light emission of the beamer case that accommodates this light source may be a milky white or non-transmissive material, or also the situation that frosted glass is used may be arranged. Now, in addition to acryl material, a plastic material such as polycarbonate may be used for circular tube 3, but also the same glass as in the fluorescent lamp may be used.

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Figure 2 is a block diagram of the starting circuit of the slender light source of this example of execution. This figure shows the case for 32 W and 40 W, but because the standard circuit board of printed circuit board 2 is constituted by an even number of boards, 4 plates for 32 W, and 6 for 40 W, the circuit has been split in 2 halves. Because for 32 W an odd number of boards is used, the circuit is split in 3 parts. To electric connection fittings 7, an alternating current source from the stabiliser that is used in the fluorescent lamp is applied, and by the full wave rectifying circuit of full wave rectifying and smoothing circuit 8, full wave rectification is carried out, and via a voltage smoothing circuit, a current that has been limited inside the regular current flows in a large number of light emitting diodes 1 that have been serially connected, and the situation arrives that the respective light emitting diodes start in an equal brightness.

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Figure 3 explains the exchange of an existing fluorescent lamp that has been entered in a beamer, for the slender light source of this invention. In the case of existing beamer 11 wherein a fluorescent lamp was used, the existing fluorescent lamp that is used as beaming tube 15 is exchanged for the slender light source of this example of execution, and globe lamp 16 of the fluorescent lamp is taken out. Because stabiliser 17 of the fluorescent lamp is simply used as such, it is left behind. The thus exchanged beamer tube 15 is entered in beamer case 18. Light emitting window 19 of beamer case 18 is covered by covering plate 20, of glass or acryl etc., but in the case that circular tube 13 of the slender light source of this example of execution is transmissive, this covering plate 20 is made a milky white or non-transmissive scattering plate. Now, in the case that circular tube 3 is transmissive, this covering plate 20 may be a milky white or non-transmissive scattering plate. In the case that circular tube 3 is milky white etc. and scatters light, covering plate 20 may be transmissive glass or plastic. This beamer 11 is used as the light source that is shown in figure 4.

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[Results of the invention]

Because, as is clear from the explanation above, this invention can make the lifespan extremely much longer, and reduce maintenance operations such as exchange, and also reduce deterioration of brightness in the course of time, by using light emitting diodes as the light source, it can prevent deterioration of detection accuracy by using it in detectors of edges etc. Moreover, because the same dimensions and the same electric connection fittings as in the standard fluorescent lamp are used, it can be used in a simple way in existing equipment wherein fluorescent lamps are used as the light source.

[Brief description of the figures]

[Figure 1]

shows the structure of this example of execution, and (A) is a longitudinal section, (B) is a cross section along X-X, and (C) a view along arrows Y-Y.

[Figure 2]

is an electric circuit figure of this example of execution.

[Figure 3]

shows the exchange with the fluorescent lamp and the installation to the beamer.

[Figure 4]

shows an example wherein a slender light source is used in the detection of edge and plate width of the web.

[Explanation of the symbols]

- 1 light emitting diode
- 2 printed circuit board
- 3 circular tube
- 4 supporting material
- 7 electric connection fitting

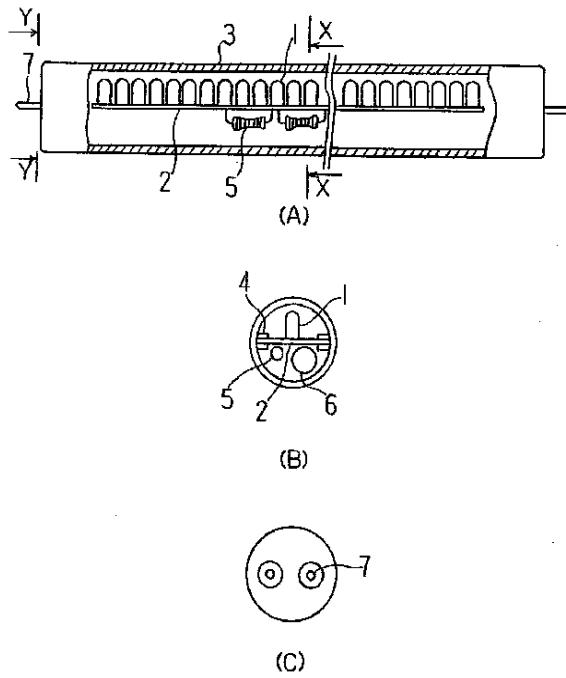
Figure 2.

full wave rectifying
and smoothing circuit

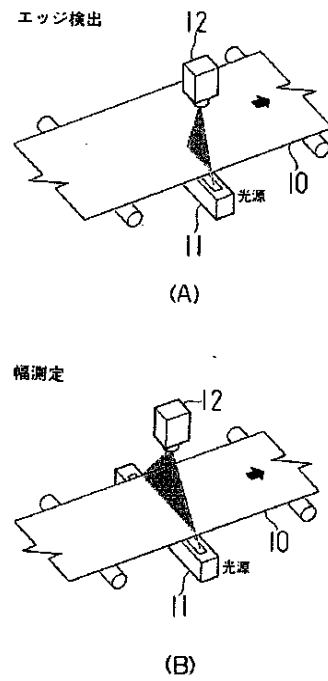
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full wave rectifying
and smoothing circuit

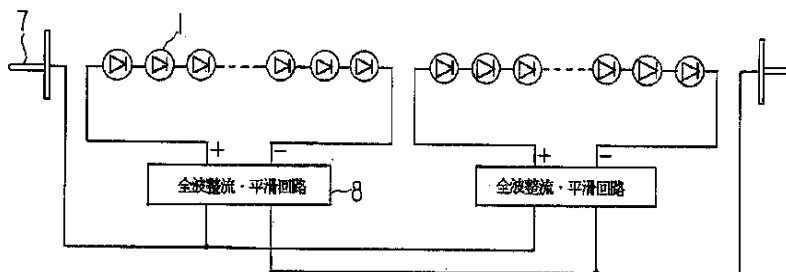
【図1】



【図4】



【図2】



【図3】

