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(54) **EMERGENCY LIGHT FIXTURE**

NOTLICHTARMATUR

APPAREIL D'ÉCLAIRAGE DE SECOURS

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Description

Object of the Invention

[0001] The present invention belongs to the field of lighting.

[0002] The object of the present invention is an emergency light fixture working with LED diodes and equipped with a novel heat dissipation system improved in relation to the system used in conventional emergency light fixtures.

Background of the Invention

[0003] There are currently a large number of emergency light fixtures on the market for passageways that can work with and without a grid power supply. These light fixtures use LED diodes as lighting means due to their low power consumption and small dimensions.

[0004] However, these light fixtures require a heat dissipation system to discharge the heat generated in led circuits. This heat dissipation system usually takes the form of fins or radiators, thus increasing the total volume of the light fixture. This in turn leads to restrictions concerning the places where these light fixtures can be installed.

[0005] Furthermore, current light fixtures also have drawbacks related to disassembly because the use of screws, welds, etc., considerably increases the time needed to perform tasks as simple as changing cells or batteries, replacing the LED circuit in the event of malfunction or breakdown, etc. Additionally, the fixing systems incorporated in current light fixtures are not flexible enough to allow a simple and quick fixing without needing to perform an excessive number of operations for measuring and positioning the anchoring orifices.

[0006] Therefore, there is still a need in the art for an emergency light fixture that is capable of solving the aforementioned problems.

[0007] Document US 2013/050996 discloses an Emergency light fixture comprising a LED lighting circuit board (64) fixed to the base (54) of a body (38) by means of elastic pliers (102) compressing said Led circuit board against a base (54), that has under a few wings (59) to provide heat sink. The LED board (64) remains joined to the body (38) and it is extracted with it when it is dismantled and the evacuation of the heat emitted by the LED occurs towards the inside of the device. On the contrary, in the case of the present invention, the LED board is mounted on the body of the fixture and is the casing the one that when it is finally mounted exercises the function of the heat sink board, with which it occurs towards the outside of the device and in addition has a surface of evacuation significantly greater than any group of sink wings, while the assembly of the LED board is not made jointly with other parts, in such a way that they do not twist or bend its pins of connection.

Description of the Invention

[0008] The present invention is an emergency light fixture according to claim 1. This configuration allows, on one hand, greatly improving the heat discharge capacity of the light fixture, because the heat generated by the LED circuit board is transmitted by conduction to the heat-diffusing wall, which in turn gives that heat off into the environment. This better performance in terms of heat dissipation capacity allows avoiding the use of fins, radiators, or similar elements, which are common in light fixtures in the prior art, a smaller emergency light fixture thus being obtained.

[0009] The heat-diffusing wall is preferably metallic, and it is more preferably made of aluminum. Concerning the thrust means, said means are elastic thrust means. According to the invention, the light fixture further comprises a body having side channels equipped with a ramp at a lower end, and where the heat-diffusing wall comprises tabs configured for sliding in said channels for coupling said diffusing wall to said base. Furthermore, the light fixture also preferably comprises an upper cover having tabs on its lower face configured for being coupled to a side groove of the upper edges of the heat-diffusing casing.

[0010] The heat-diffusing wall is therefore installed without needing to use screws, welds, or the like. The tabs of said heat-diffusing wall are simply slid through the channels of the body of the light fixture. When reaching the lower end of the side channels, the ramp causes the diffusing wall to move laterally, assuring its correct positioning, being pressure-coupled. Furthermore, the upper cover, which is equipped with tabs arranged in ribs existing on its lower face and fitting in a side groove located on the upper edges of the diffusing casing, helps to suitably position the heat-diffusing casing. Also, the lower cover and, as will be seen, the anchor plate are fixed to the body of the light fixture without needing screws or welds, thereby helping in assembly and disassembly tasks.

[0011] In another preferred embodiment, the light fixture further comprises a reflector, which is preferably parabolic-shaped, and/or a diffuser coupled to the body next to the LED lighting circuit board to enlarge the emitted light beam and make it uniform. The reflector allows enlarging the lighting area in a downward and also in a forward manner, whereas the diffuser serves to homogenize the entire lighting area for the purpose of eliminating lighting "peaks" at different points so that it is less bothersome to the human eye.

[0012] In relation to fixing the light fixture, in a preferred embodiment the present invention comprises an anchor plate configured for fixing the body of the light fixture to the wall. This anchor plate preferably comprises orifices in which there are freely rotating bushings with elongated central orifices for fixing the anchor plate to a wall. So even though the person responsible for the installation does not make holes in the wall in the exact positions

required, the freely rotating bushings can be turned until the elongated central orifices are correctly located opposite said holes.

[0013] This anchor plate is preferably connectable to the body of the light fixture as a result of a small sliding plate equipped with elastic arms ending in lugs configured for sliding in elongated orifices of the anchor plate, said small sliding plate further comprising a claw configured for fitting in a step arranged on a rear face of the body. This connection system can be released by exerting upward manual thrust on the small sliding plate which causes the claw to be released, thus separating the body of the light fixture from the anchor plate.

[0014] Furthermore, the anchor plate preferably further comprises a terminal block equipped with grooves configured for receiving connection blades provided in a base circuit board powering the LED lighting circuit board. On one hand, the terminal block allows connecting the grid power supply to the light fixture in a conventional manner, whereas the grooves form the means for connecting with the base circuit board containing the control electronics of the light fixture.

[0015] Furthermore, the light fixture of the invention preferably comprises a compartment for housing batteries which is separated from the LED lighting circuit board by at least one wall. The service life thereof is thus increased because said batteries are insulated from the heat sources existing in the light fixture.

[0016] In summary, the emergency light fixture of the invention fundamentally has the following advantages:

- Precisely the casing of the light fixture is a dual-purpose casing because, on one hand, it forms the front enclosure (the portion of the light fixture that is seen), and on the other hand, it dissipates heat produced when the LED lighting circuit is working.
- Absence of screws, welds and any type of non-removable fasteners, thereby facilitating recycling thereof, in addition to the quick and easy assembly or disassembly.
- Compact size, which contributes to saving in materials and to reducing the environmental impact because smaller dimensions allow economical, safe and environmentally-friendly transport.
- To facilitate discharging heat generated by the LEDs, the LED circuit board is compressed against a heat-dissipating plate, although without the use of screws or the like, such that the heat dissipation capacity is improved while at the same time replacement of the LED circuit in the event of malfunction or breakdown is aided.
- Wall-securing system capable of absorbing a large margin of error in the positioning of the orifices that must be made in the wall, allowing good placement of the apparatus in most cases.
- Independent compartment for housing batteries, giving them greater thermal insulation with respect to the heat sources existing in the light fixture. The serv-

ice life of the batteries is thus prolonged and easy replacement of said batteries is allowed.

Brief Description of the Drawings

[0017]

Figures 1a and 1b show respective external perspective views of the assembled light fixture and of the anchor plate separated from same, respectively.

Figure 2 is an exploded perspective view of the light fixture where the components forming it are seen.

Figures 3a-d respectively show a rear elevational view of the light fixture with the upper cover separated therefrom; a view of the upper cover; an enlarged view of the corner of the cover; and an enlarged view of the fitting of the cover on the inner edges of the diffusing wall.

Figures 4a/4b/4c respectively show an elevational view of the light fixture of the invention; a profile view with respective cutaway views of sections A-A and B-B which allow seeing the assembly or disassembly by sliding the diffusing wall which, in this case, is half-closed.

Figures 5a/5b/5c show the same views as preceding Figures 4a/4b/4c but with the diffusing wall being completely closed.

Figure 6 shows a schematic view of the light beam emitted by the LED diode and its lighting area lit by means of the reflector.

Figure 7 shows a profile view of a section of the light fixture where the position of the reflector and diffuser coupled to the lower cover is seen.

Figure 8 shows a rear perspective view of the body of the light fixture.

Figure 9 shows the same view as the preceding figure without the LED circuit or the body, but with the reflector and the lower cover.

Figure 10 corresponds to a profile cross-section view of the light fixture with the anchor plate approaching or about to be attached to the rear face of the body of the light fixture.

Figure 11 corresponds to the same preceding view but with the anchor plate now fixed to the rear face of the body of the light fixture.

Preferred Embodiment of the Invention

[0018] A particular embodiment of the invention is described below in reference to the attached drawings. This emergency light fixture (1) is preferably conceived for being placed on a wall and lighting up both the area immediately below it and a wide front area through the front face. As seen in Figure 1, the light fixture (1) object of the invention is parallelepiped-shaped and comprises an anchor plate (2) for fixing it to the wall.

[0019] The anchor plate (2) serves to couple the body (1) of the light fixture to the wall. To be fixed to the wall,

the anchor plate (2) has orifices in which there are fitted respective bushings (3) which can rotate freely inside the orifices provided in the mentioned anchor plate (2) which in turn have elongated central orifices. These elongated central orifices have dimensions such that the screws for fixing it to the wall fit therein. The use of these bushings (3) allows absorbing minor mismatches occurring in the correspondence with the holes made in the wall because they can be turned until finding a position where the screws can be placed.

[0020] Concerning the coupling of the anchor plate (2) to the body (1) of the light fixture, the plate (2) has a small sliding plate (4) having elastic arms ending in lugs running along elongated orifices made in the anchor plate (2). These elastic arms allow the vertical movement of the small plate (4) such that it allows two positions: a first position where the anchor plate (2) is separated from the body (1) of the light fixture and where the elastic arms are in the rest position; and a second position where the anchor plate (2) is fixed to the body (3) of the light fixture (1) with the elastic arms in the forced position. In this second position, a claw (21) of the small sliding plate (4) is coupled to a step (22) existing in the base (13) of the body (3) of the light fixture. So to separate the body (3) from the anchor plate (2), it is necessary to manually operate the small plate (4) by applying an upward thrust to release the claw (21) from the step (22).

[0021] The anchor plate (2) also comprises terminals (5) for coupling and connection to the grid. These terminals (5) furthermore have grooves (6) where connection blades provided in the base circuit board (7), beside the batteries (8) provided inside the light fixture, fit. The base circuit board (7) is thus connected in a simple and automatic manner upon fixing the body (1) of the light fixture to the anchor plate (2).

[0022] The body (1) of the light fixture is closed as a result of an upper cover (9) having tabs (10) provided in side ribs existing on the lower face of said cover (9), as seen in greater detail in enlarged Figure 3c, and fitting in a step or side groove (11) made on the upper edges of the heat-diffusing wall (12). This tight fit between both parts will serve for suitably positioning the diffusing wall (12) which is metallic in this example, more specifically made of aluminum, such that with the lower fitting described below the diffusing wall (12) is in continuous contact with the LED circuit (15) to dissipate heat, so it is a dual-purpose body (1). On one hand, it is the front enclosure of the light fixture, and on the other hand, it dissipates the heat produced when the LED circuit (15) which is in permanent contact starts working, as will be explained.

[0023] The diffusing wall (12) is introduced by sliding it from top to bottom through vertical side channels provided in the base (13) until the wall (12) accesses the area of the ramp (14) provided on the sides opposite the sides where the vertical side channels of the base (13) are located. As the diffusing wall (12) slides through these widened areas it adjusts as it slides in by permanently

rubbing against the front face the LED circuit board (15) which is fitted in a gap made in the front cover (16) and is forced out by thrust means (17), which is an elastic means in this case, so that contact between the diffusing wall (12) and the LED circuit board (15) is permanent. The LED circuit board (15) is therefore pressed against the aluminum diffusing wall (12), achieving optimal heat transfer between them. Furthermore, a conductive paste is preferably applied between both elements to counteract possible surfaces imperfections, and the coupling is complete.

[0024] This is clearly seen in Figures 4a/4b/4c and 5a-c. Figures 4a-c depict a position where the diffusing wall (12) of the casing is still half-closed, i.e., it has still not slid over the ramps (14) existing at the lower ends of the side edges of the body or base (13). Figures 5a-c shown equivalent views where the diffusing wall (12) is completely coupled after having slid until being fixed as a result of the ramps (14) of the side edges of the body (13). In this position, the LED circuit board (15) is permanently in contact with said diffusing wall (12). It can therefore be seen how easy it is to access the LED circuit board (15) for replacement purposes due to malfunction or breakdown.

[0025] In the lower area next to the LED circuit board (15) there has been arranged a parabolic reflector (18) having the particularity of projecting a light beam downwards, also covering a wide front lighting area. A diffuser (19) has furthermore been provided for light projection to homogenize the entire lighting area, such that lighting "peaks" at different points are eliminated for the purpose of unifying lighting in the area and making it less bothersome to the human eye. The lower portion of the body (1) of the light fixture is closed by means of a lower cover (20) with a window coinciding with the projection of the light beam reflected in the reflector (18).

[0026] Said reflector (18) is fitted between the lower cover (20) and a recess existing in the base circuit board (7) of the light fixture. This board (7) is fixed by a side edge to the inside of one of the side faces of the body (13), and by the opposite edge to the contacts of the batteries (8). Furthermore, the batteries (8) are arranged in a side compartment separate from the LED circuit board (15), as seen in Figures 9 and 10, because said board (15) is a source of heat that could shorten the service life of the batteries (8). The insulation for the mentioned compartment for the batteries (8) is complemented with a closure cover (9).

[0027] The way the light fixture of the invention is coupled to the wall for use will now be described in further detail. First, drill holes are made in the wall where the light fixture is to be fixed, and the anchor plate (2) is fixed thereto using screws. If there are any mistakes made when positioning the drill holes in the wall, the bushings (3) are simply turned to match up the elongated holes with the drill holes that are made.

[0028] Next, the body (1) of the light fixture is coupled to the anchor plate (2). Note that when performing this

coupling, the blades emerging from the terminals (5) fit in grooves (6) made in the base circuit board (7), which thus allows supplying power to the LED board (15) of the light fixture when there is mains voltage. These grooves (6) are clearly seen in Figures 8 and 9.

[0029] The mechanism for securing the body (1) to the anchor plate (2) is by means of a small sliding plate (4) with a claw (21) that can fit in a step (22) provided in a cavity existing in the rear face of the body (13) of the light fixture. The coupling takes place once the user overcomes the yield strength of the arms, having lugs running through inner elongated orifices existing in the anchor plates (2).

[0030] This can be seen in further detail in Figures 10 and 11. Specifically, Figure 10 shows how the claw (21) provided in the small sliding plate (4) is still not housed in the step or recess (22) provided on the rear face of the body (13) of the light fixture. In Figure 11, however, the small sliding plate (4) has already been moved by manual thrust means until overcoming the strength of the elastic arms. The claw (21), therefore, is already housed and retained in the step (22) provided in the body (13), such that the anchor plate (2) and the body (13) of the light fixture (1) are attached to one another.

Claims

1. Emergency light fixture comprising a body (13), a casing (12), a LED circuit board (15) housed inside said casing (12) and elastic thrust means (17) compressing said LED circuit board (15) against a heat-diffusing wall of said casing (12) **characterized in that** said heat-diffusing wall comprises tabs which are configured for sliding into vertical side channels of said body (13) wherein said side channels are equipped with a ramp at a lower end thereof for the purpose of coupling said tabs on the ramps (14) when the heat-diffusing wall slides through said side channels thereby causing the heat-diffusing wall to move laterally and establishing close contact between the heat-diffusing wall and the LED circuit board (15).
2. Emergency light fixture according to claim 1, further comprising an upper cover (9) having tabs (10) on its lower face configured for being coupled to a side groove (11) of the upper edges of the heat-diffusing wall (12) that contributes to suitably position said casing.
3. Emergency light fixture according to claim 1, where the heat-diffusing wall is metallic.
4. Emergency light fixture according to claim 3, where the heat-diffusing wall is made of aluminum.
5. Emergency light fixture according to any of the pre-

ceding claims, where the thrust means (17) is elastic.

6. Emergency light fixture according to any of the preceding claims, further comprising conductive paste arranged between the LED circuit board (15) and the heat-diffusing wall.
7. Emergency light fixture according to any of the preceding claims, further comprising a reflector (18) and/or a diffuser (19) coupled to the body (13) next to the LED lighting circuit board (15) to enlarge the emitted light beam and make it uniform.
8. Emergency light fixture according to claim 7, where the reflector (18) has a parabolic shape.
9. Emergency light fixture according to any of the preceding claims, further comprising an anchor plate (2) configured for fixing the body (13) to a wall that comprises orifices in which there are freely rotating bushings (3) with elongated central orifices for fixing the anchor plate (2) to a wall.
10. Emergency light fixture according to claim 9, where the anchor plate (2) further comprises a small sliding plate (4) equipped with elastic arms ending in lugs configured for sliding in elongated orifices of the anchor plate (2), said small sliding plate (4) further comprising a claw configured for fitting in a step (22) arranged on a rear face of the body (13).
11. Emergency light fixture according to any of claim 9, where the anchor plate (2) further comprises a terminal block (5) equipped with grooves (6) configured for receiving connection blades provided in a base circuit board (7) powering the LED circuit board (15).
12. Emergency light fixture according to any of the preceding claims, where the body (13) further comprises a compartment for housing batteries (8) which is separated from the LED lighting circuit board (15) by at least one wall.

Patentansprüche

1. Notlichtarmatur, einen Körper (13), ein Gehäuse (12), eine LED-Leiterplatte (15) innerhalb des Gehäuses (12) und elastische Schubmittel (17) umfassend, welche die LED-Leiterplatte (15) gegen eine wärmeleitende Wand des Gehäuses (12) pressen, **gekennzeichnet dadurch, dass** die wärmeleitende Wand Laschen umfasst, die zum Hineingleiten in vertikale Seitenkanäle des Körpers (13) gestaltet sind wobei die Seitenkanäle mit einer Rampe an einem unteren Ende davon ausgestattet sind, um die Laschen an die Rampen (14) zu koppeln, wenn die wärmeleitende Wand durch die Seitenkanäle gleitet,

wodurch die wärmeleitende Wand seitwärts bewegt wird und einen engen Kontakt zwischen der wärmeleitenden Wand und der LED-Leiterplatte (15) herstellt wird.

2. Notlichtarmatur nach Anspruch 1, ferner eine obere Abdeckung (9) mit Laschen (10) auf der unteren Seite umfassend, die gestaltet sind, um an eine Seitenrille (11) der oberen Kanten der wärmeleitenden Wand (12) gekoppelt zu werden, was zu einer entsprechenden Position des Gehäuses beiträgt. 5
3. Notlichtarmatur nach Anspruch 1, wobei die wärmeleitende Wand metallisch ist. 10
4. Notlichtarmatur nach Anspruch 3, wobei die wärmeleitende Wand aus Aluminium hergestellt ist. 15
5. Notlichtarmatur nach einem der vorhergehenden Ansprüche, wobei die Schubmittel (17) elastisch sind. 20
6. Notlichtarmatur nach einem der vorhergehenden Ansprüche, ferner eine leitfähige Paste, welche zwischen der LED-Leiterplatte (15) und der wärmeleitenden Wand angeordnet ist, umfassend. 25
7. Notlichtarmatur nach einem der vorhergehenden Ansprüche, ferner einen Reflektor (18) und/oder einen Diffusor (19) umfassend, der an den Körper (13) neben der LED-Lichtleiterplatte (15) gekoppelt ist, um den abgegebenen Lichtstrahl zu vergrößern und zu vereinheitlichen. 30
8. Notlichtarmatur nach Anspruch 7, wobei der Reflektor (18) eine parabolische Form aufweist. 35
9. Notlichtarmatur nach einem der vorhergehenden Ansprüche, ferner eine Ankerplatte (2) umfassend, welche zum Befestigen des Körpers (13) an einer Wand gestaltet ist, die Öffnungen umfasst, in denen sich frei drehende Buchsen (3) mit länglichen zentralen Öffnungen zum Befestigen der Ankerplatte (2) an einer Wand vorhanden sind. 40
10. Notlichtarmatur nach Anspruch 9, wobei die Ankerplatte (2) ferner eine kleine Gleitplatte (4), welche mit elastischen Armen, die in in länglichen Öffnungen der Ankerplatte (2) gleitende Ansätze enden, ausgestattet ist, wobei die kleine Gleitplatte (4) ferner eine Klaue umfasst, welche zum Einpassen in einem Absatz (22), der an einer hinteren Seite des Körpers (13) angeordnet ist, gestaltet ist. 45
11. Notlichtarmatur nach Anspruch 9, wobei die Ankerplatte (2) ferner einen Anschlussblock (5) umfasst, welcher mit Rillen (6), die zum Empfangen von Verbindungszungen, die in einer die LED-Leiterplatte

(15) speisenden Grundleiterplatte (7) bereitgestellt sind, ausgestattet ist.

12. Notlichtarmatur nach einem der vorhergehenden Ansprüche, wobei der Körper (13) ferner ein Fach zum Aufnehmen von Batterien (8) umfasst, welches von der LED-Lichtleiterplatte (15) durch mindestens eine Wand getrennt ist.

Revendications

1. Dispositif d'éclairage de secours comprenant un corps (13), un boîtier (12), un circuit imprimé LED (15) logé à l'intérieur dudit boîtier (12) et des moyens de poussée élastiques (17) comprimant ledit circuit imprimé LED (15) contre une paroi de diffusion de la chaleur dudit boîtier (12), **caractérisé en ce que** ladite paroi de diffusion de la chaleur comprend des pattes configurées pour coulisser dans des canaux latéraux verticaux dudit corps (13) dans lequel lesdits canaux latéraux sont équipés d'une rampe à une extrémité inférieure de cette dernière dans le but de coupler lesdites pattes sur les rampes (14) lorsque la paroi de diffusion de la chaleur glisse à travers lesdits canaux latéraux, permettant à la paroi de diffusion de la chaleur de se déplacer latéralement et d'établir un contact étroit entre la paroi de diffusion de la chaleur et le circuit imprimé LED (15).
2. Dispositif d'éclairage de secours, selon la revendication 1, comprenant en outre un couvercle supérieur (9) comportant des pattes (10) sur sa face inférieure configurée pour être couplée à une rainure latérale (11) des bords supérieurs de la paroi de diffusion de la chaleur (12) contribuant à positionner ledit boîtier de manière appropriée.
3. Dispositif d'éclairage de secours, selon la revendication 1, dans lequel la paroi de diffusion de la chaleur est métallique.
4. Dispositif d'éclairage de secours, selon la revendication 3, dans lequel la paroi de diffusion de la chaleur est fabriquée en aluminium.
5. Dispositif d'éclairage de secours, selon l'une quelconque des revendications précédentes, dans lequel le moyen de poussée (17) est élastique.
6. Dispositif d'éclairage de secours selon l'une quelconque des revendications précédentes, comprenant en outre une pâte conductrice disposée entre le circuit imprimé LED (15) et la paroi de diffusion de chaleur.
7. Dispositif d'éclairage de secours, selon l'une quelconque des revendications précédentes, compre-

nant en outre un réflecteur (18) et/ ou un diffuseur (19) couplé au corps (13) à côté du circuit imprimé d'éclairage LED (15) pour agrandir le faisceau lumineux émis et le rendre uniforme.

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8. Dispositif d'éclairage de secours, selon la revendication 7, dans lequel le réflecteur (18) présente un aspect parabolique.
9. Dispositif d'éclairage de secours, selon l'une quelconque des revendications précédentes, comprenant en outre une plaque d'ancrage (2) configurée pour fixer le corps (13) à une paroi qui comprend des orifices dans lesquels sont disposées des douilles à rotation libre (3) avec des orifices centraux allongés pour la fixation de la plaque d'ancrage (2) sur une paroi.
10. Dispositif d'éclairage de secours, selon la revendication 9, dans lequel la plaque d'ancrage (2) comprend en outre une petite plaque coulissante (4) équipée de bras élastiques se terminant par des languettes configurées pour coulisser dans des orifices allongés de la plaque d'ancrage (2), ladite petite plaque coulissante (4) comprenant en outre une griffe configurée pour le montage dans une marche (22) disposée sur une face arrière du corps (13).
11. Dispositif d'éclairage de secours, selon la revendication 9, dans lequel la plaque d'ancrage (2) comprend en outre un bornier (5) équipé de rainures (6) configurées pour recevoir des lames de connexion prévues dans un circuit imprimé de base (7) alimentant le circuit imprimé LED (15).
12. Dispositif d'éclairage de secours, selon l'une quelconque des revendications précédentes, dans lequel le corps (13) comprend en outre un compartiment pour loger des batteries (8) séparé du circuit imprimé d'éclairage LED (15) par, au moins, une paroi.

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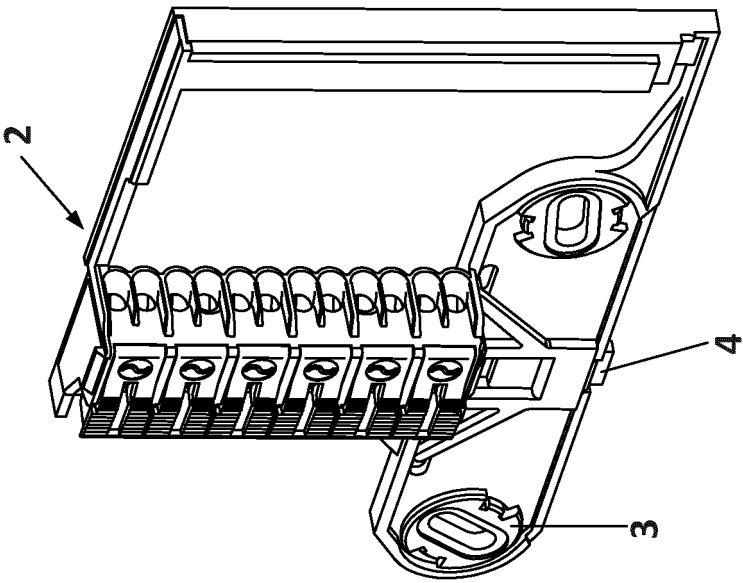


FIG. 1b

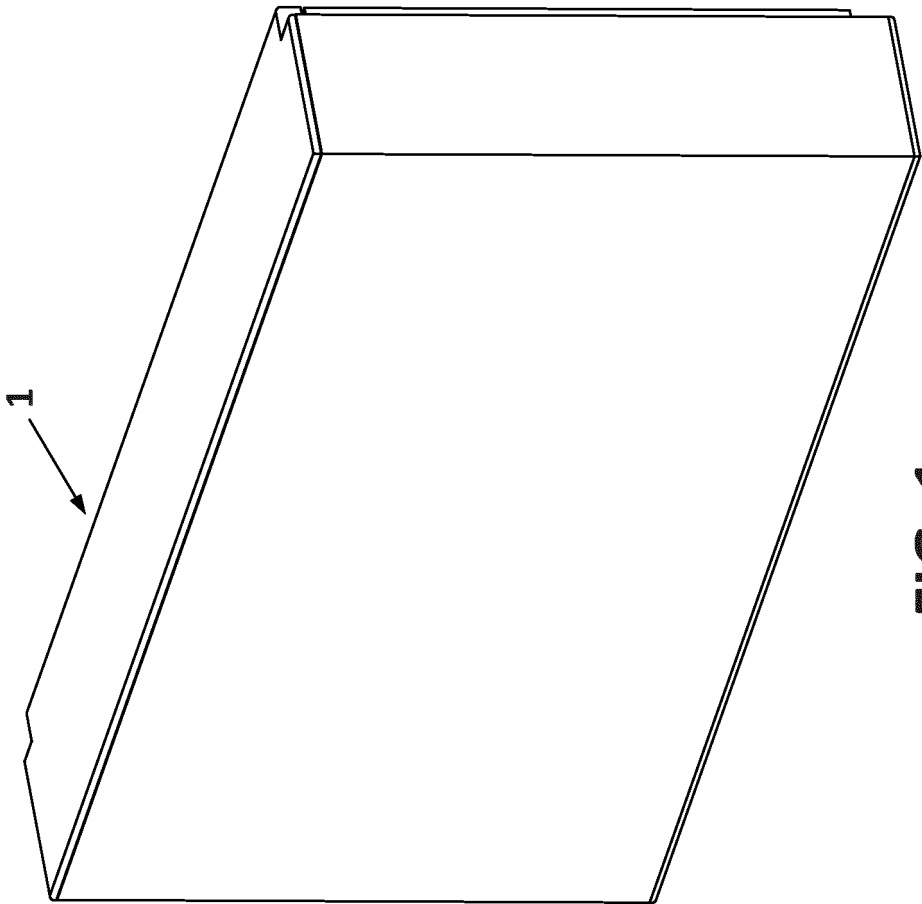


FIG. 1a

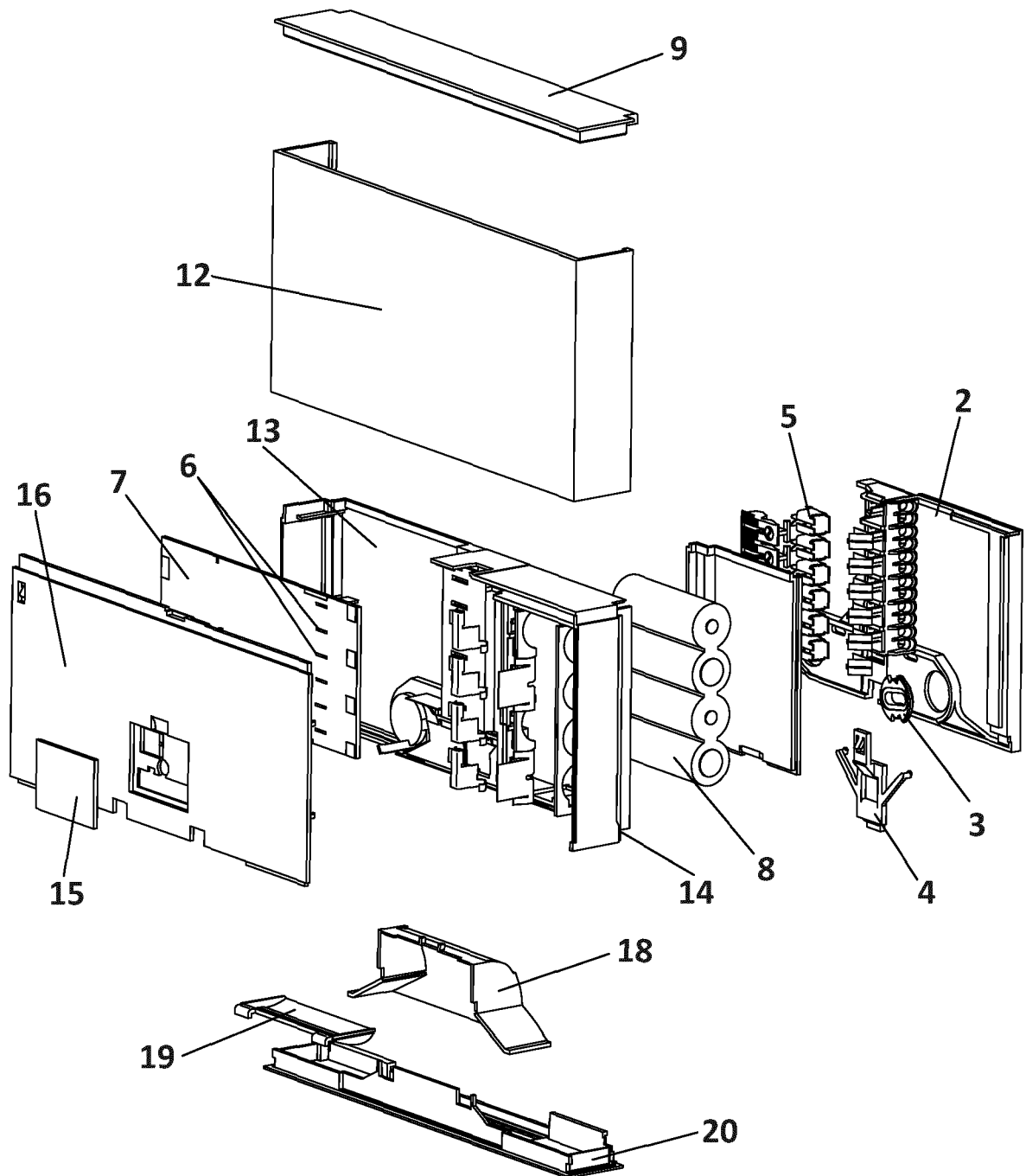
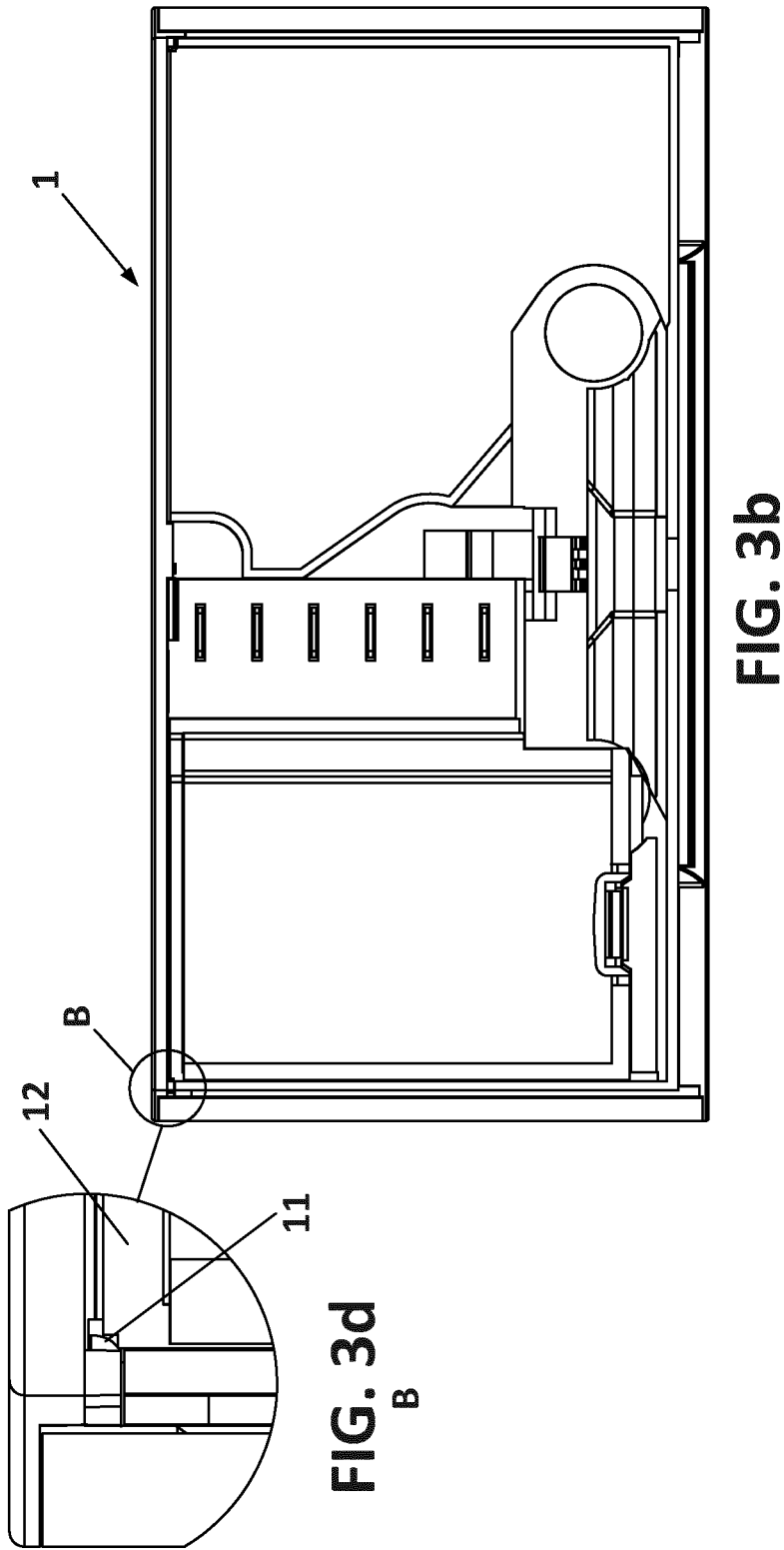
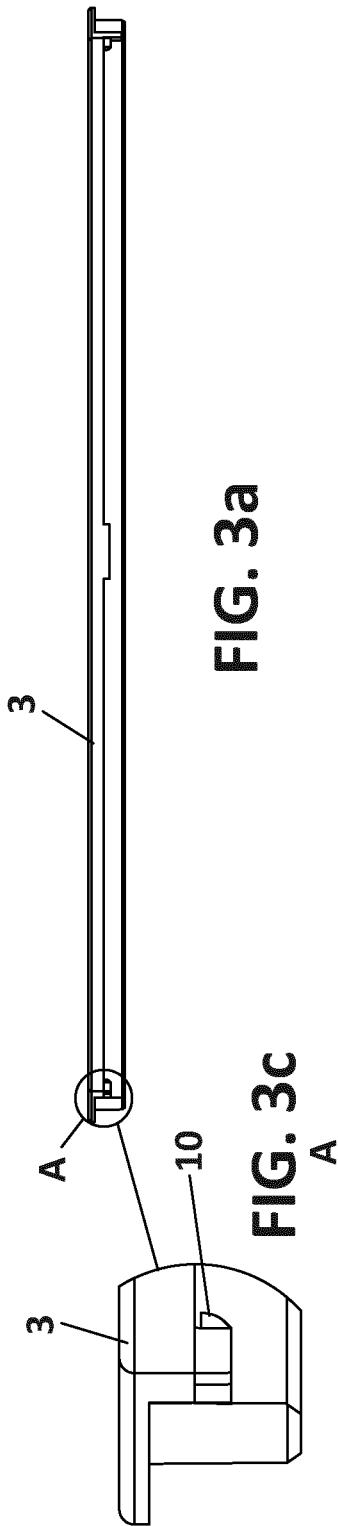


FIG. 2



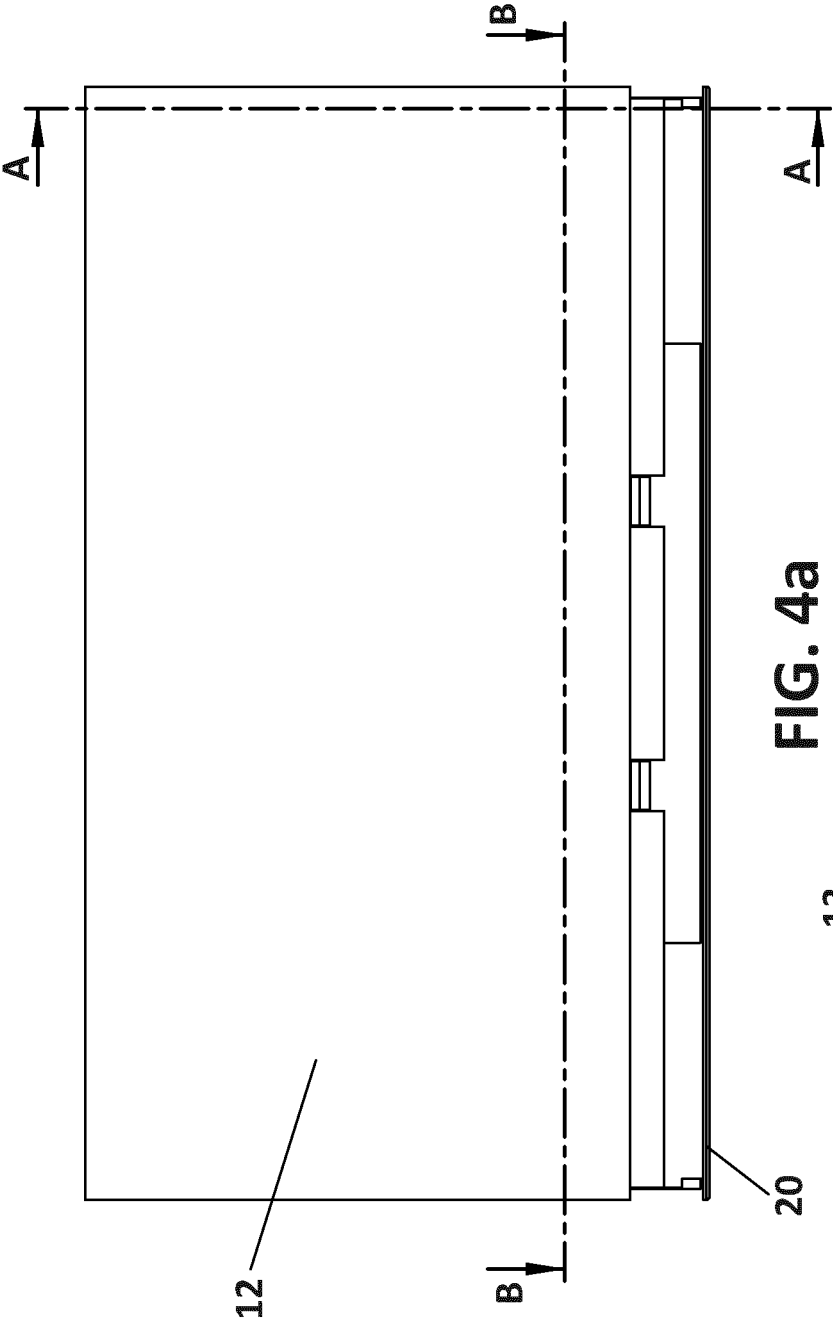


FIG. 4a

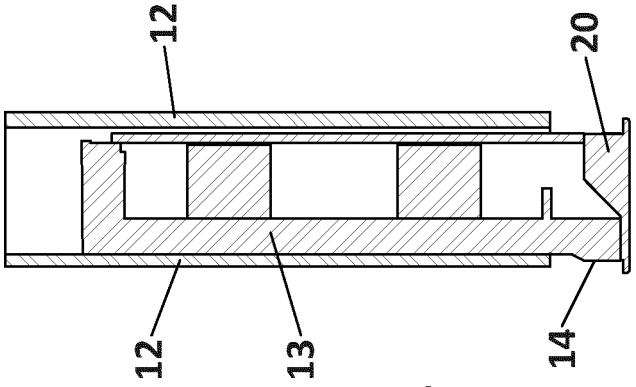


FIG. 4b
A-A

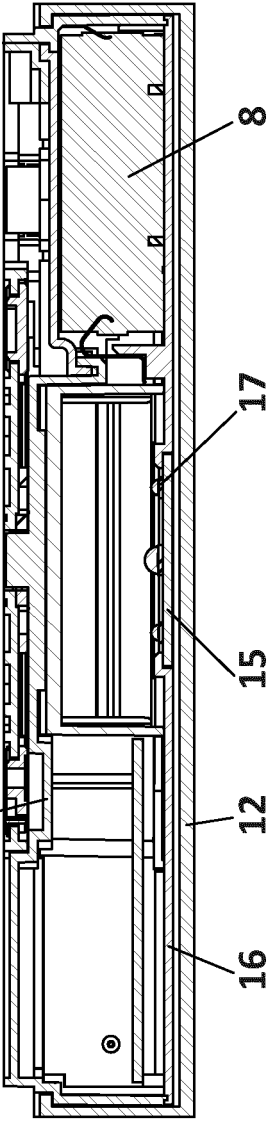


FIG. 4c
B-B

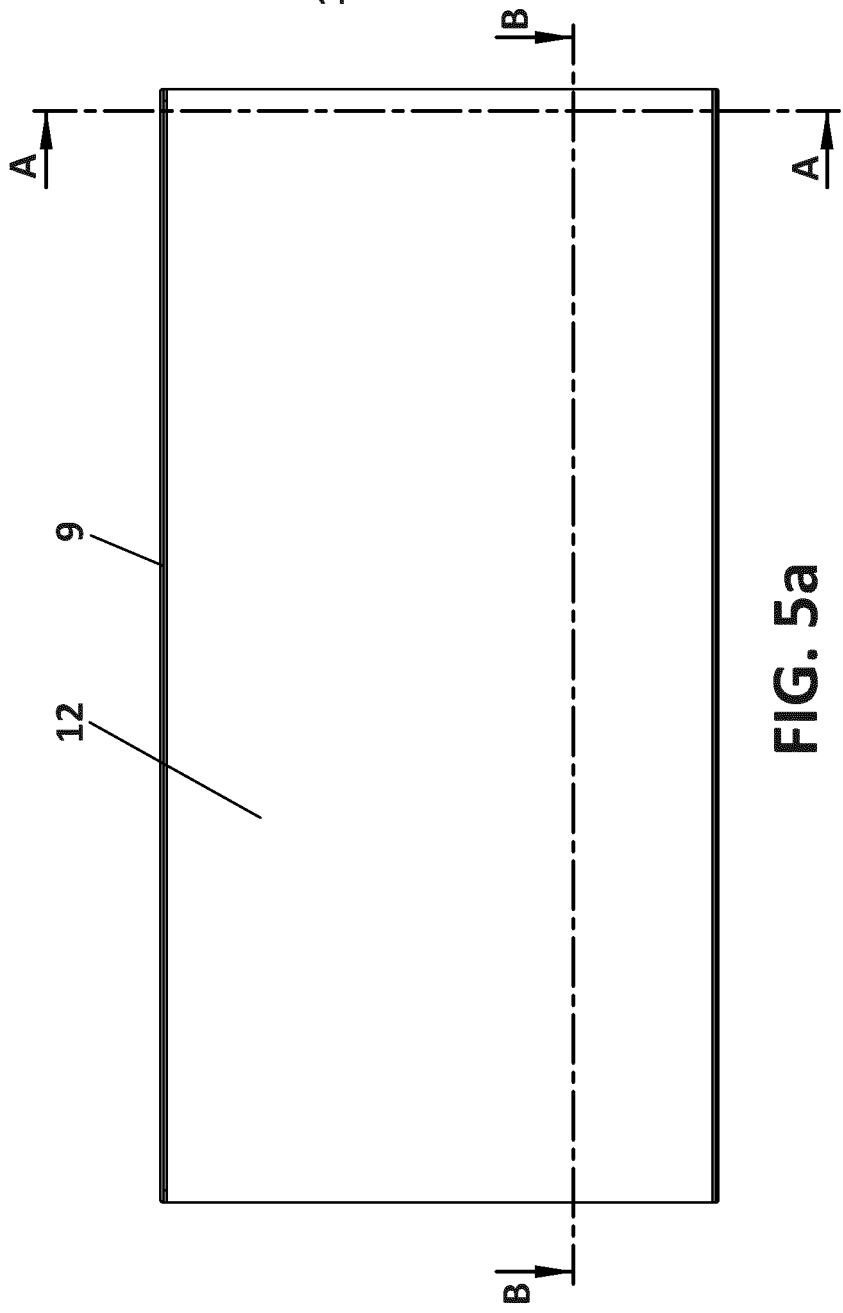


FIG. 5a

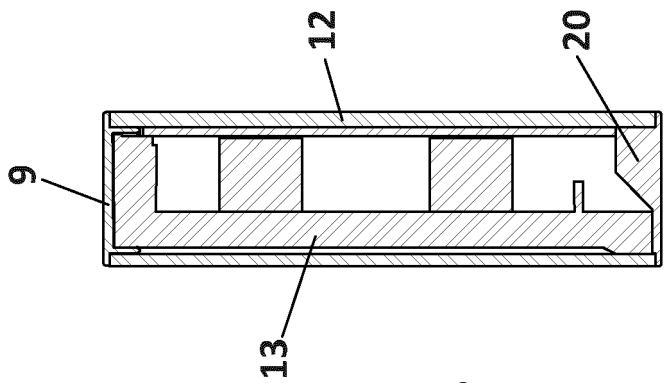


FIG. 5b
A-A

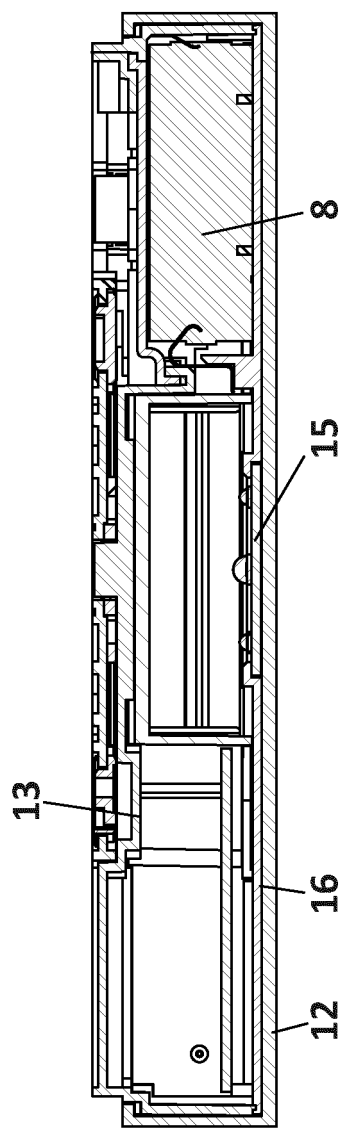


FIG. 5c
B-B

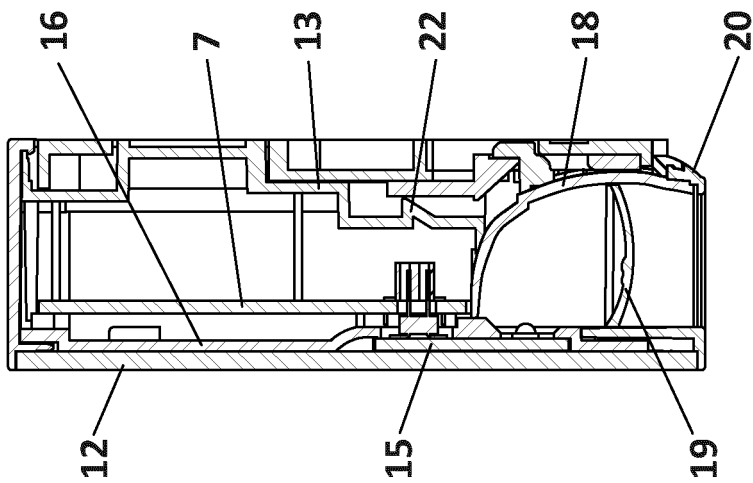


FIG. 7

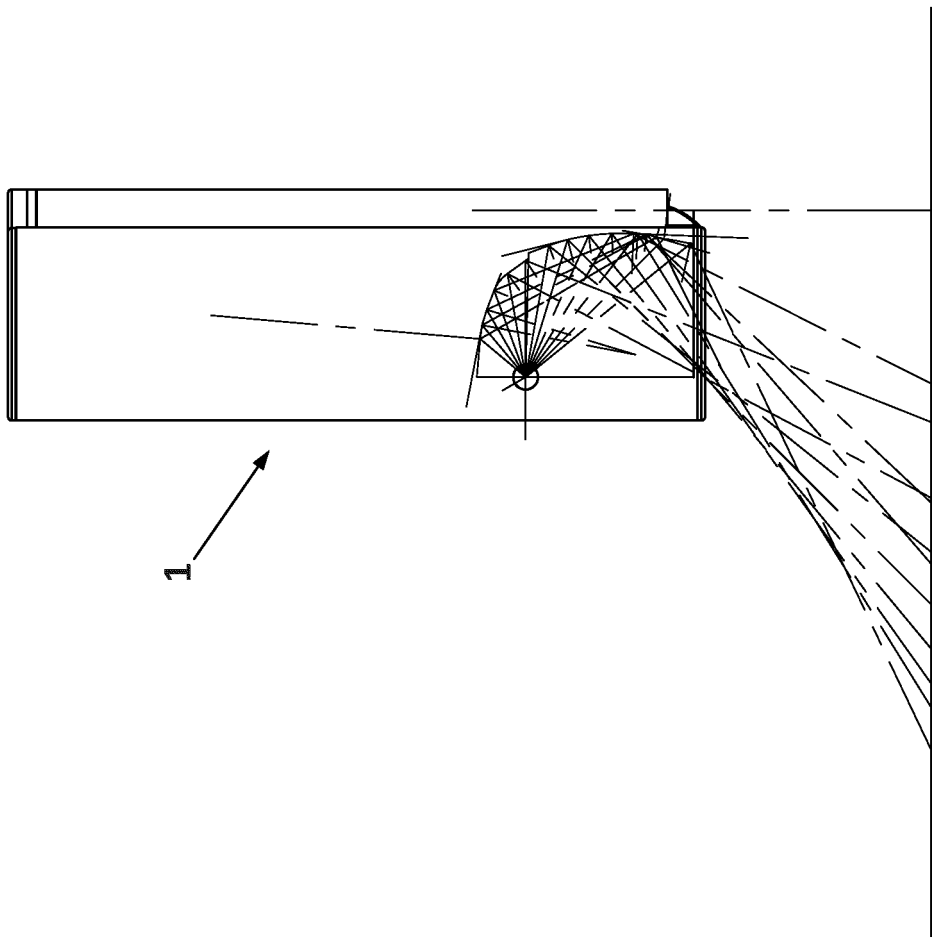


FIG. 6

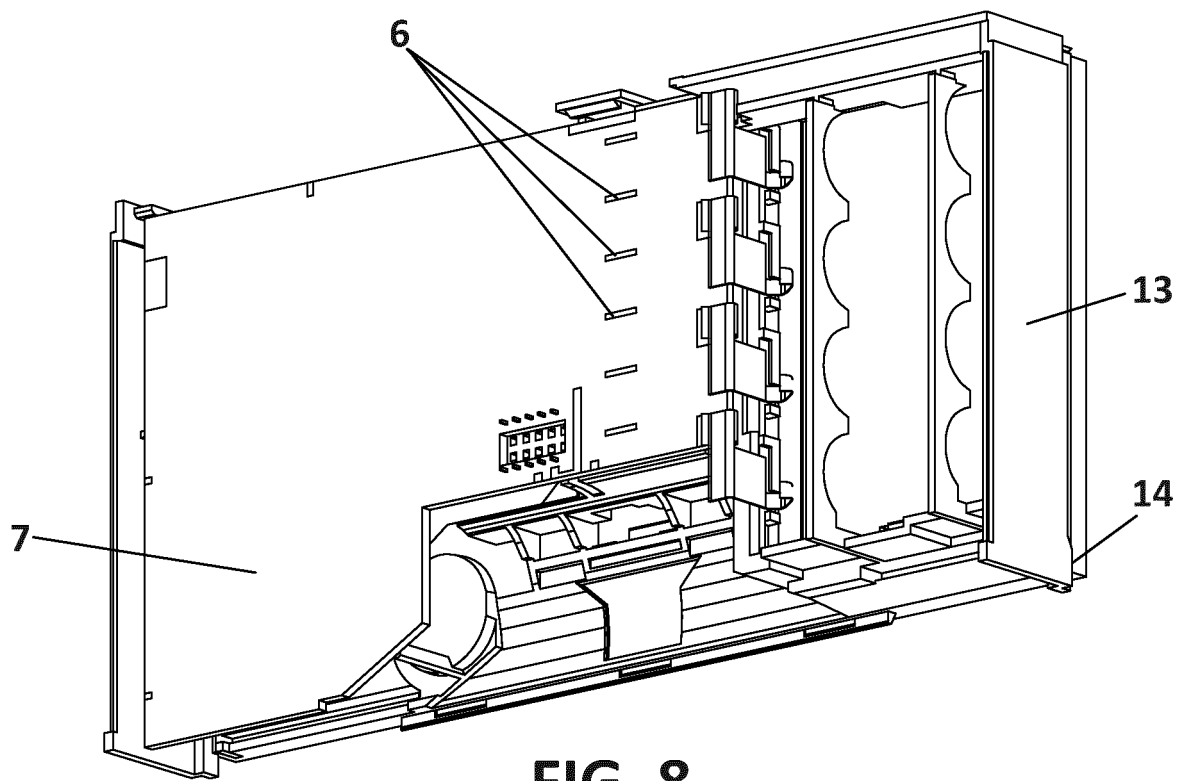


FIG. 8

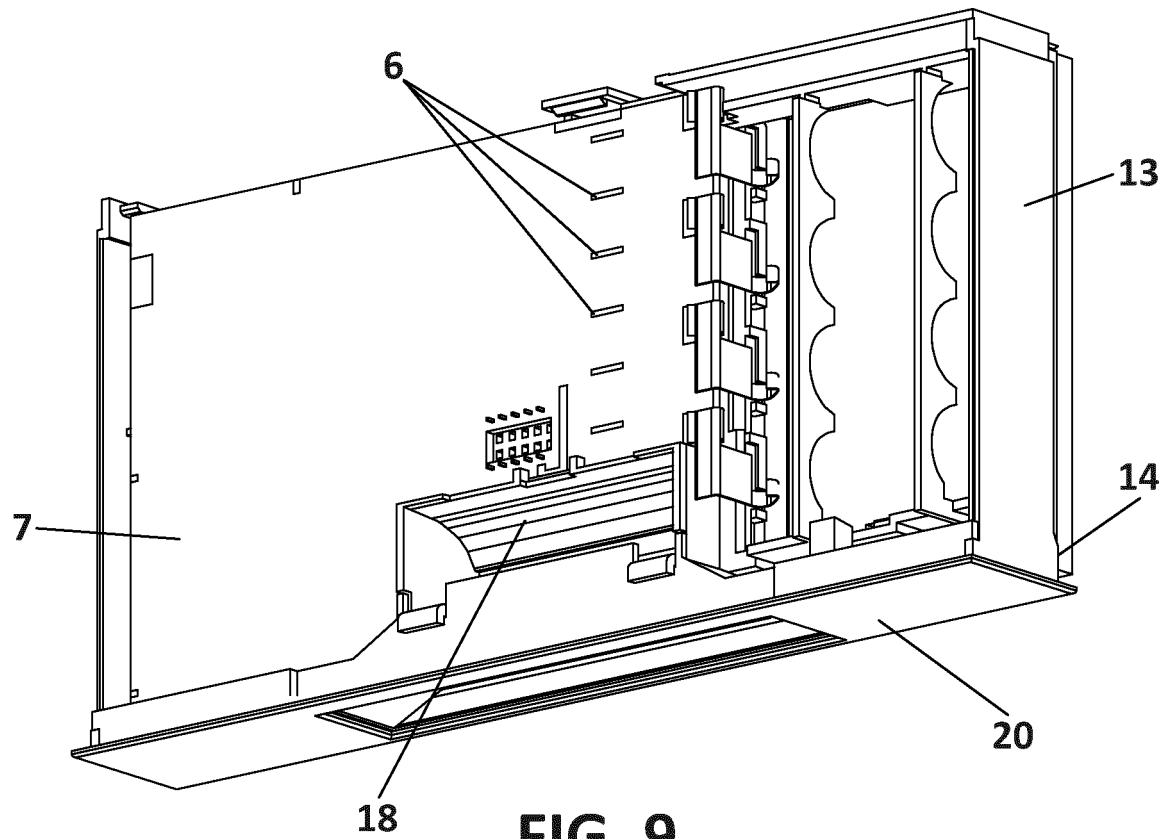


FIG. 9

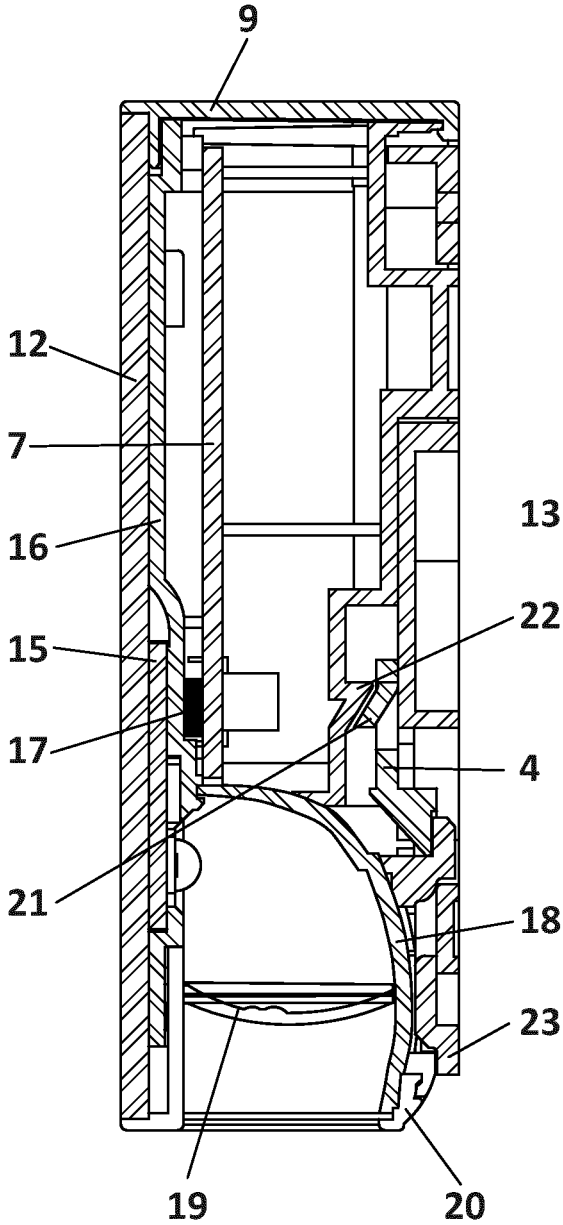


FIG. 10

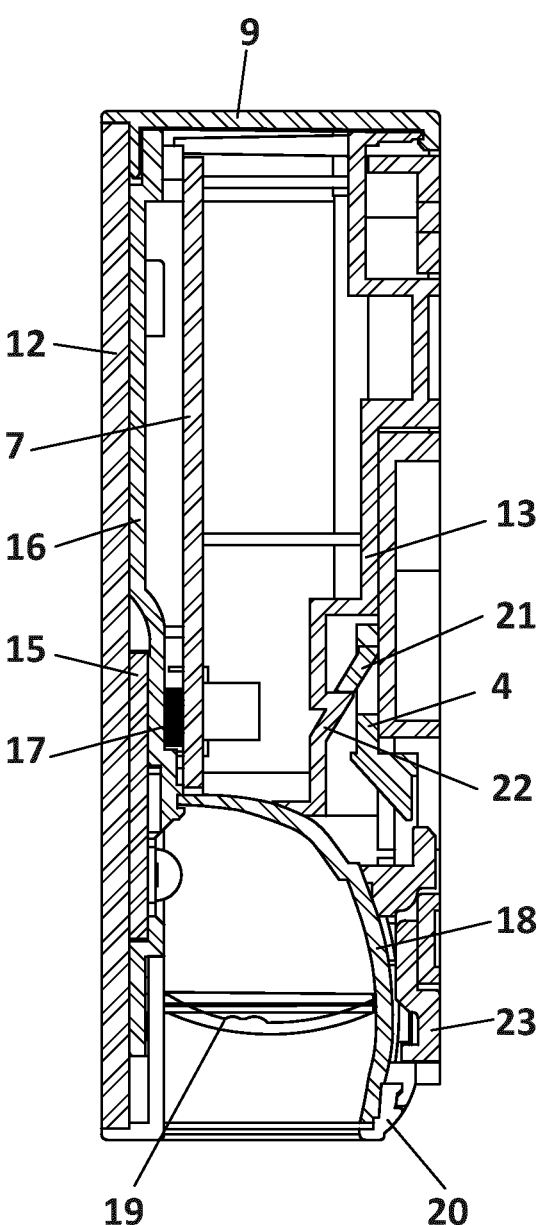


FIG. 11

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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