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(54) **LED signalling device, particularly for railways purposes**

(57) The invention relates to an optical signalling device, particularly for railway use, comprising a LED matrix (16), made up of a plurality of LEDs, a lens matrix (14), made up of a number of lenses (15) corresponding to the number of LEDs of the LED matrix (16), and supply means (9, 10) for said LED matrix.

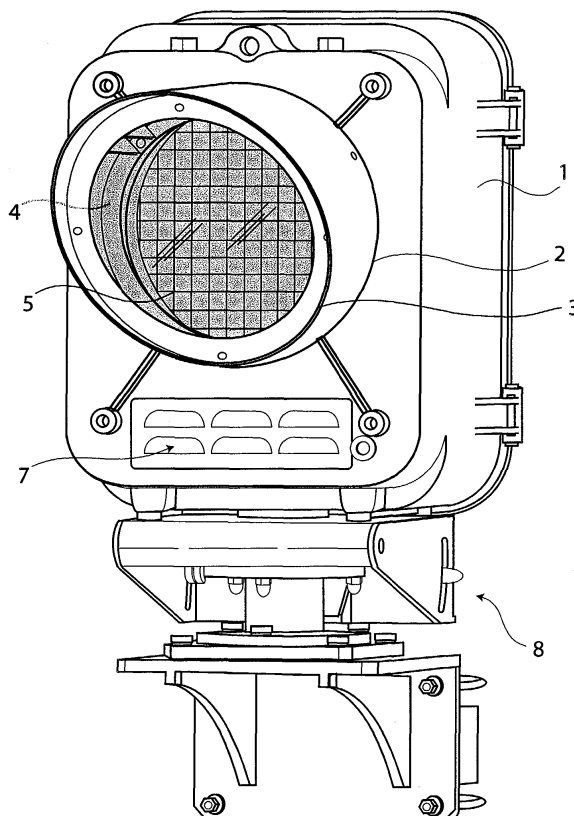


Fig. 1

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Description

[0001] The present invention relates to a LED optical signalling device, particularly for railway purposes, fitted in a suitable lens system.

[0002] More specifically, the invention concerns to a device of the above kind, realised in such a way to prevent the complete operation of the same device.

[0003] In the following, the specification will be particularly directed to a railway signalling system, but it is to be understood that the inventive solution can be applied to every other kind of use requiring this kind of device.

PRIOR ART

[0004] As it is well known, at present high intensity filament lamps are used in the railway signalling optical devices.

[0005] It is also well known that, in a railway network it is not possible to risk that one or more signalling devices are out of order, such an event creating very dangerous situations for the railway traffic.

[0006] Consequently, when managing the railway network, a very accurate maintenance of the signalling devices must be carried out.

[0007] The kind of lamps presently employed provides rather pressing maintenance responsibility. In fact, structure and features of the traditional signals based on filament lamps (both standard or halogen lamps) make it indispensable the preventive maintenance, i.e. before the end of the average useful life of the specific lamp employed, both to maintain under control the unavoidable decline of the lamp performance after some time, and to avoid complete failure (breakage of the filament or of the under vacuum bulb).

[0008] It is thus well evident that said procedure is very onerous both for the maintenance costs and for the time necessary to check all the railway network. Furthermore, a waste of the useful life of the lamps occurs, since the lamps must be replaced before their average duration to avoid that the railway line remains without signalling device, thus creating discomforts that can also be very dangerous.

[0009] Furthermore, systems based on incandescence lamps are not convenient for electric energy consumption reasons. Finally, they are not convenient for the heat generated, thus causing also possible cooling problems.

OBJECTS OF THE INVENTION

[0010] In view of the above, it is well evident the need of having a railway signalling system as suggested by the present invention, having a reduced maintenance needing and that, in case of failure, allows in any case to work as provided not leaving the line completely without the device. Further, it is added the convenience of an electrical energy saving, making the device more

economic. Particularly, by the use of high intensity LEDs, provided according to a matrix arrangement, it is necessary a suitable lens focusing system to obtain the signalling intensity sufficient to fulfil the railway rules.

[0011] In this situation it is included the solution suggested according to the present invention.

[0012] Therefore, object of the present invention is that of developing a railway signalling system, allowing to use high intensity LED, with fractionated supply circuits (redundancy) in such a way to make it possible to limit the maintenance of the above signalling system and that further allows to avoid, in case of failure, the lack of operation of the whole system.

[0013] Another object of the present invention is that of providing a solution allowing to limit the electric energy consumption and to simplify the maintenance with suitable dismounting and access systems to the optical group, to the supply cables and/or to the system housing.

[0014] A further object of the present invention is that of reducing the dimensions of the system.

SUMMARY OF THE INVENTION

[0015] It is therefore specific object of the present invention, an optical signalling device, particularly for railway use, comprising a LED matrix, made up of a plurality of LEDs, a lens matrix, made up of a number of lenses corresponding to the number of LEDs of the LED matrix, and supply means for said LED matrix.

[0016] Preferably, according to the invention, said LED matrix, in order to obtain a perfect agreement among the different chromatic co-ordinates of the different colours emitted and those provided by the different Rules (railway, road, etc. Rules), provides an additive system composing a light emitted by a plurality of light emitted by a lower number of colour correction LEDs, interposed among the main LEDs.

[0017] Always according to the invention, said plurality of main LEDs is comprised of LEDs having different colours.

[0018] Still according to the invention, said LEDs are series connected in different groups, each group being supplied by a separated generator.

[0019] Particularly, according to the invention, said groups are supplied by constant current generators.

[0020] Furthermore, according to the invention, each LED provides in parallel one Zener diode, having the double function of protection against overvoltage and of current bypass, making the failure of one LED not important (opening) on the operation and the luminosity of the other LEDs of the same group.

[0021] Further, according to the invention, said lenses of said lens matrix are lenses having a substantially square section.

[0022] Still according to the invention, said colour correction LEDs are provided on the corners of said lenses.

[0023] Preferably, according to the invention, said

lenses are provided at a distance from said main LEDs, preferably at a distance of 35 mm.

[0024] Furthermore, according to the invention, said lenses have the following dimensions: sides of 16.5 mm and height of 45.8 mm.

[0025] Still according to the invention, an antireflex optical glass is provided in front of said lens matrix.

[0026] Always according to the invention, a sunshade element is provided, to protect the optical system.

[0027] Furthermore, according to the invention, said signalling device provides a signal orientation mechanism, preferably according to a vertical movement and a horizontal movement, to preferably obtain a $\pm 8^\circ$ adjustment.

[0028] Particularly, said orientation mechanism can be handled by means provided within the signalling device.

SHORT DESCRIPTION OF THE DRAWINGS

[0029] The present invention will be now described, for illustrative but not limitative purposes, according to its preferred embodiments, with particular reference to the figures of the enclosed drawings, wherein:

figure 1 is a perspective view of an embodiment of the signalling device according to the invention;
figure 2 is a rear perspective view of the device of figure 1;

figure 3 is a first exploded perspective front view of the optical assembly of the device of figure 1;

figure 4 is a second exploded perspective front view of the optical assembly of the device of figure 1;

figure 5 is a third exploded perspective front view of the optical assembly of the device of figure 1; and

figure 6 is an exploded perspective rear view of the optical assembly of the device of figure 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0030] Observing first figures 1 and 2 of the enclosed drawings, it is shown a signalling device according to the invention, comprising an outer housing 1, providing a circular opening 2, protected by a sunshade 3, and another parallel flat optical glass 4, with anti-reflex treatment. Through said opening 2 the lighting beam passes, emerging from the optical system 5 that, therefore, remains insulated with respect to the sun and the bad weather, and that will be described in greater detail with reference to figures 3 - 6.

[0031] A box 6 is provided within the housing 1, the inner ventilation of which is ensured by slots 7 provided on the front part of the housing 1, and protected by a very narrow mesh stainless steel net, having an anti-fly effect.

[0032] Under the housing 1 an orientation device 8 is provided.

[0033] Observing specifically figure 2, it can be noted

that the metal box 6 containing the optical assembly 5 is housed within the outer housing 1, comprised of thermoplastic, shock-resistant, fire-retardant material, and is integral with the same. In the figure, the supply cables 9 and the quick coupling terminal board 10 can be observed.

[0034] Since the LED bearing board, the optical assembly and the supply circuits are a single sub-assembly, it is possible to dismount and to assemble them in few seconds, simply detaching the supply cables from the quick coupling terminal board 10 and loosening the screws (not shown) with a knurled opening and making the assembly sliding in a blocking guide 11. The figure further shows the orientation system 8 that, thanks to two independent vertical and horizontal movements, can very precisely orient the device according to the invention within a range of $\pm 8^\circ$ with respect to the fixing position. Said orientation mechanism 8, external with respect to the plastic housing 2, but protected with respect to dust and bad weather, is controlled by two knobs 12 and 13, provided within the housing 2, and thus not reachable by unauthorised persons. Knobs 12 and 13 have a first grade resolution.

[0035] Figure 3 represents the exploded view of the optical system 5 comprising a rectangular lens matrix 14. Each lens 15 has, in the illustrative, but not limitative embodiment shown in the figures, a side of 16.1 mm, a thickness of 45.8 mm and are spaced 35 mm from the diode matrix 16, said matrix 16 being comprised of a printed board on which a plurality of different LEDs is mounted, with a distribution studied to realise a single outlet beam for the three required colours. Obviously, measures of lenses cannot be considered limitative, being chosen each time according to the specific use of the signalling device according to the invention.

[0036] Interposed diodes 17 are evident among the lenses 15, they being used as colour correctors. In the same figure it can be seen that the electronics, made up of the board with the LEDs 16 and the lens matrix 14 are fully contained within the equipotential metallic box 6, floating with respect to the ground and insulated with respect to the same. They are particularly put into evidence the front part 18, the lateral part 19 and the rear panel 19 of the box 6. The sole particulars exiting from outside said box 6 are the supply cables 21.

[0037] Figure 4 shows a different exploded view of the optical system 5. Particularly, it is noted the lens matrix 14, the metallic front part 18, and a lateral metallic protection 22, containing the optical system 5. They can also be noted the colour correcting diodes 17, interposed between the lenses and the mounting base 23 for the diodes. Finally, it is shown the rear panel 20 along with fixing screws 24.

[0038] Figure 5 shows a further exploded front view of the optical system 5, from which it is possible to observe the optical group 18, protection gaskets 25, lens matrix 14, LEDs interposed among lenses 17, the lateral protection of the system 22, the rear mounting base of

the system 23 and the rear device closure panel 20.

[0039] Figure 6 shows an exploded rear view of the system 5, from which it is possible to distinguish the rear fixing screws 24, the fixing panel 26 for the same screws, the lateral protection of the optical system 22, the lens matrix 14, the protection gaskets 25 and finally the front protection 18.

[0040] Luminous diodes are series supplied, divided into small groups (groups), by suitable current generators.

[0041] Current supply criteria along with the protection circuits of each single LED make it not important the short circuit or the interruption of a LED on the luminosity of the other diodes.

[0042] Electronics are designed in order to obtain the maximum reliability and safety, according to the criteria imposed by the 50129 EN Rule (Safety Related Electronic System for Signalling).

[0043] Failure of one or more components does not influence in a determinant way the luminous beam of the signal. Further, it has been structured in such a way that possible failures really modify the absorbed current; this arrangement (that can be easily deactivated if required) allows the installation of the signal on lines provided with differential sensors, maintaining the provided alarm capacity.

[0044] All the components are oversized, even if compared with the large temperature range within which the device must work.

[0045] Movements are pivoted on anti-friction materials and all the metallic particulars are subjected to galvanic treatments to prevent oxidation phenomenon.

[0046] Laying is carried out by a sight, integral with the optical group and aligned with the mechanical axis of the same, comprised of a hole and a narrow cross-shaped slit, distant each other about 20 mm.

[0047] Electronics have a double safety since it is included within a metallic watertight box, that is further protected by the outer housing designed to give a IP56 protection grade.

[0048] Signalling device is provided with suitable brackets both for the coupling with a pole or with a lattice. If required, suitable adapters are provided allowing also the use of traditional brackets until now on filament lamp signals.

EXAMPLES

[0049] While studying the device according to the invention, two signalling devices have been realised, having the same structure and technology, however providing the possibility to choose between two luminous intensity levels. Information that will be provided must be taken as exemplificative of the invention, not being any limitation of its scope.

[0050] The biggest model (SOL/01) is a three aspects light having luminous intensity according to the technical rule "static commutation devices for luminous fix sig-

nals". It is housed within a housing having the following dimensions 530 cm length, 420 cm height, 281 cm depth.

[0051] Diaphragm of the light has a diameter of 300 mm.

[0052] Identical features and chromatic co-ordinates have the two aspects and single aspect lights having the same outer dimensions.

[0053] It has further been experimentally realised a light model (SOL/02) having the same chromatic features, but with the intensity of the beam that is the half with respect to the above models and with a lower diameter of the diaphragm (210 mm), with dimensions of the outer housing lower than 464 cm x 353 cm x 281 cm. Both models can be, if required, provided with ground plates having radiating diaphragms according to the rules of the relevant Railway Authority.

[0054] Technical Features

- optical signal with one, two or three colours (red, green, yellow) with static commutation with a single beam outlet point;
- sources: high intensity LEDs with concentrated beam;
- connections: LEDs are connected each other in series in groups having variable dimensions;
- group supply: direct current. In order to improve the reliability, each group has a separated current generator;
- supply: each colour is activated providing two wire supply (120-150 Vac, 50 Hz);
- supply connection: by connector with terminals;
- colours: according to the chromatic co-ordinates provided by the 9226 UNI rule for the class 1 signals;
- luminous intensity: for the SOL/01 model according to the technical specification "Static commutation devices for luminous fixed signals" (Prog. STF IS 393 of 08.10.1998) and particularly:
 - Red 2500 cd
 - Green 7000 cd
 - Yellow 14000 cd;
- luminous intensity; for the SOL/02 model about the half of the SOL/01 model, i.e.

Red 1200 cd
Green 3200 cd
Yellow 6000 cd;

- visibility: beyond 400 m for both models;
- supply voltage: 120 or 150 V (+ 6/-10%) Vca; 50 Hz;
- diameter of the optical diaphragm:

SOL/01 $\varnothing$ 300 mm
SOL/01 $\varnothing$ 210 mm

- fine orientation system: along two axis (vertical and horizontal) $\pm 8^\circ$ with graduated knobs.
- laying: by optical target provided within the housing;
- dimensions: SOL/01 = 530x420x281

SOL/02 = 464x353x281
 SOL/01 about 16 kg weight
 SOL/02 about 12 kg weight

- operation temperature: -25°C - -70°C
- environment humidity: 45% - 95%
- protection grade: IP56
- estimated MTBF: 40,000 hours

[0055] The present invention has been described for illustrative but not limitative purposes, according to its preferred embodiments, but it is to be understood that modifications and/or changes can be introduced by those skilled in the art without departing from the relevant scope as defined in the enclosed claims.

Claims

1. Optical signalling device, particularly for railway use, **characterised in that** it comprises a LED matrix, made up of a plurality of LEDs, a lens matrix, made up of a number of lenses corresponding to the number of LEDs of the LED matrix, and supply means for said LED matrix.
2. Optical signalling device, particularly for railway use, according to claim 1, **characterised in that** said LED matrix, in order to obtain a perfect agreement among the different chromatic co-ordinates of the different colours emitted and those provided by the different Rules (railway, road, etc. Rules), provides an additive system composing a light emitted by a plurality of light emitted by a lower number of colour correction LEDs, interposed among the main LEDs.
3. Optical signalling device, particularly for railway use, according to claim 1 or 2, **characterised in that** said plurality of main LEDs is comprised of LEDs having different colours.
4. Optical signalling device, particularly for railway use, according to one of the preceding claims, **characterised in that** said LEDs are series connected in different groups, each group being supplied by a separated generator.
5. Optical signalling device, particularly for railway use, according to claim 4, **characterised in that** said groups are supplied by constant current generators.
6. Optical signalling device, particularly for railway use, according to claim 4 or 5, **characterised in that** each LED provides in parallel one Zener diode, having the double function of protection against overvoltage and of current bypass, making the failure of one LED not important (opening) on the operation and the luminosity of the other LEDs of the same group.
7. Optical signalling device, particularly for railway use, according to one of the preceding claims, **characterised in that** said lenses of said lens matrix are lenses having a substantially square section.
8. Optical signalling device, particularly for railway use, according to one of the preceding claims 2 - 7, **characterised in that** said colour correction LEDs are provided on the corners of said lenses.
9. Optical signalling device, particularly for railway use, according to one of the preceding claims, **characterised in that** said lenses are provided at a distance from said main LEDs, preferably at a distance of 35 mm.
10. Optical signalling device, particularly for railway use, according to one of the preceding claims, **characterised in that** said lenses have the following dimensions: sides of 16.5 mm and height of 45.8 mm.
11. Optical signalling device, particularly for railway use, according to one of the preceding claims, **characterised in that** an antireflex optical glass is provided in front of said lens matrix.
12. Optical signalling device, particularly for railway use, according to one of the preceding claims, **characterised in that** a sunshade element is provided, to protect the optical system.
13. Optical signalling device, particularly for railway use, according to one of the preceding claims, **characterised in that** said signalling device provides a signal orientation mechanism.
14. Optical signalling device, particularly for railway use, according to claim 13, **characterised in that** said signal orientation mechanism allows an orientation according to a vertical movement and a horizontal movement, to preferably obtain a $\pm 8^\circ$ adjustment.
15. Optical signalling device, particularly for railway use, according to claim 13 or 14, **characterised in that** said orientation mechanism is handled by means provided within the signalling device.
16. Optical signalling device, particularly for railway use, according to one of the preceding claims, **characterised in that** said signalling device provides a signal orientation mechanism.

use, according to each one of the preceding claims,
substantially as illustrated and described.

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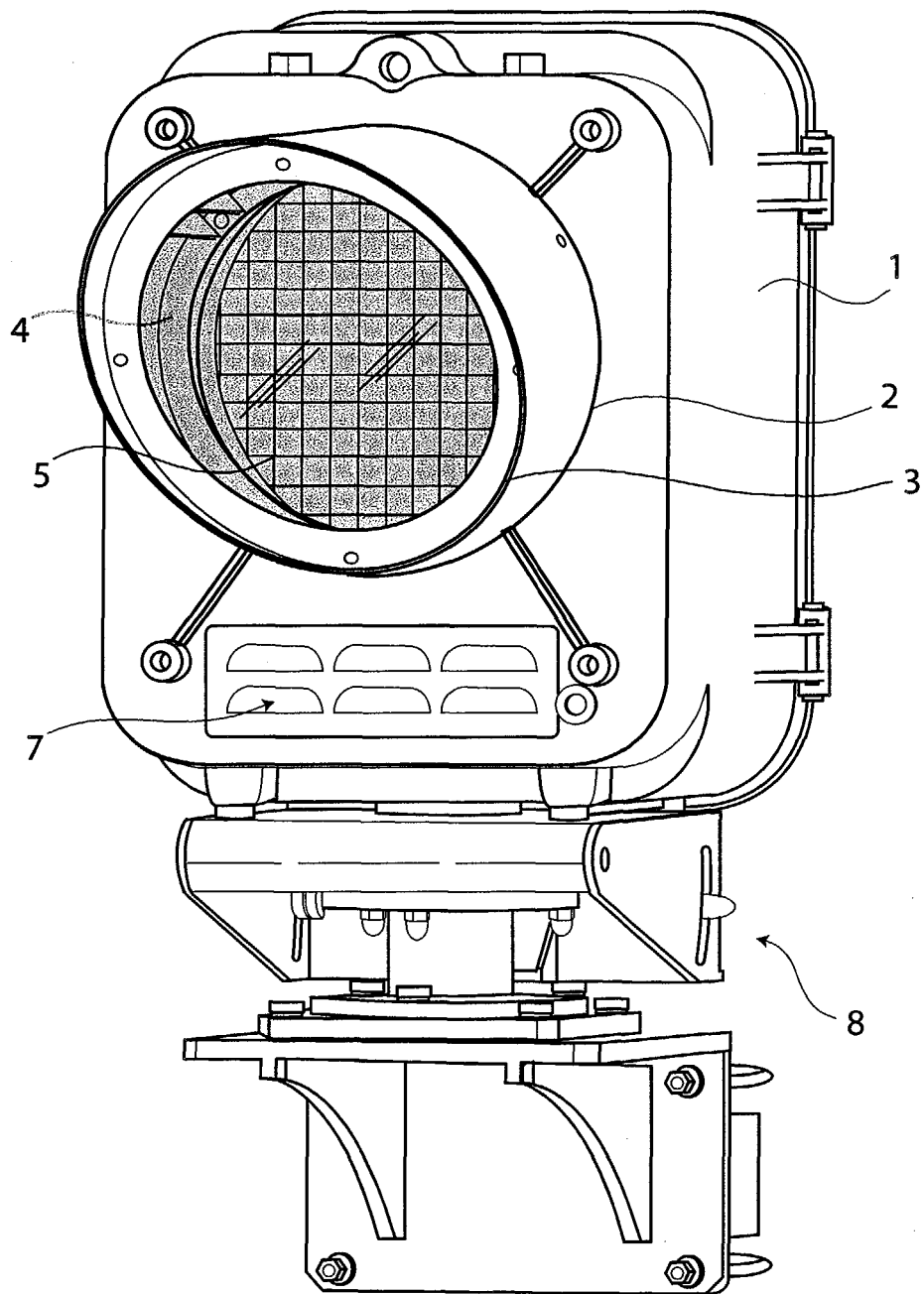


Fig. 1

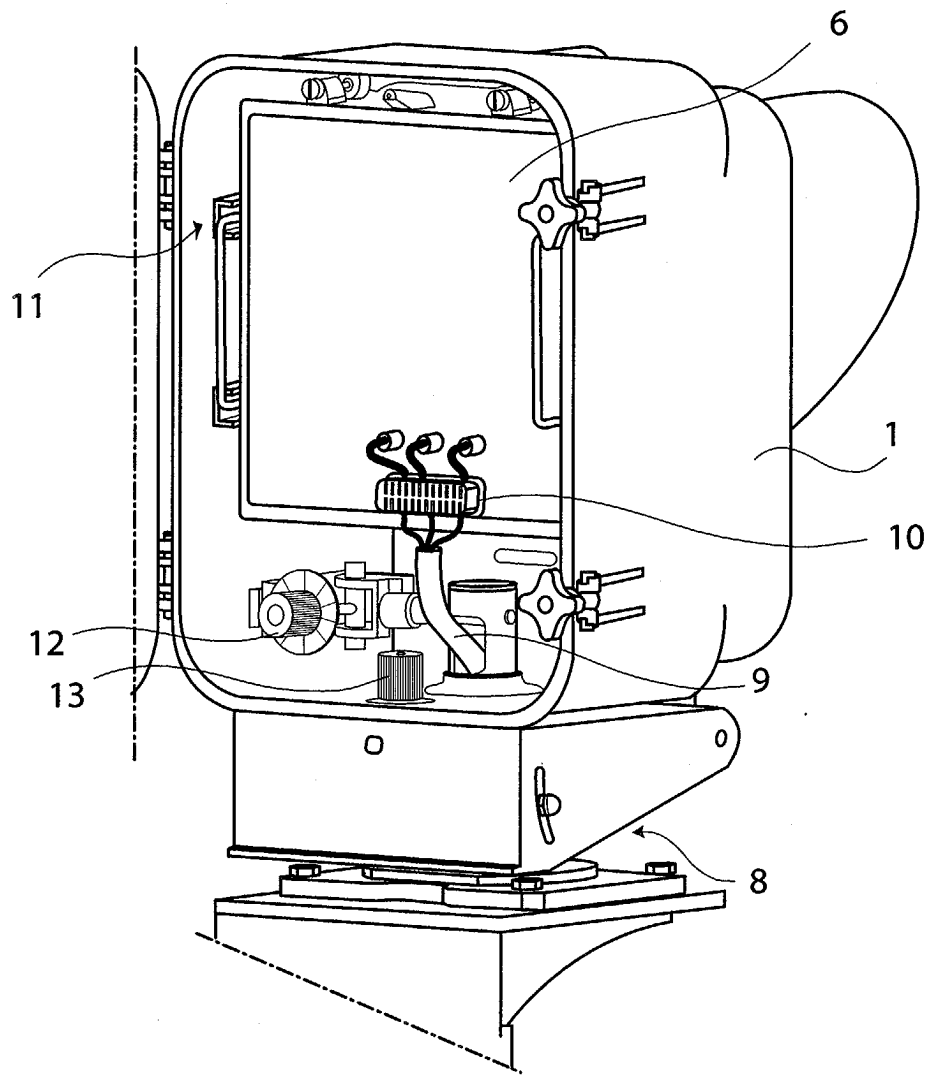


Fig. 2

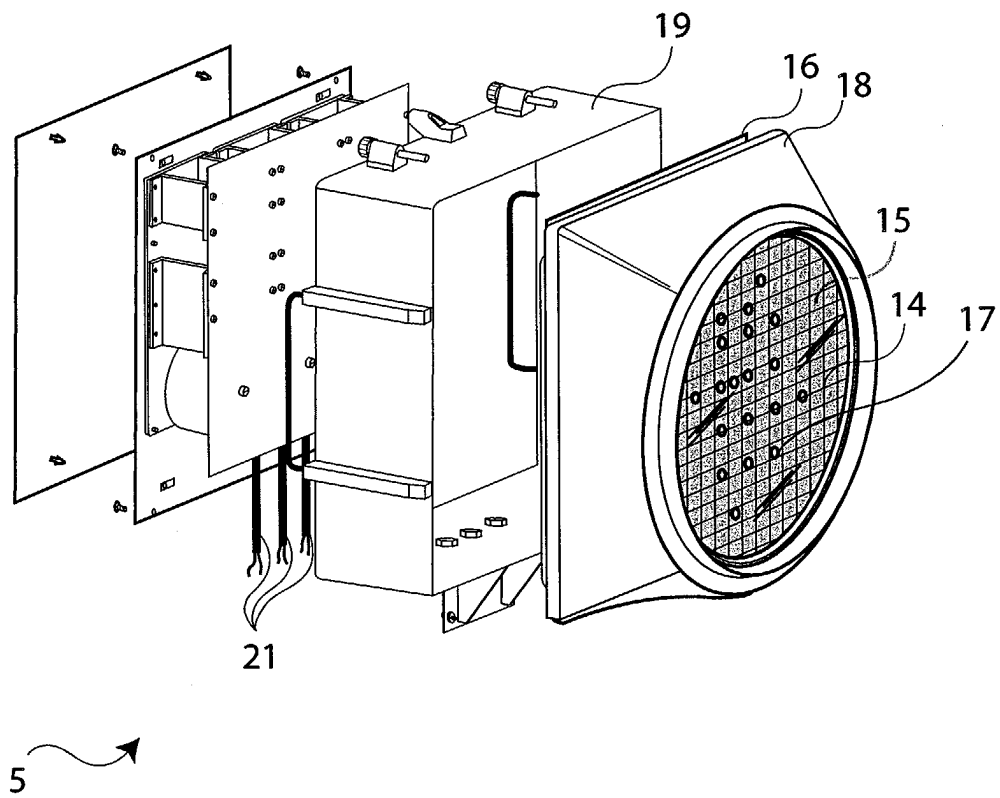


Fig. 3

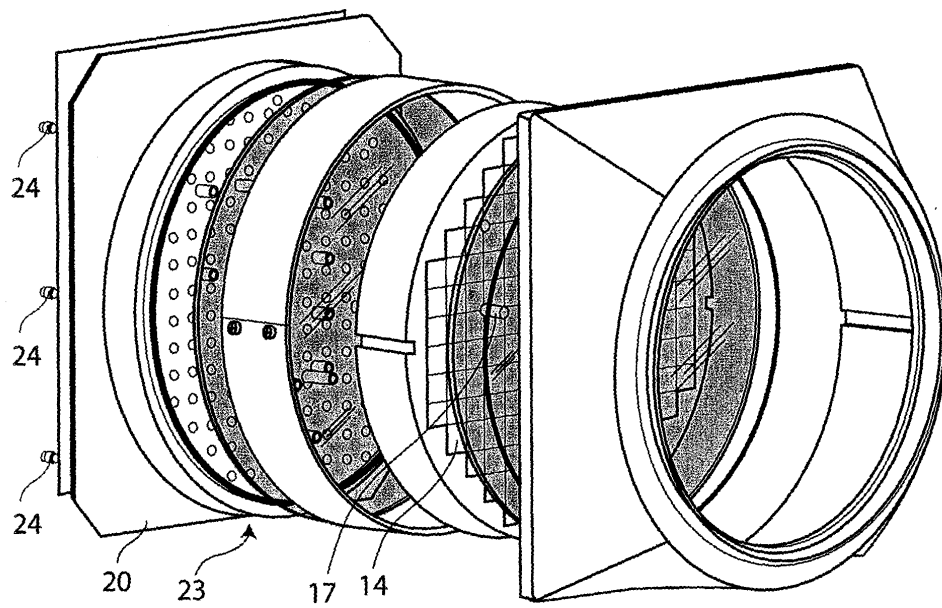


Fig. 4

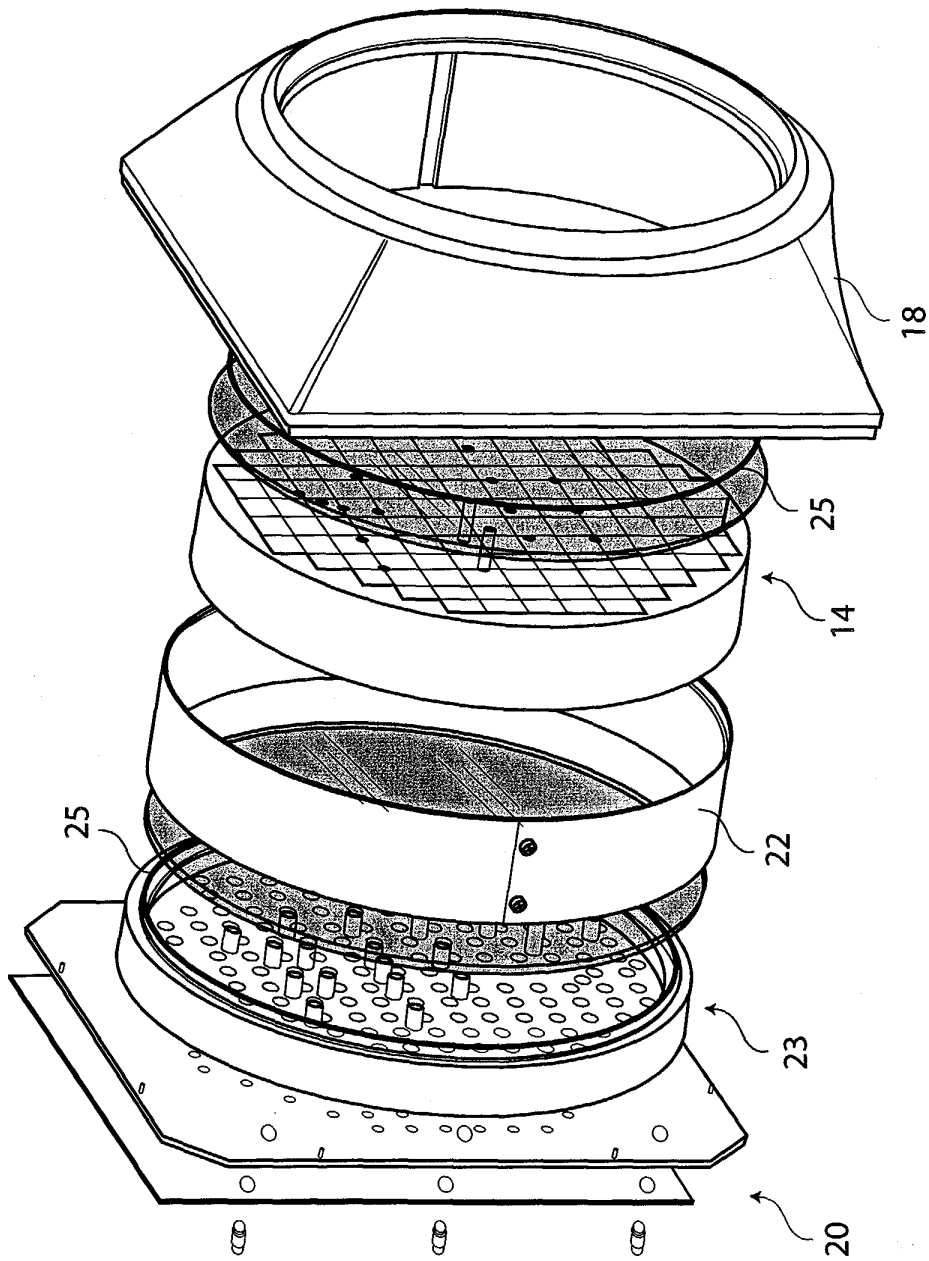


Fig. 5

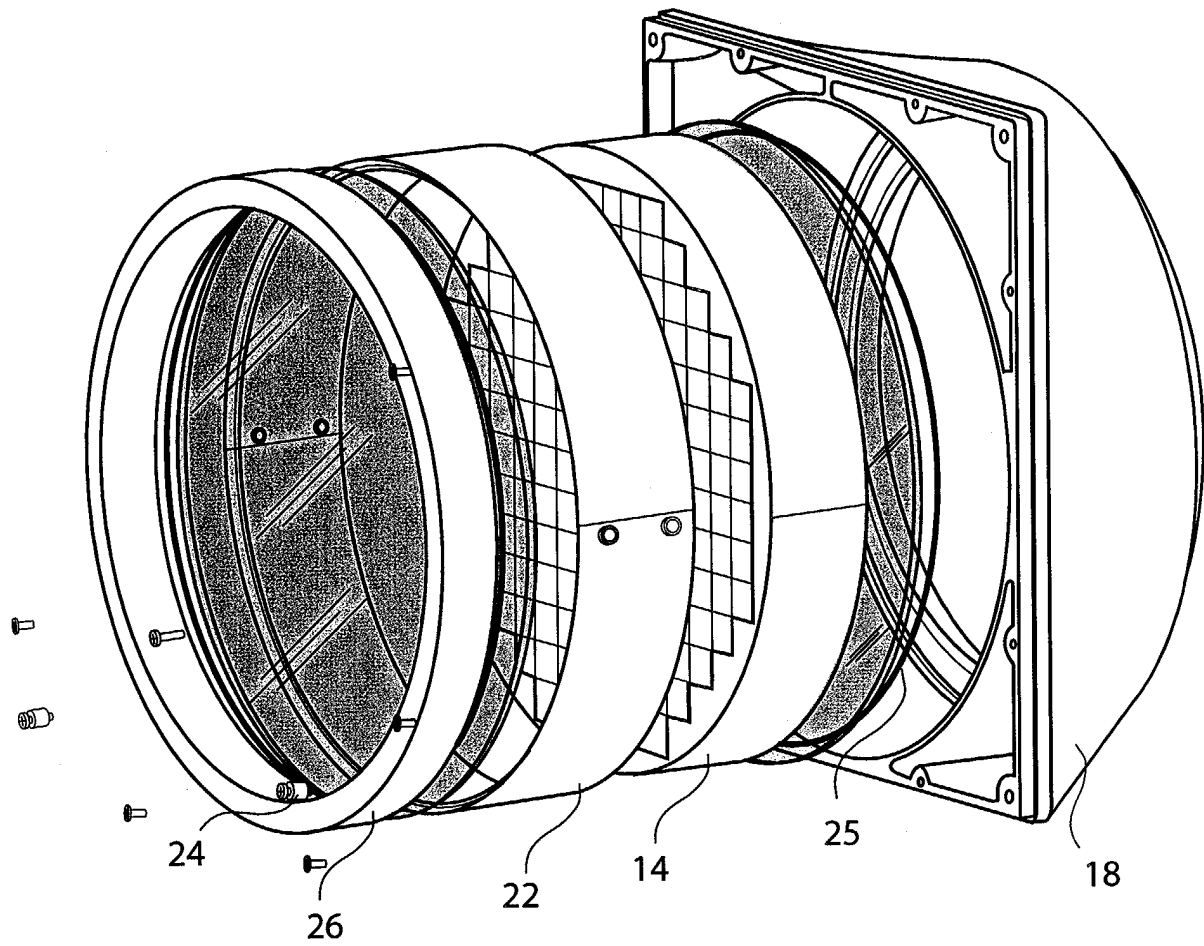


Fig.6