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(54) **AN ENCLOSURE AND MOUNTING ASSEMBLY FOR AN ANTENNA**

GEHÄUSE UND MONTAGEBAUGRUPPE FÜR EINE ANTENNE

COFFRET ET ENSEMBLE DE MONTAGE POUR UNE ANTENNE

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Description

Field of the Invention

[0001] Embodiments of the present invention relate to an enclosure and mounting assembly for an antenna.

Background

[0002] In 2G and 3G cellular wireless networks, base stations provide the coverage for end user access. The most popular macro base station has one or several radios or transmitters and receivers (TRX) inside, configured in one or several sector fashion, and covers a radius of a few kilometres. Antennas are mostly external, large in size, and connected to the TRX via cables and connectors. The whole base station needs a specialized cellular site to install, due to the physical size of equipment, high power consumption, and height requirements.

[0003] For broadband wireless service beyond 3G, a lot more smaller base stations need to be deployed in areas where there is a concentration of heavy data traffic. They need multiple-sector and multiple-radio support to maximize capacity. The traditional Macro cells have to be scaled down to Micro or even Pico cells, with a radius shrinking from a few kilometres to a few hundred meters. The mounting sites for such small base stations are less cellular specific, such as walls of building, rooftop of building, street light post, utility poles, traffic lights, etc...

[0004] An antenna mast carring cellular base stations is disclosed in DE 102005063234

[0005] Due to the large number of sites required for small broadband wireless base stations, on-location weather proof and temperature controlled cabinets are normally unavailable. Also the physical infrastructure will not be able to support very large or heavy equipment due to weight and wind load. The present applicant has identified a need for smaller, lighter base stations that consume less energy.

[0006] From an operations point of view, the present applicant has identified the need to make the installation process simple and fool proof since there will be many units to install and it would be advantageous if the base stations could be installed without requiring a highly skilled engineer. The most time consuming operations involved in installing current base stations are antenna mounting, orientation, cable connection with TRX, and cable connector weather proofing.

[0007] There is increasing pressure on reducing the cost of small base stations themselves. Downsized Macro base stations are ill-fit to achieve the cost target due to their over engineered designs.

[0008] It is an aim of certain embodiments of the present invention to solve one or more of the aforementioned problems.

Summary

[0009] According to a first embodiment of the present invention there is provided an apparatus comprising: a radome; and a tube disposed within, and mounted to, the radome, wherein the tube has an outer surface adapted for mounting transmitter and/or receiver components thereon and an inner surface defining a cooling chimney, and wherein the radome has an opening at each end of the tube for allowing air to circulate through the cooling chimney. The tube comprises one or more cross-bracing elements disposed within the cooling chimney between points on the inner surface of the tube. The one or more cross-bracing elements function to strengthening the apparatus while still allowing air to flow through the cooling chimney.

[0010] The aforementioned arrangement has been found to provide a low cost, compact, and readily constructed apparatus for embedding multiple active antennas in an enclosed structure. The central tube serves to form both a mounting and isolation structure for the transmitter and/or receiver components and also a cooling chimney for removing heat generated by the transmitter and/or receiver components. The tube also acts as a structural backbone for the apparatus.

[0011] The tube may have a plurality of sides and be adapted for mounting a transmitter and/or receiver on each one of the sides. For example, the tube may have a substantially triangular cross-section. An active antenna may be mounted on each of the three sides of the triangular cross-sectioned tube. In such a triangular cross-sectioned arrangement, the radome may also have a substantially triangular cross-section for compactness and ease of mounting the tube therein. The complementary shape of the tube and radome also aids in sealing areas where the transmitter and/or receiver components are mounted.

[0012] The tube may be made of aluminium. An aluminium tube is lightweight and has been found to be ideal in functioning as a structural backbone, a radio frequency insulator among sectors, and a heat sink for electronic components.

[0013] The radome may be made of plastic which is lightweight and provides RF-transparency to embedded antennas. In order to aid transportation and installation, the radome may comprise a handle on an outer surface thereof for carrying the apparatus. According to one arrangement, the handle is disposed over one of the openings in the radome for reducing ingress of moisture, dust, and/or other debris while still allowing air to exit the opening. For example, the apparatus may be adapted to be mounted with the tube orientated in a vertical direction with a top and bottom opening. Air can then circulate up the chimney with cool air entering through the bottom opening and heated air exiting through the top opening by convection. In order to avoid debris falling into the top opening, the handle may be disposed thereover.

[0014] A bottom plate may be provided for mounting

the tube to the radome. In this case, one of the openings in the radome for allowing air to circulate through the cooling chimney may be defined by the bottom plate.

[0015] The tube may be mounted to the radome to form a seal at each end of the tube isolating air within the cooling chimney from a region between the outer surface of the tube and an inner surface of the radome. For example, a gasket may be provided at each end of the tube to form the seal. The region between the outer surface of the tube and the inner surface of the radome may be sealed to an ingress protection rating of at least 67 (IP67). Such a seal protects electronic components mounted therein from dust and moisture.

[0016] The transmitter and/or receiver components can be provided in various forms. In one arrangement the outer surface of the tube is adapted for mounting electronic boards comprising the transmitter and/or receiver components.

[0017] The apparatus of certain embodiments of the present invention may be provided with transmitter and/or receiver components to form a base station of a wireless communications network, for example, a mobile phone network.

Brief Description of the Figures

[0018] For a better understanding of the present invention and to show how the same may be carried into effect, embodiments of the present invention will now be described by way of example only with reference to the accompanying drawings, in which:

Figure 1 shows an exploded view of a wireless base station according to an embodiment of the invention;
Figure 2 shows a top view illustrating the cross-section of a central triangular aluminium tube of the wireless base station of Figure 1 with electronic boards mounted thereon;
Figure 3 shows a side cross-section view of the wireless base station of Figure 1 illustrating convection cooling through a cooling chimney defined by the central triangular aluminium tube of Figure 2;
Figure 4 shows a perspective view of the fully constructed wireless base station of
Figure 1; and
Figure 5 shows the wireless base station mounted to a post.

Description of Exemplifying Embodiments

[0019] Certain embodiments of the invention provide multiple-sector multiple-radio base stations with embedded antennas. These embodiments can be used as micro or pico base stations deployed outdoors in high density to provide broadband wireless access.

[0020] The mechanical design of one such wireless base station consists of the following three elements: a central aluminium chimney; a plastic radome disposed around the central aluminium chimney with a handle; and a bottom plate for mounting the chimney in the radome. Figure 1 shows an exploded view of such a wireless base station.

[0021] This design centers around an aluminium chimney (1), which acts simultaneously as the structural backbone, a radio frequency insulator among sectors, a heat sink for electronic components, and a chimney for self convection.

[0022] The external enclosure, or radome (2), is integrated with a handle doubled as a rain/dust cover for the ventilation holes. The plastic radome is transparent to radio waves so that the embedded antennas can function properly.

[0023] The bottom plate (3) provides an interface to a mounting unit (shown in Figure 5) and weather proof external connectors (4) for power and data. It is also the mechanical foundation for securing the aluminium chimney (1) and the radome (2). Cool air is flown inside the chimney through the bottom plate (3).

[0024] In this design, all external antennas, cables, and connectors are eliminated. The number of parts in the wireless base station is low for cost-efficiency, fast assembly and installation.

[0025] The bottom plate (3) is a single injection moulded part made of glass-reinforced PA66. With the aluminium chimney (1), it forms the rigid backbone of the base station. The bottom plate (3) has a cylindrical interface for mounting to a cylindrical fastening element of a mounting unit (showing in Figure 5). The cylindrical interface also doubles as an inlet channel for cool air. Cable entry areas are located on the bottom of the bottom plate (3) and provide fastening points for the cable glands.

[0026] Two cable hatches (4) (one for power, one for data connectors) provide weather protection for the areas of cable entry to an ingress protection rating of 67 (IP 67). The two cable hatches (4) also provide strain relief to the cables. Cable glands are integrated with flexible drop stopper arms and captive screws to avoid accidental fall of parts.

[0027] A top gasket (5a) is provided between the aluminium chimney (1) and the radome (2). A bottom gasket (5b) is provided between aluminium chimney (1) and the bottom plate (3). A partition gasket (5c) is provided between the radome (2) and bottom plate (3). Electronic boards (6a, 6b, 6c) are mounted on outer faces of the triangular aluminium chimney. The gaskets serve to seal the electronics area within an enclosure between the outer surface of the aluminium chimney (1) and the inner surface of the radome (2) to an ingress protection rating of 67. The top and bottom gaskets (5a, 5b) can be stamped out of a sheet of elastic material. The partition gasket (5c) may be an injection moulded elastomer.

[0028] The core of the wireless base station is provided by the triangular cross-sectioned aluminium chimney (1) which is shown in more detail in Figure 2. The chimney (1) has multiple functions: it forms the rigid chassis of the apparatus onto which electronics are fixed; and it defines

a cooling chimney though which air can flow. A cross-bracing structure (7) in the middle of the triangular profile adds additional heat sink capability to the chimney by increasing surface area. The cross-bracing structure (7) also serves to strengthen the apparatus.

[0029] Electronic boards (6a, 6b, 6c) are mounted on outer faces of the triangular aluminium chimney. Recesses (8) may be provided in the outer surface of the chimney for receiving electronic components (9) therein. The recesses (8) allow mounting of electronic components (9) that have a building height beyond a few millimetres. This enables integration of an AC/DC power supply and external interface circuits in a compact arrangement.

[0030] The aluminium chimney (1), together with radome (2), bottom plate (3), and the gaskets (5a, 5b, 5c) form an extremely strong sandwich structure. Attached to the stiff sheet metal mounting unit (shown in Figure 5), the wireless base station can withstand severe wind loads and vibration. Inside the triangular profile the cross bracing pattern (7) is applied to make it easier to produce and add additional mechanical sturdiness. Thermal management is illustrated in Figure 3. There are two methods to transfer excess heat from the electronic components: conduction of heat from the electronic components into the aluminium profile (2); and convection from the aluminium profile to the outside of the apparatus via air flowing through the chimney. In order to improve heat transfer, conductive thermal pads may be provided between hot electronic components and the aluminium profile. Heat conducts to the inner surface of the profile and eventually heats the air in the chimney. Warm air rises towards the top of the wireless base station through the chimney and out of ventilation holes (10). Rising hot air produces lower pressure inside the chimney and cool air starts to flow into the chimney from the bottom through the cylindrical fastening element (12). Due to low flow rate, only the smallest dust particles enter inside the base station.

[0031] The triangular, closed shape of the aluminium chimney (1) provides isolation and RF-shielding between antenna sectors. With the top and bottom gaskets (5a, 5b), the aluminium chimney (1) separates the IP-protected area and the open cooling area within. The triangular shape that hides the antennas from each other delivers about 40dB isolation in between the sectors.

[0032] The outer surface of the radome (2) is illustrated in Figure 4 showing the ventilation holes (10) and handle (14). The radome may be formed as a single injection moulded PC/ABS part. With the chimney and the gaskets it protects the electronics and allows the heated air to flow outside the apparatus. The radome provides RF-transparency to the embedded antennas. The integrated handle (14) is disposed over the ventilation holes (10) to protect against ingress of rain and debris. This structure allows easy handling and installation of the apparatus, while also providing a protected thermal exit.

[0033] Figure 5 shows the wireless base station mounted to a post (15) by a mounting unit (16). The mounting unit (16) provides the means to install the wireless base station to vertical, horizontal or slanted poles (such as lamp posts) or onto a wall. The mounting unit (16) has a swivel mechanism to provide tilt adjustment of 90 degrees.

[0034] The wireless base station is designed such that assembly is efficient and fast, following top to bottom logic. The steps involved in assembly are as follows:

1. The bottom gasket is placed in its position into the bottom plate and secured with adhesive;
2. The top gasket is placed in its position inside the top of the radome and secured with adhesive;
3. The aluminium chimney is secured to the bottom plate with self-tapping screws;
4. Antenna/radio sub-assemblies, PWR and 1/F boards are secured to the chimney with self-tapping screws;
5. The chimney, equipped with electronics boards, is slid inside the radome and secured to it with screws through the bottom plate; and
6. The cable hatches are secured into their positions with captive screws.

[0035] The wireless base station can be installed by one person only, in less than half an hours time. The typical installation of the base station involves the following steps:

1. Fixing the mounting unit to the selected mounting interface (pole or a wall).
2. Measuring and adjusting the planarity of the mounting unit (the base station is generally mounted in an upright position).
3. Positioning the wireless base station node on the mounting unit and aligning the node towards neighbouring nodes by rotating it around its vertical axis.
4. Opening cable hatches and connecting cables (pwr or pwr + data).
5. Closing hatches and securing with captive screws.

[0036] After performing the aforementioned installation steps the base station is ready to be powered up.

[0037] Embodiments provide a small multi-sector base station design with embedded antenna without sacrificing high performance as all the benefits of multiple-sector design such as frequency re-use, noise reduction, and radio energy focusing are retained. Excellent heat dissipation is provided purely by self convection. No fans are required and there is no need for environmentally controlled site cabinets. Embodiments are cheap to manufacture and assemble. The aluminium profile can be formed by extrusion and then cut to a desired length. No post-processing is needed. Self threading screw holes, alignment rails and heat sink are all designed into the profile. The radome with integral handle and bottom plate can both be single-shot injection moulded parts well suited for mass production. Sectors may be symmetrical which enables per sector sub-assembly of antenna and

radio.

[0038] Installation is simple due to the light weight of the apparatus and single hand operation via the built-in handle. No external antennas are required and few or no cables and connectors are required to be attached at mounting height. Little or no node orientation is needed. The unit may be easily mounted on any vertical or horizontal pole or attached to a wall. The final assembly of the whole unit should not take one person more than 15 minutes of labour.

[0039] The base station may be used as a node in any broadband radio technology. Examples include WLAN, WiMAX, and 2G/3G/nG cellular base stations. Embodiments can significantly reduce the size and cost of multi-sector base station.

[0040] While this invention has been particularly shown and described with reference to preferred embodiments, it will be understood to those skilled in the art that various changes in form and detail may be made without departing from the scope of the invention as defined by the appendant claims.

Claims

1. An apparatus comprising:

   a radome (2); and
   a tube (1) disposed within, and mounted to, the radome (2),
   wherein the tube (1) has an outer surface adapted for mounting transmitter and/or receiver components (9) thereon and an inner surface defining a cooling chimney,
   wherein the radome has an opening at each end of the tube for allowing air to circulate through the cooling chimney; **characterized in that**
   the tube (1) comprises one or more cross-bracing elements (7) disposed within the cooling chimney between points on the inner surface of the tube for strengthening the tube while still allowing air to flow through the cooling chimney.

2. An apparatus according to claim 1, wherein the tube has a plurality of sides and is adapted for mounting a transmitter and/or receiver on each one of the sides.

3. An apparatus according to claim 1 or 2, wherein the tube has a substantially triangular cross-section.

4. An apparatus according to claim 3, wherein the radome has a substantially triangular cross-section.

5. An apparatus according to any preceding claim, wherein the tube is made of aluminium.

6. An apparatus according to any preceding claim, wherein the radome is made of plastic.

7. An apparatus according to any preceding claim, wherein the radome comprises a handle on an outer surface thereof for carrying the apparatus.

8. An apparatus according to claim 7, wherein the handle is disposed over one of the openings in the radome for reducing ingress of moisture and dust while still allowing air to exit the opening.

9. An apparatus according to any preceding claim, further comprising a bottom plate for mounting the tube to the radome.

10. An apparatus according to claim 9, wherein one of the openings in the radome for allowing air to circulate through the cooling chimney is defined by the bottom plate.

11. An apparatus according to any preceding claim, wherein the tube is mounted to the radome to form a seal at each end of the tube isolating air within the cooling chimney from a region between the outer surface of the tube and an inner surface of the radome.

12. An apparatus according to claim 11, wherein a gasket is provided at each end of the tube to form the seal.

13. An apparatus according to claim 11 or 12, wherein the region between the outer surface of the tube and the inner surface of the radome is sealed to a level of at least IP67.

14. An apparatus according to any preceding claim, wherein the outer surface of the tube is adapted for mounting electronic boards comprising the transmitter and/or receiver components.

15. An apparatus according to any preceding claim, further comprising the transmitter and/or receiver components mounted on the outer surface of the tube.

16. An apparatus according to claim 15, wherein the apparatus is adapted to form a base station of a wireless communications network.

Patentansprüche

1. Vorrichtung, die Folgendes umfasst:

   ein Radom (12) und
   ein Rohr (1), das darin angeordnet ist und an dem Radom (2) montiert ist,
   wobei das Rohr (1) eine äußere Oberfläche be-

sitzt, die dafür ausgelegt ist, daran Sender- und/oder Empfängerkomponenten (9) zu montieren, und eine innere Oberfläche besitzt, die einen Kühlungskamin definiert,
wobei das Radom an jedem Ende des Rohrs eine Öffnung besitzt, um zuzulassen, dass durch den Kühlungskamin Luft zirkuliert; **dadurch gekennzeichnet, dass**
das Rohr (1) ein oder mehrere Versteifungselemente (7) umfasst, die in dem Kühlungskamin zwischen Punkten an der inneren Oberfläche des Rohrs angeordnet sind, um das Rohr zu verstärken und dabei dennoch zuzulassen, dass Luft durch den Kühlungskamin strömt.

2. Vorrichtung nach Anspruch 1, wobei das Rohr mehrere Seiten besitzt und dafür ausgelegt ist, dass an jeder der Seiten ein Sender und/oder Empfänger montiert wird.

3. Vorrichtung nach Anspruch 1 oder 2, wobei das Rohr einen im Wesentlichen dreieckigen Querschnitt besitzt.

4. Vorrichtung nach Anspruch 3, wobei das Radom einen im Wesentlichen dreieckigen Querschnitt besitzt.

5. Vorrichtung nach einem vorhergehenden Anspruch, wobei das Rohr aus Aluminium hergestellt ist.

6. Vorrichtung nach einem vorhergehenden Anspruch, wobei das Radom aus Kunststoff hergestellt ist.

7. Vorrichtung nach einem vorhergehenden Anspruch, wobei das Radom an einer äußeren Oberfläche hiervon einen Griff umfasst, um die Vorrichtung zu tragen.

8. Vorrichtung nach Anspruch 7, wobei der Griff über einer der Öffnungen in dem Radom angeordnet ist, um ein Eindringen von Feuchtigkeit und Staub zu verringern, obwohl der Austritt von Luft durch die Öffnung möglich ist.

9. Vorrichtung nach einem vorhergehenden Anspruch, die ferner eine Bodenplatte aufweist, um das Rohr an dem Radom zu montieren.

10. Vorrichtung nach Anspruch 9, wobei eine der Öffnungen in dem Radom, um zu ermöglichen, dass durch den Kühlungskamin Luft zirkuliert, durch die Bodenplatte definiert ist.

11. Vorrichtung nach einem vorhergehenden Anspruch, wobei das Rohr in dem Radom montiert ist, um an jedem Ende des Rohrs eine Abdichtung zu bilden, um die Luft in dem Kühlungskamin gegenüber einem Bereich zwischen der äußeren Oberfläche des Rohrs und einer inneren Oberfläche des Radoms zu isolieren.

12. Vorrichtung nach Anspruch 11, wobei an jedem Ende des Rohrs eine Dichtung vorgesehen ist, um die Abdichtung zu bilden.

13. Vorrichtung nach Anspruch 11 oder 12, wobei der Bereich zwischen der äußeren Oberfläche des Rohrs und der inneren Oberfläche des Radoms bis zu einem Grad von wenigstens IP67 abgedichtet ist.

14. Vorrichtung nach einem vorhergehenden Anspruch, wobei die äußere Oberfläche des Rohrs dafür ausgelegt ist, elektronische Platten, die Sender- und/oder Empfängerkomponenten enthalten, zu montieren.

15. Vorrichtung nach einem vorhergehenden Anspruch, die ferner Sender- und/oder Empfängerkomponenten, die an der äußeren Oberfläche des Rohrs montiert sind, umfasst.

16. Vorrichtung nach Anspruch 15, wobei die Vorrichtung dafür ausgelegt ist, eine Basisstation eines drahtlosen Kommunikationsnetzes zu bilden.

Revendications

1. Un appareil comprenant :

un radôme (2), et
un tube (1) disposé à l'intérieur de, et monté sur, le radôme (2),
dans lequel le tube (1) possède une surface extérieure adaptée au montage de composants d'émetteur et/ou de récepteur (9) sur celle-ci et une surface intérieure définissant une cheminée de refroidissement,
dans lequel le radôme possède une ouverture à chaque extrémité du tube de façon à permettre à de l'air de circuler au travers de la cheminée de refroidissement, **caractérisé en ce que**
le tube (1) comprend un ou plusieurs éléments d'entretoisement (7) disposés à l'intérieur de la cheminée de refroidissement entre des points sur la surface intérieure du tube destinés à renforcer le tube tout en permettant néanmoins à de l'air de circuler au travers de la cheminée de refroidissement.

2. Un appareil selon la revendication 1, dans lequel le tube possède une pluralité de côtés et est adapté au montage d'un émetteur et/ou récepteur sur chacun des côtés.

3. Un appareil selon la revendication 1 ou 2, dans lequel le tube possède une section transversale sensiblement triangulaire.

4. Un appareil selon la revendication 3, dans lequel le radôme possède une section transversale sensiblement triangulaire.

5. Un appareil selon l'une quelconque des revendications précédentes, dans lequel le tube est en aluminium.

6. Un appareil selon l'une quelconque des revendications précédentes, dans lequel le radôme est en plastique.

7. Un appareil selon l'une quelconque des revendications précédentes, dans lequel le radôme comprend une poignée sur une surface extérieure de celui-ci pour le transport de l'appareil.

8. Un appareil selon la revendication 7, dans lequel la poignée est disposée par dessus l'une des ouvertures dans le radôme de façon à réduire l'entrée d'humidité et de poussière tout en permettant néanmoins à de l'air de s'échapper de l'ouverture.

9. Un appareil selon l'une quelconque des revendications précédentes, comprenant en outre une plaque de base destinée au montage du tube sur le radôme.

10. Un appareil selon la revendication 9, dans lequel l'une des ouvertures dans le radôme destinée à permettre à de l'air de circuler au travers de la cheminée de refroidissement est définie par la plaque de base.

11. Un appareil selon l'une quelconque des revendications précédentes, dans lequel le tube est monté sur le radôme de façon à former un joint d'étanchéité à chaque extrémité du tube en isolant de l'air à l'intérieur de la cheminée de refroidissement à partir d'une zone entre la surface extérieure du tube et une surface intérieure du radôme.

12. Un appareil selon la revendication 11, dans lequel un joint statique est placé à chaque extrémité du tube de façon à former le joint d'étanchéité.

13. Un appareil selon la revendication 11 ou 12, dans lequel la zone entre la surface extérieure du tube et la surface intérieure du radôme est scellée à un niveau d'au moins IP67.

14. Un appareil selon l'une quelconque des revendications précédentes, dans lequel la surface extérieure du tube est adaptée au montage de cartes électroniques comprenant les composants d'émetteur et/ou de récepteur.

15. Un appareil selon l'une quelconque des revendications précédentes, comprenant en outre les composants d'émetteur et/ou de récepteur montés sur la surface extérieure du tube.

16. Un appareil selon la revendication 15, dans lequel l'appareil est adapté de façon à former une station de base d'un réseau de communications sans fil.

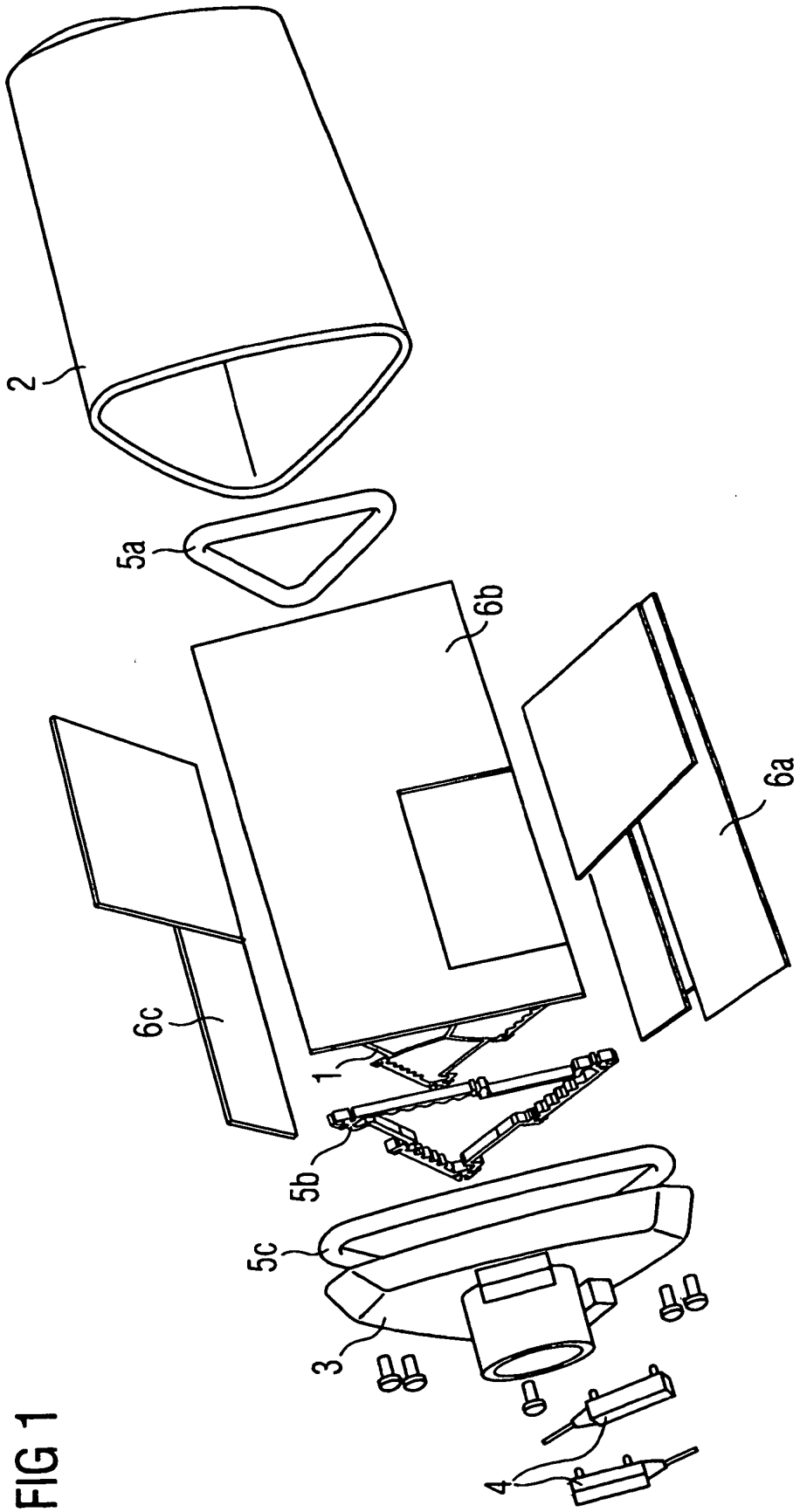


FIG 1

FIG 2

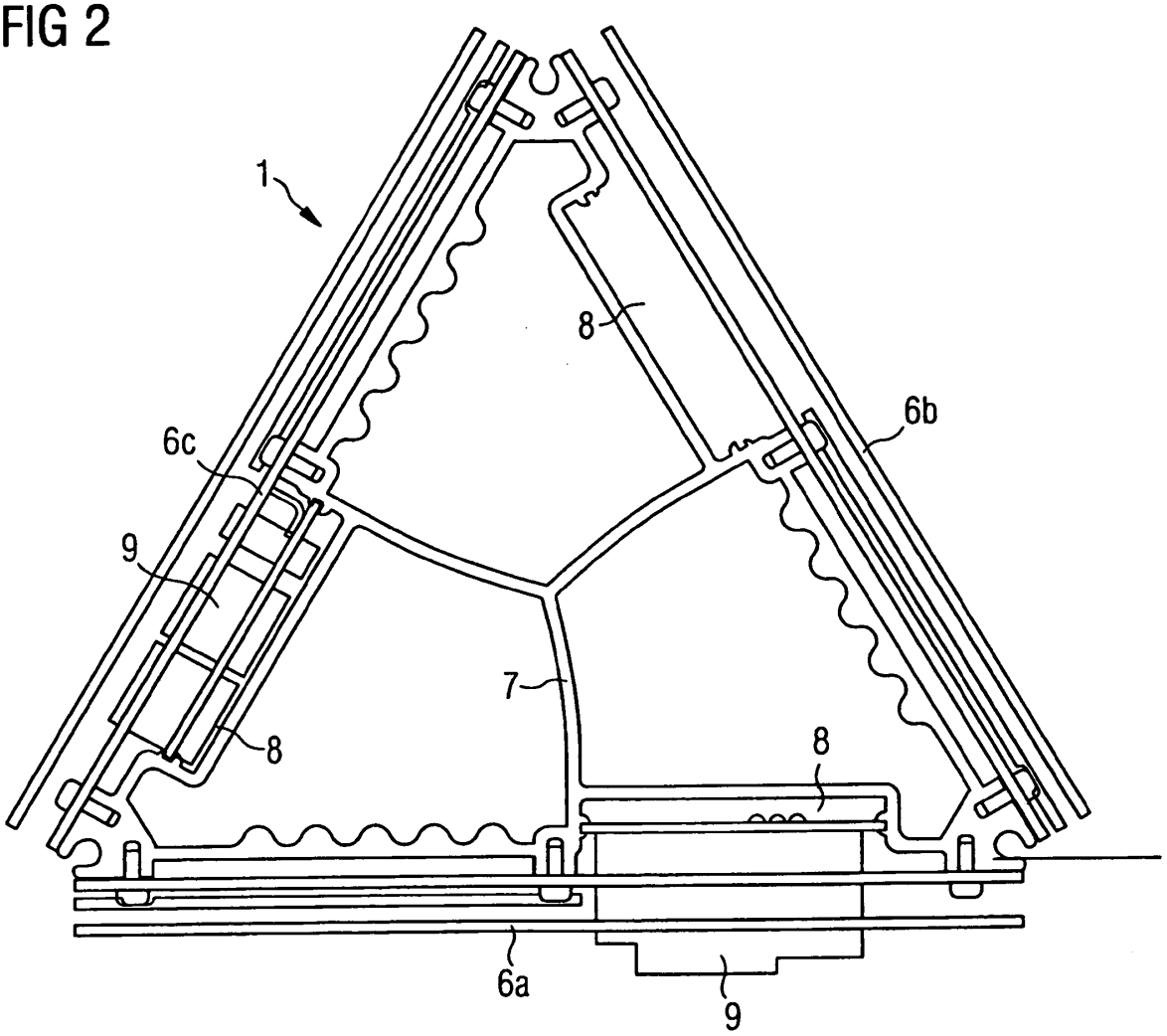


FIG 3

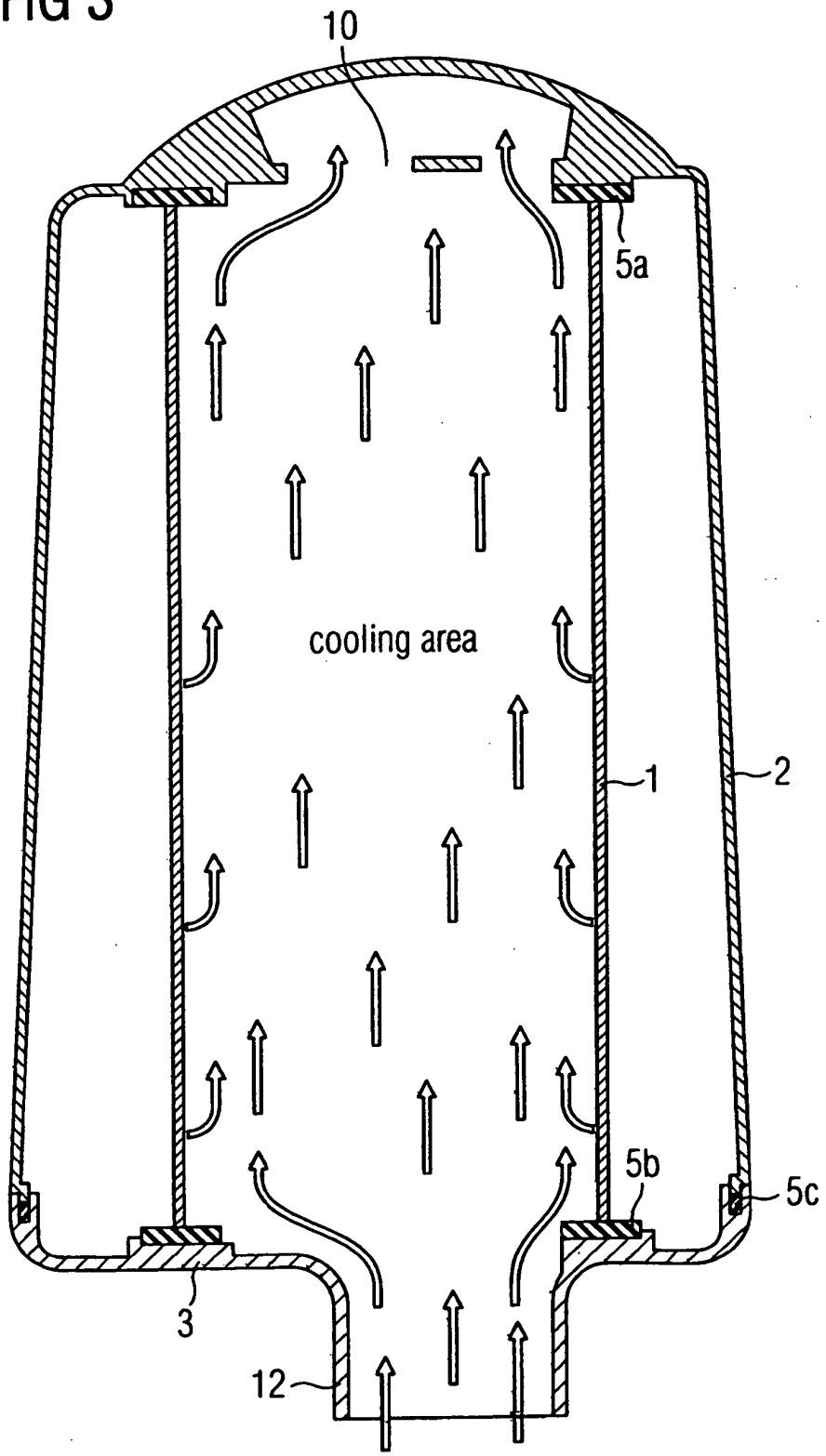


FIG 4

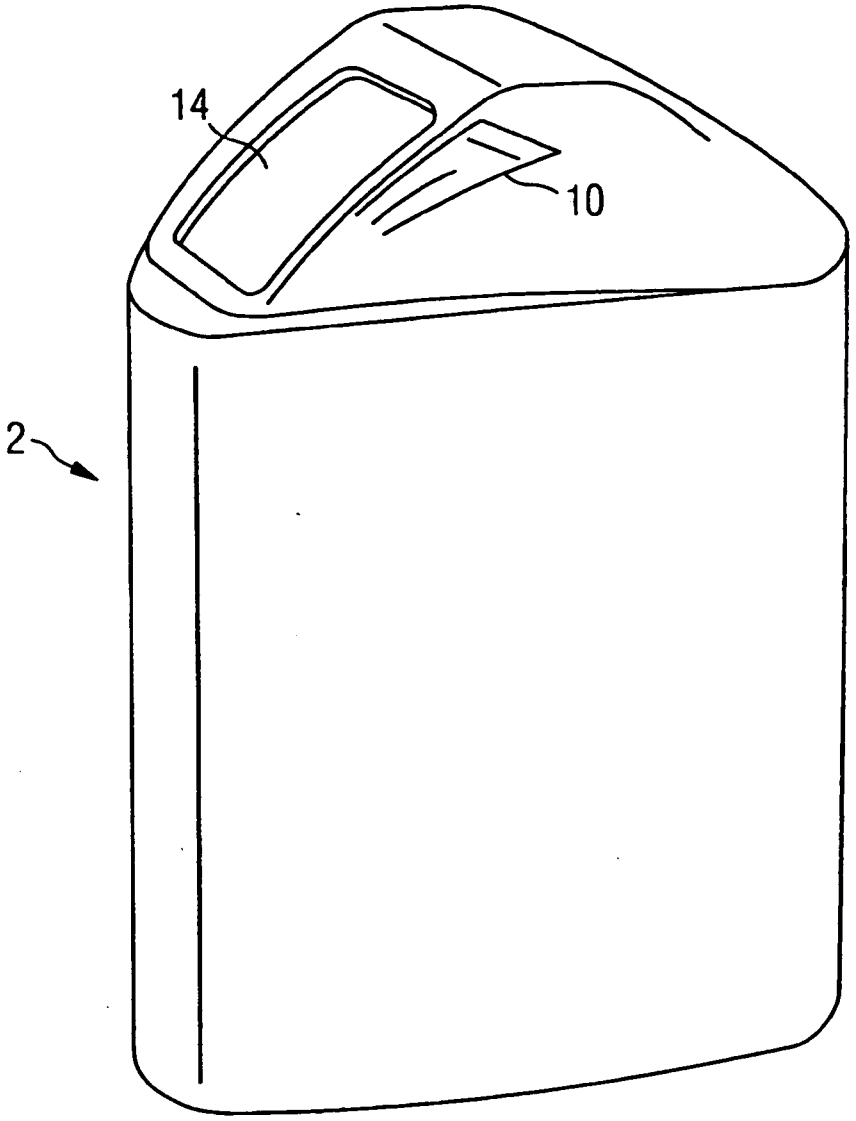
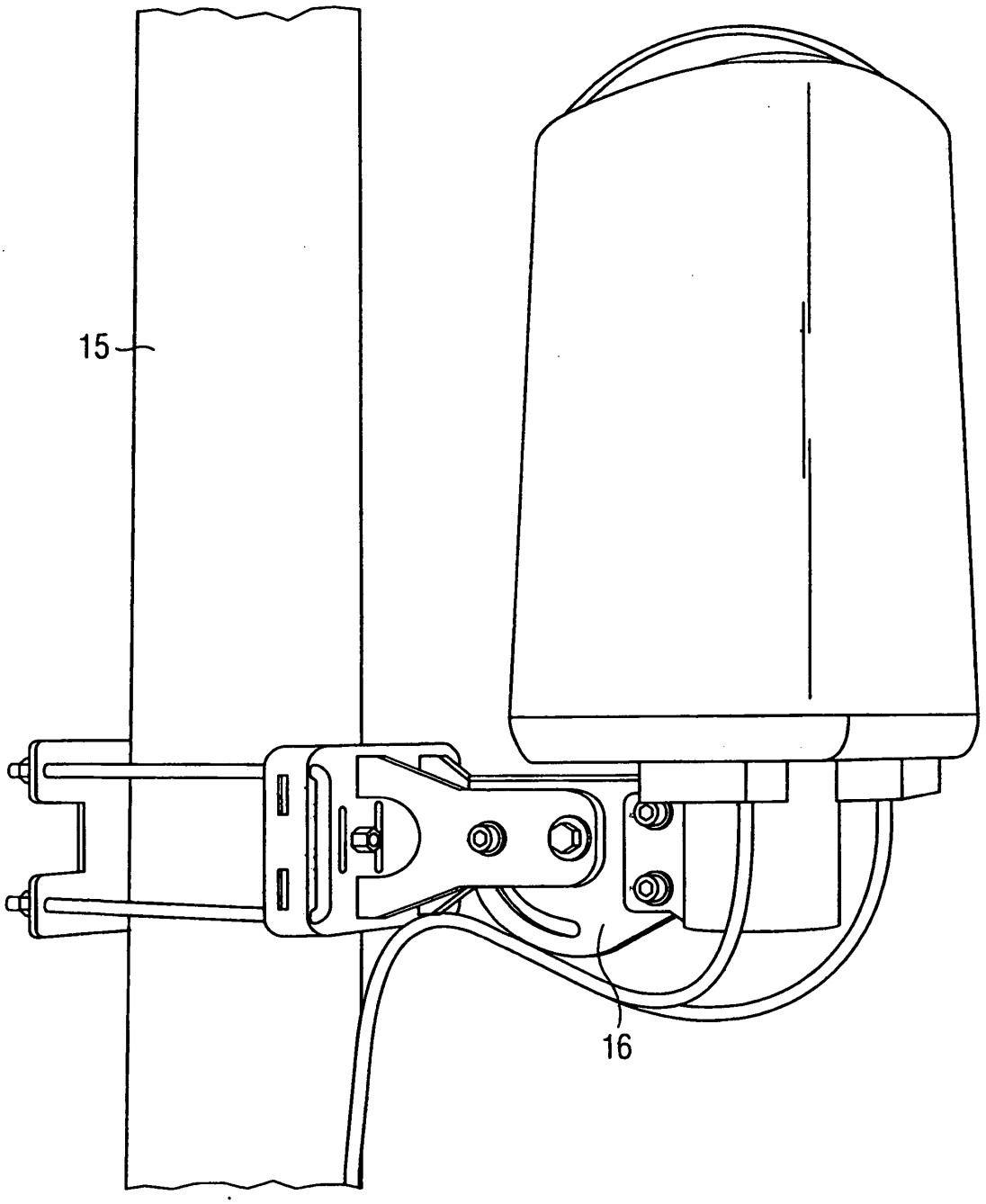


FIG 5



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