(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 3 079 130 B1

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
13.12.2017 Bulletin 2017/50

(21) Application number: **15162861.7**

(22) Date of filing: **08.04.2015**

(51) Int Cl.:
G08B 5/38 *(2006.01)*

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

WANDMONTIERTE VISUELLE ALARMVORRICHTUNG

DISPOSITIF D'ALARME VISUELLE À MONTAGE MURAL

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

(43) Date of publication of application:
12.10.2016 Bulletin 2016/41

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EP 3 079 130 B1

Printed by Jouve, 75001 PARIS (FR)

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/m^2 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.

[0006] 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 m^2. 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 achieve a minimum illuminance within this cuboid of 0.4 lux.

[0007] 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.

[0008] 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.

[0009] 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. 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. EP 2 858 047 A1 filed earlier than the present application, but published thereafter shows a principal configuration of a visual alarm device comprising a corresponding control circuit for optimizing the output of a plurality of LEDs.

[0010] US 2014/0268753 discloses an indicator assembly for a visual life safety alarm including a hollow, generally frustoconical reflector ring having an angled wall. The reflector ring is mounted to a housing of the visual life safety alarm at a first end. A first plurality of light devices is mounted to the housing within a first opening of the first end of the reflector ring. Light from the first plurality of light devices is configured to emit in a generally forwards direction. A second plurality of light devices is mounted to the housing near the angled wall of the reflector ring, opposite the first plurality of light devices. Light from the second plurality of light devices is configured to reflect from the angled wall in a direction generally angled from the visual safety alarm.

[0011] US 2012/0038479 A1 discloses an illumination device which includes a light source. The illumination device is arranged to be mounted to a wall at a mounting height with respect to a floor. The illumination device being arranged to, in use, illuminate a predetermined area of the floor, wherein: the mounting height is between 0.4 and 0.8 meters from the floor; and the predetermined area of the floor has a substantial rectangular shape. The illumination device is intended as escape route or panic illumination.

[0012] It is the object of the present invention to provide a wall mounted visual alarm device having an improved illumination system.

[0013] According to the present invention the above object is achieved by a visual alarm device according to claim 1. The dependent claims are directed to different advantageous aspects of the invention.

[0014] 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.

[0015] Preferred embodiments of the invention will be described based on the above figures.

[0016] Fig. 1 shows an exploded view of a combined audio and visual alarm device configured to be mounted at a wall.

[0017] 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.

[0018] As can be seen in Fig. 2 within the housing there is provided a printed circuit board (pcb) 15.

[0019] A piezoelectric sound element 11 and a plurality of LEDs 13 are provided within the housing.

[0020] 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.

[0021] Fig. 2 shows in more detail the optical components of the VAD of Fig. 1.

[0022] 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.

[0023] The VAD of the preferred embodiment is equipped with five LEDs 13 and the corresponding optics,

[0024] As mentioned before, the VAD of Fig. 1 and Fig. 2 is intended as a wall mounted VAD.

[0025] 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.

[0026] 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 Ieff 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 "t2-t1" is the pulse duration (seconds).

[0027] Normally, the maximum value of effective intensity is obtained when t2 and t1 are chosen so that the effective intensity is equal to the instantaneous intensity at t2 and t1.

[0028] 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.

[0029] 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.

[0030] An increase in pulse duration leads to an increase in effective intensity. The behavior is non-linear.

[0031] 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.

[0032] 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.

[0033] 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.

[0034] In order to maximize the efficiency of a wall mounted VAD, a reflector design has been chosen to closely form a cuboid shape.

[0035] 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.

[0036] 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.

[0037] 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.

[0038] 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.

[0039] 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: 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.

[0040] The left hand side wall is illuminated by the left hand side 'arm' 19 and left hand side cavity 17 of the reflector using direct and reflected light.

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.

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.

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.

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.

[0041] As an alternative a simple low cost metallized plastic part would be suitable for the reflector 17.

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.

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.

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.

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); the plurality of light emitting devices (13) consisting 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;
   a reflector body (17) configured to direct the light emitted by the light emitting devices (13) into four partially overlapping predetermined fields by means of individual faceted cavities, the reflector body (17) comprises a center reflector cavity and left hand and right hand reflector cavities;
   these fields comprising:

      a first field covering a front wall and far floor of the cuboid shape and being illuminated by direct light of the three middle LEDs and light reflected by the center cavity;
      a second field covering the left hand side wall of the cuboid shape being illuminated by direct light of the

lefthand side LED and light reflected by the left hand cavity;
a third field covering the right hand side wall of the cuboid shape being illuminated by direct light of the righthand side LED and light reflected by the right hand cavity; and
a fourth field covering the near floor area around and under the visual alarm device of the cuboid shape illuminated solely by reflections from a top center part of the center reflector cavity.

2. 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 A1 layer formed by aluminum physical vapour deposition.

3. The visual alarm device of claim 2, 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 colors of the visual alarm device.

4. The visual alarm device of any of claims 1 to 3, wherein
the four fields have respective overlaps at the edges of the cuboid shape so that the highest illumination of all will occur at the lower corners of the front wall.

Patentansprüche

1. Visuelle Alarmvorrichtung, die ausgestaltet ist, um an einer Befestigungswand angebracht zu werden und um eine Kubusform mit einem Blitzlicht mit einer mindest Lichtintensität auszuleuchten, wobei die visuelle Alarmvorrichtung umfasst:

ein Gehäuse (1, 3), das ausgestaltet ist, um an der Befestigungswand angebracht zu werden;
eine Mehrzahl von lichtemittierenden Vorrichtungen (13), die in dem Gehäuse (1, 3) vorgesehen sind, wobei die Mehrzahl von lichtemittierenden Vorrichtungen (13) aus fünf LEDs bestehen, die im Wesentlichen in einer Reihe auf einer gedruckten Leiterplatte (15) angebracht sind, wobei die äußeren LEDs der Reihe auf zugeordneten Armen (19) vorgesehen sind und mit einem Winkel von im Wesentlichen 40° im Bezug auf die Befestigungswand geneigt sind, wenn die visuelle Alarmvorrichtung an der Befestigungswand angebracht ist;
einen Reflektorkörper (17), der ausgestaltet ist, um das von den lichtemittierenden Vorrichtungen (13) emittierte Licht in vier teilweise überlappende vorgegebene Felder zu lenken, mittels von jeweiligen mit Facetten versehenen Ausnehmungen, wobei der Reflektorkörper (17) eine mittlere Reflektorausnehmung und linksseitige und rechtsseitige Reflektorausnehmungen umfasst;
wobei diese Felder umfassen:

ein erstes Feld, das eine Vorderwand und einen entfernten Boden der Kubusform bedeckt und das durch direktes Licht der drei mittleren LEDs und von dem Licht, das von der mittleren Ausnehmung reflektiert wird, beleuchtet wird;
ein zweites Feld, das die linke Seitenwand der Kubusform bedeckt, das von direktem Licht der linksseitigen LED und von Licht, das von der linksseitigen Ausnehmung reflektiert wird, beleuchtet wird;
ein drittes Feld, das die rechte Seitenwand der Kubusform bedeckt, das von direkten Licht von der rechtsseitigen LED und Licht, das von der rechtsseitigen Ausnehmung reflektiert wird, beleuchtet wird, und
ein viertes Feld, das den nahen Bodenbereich der Kubusform um und unter der visuellen Alarmvorrichtung bedeckt, welches ausschließlich durch Reflektionen von einem oberen Mittelteil der mittleren Reflektorausnehmung beleuchtet wird.

2. Visuelle Alarmvorrichtung nach Anspruch 1, bei der
der Reflektorkörper eine Mehrzahl von reflektierenden Oberflächen umfasst, die durch eine Metallschicht bedeckt sind, vorzugsweise einer Aluminiumschicht, die aus Aluminium mittels physikalischer Dampfphasenabscheidung gebildet ist.

3. Visuelle Alarmvorrichtung nach Anspruch 2, bei der der Reflektorkörper (17) einen dielektrischen Spiegel umfasst, der verstärkte Plasmaüberzugsschichten verwendet, welche zur Arbeit in dem sichtbaren Spektrum optimiert sind, oder an die geforderten Farben der visuellen Alarmvorrichtung angepasst sind.

4. Visuelle Alarmvorrichtung nach Anspruch 1 bis 3, bei der
die vier Felder jeweilige Überlappungsbereiche an den Kanten der Kubusform haben, so dass die höchste Beleuch-

tung insgesamt an deren unteren Ecken der Vorderwand auftritt.

Revendications

1. Dispositif d'alarme visuel configuré pour être monté sur un mur de montage et pour illuminer une forme cuboïde avec une lumière flash ayant une intensité de lumière minimale, le dispositif d'alarme visuel comprenant :

   un logement (1, 3) configuré pour être monté sur le mur de montage ;
   une pluralité de dispositifs émetteurs de lumière (13) prévus dans le logement (1, 3) ; la pluralité de dispositifs émetteurs de lumière (13) consistant en cinq DEL montées sensiblement selon une rangée sur une carte de circuit imprimé (15), les DEL externes de la rangée étant prévues sur des bras dédiés (19) et inclinées avec un angle de sensiblement 40° par rapport au mur de montage, lorsque le dispositif d'alarme visuel est monté sur le mur de montage ;
   un corps de réflecteur (17) configuré pour diriger la lumière émise par les dispositifs émetteurs de lumière (13) en quatre champs prédéterminés partiellement chevauchants au moyen de cavités facettées individuelles, le corps de réflecteur (17) comprend une cavité de réflecteur centrale et des cavités de réflecteur main gauche et main droite ;
   ces champs comprenant :

      un premier champ couvrant un mur avant et un plancher distant de la forme cuboïde et étant illuminé par de la lumière directe des trois DEL milieu et la lumière réfléchie par la cavité centrale ;
      un deuxième champ couvrant le mur latéral main gauche de la forme cuboïde étant illuminé par de la lumière directe de la DEL côté main gauche et la lumière réfléchie par la cavité main gauche ;
      un troisième champ couvrant le mur latéral main droite de la forme cuboïde étant illuminé par de la lumière directe de la DEL côté main droite et la lumière réfléchie par la cavité main droite ; et
      un quatrième champ couvrant la zone de plancher proche autour et au-dessous du dispositif d'alarme visuel de la forme cuboïde illuminé seulement par des réflexions depuis une partie centrale de dessus de la cavité de réflecteur centrale.

2. Dispositif d'alarme visuel selon la revendication 1, dans lequel
   le corps de réflecteur comprend une pluralité de surfaces réfléchissantes couvertes par une couche de métal, de préférence une couche d'Al formée par dépôt physique en phase vapeur d'aluminium.

3. Dispositif d'alarme visuel selon la revendication 2, dans lequel le corps de réflecteur (17) est un miroir diélectrique utilisant des surcouches de plasma améliorées, optimisées pour fonctionner dans le spectre visuel ou concorder avec des couleurs requises du dispositif d'alarme visuel.

4. Dispositif d'alarme visuel selon l'une quelconque des revendications 1 à 3, dans lequel
   les quatre champs ont des chevauchements respectifs au niveau des bords de la forme cuboïde pour que la plus forte illumination de tous se produise au niveau des coins inférieurs du mur avant.

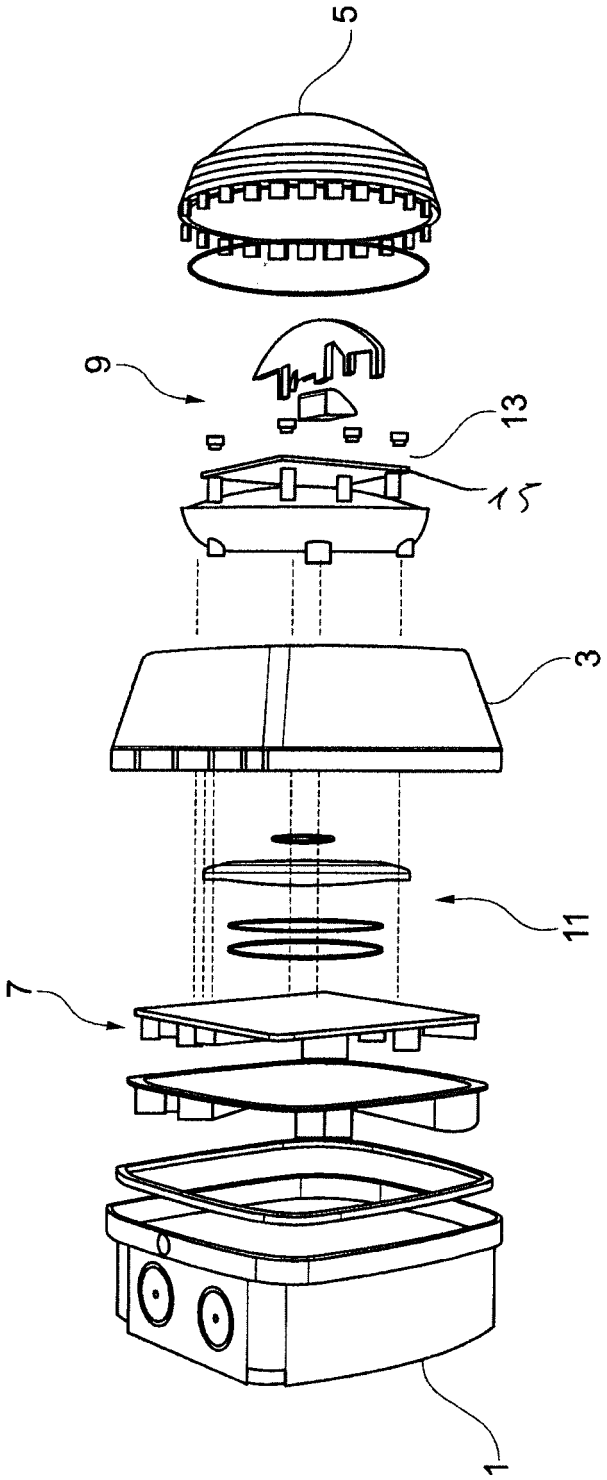


Fig. 1

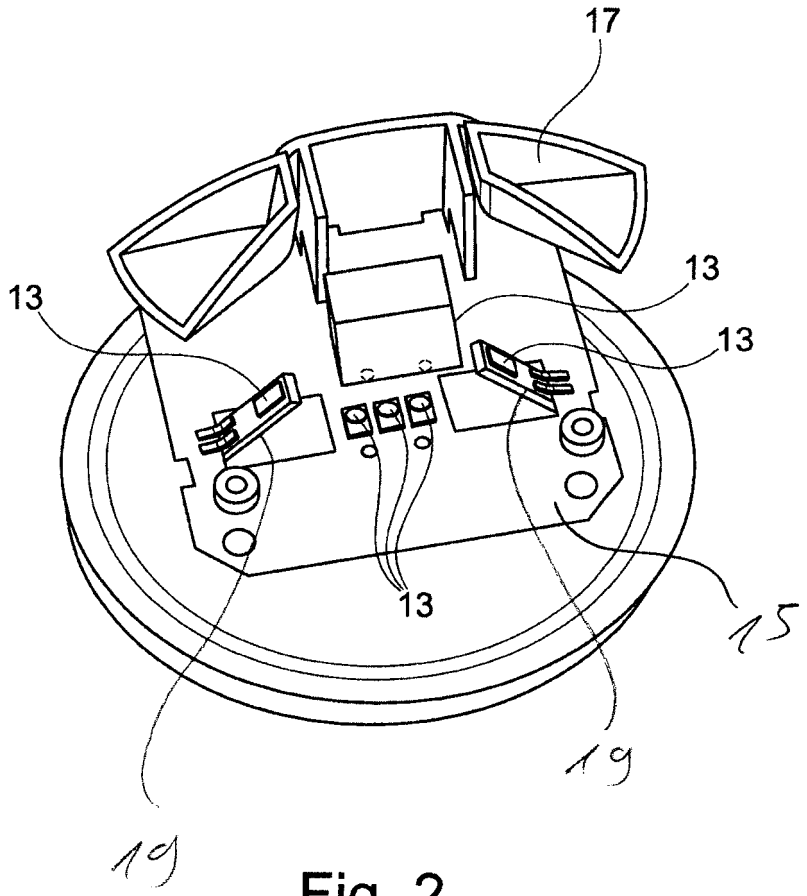


Fig. 2

Fig.1

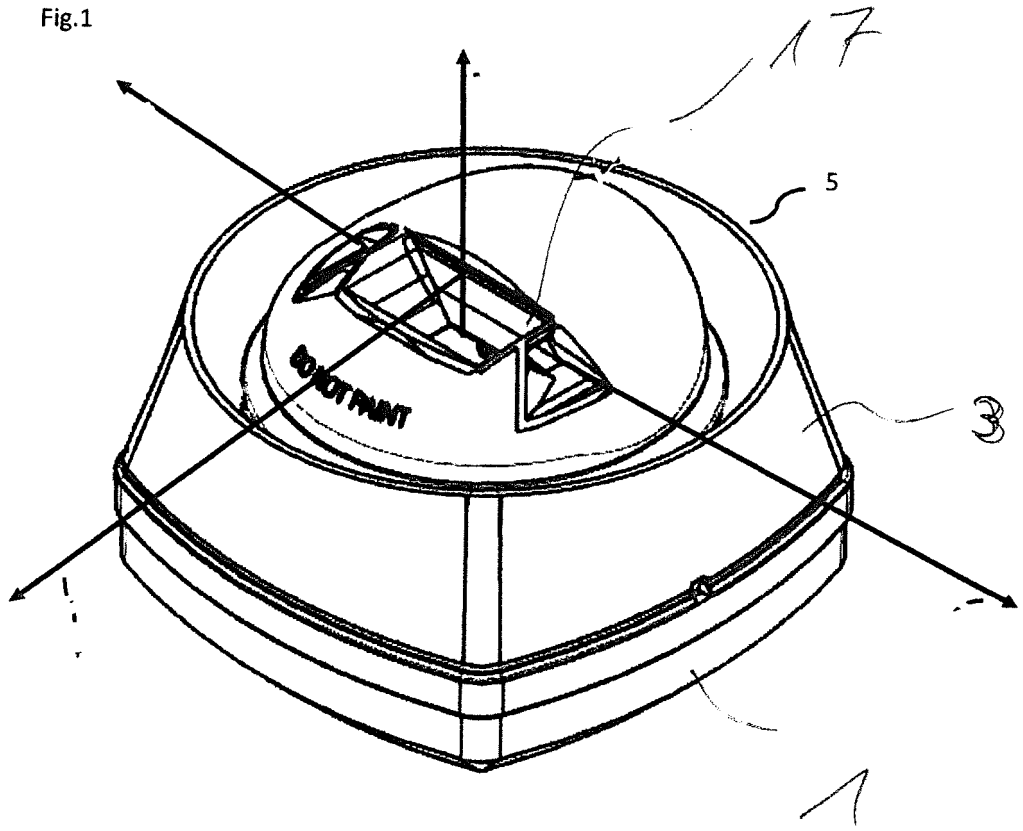


Fig. 3

REFERENCES CITED IN THE DESCRIPTION

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