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(54) **WALL MOUNTED VISUAL ALARM DEVICE**

(57) The invention concerns a visual alarm device configured to be mounted on a mounting wall and to illuminate a cuboid shape with a flash light having a minimum light intensity, the visual alarm device comprising a housing 1, 3 configured to be mounted on the mounting wall, a plurality of light emitting devices (13) provided in the housing 1, 3, a reflector body 17 configured to direct the light emitted by the light emitting devices 13 into

four partially overlapping predetermined fields. According to the invention these fields comprise a first field covering a front wall and far floor of the cuboid shape, a second field covering the left hand side wall of the cuboid shape, a third field covering the right hand side wall of the cuboid shape, and a fourth field covering the near floor area around and under the visual alarm device of the cuboid shape.

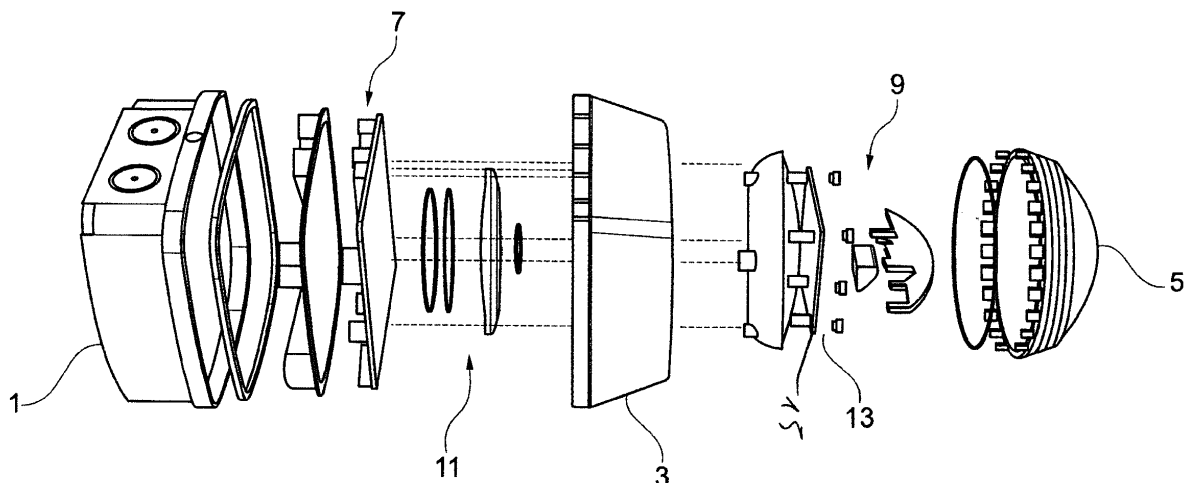


Fig. 1

Description

[0001] The present invention relates to a visual alarm device (VAD) for informing people within a building about hazardous situations or events.

[0002] The European Standard EN54-23 specifies the requirements, test methods and performance criteria for visual alarm devices in a fixed installation intended to signal a visual warning of a fire between the fire detection and fire alarm system and the occupants of a building. The visual alarm devices can be pulsing or flashing visual alarm devices.

[0003] According to this standard VADs can be classified into three categories, namely ceiling mounted devices, wall mounted devices and an open class category. Each of these categories has specific targets for light distribution patterns. The devices will have to guarantee a coverage volume where a required illumination of 0.4 lux or 0.4 lm/m² is met.

[0004] The flash rate of a VAD should be between 0.5 Hz and 2 Hz and should emit either a red or white flash.

[0005] Wall mounted VAD will be effective in a wide range of applications. The manufacturer will indicate a mounting height, which is a minimum 2.4 m, followed by the width of a square room over which the VAD will provide coverage. Therefore, the specification code with a VAD suitable for a wall application could read W-2.4-6, i.e. mounted at a height of 2.4 m the VAD will cover a room 36 m². The VAD will therefore be required to cover the volume below its mounting height. In other words, a wall mounted VAD of the type W-x-y is required to illuminate a cuboid of a height x and with basic square area having an edge length y, so as to archive a minimum illuminance within this cuboid of 0.4 lux.

[0006] To meet the requirements of BS EN54-23 and cover a practical room size encountered in most situations, VADs need to have higher light output levels than those generally used in the market today, leading to a significant increase in current consumption due to the use of higher output devices or to a greater number of less powerful units. Accordingly the design of the light distribution had become more relevant.

[0007] In order to produce the largest coverage for a given total lumen output (or power input), then highly efficient shaping optics are required. Perfect optics would evenly illuminate the faces of the cuboid, however it should be noted that the effective Candela output in any direction in the cuboid increases with the square of the distance making the shaping optics extremely difficult to design with good efficiency.

[0008] Additionally for a cost effective design, an audio alarm or alarm sounder would need to be incorporated into the device. The coverage of this sounder is dictated mainly by its sound pressure level (SPL) and the background noise level in a building. It is generally expected for a wall mounted sounder to have a rating that exceeds 100dB (A) at 1m and be suitable for a relatively large coverage area in most applications.

[0009] This means that on a combined device, if the VAD coverage can't match the sounder coverage to any reasonable extent, then a cost effective solution cannot be realized. It should be noted that the cost of installing alarm devices is usually many times higher than the actual unit cost of any additional device.

[0010] EP 13186980.2, which discloses internal state of the art not yet published, shows a principal configuration of a visual alarm device comprising a corresponding control circuit for optimizing the output of a plurality of LEDs.

[0011] It is the object of the present invention to provide a wall mounted visual alarm device having an improved illumination system.

[0012] The object is achieved by a visual alarm device configured to be mounted on a mounting wall and to illuminate a cuboid shape with a flash light having a minimum light intensity, the visual alarm device comprising a housing configured to be mounted on the mounting wall, a plurality of light emitting devices provided in the housing, a reflector body configured to directed the light emitted by the light emitting devices into four partially overlapping predetermined fields, these fields comprising a first field covering a front wall and far floor of the cuboid shape, a second field covering the left hand side wall of the cuboid shape, a third field covering the right hand side wall of the cuboid shape, and a fourth field covering the near floor area around and under the visual alarm device of the cuboid shape.

[0013] According to an advantageous aspect the plurality of light emitting devices consists of five LEDs mounted substantially in a row on a printed circuit board.

[0014] According to a further advantageous aspect the outer LEDs of the row being provided on dedicated arms and inclined with an angle of substantially 40° with regard to the mounting wall, when the visual alarm device is mounted on the mounting wall.

[0015] According to the invention, preferably, the reflector body comprises a plurality of reflecting surfaces covered by a metal layer, preferably an Al layer formed by aluminum physical vapour deposition.

[0016] It is further preferred that the reflector body is a dielectric mirror using enhanced plasma overcoat layers, optimized to work in the visual spectrum or matching to required colours of the visual alarm device.

[0017] Additionally, in a preferred embodiment the four fields have greater respective overlaps at the edges of the cuboid shape which have the longest path lengths from the visual alarm device.

[0018] In the following preferred embodiments of the invention will be described with reference to the drawings, showing:

Fig. 1 shows an exploded view of a wall mounted VAD;

Fig. 2 shows in more detail the optical elements of the VAD of Fig. 1; and

Fig. 3 a perspective view of the VAD of Fig. 1.

[0019] Preferred embodiments of the invention will be described based on the above figures.

[0020] Fig. 1 shows an exploded view of a combined audio and visual alarm device configured to be mounted at a wall.

[0021] This VAD comprises mounting box 1 and an outer horn 3 forming together a housing. The housing of this embodiment further comprises a horn cup or cover 5.

[0022] As can be seen in Fig. 2 within the housing there is provided a printed circuit board (pcb) 15.

[0023] A piezoelectric sound element 11 and a plurality of LEDs 13 are provided within the housing.

[0024] Although not shown in Fig. 1 the alarm device is configured so as to be connected to a two wired bus for supplying power and commands to the alarm device. Different bus configurations, e.g. those having dedicated lines for power supply and for commands, can be used instead.

[0025] Fig. 2 shows in more detail the optical components of the VAD of Fig. 1.

[0026] The VAD of this example comprises five LEDs 13 in total. Two of them are fixed on raised tabs or arms 19. Furthermore, a reflector 17 cooperates with the LEDs 13 so as to guide the light emitted from the LEDs 13 in the desired directions.

[0027] The VAD of the preferred embodiment is equipped with five LEDs 13 and the corresponding optics,

[0028] As mentioned before, the VAD of Fig. 1 and Fig. 2 is intended as a wall mounted VAD.

[0029] The LEDs 13 in the VAD will be operated in case of an alarm or for testing purposes so as to emit light in form of pulses or flashes.

[0030] The luminous intensity of pulsed light is different compared to the intensity of non-pulsed light due to the behavior of the human eye. The so called effective intensity I_{eff} of pulsed light, expressed in candela can be determined with the following equation, the Blondel-Rey equation

$$I_{eff} = \frac{\int_{t_1}^{t_2} I(t) dt}{a + (t_2 - t_1)}$$

where " $I(t)$ " is the instantaneous intensity in candela as a function of time, " a " is the Blondel-Rey constant and " t_2-t_1 " is the pulse duration (seconds).

[0031] Normally, the maximum value of effective intensity is obtained when t_2 and t_1 are chosen so that the effective intensity is equal to the instantaneous intensity at t_2 and t_1 .

[0032] From the Blondel-Rey equation it is clear that the effective intensity depends on the pulse duration. The average power also depends on the flash rate, which is not considered in the Blondel-Rey equation.

[0033] For rectangular or square pulses the above equation reduces to

$$I_{eff} = I_0 \frac{\Delta t}{a + \Delta t}$$

with the steady state intensity I_0 and the pulse duration Δt .

[0034] An increase in pulse duration leads to an increase in effective intensity. The behavior is non-linear.

[0035] The Blondel-Rey factor is the reciprocal of the ratio between effective intensity to steady state intensity. It describes how much more luminous intensity in a pulse is needed to reach the steady state intensity of non-pulsed light.

[0036] As example, for a pulse duration of 50ms the effective intensity is only about 20% of the steady state intensity. The luminous intensity of the pulse needs to be five times higher to reach the steady state intensity. As consequence, five times more pulse power is needed.

[0037] The average power will always increase with increasing pulse duration because to double the pulse duration means not to double the effective intensity or to halve the pulse power. In order to maximize the efficiency of a wall mounted VAD, a reflector design has been chosen to closely form a cuboid shape.

[0038] The reflector 17 has a characteristically sharp cut-off for rays falling outside the required cuboid illumination fields. The reflector 17 is mounted under a sealed optical cover 5. This cover 5 is a simple clear optical cover, whose shape also forms part of a sounder horn. This simple cover 5 has only a small influence optically at certain ray angles.

As the small influence of the cover 5 can be pre-compensated by the reflector 17, it does not need to be discussed in any detail.

[0039] LEDs 13 have been used in the design with 3 forward facing LEDs in a center reflector cavity and 2 LED 'arms' mounted in left hand and right hand reflector cavities. The 2 LED 'arms' 19 are angled at +/- 40 degrees by a PCB design using the fiberglass material in torsion, so that stress fracturing does not occur.

[0040] This results in a standard robust low cost PCB 15, in which the LEDs can be fitted without the PCB 15 having to have a special support during surface mount component placement. The PCB 'arms' 19 are then bent at a slightly larger angle than required, so that a permanent angle remains after it has relaxed, but which is slightly less than the final 40 degrees. This ensures that a small cantilever force will be exerted by the torsion of the PCB 15 in the final assembly i.e. it will be forced to the correct angle by the moldings.

[0041] Note that in the final position in the moldings, the LEDs 13 on the 'arms' 19 will raise the ray origin above the level of the opaque main horn molding for the sounder.

[0042] The optical concept employed by the VAD, works by having the reflector break-up the required cuboid illumination shape into 4 semi-overlapping fields. Each field is optimized for an even illumination on separate parts of the cuboid using the LED or LEDs 13 in each individual faceted cavity. The combined composite illumination then forms the desired overall shape. The illuminated fields are listed below:

[0043] The front wall and far floor areas are illuminated by the middle cavity of the reflector using the 3 middle LEDs using direct and reflected light.

[0044] The left hand side all is illuminated by the left hand side left hand side 'arm' 19 and left hand side cavity 17 of the reflector using direct and reflected light.

[0045] The right hand side wall is illuminated by the right hand side LED 'arm' 19 and right hand side cavity of the reflector 17 using direct and reflected light.

[0046] The near floor area, i.e. the area around and under the VAD is illuminated solely by reflections from the top center part of the middle reflector cavity, raising the apparent ray origin above the main horn molding.

This design implies that a relatively higher light output or effective Candela level will occur on the overlapping boundaries of the illuminated fields.

[0047] This overlap has been designed to occur at the edges of the cuboid which have the longest path lengths from the VAD and therefore require a relatively higher illumination. Note that the highest illumination of all will occur at the lower corners of the front wall.

[0048] Ideally the reflector 17 would be a dielectric mirror using enhanced plasma overcoat layers, optimized to work in the visual spectrum or at least matched to the required VAD colours.

[0049] As an alternative a simple low cost metalized plastic part would be suitable for the reflector 17.

[0050] The reflector of the shown embodiment is formed by aluminum physical vapour deposition (PVD) onto a 2 part plastic molding. This process evaporates pure aluminum in a vacuum chamber. While the reflectivity of aluminum is not quite as good as silver at the operating wavelengths required, it is low cost and inherently forms a very thin protective transparent barrier if exposed to the production atmosphere for a long time prior to fitting in a sealed cover molding.

[0051] As the complete VAD using the reflector 17 forms a very efficient cuboid shape, this enables the largest coverage volume for the lowest amount of power.

[0052] The reflector efficiency also has a benefit for the LEDs 13 and drive circuit, as it enables the LEDs 13 to be driven at a shorter pulse duration and a lower peak current which improves the efficiency and reliability of the overall design.

[0053] Additionally the fire alarm system providing the power for the VADs 13 also benefits, so that more VADs are possible for any given fire alarm circuit and the voltage drops on the cables are reduced.

Claims

1. A visual alarm device configured to be mounted on a mounting wall and to illuminate a cuboid shape with a flash light having a minimum light intensity, the visual alarm device comprising:

a housing (1, 3) configured to be mounted on the mounting wall;
a plurality of light emitting devices (13) provided in the housing (1, 3);
a reflector body (17) configured to direct the light emitted by the light emitting devices (13) into four partially overlapping predetermined fields;
these fields comprising:

a first field covering a front wall and far floor of the cuboid shape;
a second field covering the left hand side wall of the cuboid shape;
a third field covering the right hand side wall of the cuboid shape; and

a fourth field covering the near floor area around and under the visual alarm device of the cuboid shape.

2. The visual alarm device according to claim 1, wherein
the plurality of light emitting devices (13) consists of five LEDs mounted substantially in a row on a printed circuit
board (15);
the outer LEDs of the row being provided on dedicated arms (19) and inclined with an angle of substantially 40°
with regard to the mounting wall, when the visual alarm device is mounted on the mounting wall.
3. The visual alarm device of claim 1, wherein
the reflector body comprises a plurality of reflecting surfaces being covered by a metal layer, preferably an Al layer
formed by aluminum physical vapour deposition.
4. The visual alarm device of claim 3, wherein the reflector body (17) is a dielectric mirror using enhanced plasma
overcoat layers, optimized to work in the visual spectrum or matching to required colours of the visual alarm device.
5. The visual alarm device of any of claims 1 to 4, wherein
the four fields have greater respective overlaps at the edges of the cuboid shape which have the longest path lengths
from the visual alarm device.

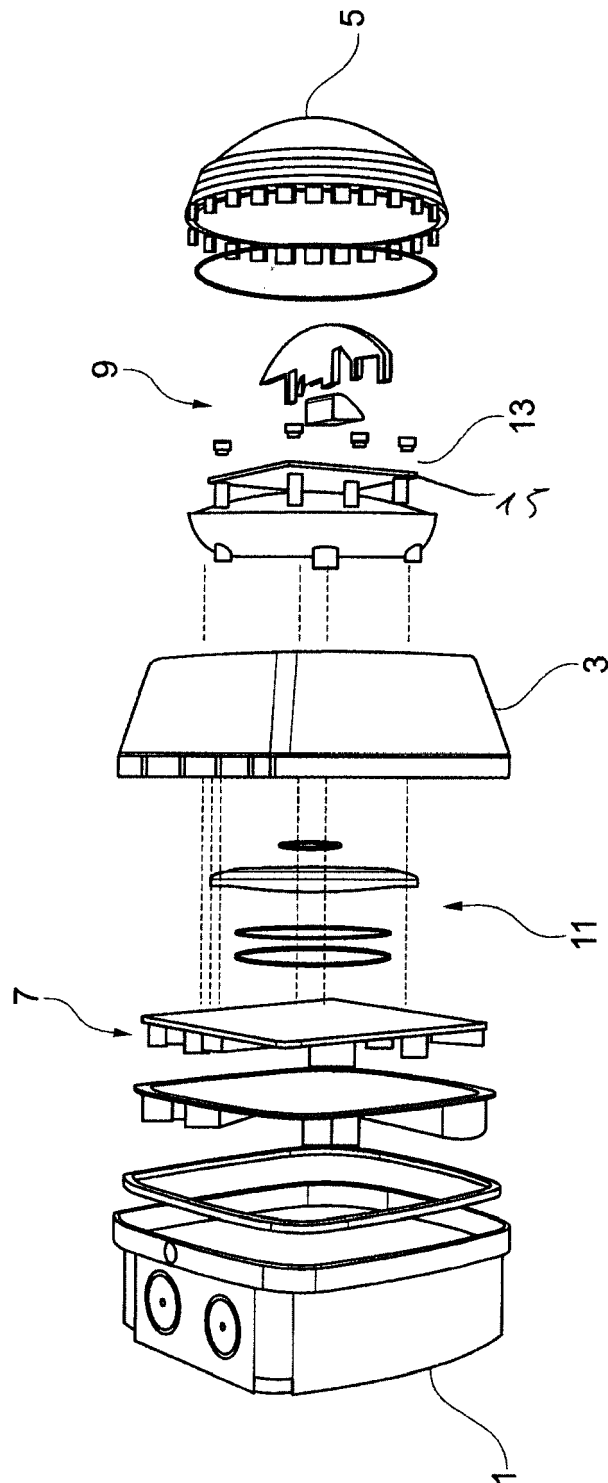


Fig. 1

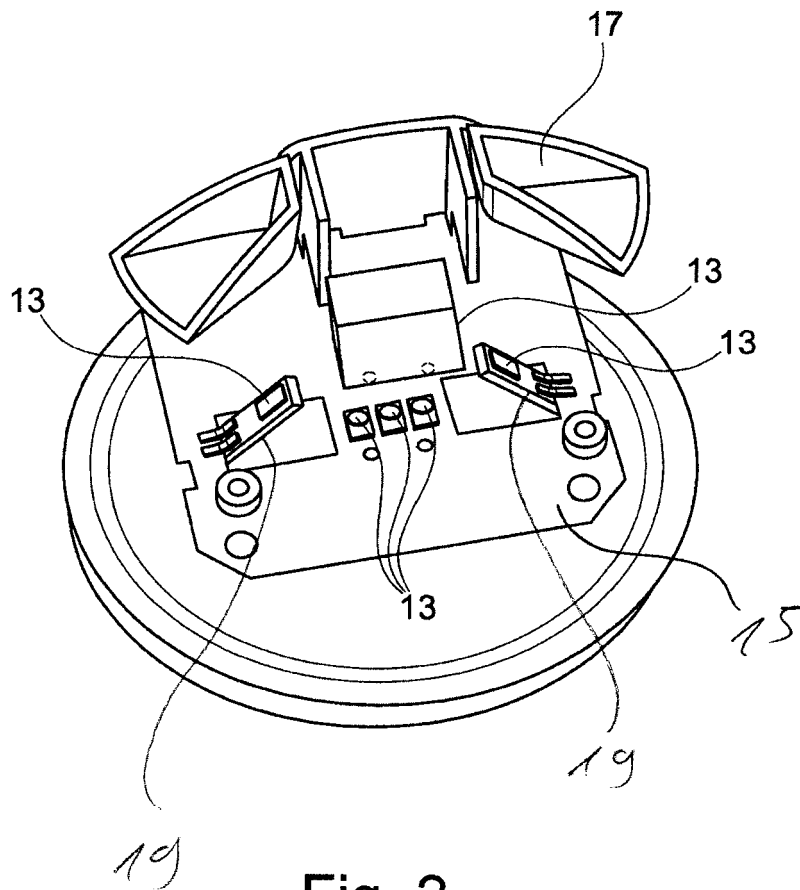


Fig. 2

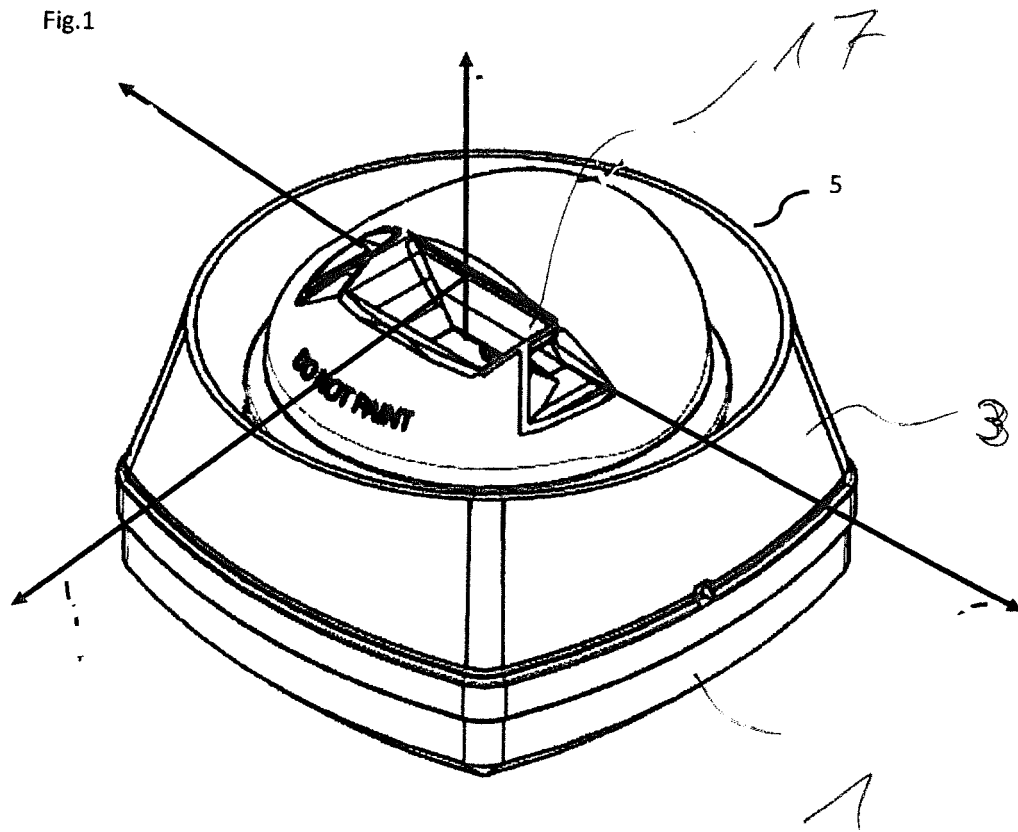


Fig. 3



EUROPEAN SEARCH REPORT

Application Number
EP 15 16 2861

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2014/268753 A1 (BUCHHOLZ MATTHEW J [US] ET AL) 18 September 2014 (2014-09-18) * abstract * * paragraph [0021] - paragraph [0022]; figure 1 * * paragraph [0024] - paragraph [0028]; figures 8,9 * * claims 1,4 *	1,3,5	INV. G08B5/38
X	US 2012/038479 A1 (TEN WOLDE MICHAEL ROBERT [NL]) 16 February 2012 (2012-02-16) * abstract * * paragraph [0024] - paragraph [0027]; figure 1 * * paragraph [0052] - paragraph [0055]; figure 1 * * paragraph [0090] - paragraph [0091] *	1,3,4	
			TECHNICAL FIELDS SEARCHED (IPC)
			G08B F21V
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 13 October 2015	Examiner Heß, Rüdiger
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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EPO FORM 1503 03/02 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 15 16 2861

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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13-10-2015

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REFERENCES CITED IN THE DESCRIPTION

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