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(54) Led lighting device with modular optical system

(57) An LED lighting device with modular optical system, including at least one LED element (6) and at least one lighting module (5) that is associated with the LED element and is adapted to distribute a light beam emitted by the LED element according to a given photometric model; the lighting module includes a primary optical element (8) and a secondary optical element (9), which cooperates with the primary optical element in order to distribute the light beam. The primary and secondary optical elements are interchangeable in order to modify the photometric model.

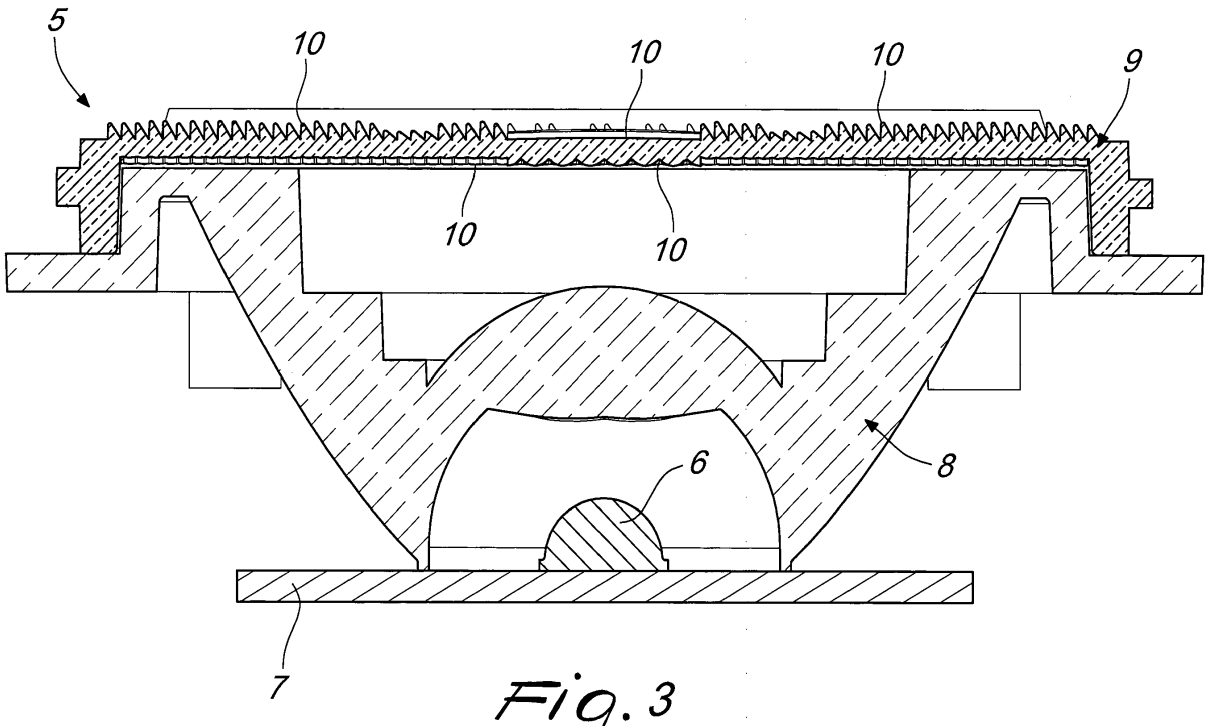

Fig. 3

EP 2 865 939 A1

Description

[0001] The present invention relates to an LED lighting device with modular optical system.

[0002] The lighting device according to the present invention is studied particularly for luminaires for lighting large indoor and outdoor spaces.

[0003] As is known, traditional luminaires, for example the ones that use discharge lamps, allow to modify the light emission characteristics by virtue of different mounting positions of the lamp with respect to the reflector.

[0004] In LED luminaires, this possibility is not allowed and manufacturers are forced to manufacture a different model for each individual application.

[0005] This limitation affects heavily the convenience of prefabricating the components and therefore affects costs.

[0006] In order to obviate this drawback and ensure at the same time an excellent yield, LED luminaire manufacturers have adopted various strategies.

[0007] A first solution consists in preparing the plate in which each LED has a different inclination that can lead to an optimum lighting spot mosaic, according to the photometric system that one wishes to obtain.

[0008] This solution, which allows to utilize to the maximum possible extent the potential of LEDs, without reducing the luminous intensity with additional corrective optical assemblies, is however expensive from the point of view of industrialization.

[0009] Another solution, which is cheaper than the preceding one, consists in preparing various rows of LEDs on a plate and in applying different lenses and microlenses for each LED, with the task of diffusing the light appropriately.

[0010] A further solution consists in preparing various rows of LEDs on a plate, arranging around each LED a refractor that is capable of defining a specific photometric model, in a manner similar to a traditional lamp.

[0011] It is known to provide the refractor in two components, generally defined as a primary optical system and a secondary optical system.

[0012] The light emitted by the LED unit, which has its own lens, is first refracted by the primary optical system and then by the secondary optical system.

[0013] Such construction allows to modify the photometric model of each LED unit, combining optical systems having different characteristics.

[0014] A drawback of such system is that each optical solution is tied closely to the LED unit that is used and to the interaction with the other lighting units that are used in the same luminaire.

[0015] In other words, the luminaire manufactured with this system necessarily has to be installed exactly as planned and cannot be utilized in a different manner.

[0016] From the production standpoint also, it is necessary to provide a large number of optical components, each of which can be used in combination only with the specific optical components for which it has been designed.

[0017] WO2013009197 discloses a luminaire of the above described type, having an input lens, with fixed or adjustable focal length, and an output panel set of lenses, with fixed or adjustable position with respect to the input lens. The output lens may be inclined at different angles with respect to the input lens by using different replaceable parts.

[0018] The aim of the present invention is to provide an LED lighting device with modular optical system that overcomes the drawbacks of the cited prior art.

[0019] Within the scope of this aim, an object of the invention is to provide a device that allows to reduce the number of optical components of a different type that are needed to provide lighting units with different photometric characteristics.

[0020] An important object of the invention is to provide a device that allows to modify the photometric characteristics of the luminaire in which it is installed, without replacing any component.

[0021] Another object is to provide a lighting device that allows modification of the photometric characteristics of the luminaire in which it is installed, without replacing any components, even on the part of the end user.

[0022] Another object of the present invention is to provide a device which, by virtue of its particular constructive characteristics, is capable of giving the greatest assurances of reliability and safety in use.

[0023] This aim and these and other objects that will become better apparent hereinafter are achieved by an LED lighting device with modular optical system, comprising at least one LED element and at least one lighting module that is associated with said LED element and is adapted to distribute a light beam emitted by said LED element, according to a given photometric model; said device being characterized in that said lighting module comprises a primary optical element and a secondary optical element, said secondary optical element cooperating with said primary optical element in order to distribute said light beam; said primary and secondary optical elements being interchangeable in order to modify said photometric model; a same secondary optical element can be applied to a same primary optical element in different positions in order to modify said photometric model.

[0024] Further characteristics and advantages will become better apparent from the description of preferred but not exclusive embodiments of the invention, illustrated by way of non-limiting example in the accompanying drawings, wherein:

Figure 1 is a partially exploded perspective view of the LED lighting device according to the present invention;

Figure 2 is a partially exploded perspective view, from below, of the device of figure 1;

Figure 3 is a sectional side view of a lighting module;

Figure 4 is a perspective view of the front part of the

lighting module;

Figure 5 is a perspective view, in which the secondary optical element is installed rotated through 90° with respect to its position in figure 4;

Figure 6 is a schematic transverse sectional view of an example of behavior of the light beams;

Figure 7 is a perspective view of a luminaire provided with the device according to the present invention;

Figure 8 is a front view of the luminaire of figure 7;

Figure 9 is a rear view of the luminaire of figure 8.

[0025] With reference to the cited figures, the LED lighting device with modular optical system, according to the invention, generally designated by the reference numeral 1, comprises a supporting plate 2 that is associated with a heat sink 3, constituted by a body provided with fins, preferably made of metal, for example aluminum.

[0026] The supporting plate 2 has a plurality of seats 4, each of which is adapted to accommodate a respective lighting module 5.

[0027] Each lighting module 5 is arranged at a respective LED element 6, constituted by one or more LEDs, applied to a base plate 7, connected to the heat sink 3.

[0028] According to the present invention, each lighting module 5 has a primary optical element 8 and a secondary optical element 9, that is variable.

[0029] The primary optical element 8 can be constituted by a reflector and/or by a lens or a light guide.

[0030] The secondary optical element 9 is advantageously constituted by an interchangeable disk, which can be shaped so as to have different light diffusion and transmission characteristics.

[0031] According to a preferred embodiment, the disk 9 has a series of contoured regions 10, optionally on both sides.

[0032] The contoured regions 10 can be constituted by prism-like notches or other appropriate shapes adapted to refract the light beams according to a preselected photometric pattern.

[0033] According to the present invention, the secondary optical element 9 is associated with the primary optical element 8 by means of a bayonet coupling or other coupling system, which allows to apply the secondary optical element 9 with a variable angle of rotation with respect to the primary optical element.

[0034] Figures 4 and 5 show, by way of example, the secondary optical element 9 mounted on the primary optical element, rotated through 90° between one position and the other.

[0035] The bayonet coupling system or other preselected coupling system can be configured so as to allow the assembly of the secondary optical element 9 with different angles, discretely or continuously, so as to allow to vary the direction and distribution of the light beam and therefore vary the photometric model of the device.

[0036] In order to ensure water tightness and resistance to humidity, the secondary optical element 9 is mounted on the primary optical element 8 with the interposition of a gasket 13.

[0037] The device 1 can be used in luminaires having various shapes and dimensions.

[0038] Figures 7-9 show an example of application of the device 1 in a luminaire 100 constituted by a casing 101, for example made of thermoplastic material.

[0039] The casing 101 accommodates the device 1 in a receptacle that is adjacent to a compartment 102, which contains the power supply and control systems, not shown in the figures.

[0040] Advantageously, the lighting device 1 has a tubular element 11, which is integral with the supporting plate 2 and is adapted to contain the electrical cables that connect the base plate 7, which supports the LEDs 6, to the power supply and control systems, arranged within the compartment 102.

[0041] The tubular element 11 has a flanged insert 12 that is adapted to enter an adapted hole, not visible in the figures, provided in the second compartment 102.

[0042] The lighting device 1, completely assembled and with the power supply cables inserted in the tubular element 11, is arranged within the receptacle by inserting first the flanged insert 12 in the hole of the compartment 102.

[0043] The seal between the tubular element and the compartment 102 can be ensured by means of an adapted gasket.

[0044] The tubular element 11 allows to speed up and facilitate the assembly of the device 1 in the luminaire 100 and prevents the presence of visible wires.

[0045] By combining different primary optical elements 8, constituted by lenses or reflectors, with different secondary optical elements 9, constituted by diffuser discs having different optical characteristics, it is possible to obtain luminous emissions with various photometric characteristics.

[0046] The end user himself can easily vary the luminous emission by varying the position of each secondary optical element 9 simply by turning it with respect to the primary optical element 8.

[0047] For example, the same luminaire 100 can be installed vertically or horizontally, maintaining exactly the same distribution and direction of the light beam, simply by rotating each secondary optical element 9 through 180°.

[0048] In practice it has been found that the invention achieves the intended aim and objects, providing an LED lighting device with a modular optical system that is constituted by a series of lighting modules that allow to vary the photometric characteristics of the device simply and cheaply from a production standpoint.

[0049] The device according to the present invention also allows a variation of the direction of the light beam, by the end user, simply by varying the position of the secondary optical elements 9 with respect to the primary optical elements 8 on which they are assembled.

Claims

1. An LED lighting device with modular optical system, comprising at least one LED element and at least one lighting module that is associated with said LED element and is adapted to distribute a light beam emitted by said LED element, according to a given photometric model; said device being **characterized in that** said lighting module comprises a primary optical element and a secondary optical element, said secondary optical element cooperating with said primary optical element in order to distribute said light beam; said primary and secondary optical elements being interchangeable in order to modify said photometric model; a same secondary optical element can be applied to a same primary optical element in different positions in order to modify said photometric model.

2. The device according to claim 1, **characterized in that** said secondary optical element is mounted on said primary optical element in a detachable manner.

3. The device according to claim 1, **characterized in that** it comprises a supporting plate which comprises one or more seats, each of which is adapted to accommodate a respective lighting module; each lighting module being arranged at a respective LED element applied to a base plate.

4. The device according to claim 4, **characterized in that** it comprises a heat sink associated with said base plate and with said supporting plate.

5. The device according to claim 1, **characterized in that** said primary optical element is constituted by a reflector and/or by a lens or a light guide.

6. The device according to claim 1, **characterized in that** said secondary optical element is constituted by a disk that has a series of contoured regions.

7. The device according to claim 6, **characterized in that** said contoured regions comprise prism-like notches or other appropriate shapes adapted to refract light beams according to a chosen photometric pattern.

8. The device according to claim 1, **characterized in that** said secondary optical element is associated with said primary optical element by means of a bayonet coupling.

9. The device according to claim 1, **characterized in that** said secondary optical element is mounted on said primary optical element with the interposition of a gasket.

10. The device according to claim 1, **characterized in that** it comprises a tubular element, which is integral with said supporting plate, and is adapted to contain electric wires that connect said base plate that supports said LED elements to the power supply and control systems of a luminaire in which said lighting device is installed.

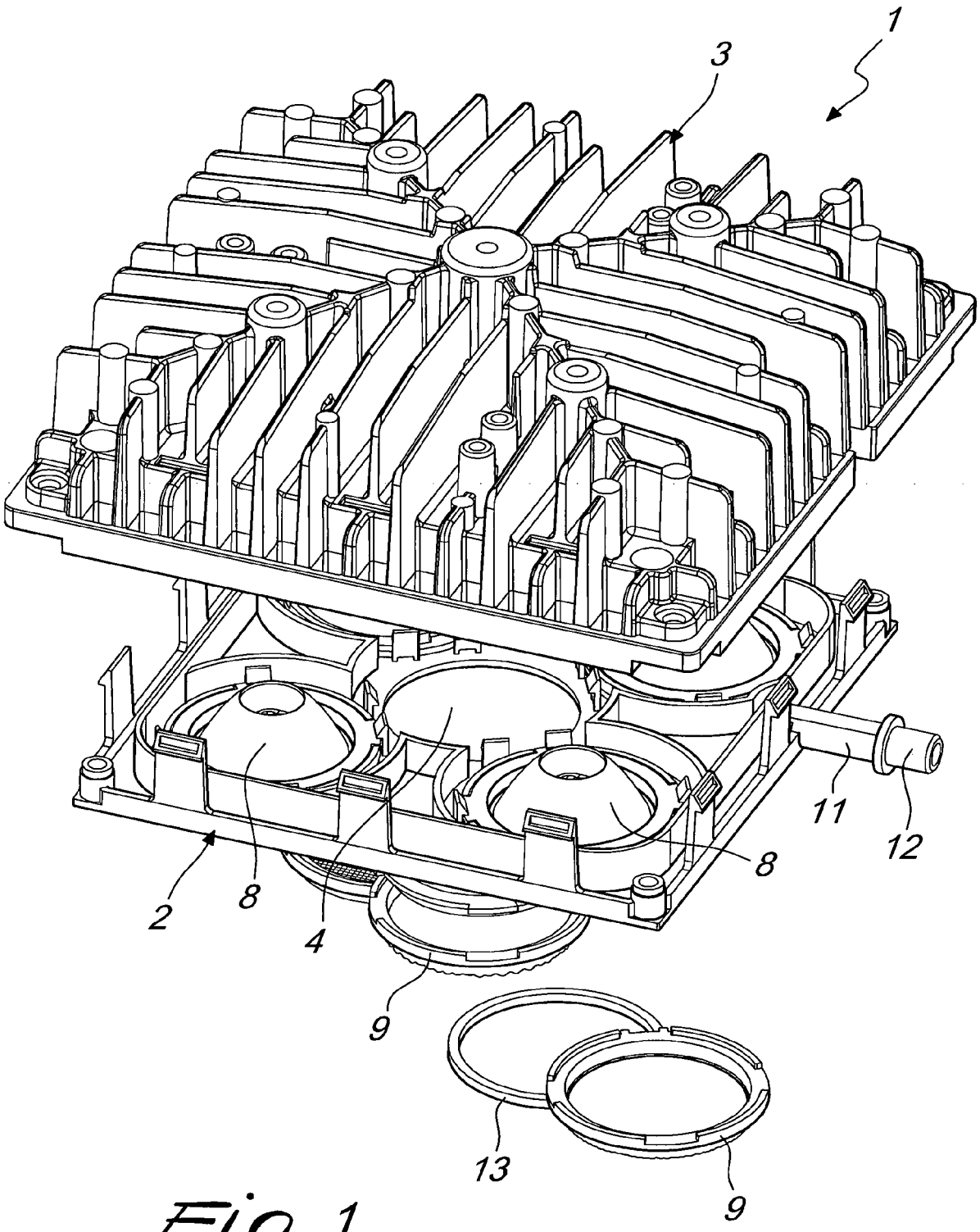

Fig. 1

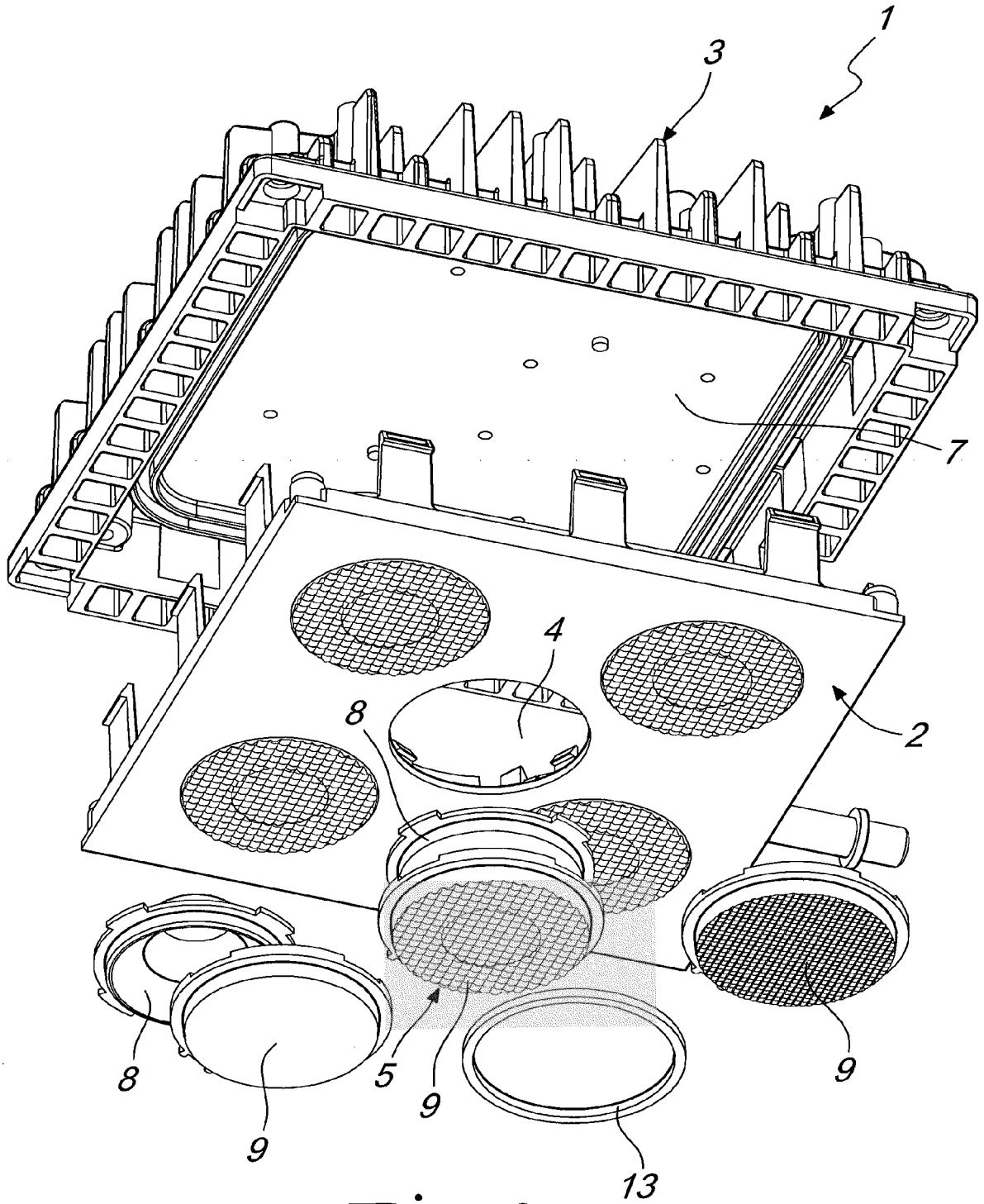

Fig. 2

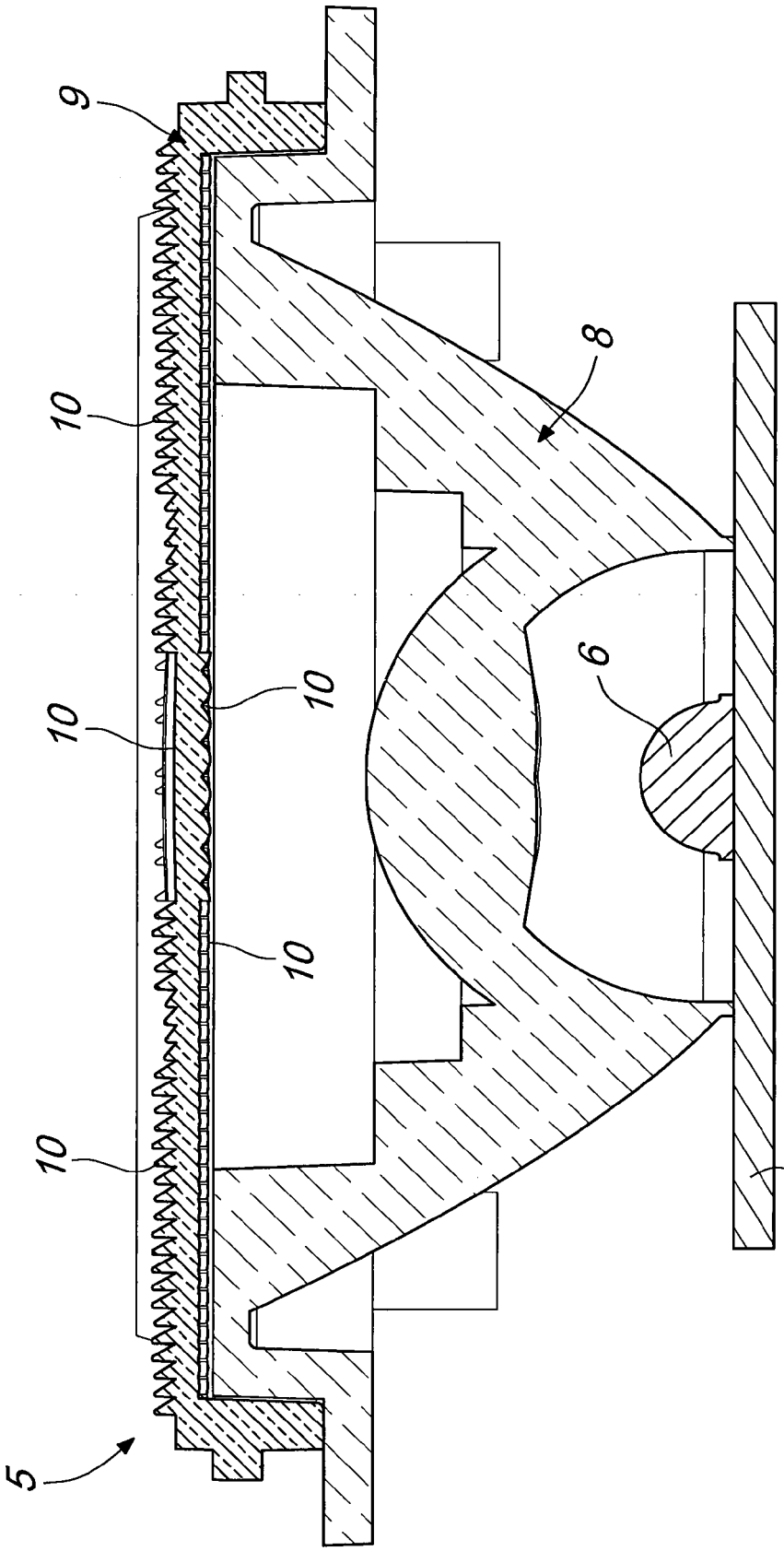

Fig. 3

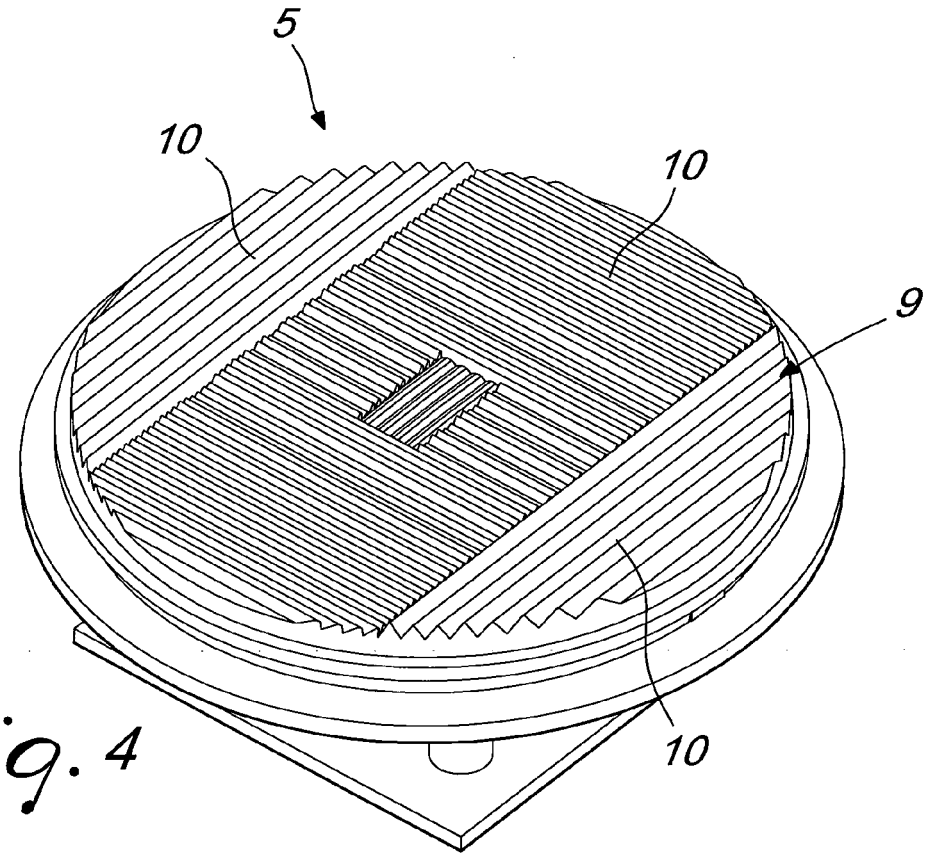

Fig. 4

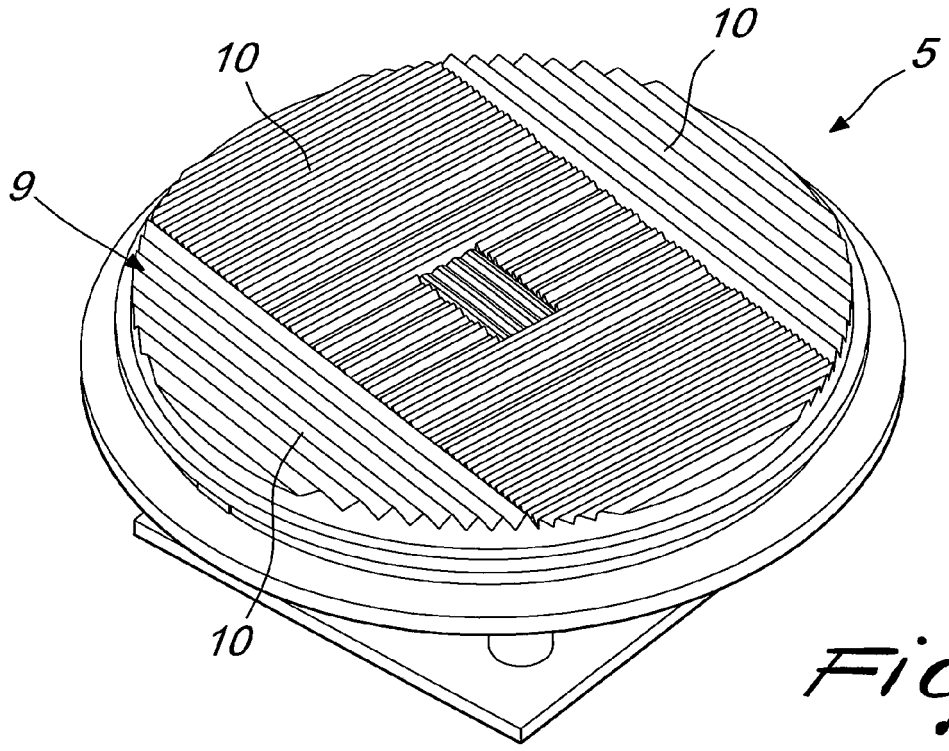

Fig. 5

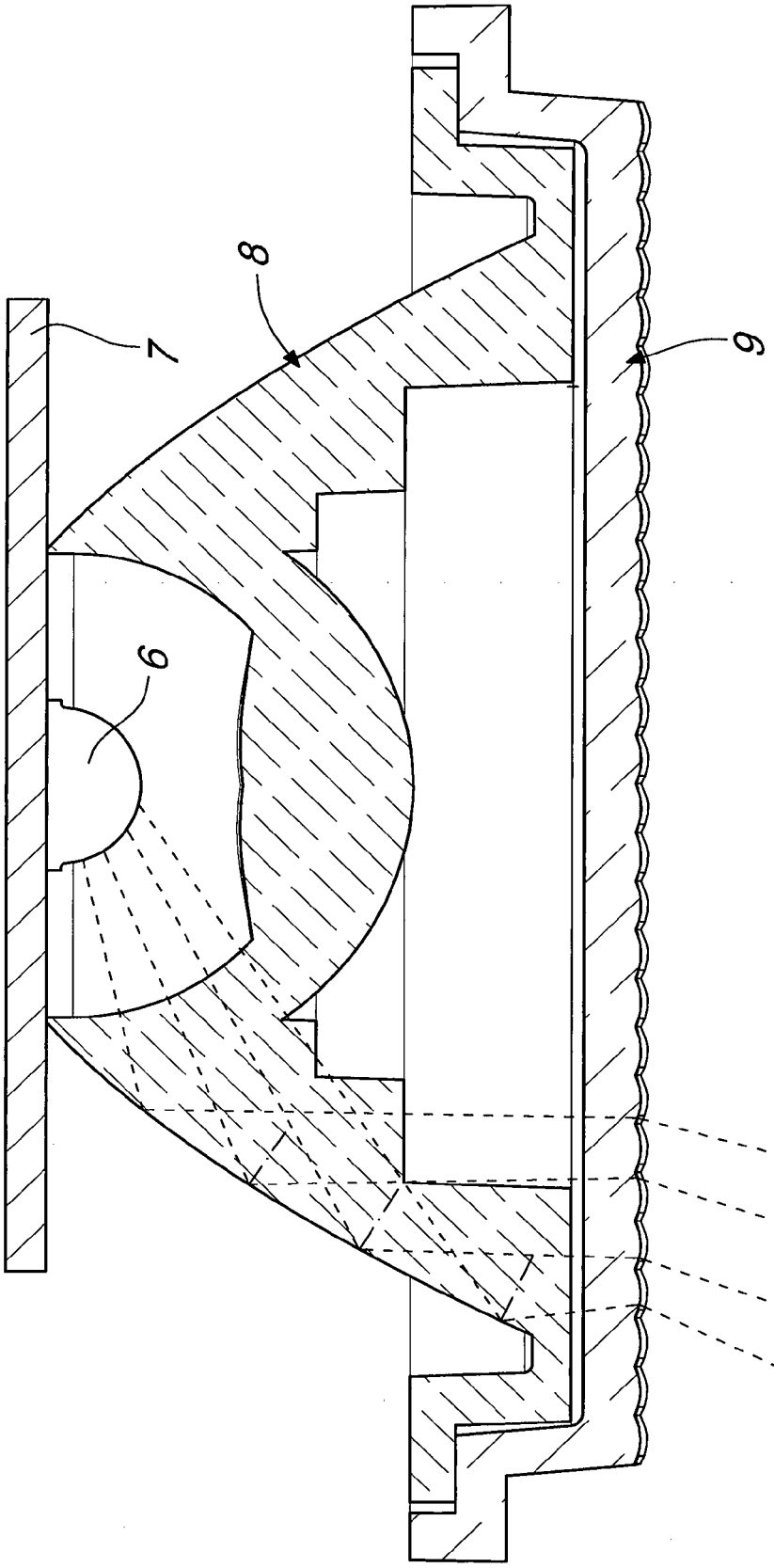

Fig. 6

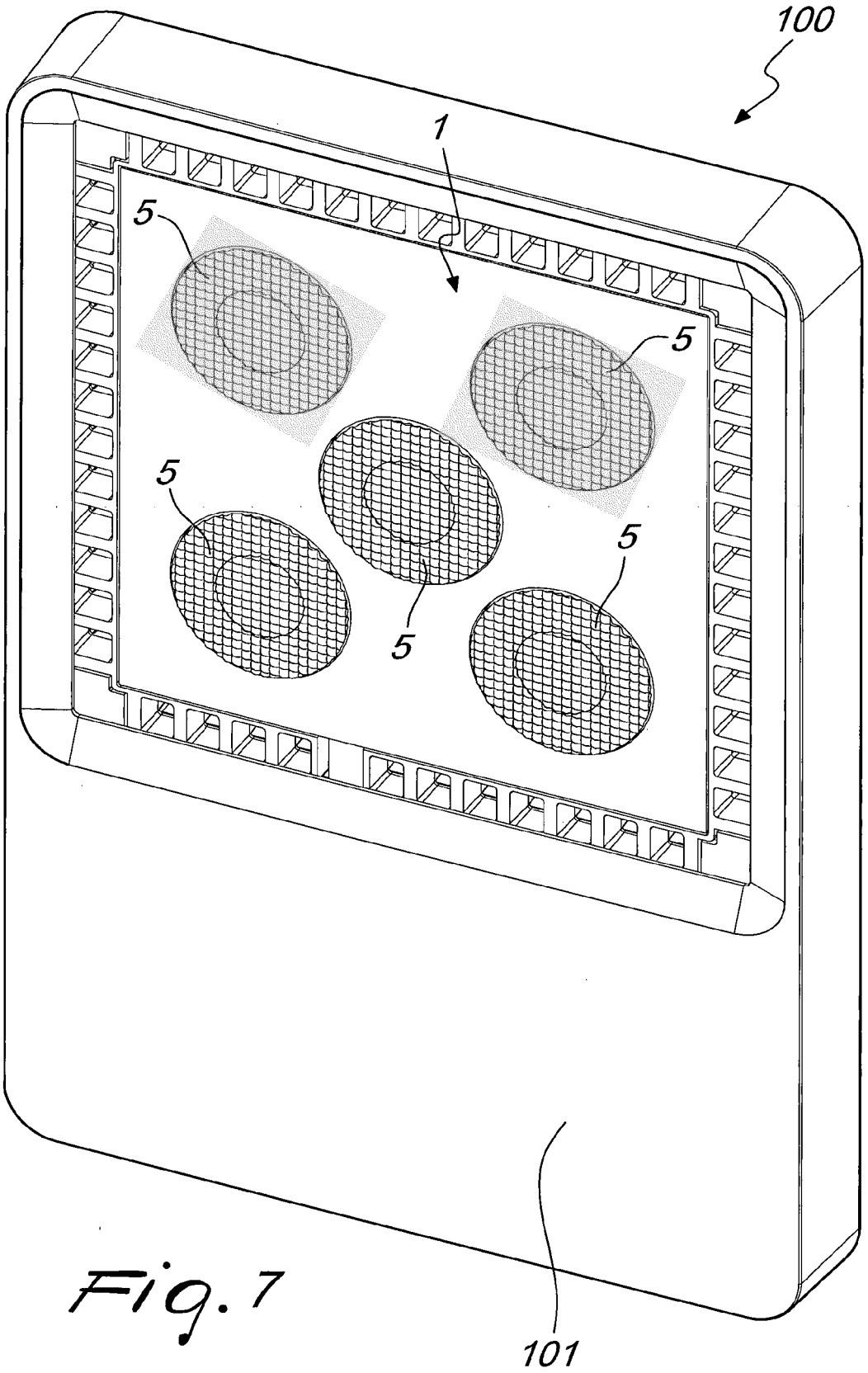

Fig. 7

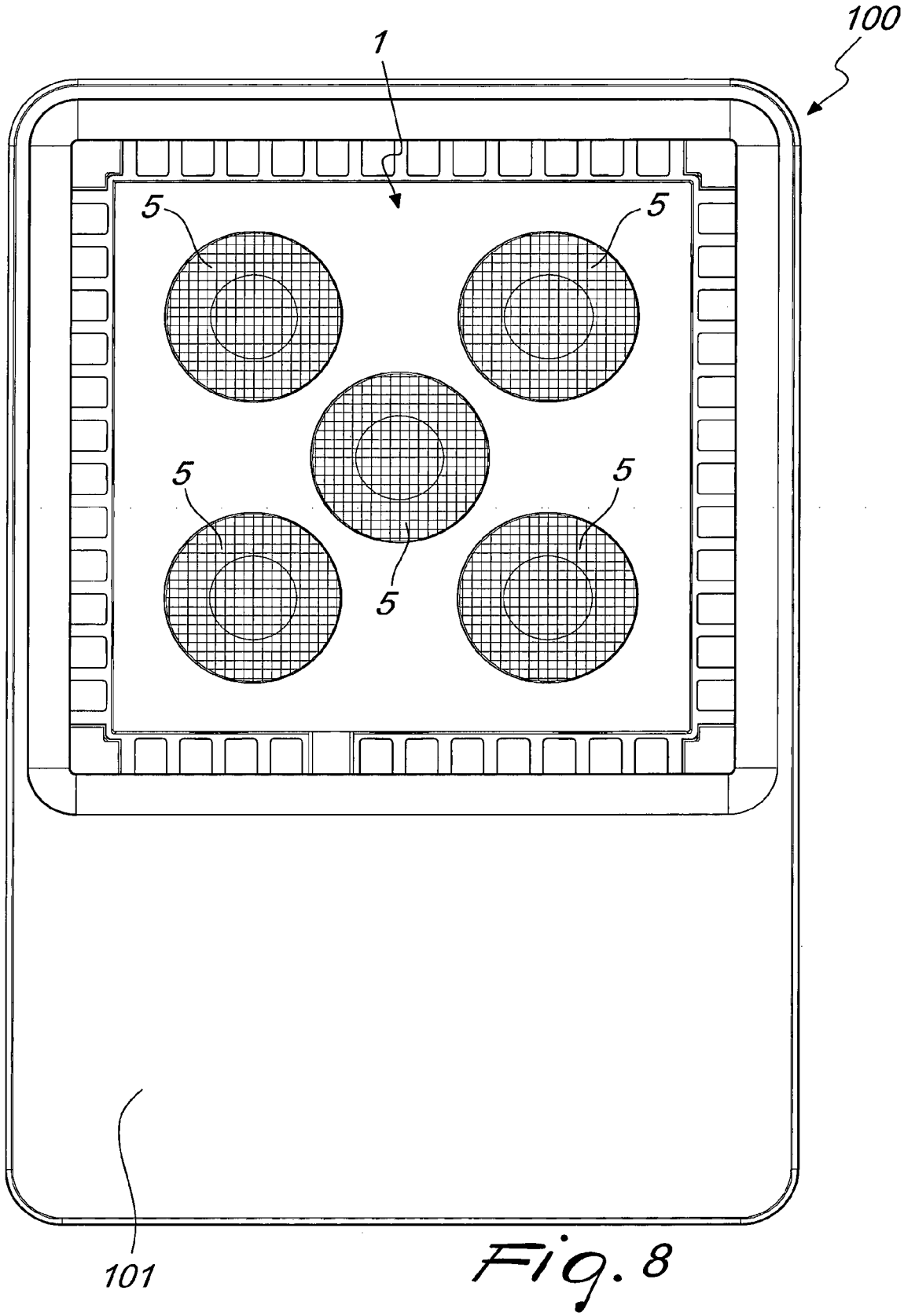

Fig. 8

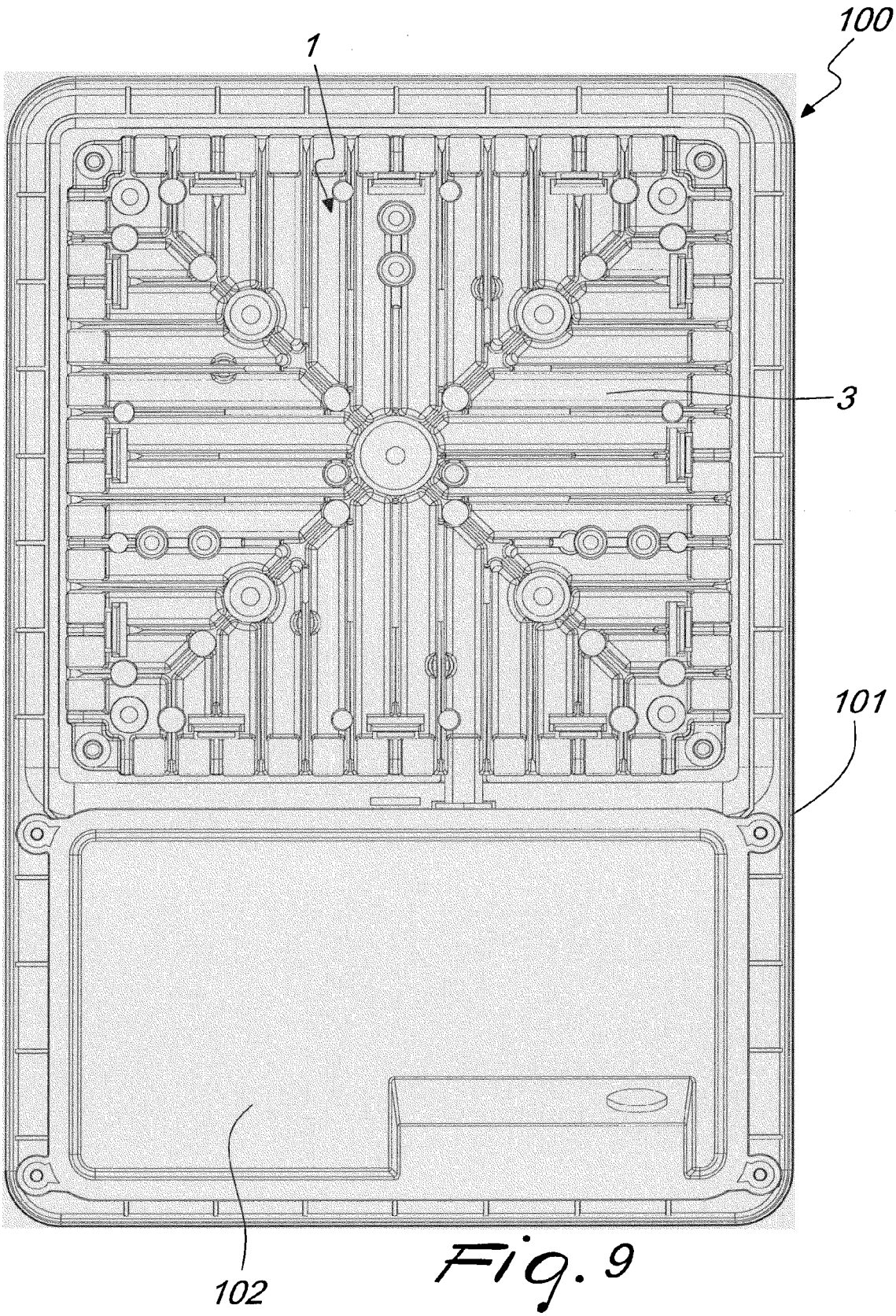

Fig. 9

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EUROPEAN SEARCH REPORT

Application Number
EP 14 00 3569

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F21V
F21Y

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	13 February 2015	Thibaut, Arthur

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EUROPEAN SEARCH REPORT

Application Number
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The present search report has been drawn up for all claims

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