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(54) ANTENNA ASSEMBLY FOR A VEHICLE

ANTENNENANORDNUNG FÜR EIN FAHRZEUG

ENSEMBLE ANTENNE POUR VÉHICULE

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Description

Technology Field

[0001] This invention generally relates to antenna assemblies for vehicles, and more specifically to a heat dissipation system for an antenna assembly for a vehicle.

Background Art

[0002] In wireless communication systems for vehicles, a modem for the vehicle is typically placed a great distance away from an antenna in order to prevent electro-magnetic signals from the modem from interfering with the antenna. This often requires a long coaxial cable wired throughout the vehicle.

[0003] General definitions for terms utilized in the pertinent art are set forth below.

[0004] BLUETOOTH technology is a standard short range radio link that operates in the unlicensed 2.4 gigahertz band.

[0005] Code Division Multiple Access ("CDMA") is a spread spectrum communication system used in second generation and third generation cellular networks, and is described in U.S. Patent Number 4901307.

[0006] GSM, Global System for Mobile Communications is a second generation digital cellular network.

[0007] The Universal Mobile Telecommunications System ("UMTS") is a wireless standard.

[0008] Long Term Evolution ("LTE") is a standard for wireless communication of high-speed data for mobile phones and data terminals and is based on the GSM/EDGE and UMTS/HSPA communication network technologies.

[0009] LTE Frequency Bands include 698-798MHz (Band 12, 13, 14, 17); 791-960MHz (Band 5, 6, 8, 18,19,20); 1710-2170MHz (Band 1, 2, 3, 4, 9, 10, 23, 25, 33, 34, 35, 36, 37, 39); 1427-1660.5MH (Band 11, 21, 24); 2300-2700MHz (Band 7, 38, 40, 41); 3400-3800MHz (Band 22, 42, 43).

[0010] Antenna impedance and the quality of the impedance match are most commonly characterized by either return loss or Voltage Standing Wave Ratio.

[0011] Surface Mount Technology ("SMT") is a process for manufacturing electronic circuits wherein the components are mounted or placed directly onto a surface of a printed circuit board ("PCB ").

[0012] The APPLE IPHONE 5 LTE Bands include: LTE700 /1700/2100 (698-806MHz/1710-1785MHz/1920-2170MHz); LTE 850/1800/2100 (824-894MHz/1710-1880MHz/1920-2170MHz); and LTE 700/850/1800/1900/2100 (698-806MHz/824-894MHz/1710-1880MHz/1850-1990MHz/1920/2170).

[0013] The SAMSUNG GALAXY® SIii LTE Bands include: LTE 800/1800/2600 (806-869MHz/1710-1880MHz/2496-2690MHz.

[0014] The NOKIA LUMIA® 920 LTE Bands: LTE 700/1700/2100 (698-806MHz/1710-1785MHz/1920-2170MHz); LTE 800/900/1800/2100/2600 (806-869MHz/880-960MHz/1710-1880MHz/1920-2170MHz/2496-2690MHz).

[0015] The long coaxial cable that connects a modem to an antenna on a vehicle leads to signal losses due to the length of the coaxial cable. Thus, there is a need for placement of a modem in proximity of an antenna for a vehicle system.

[0016] Prior art document US 2019/312342 A1 discloses a communication system, comprising at least one housing having a first and an additional housing part. In the housing, a circuit board having electronic components is arranged, and outside the housing, at least one antenna element is arranged. The invention is characterized in that an antenna support that is connectable to the housing is provided, wherein the at least one antenna element is arranged on the surface and/or inside the antenna support.

[0017] Prior art document FR 3 069 129 A1 discloses a on-board telematic device intended to be attached to a metal part of a body of a motor vehicle comprises, according to the invention, a housing integrating a printed circuit board, a face of which supports at least one electronic power component, a radiofrequency antenna, intended to extend through an opening of the metal part, and a metal screen interposed between a lower part of the antenna, on the one hand, and the printed circuit board and said at least one component, on the other hand, in order to isolate the antenna from parasitic emissions. The component is placed in line with the metal screen and in thermal contact with a portion of said screen, and said screen is made of a thermally conductive material so as to form a thermal transfer means between the electronic power component and the metal part.

[0018] Prior art document US 2009/231186 A1 discloses a satellite antenna terminal includes a circuit board having first and second opposite surfaces. A plurality of antenna elements are disposed on the first surface of the circuit board and are operative to receive Radio Frequency (RF) signals from a satellite. One or more signal processing devices are disposed on the second surface of the circuit board and are coupled to process the RF signals received by the antenna elements.

Summary Of The Invention

[0019] One aspect of the present invention is a heat dissipation system according to claim 1.

[0020] The present invention eliminates the signal loss over the cables connecting the modem to the antenna since the modem and antenna are in relative proximity.

[0021] The present invention also replaces several coaxial cables with a single cable.

Brief Description Of The Drawings

[0022]

FIG. 1 is an exploded view of an antenna assembly for a vehicle.
FIG. 2 is a top plan view of a base portion of an antenna assembly for a vehicle.
FIG. 3 is a side elevation of the base portion of FIG. 2.
FIGS. 4 is a side elevation view of a housing for an antenna assembly for a vehicle.
FIG. 5 is a side elevation view of an antenna assembly for a vehicle with a partial cut-away view.
FIG. 6 is a top plan view of an antenna assembly for a vehicle.
FIG. 7 is a top plan view of a top lid for an antenna assembly for a vehicle.
FIG. 8 is a top plan view of a modem for an antenna assembly for a vehicle.
FIG. 9 is block diagram of an antenna assembly connect to an internal modem of a vehicle.
FIG. 10 is block diagram of an antenna assembly connect to an internal modem of a vehicle.
FIG. 11 is an illustration of a vehicle with an antenna assembly.
FIG. 12 is an illustration of a vehicle with an antenna assembly connected to an internal modem of a vehicle.
FIG. 13 is an exploded view of an antenna assembly for a vehicle.
FIG. 13A is an isolated view of components of FIG. 13.
FIG. 14 is a perspective view of an antenna assembly for a vehicle.

Best Mode(s) For Carrying Out The Invention

[0023] An antenna assembly 25 is shown in FIG. 1. The antenna assembly 25 preferably comprises a base 60, a modem 50, a top lid 40 and a housing 30. Alternatively, the antenna assembly comprises a base 60, a modem 50, router (not shown), a top lid 40 and a housing 30. The base 60 is preferably composed of an aluminum material. The modem 50 is disposed on the base 60. The top lid 40 is to cover the base 60 and modem 50, and the top lid 40 preferably comprises at least one antenna element disposed on an exterior surface. A radiofrequency cable 70 is attached to the modem 50 and secured to the base 60 by bolt 71. The housing 30 covers the top lid 40 and the base 60. The top lid 40 acts as an electro-magnetic barrier for the modem 50 to maintain the electro-magnetic signals inside of the base 60 to prevent interference with the antenna signals.

[0024] As shown in FIGS. 2 and 3, the base 60 includes a body 61 with an interior surface 62. A side wall 63 defines an interior compartment 65 in which a first plurality of heat dissipation elements 66a-66e and a second plurality of heat dissipation elements 67a-67e. An aperture 64 extends through the body 61 for access by at least one cable. The base 60 is preferably composed of a die-cast aluminum material to prevent electro-magnetic signals from the modem 50 from interfering with the antennas on the top lid 40. In this manner, the modem 50 is capable of being placed in proximity to the antennas on the top lid 50 without interference from electro-magnetic signals with the antennas on the top lid 40.

[0025] The first plurality of heat dissipation elements 66a-66e and the second plurality of heat dissipation elements 67a-67e dissipate heat that is generated by the operation of the modem 50.

[0026] The sidewall 63, in addition to acting as electro-magnetic barrier, also provides a structure for placement of the top lid 40 thereon.

[0027] As shown in FIG. 3, the base 60 preferably has a height H2 ranging from 0.5 inch to 1.0 inch, a height, H1, ranging from 0.05 inch to 0.15 inch, and a height, H3, ranging from 0.15 inch to 0.30 inch The base preferably has a width ranging from 2.5 inches to 3.5 inches, and a length, L1, ranging from 6.0 inches to 8.0 inches. The aperture 64 is preferably from 1.0 inch to 1.25 inches across.

[0028] As shown in FIG. 7, the top lid 40 comprises a first antenna element 42, a second antenna element 43 and a third antenna element 41. Preferably the first antenna element 42 is a multi-band antenna for cellular communications. Alternatively, the first antenna element is a 5G Sub 6GHz antenna or a mmWave antenna.

[0029] Preferably, the second antenna element 43 is selected from the group of antennas consisting of a WiFi 2G antenna, a WiFi 5G antenna, a DECT antenna, a ZigBee antenna, and a Zwave antenna. The WiFi 2G antennas are preferably 2400-2690 MegaHertz. The WiFi 5G antenna is preferably a 5.8 GigaHertz antenna. Alternatively, the second antenna element 43 operates at 5.15GHz or at 5.85GHz. Other possible frequencies for the second antenna element 43 include 5150MHz, 5200 MHz, 5300 MHz, 5400 MHz, 5500 MHz, 5600 MHz, 5700 MHz, 5850 MHz, and 2.4GHz. The second antenna element 43 preferably operates on an 802.11 communication protocol. Most preferably, the second antenna element 43 operates on an 802.11n communication protocol. Alternatively, the second antenna element 43 operates on an 802.11b communication protocol. Alternatively, the second antenna element 43 operates on an 802.11g communication protocol. Alternatively, the second antenna element 43 operates on an 802.11a communication protocol. Alternatively, the second antenna element 43 operates on an 802.11ac communication protocol.

[0030] The third antenna element 41 is preferably a GPS/GLONASS module.

[0031] Those skilled in the pertinent art will recognize that other antenna types may be used for the first antenna element 42, the second antenna element 43 and/or the third antenna element 41 without departing from the scope of the present invention.

[0032] The top lid 40 is preferably composed of an aluminum material, at least on a bottom surface. Alternatively, the top lid 40 is composed of materials that can act as a barrier to electro-magnetic signals.

[0033] The modem 50 preferably includes at least one of a computation component, a communication chip 55, a switch, an antenna switch circuit, a GNSS reception component 56, a security access module 53, a mobile phone communication component 54, and a power supply source. The computation component preferably includes a CPU 51, a memory 52, and an interface (I/F) component. The modem 50 preferably operates for cellular protocols including 3G, 4G, 4G HPUE and 5G technology. HPUE is High Power User Equipment, and is more specifically a special class of user equipment for a cellular network, such as a LTE cellular network.

[0034] Preferably, the housing 30 is composed of a polypropylene material. As shown in FIGS. 4, 5 and 6, the housing 30 preferably has a height, H4, ranging from 50 to 90 millimeters (mm), more preferably from 60 to 80mm, and most preferably from 65 to 75mm. The housing 30 preferably has a length, L2, ranging from 100 to 250mm, more preferably from 150 to 200mm, and most preferably from 160 to 190mm. The housing 30 preferably has a width, W1 ranging from 50 to 100mm, more preferably from 60 to 90mm, and most preferably from 65 to 85mm. An internal width W2 is preferably 70 to 80mm. A width W3 is preferably 10 to 15mm. The housing 30 has a sidewall 32, a crown 33 and a rear wall 31. The walls of the housing 30 preferably have a thickness ranging from 2 to 7mm, and most preferably are 5mm.

[0035] Another embodiment of the invention is set forth in FIGS. 9-12. The antenna assembly system is used as a remote modem plus an antenna plus a serial communication system for upgrading existing installed routers to 5G sub 6GHz, or adding a failover modem. To upgrade an existing router to 5G with a new internal modem, a technician must: remove the router from the vehicle; take the router apart to remove the modem; install a new modem; install the router in the vehicle; and test the router to verify the new modem is working properly.

[0036] To upgrade an existing router to 5G using an antenna assembly of the present invention, a technician must, leveraging the already-installed coax cables (as shown in FIG. 9): loosen the existing antenna on a vehicle roof; cut the coax cables; add a coax connector to two of the cables; use one coax cable for powering the antenna assembly and for serial Ethernet communications; use the second coax cable for GPS/GNSS; connect a coax-to-Ethernet combiner and power injector to the router's spare Ethernet WAN port to 12V power (it combines Ethernet and power and conveys them over coax) and to an ignition sense; configure the router to use the Ethernet port as the WAN if it is not already configured; test the router to verify it is communicating over the new modem; remove the existing antenna and cables; disconnect the coax cables from the router; remove the antenna from the roof of the vehicle; install the new antenna and connect the coax cables to the router; connect the injector module to the router Ethernet, vehicle power and ignition sense; connect the combiner module Ethernet connector to the router; configure the router to use the Ethernet port as the WAN if it is not already configured; and test the router to verify it is communicating over the new modem.

[0037] FIG. 9 illustrates the removal of the existing antenna 900 of a vehicle, and the installation of an embodiment of antenna assembly 25 as described herein. FIGS. 10-12 illustrate the connections between the antenna assembly and the existing router 125 of the vehicle 1100. The antenna assembly 25 preferably comprises a base 60, a modem 50, a CPU 51, a combiner 92, a power regulator 94, and a plurality of antenna elements 31,32, 43 and 44 within a housing 30. Four coaxial cables 131, 132, 133 and 135 are connected from the antenna assembly 25 to connectors on the vehicle. The coaxial cable 135 is connected to an injector 105, the coaxial cables 132 and 133 are connected to WiFi connectors 161 and 162 of a router 125. The coaxial cable 131 is connected to a GPS/GNSS connector 160 of the router 125. The injector 105 comprises a reset button 95, a SIM card 96, a USB connection 97 and a power-conditioning unit. The router 125 preferably comprises a modem 130, an Ethernet or USB WAN connector 170, LTE connectors 163 and 164, an ignition sense and 12Volt connector 171 which an ignition sense cable 185 and 12Volt cable 190 connect thereto.

[0038] Using certain embodiments described herein, there is no need to remove, open the existing router, remove and replace modem module, close the router, re-install the router, test the router and modem.

[0039] Using certain embodiments described herein, installation is quicker and a lower risk (no static discharge accidental damage to the router or modem due to opening the router).

[0040] Signal loss is typically higher at 5G mid-band frequencies than traditional cellular, and those losses are mitigated if not eliminated by the present invention. Using the modem that is embedded in the antenna housing avoids cable loss and thereby extends coverage range.

[0041] A user of certain embodiments of antenna assemblies described herein can continue to use the software they have been using with their existing router.

[0042] The combiner 92 preferably inputs a wide area network connection from the router for send and receive data to/from Internet, and an ignition sense to put the unit to sleep and draw minimal power when the ignition is off. The combiner 92 also inputs twelve volts to power the antenna assembly 25, which allows the combiner 92 to perform power regulation and surge protection, and pass the power up to the modem 50 in the antenna housing 60. The combiner 92 also inputs a SIM card for a carrier (AT&T, Verizon, etc.) subscriber identity module remoted from the modem 50 so that it can be easily accessed in the trunk of the vehicle 1100. All of the above are combined and sent up to the antenna assembly 25 over the

existing coaxial cable, or over the Ethernet plus other wires.

[0043] FIGS. 13, 13A and 14 illustrate thermal dissipation and isolation features that are utilized in certain embodiments of an antenna assembly 25 for a vehicle to optimize heat removal and to protect certain heat sensitive components. The antenna assembly 25 preferably comprises a housing 30, a top lid 40 with antenna elements and a base 60. The base 60 preferably has a body 61 and a heat sink 68, but those skilled in the pertinent art will recognize that the base may take various other forms without departing from the scope of the present invention. The body 61 preferably has a structure that forms a mounting surface 65 for some, or all, of the rest of the components of the antenna assembly 25. In some embodiments, the body 61 has an internal compartment or recess 65 forming a mounting surface 69 for mounting certain components directly on the body 61 itself, while other components are mounted on other features that themselves are mounted to the body 61. In certain embodiments having a recess 65 formed by a sidewall 63, the recess 65 has a shape that allows components to be mounted in proximity to or in contact with the heat sink 68. In yet other embodiments, the recess 65 is formed in a shape that allows components to contact the heat sink 68 in substantially different areas, thereby transmitting their respective generated heat to different parts of the heat sink 68, and minimizing the crossflow of heat from one component to another through the heat sink 68. For example, a first area of the heat sink 68 is located on one side of the base 60 and a second area of the heat sink 68 is located on an opposing side of the base 60. Alternatively, a first area of the heat sink 68 is located on one side of the base 60, a second area of the heat sink 68 is located on an opposing side of the base 60, and a third area of the heat sink 68 is located at a rear section of the base 60. Those skilled in the pertinent art will recognize that the heat sink 68 may be partitioned into multiple areas without departing from the scope of the present invention. The heat sink 68 preferably comprises a plurality of heat dissipation elements. The heat dissipation elements are preferably fins or pins. In some embodiments, the recess 65 is generally rectangular and has mounting surfaces such that one component is in contact with one side of the heat sink 68 formed by the recess 65 and heat from another component is directed to another side of the heat sink 68 formed by the recess. The component mounting surface 69 is preferably formed to mount multiple components that have different heat sensitivities and heat generating characteristics. For example, a first component, such as a modem 50, has a high heat sensitivity and lower heat generation and a second component, such as a high-power amplifier 57, has a lower heat sensitivity, but a much higher heat generation characteristic. Those of skill in the art will know that for different components, different heat sensitivities and different heat generating characteristics may apply and may require further heat dissipation features.

In some embodiments, to increase the flow of heat from the components mounted on the base 60, heat transfer plates 72, 73 are attached to the body 61 or heat sink 68 and in thermal contact with the components mounted on the body 61. The heat transfer plates 72, 73 are preferably mounted directly on the components (e.g., modem 50 and high-power amplifier 57) or alternatively in thermal contact with the components via thermally conductive materials 1302 and 1303 (as shown in FIG. 13A). The heat transfer plates 72, 73 of in these embodiments are mounted directly or via fasteners to the body 61 or the heat sink 68. In a preferred embodiment, the first and second heat transfer plates are each made of material selected from the list consisting of copper, aluminum, graphite, carbon diamond, magnesium, gold, silver, aluminum nitride, silicon carbide, and zinc. To provide additional thermal insulation between the components mounted to the body 61, slots (not shown) are formed by molding, cutting or otherwise in the mounting surface 69, to impede the flow of heat from one component to another and encourage the heat flow through the heat sink 68.

[0044] In other embodiments, further thermal insulation of the antenna assembly 25 from the vehicle 1100 is desired to prevent heat from the vehicle 1100 from transferring to the antenna assembly 25. In these embodiments, each interface between the antenna assembly 25 and the vehicle 1100 is evaluated for thermal insulation. In these embodiments, a thermally insulative pad 75 is added between the base 61 to reduce heat transmitted from the vehicle 1100 to the antenna assembly 25. In alternative embodiments, the thermally insulative pad 75 is also water resistant to aid in the prevention of water intrusion around and under the antenna assembly 25. In alternative embodiments, a thermally insulative washer 74 is installed between the mounting nut 71 and the vehicle 1100. In other embodiments, a thermally insulative bushing 76, or other thermally insulating part, is installed between the threaded tube 72, through which the radiofrequency cable 70 is routed, that fastens with the mounting nut 71 and the vehicle 1100 to avoid heat transfer from the vehicle 1100.

Claims

1. A heat dissipation system comprising an antenna assembly (25) for a vehicle (1100), the antenna assembly (25) having an amplifier (57) that generates heat during operation and a modem (50) that generates heat during operation, the heat dissipation system comprising:

   a base (60) comprising a body (61) and a heat sink (68), the heat sink (68) comprising a plurality of heat dissipation elements (66a-66e) and the body (61) defining a recess (65) forming a component mounting surface (69);

a first heat transfer plate (72) in thermal contact with the amplifier (57);
a second heat transfer plate (73) in thermal contact with the modem (50); and
a thermally insulative material disposed between the modem (50) and the base (60) configured to minimize the heat transferred from the amplifier (57) to the modem (50).
wherein the modem (50) and amplifier (57) are disposed within the recess (65) on the component mounting surface (69);
wherein the first heat transfer plate (72) is in thermal contact with a first area of the heat sink (68) and the second transfer plate (73) is in thermal contact with a second area of the heat sink (68) separate from the first part of the heat sink (68).

2. The heat dissipation system according to Claim 1, further comprising a thermally conductive material (1302, 1303) disposed between the amplifier (57) and the first heat transfer plate (72) and between the modem (50) and the second heat transfer plate (73).

3. The heat dissipation system according to Claim 1, wherein the amplifier (57) generates heat at a certain operating condition, wherein the modem (50) is sensitive to thermal conditions, and wherein the thermally insulative material (75) is configured to minimize the heat transferred from the amplifier (57) to the modem (50).

4. The heat dissipation system according to Claim 1, wherein the recess (65) is substantially a rectangle and wherein the first area of the heat sink (68) is on one side of the recess (65) and the second area of the heat sink (68) is on a different side of the recess (65).

5. The heat dissipation system according to Claim 1, further comprising:

a thermally insulative pad (75); and
a cable assembly;
wherein the thermally insulative pad (75) is positioned between the base (60) and the vehicle (1100), and wherein the cable assembly is adapted to fasten the antenna assembly (25) to the vehicle (1100).

6. The heat dissipation system according to Claim 5, the cable assembly further comprising:

a threaded tube (72);
a communication cable (70);
a cable assembly retaining nut (71) adapted to mate with the threaded tube (72);
a tube bushing (76) adapted to fit around the threaded tube (72); and
a washer (74), adapted to fit around the threaded tube (72) and mate with the surface of the vehicle (1100);
wherein, the tube bushing (76) and washer (74) are each made of a thermally insulative material selected to minimize the transfer of heat from the vehicle (1100) to the antenna assembly (25).

7. The heat dissipating antenna assembly according to Claim 1, wherein the first and second heat transfer plates (72, 73) are each made of material selected from the list consisting of copper, aluminum, graphite, carbon diamond, magnesium, gold, silver, aluminum nitride, silicon carbide, and zinc.

Patentansprüche

1. Wärmeableitungssystem, das eine Antennenbaugruppe (25) für ein Fahrzeug (1100) umfasst, wobei die Antennenbaugruppe (25) einen Verstärker (57), der während des Betriebs Wärme erzeugt, und ein Modem (50), das während des Betriebs Wärme erzeugt, aufweist, wobei das Wärmeableitungssystem Folgendes umfasst:

eine Basis (60), die einen Körper (61) und eine Wärmesenke (68) umfasst, wobei die Wärmesenke (68) eine Vielzahl von Wärmeableitungselementen (66a-66e) umfasst und der Körper (61) eine Aussparung (65), die eine Komponentenmontageoberfläche (69) bildet, definiert;
eine erste Wärmeübertragungsplatte (72) in thermischem Kontakt mit dem Verstärker (57);
eine zweite Wärmeübertragungsplatte (73) in thermischem Kontakt mit dem Modem (50); und
ein wärmedämmendes Material, das zwischen dem Modem (50) und der Basis (60) angeordnet und dazu ausgebildet ist, die von dem Verstärker (57) an das Modem (50) übertragene Wärme zu minimieren;
wobei das Modem (50) und der Verstärker (57) innerhalb der Aussparung (65) auf der Komponentenmontageoberfläche (69) angeordnet sind;
wobei die erste Wärmeübertragungsplatte (72) in thermischem Kontakt mit einer ersten Fläche der Wärmesenke (68) ist und die zweite Übertragungsplatte (73) in thermischem Kontakt mit einer zweiten Fläche der Wärmesenke (68) ist, die von dem ersten Teil der Wärmesenke (68) getrennt ist.

2. Wärmeableitungssystem nach Anspruch 1, das ferner ein wärmeleitendes Material (1302, 1303) umfasst, das zwischen dem Verstärker (57) und der ersten Wärmeübertragungsplatte (72) und zwischen dem Modem (50) und der zweiten Wärmeübertra-

gungsplatte (73) angeordnet ist.

3. Wärmeableitungssystem nach Anspruch 1, wobei der Verstärker (57) bei einem bestimmten Betriebszustand Wärme erzeugt, wobei das Modem (50) empfindlich gegenüber Wärmezuständen ist und wobei das wärmedämmende Material (75) dazu ausgebildet ist, die von dem Verstärker (57) an das Modem (50) übertragene Wärme zu minimieren.

4. Wärmeableitungssystem nach Anspruch 1, wobei die Aussparung (65) im Wesentlichen ein Rechteck ist und wobei die erste Fläche der Wärmesenke (68) auf einer Seite der Aussparung (65) und die zweite Fläche der Wärmesenke (68) auf einer anderen Seite der Aussparung (65) ist.

5. Wärmeableitungssystem nach Anspruch 1, das ferner Folgendes umfasst:

ein wärmedämmendes Polster (75); und
einen Kabelsatz;
wobei das wärmedämmende Polster (75) zwischen der Basis (60) und dem Fahrzeug (1100) positioniert ist und wobei der Kabelsatz dazu angepasst ist, die Antennenbaugruppe (25) an dem Fahrzeug (1100) zu befestigen.

6. Wärmeableitungssystem nach Anspruch 5, wobei der Kabelsatz ferner Folgendes umfasst:

ein Gewinderohr (72);
ein Kommunikationskabel (70);
eine Kabelsatzhaltemutter (71), die dazu angepasst ist, mit dem Gewinderohr (72) in Eingriff zu gelangen;
eine Rohrdurchführung (76), die dazu angepasst ist, um das Gewinderohr (72) herum zu passen; und
eine Scheibe (74), die dazu angepasst ist, um das Gewinderohr (72) herum zu passen und mit der Oberfläche des Fahrzeugs (1100) in Eingriff zu gelangen;
wobei die Rohrdurchführung (76) und die Scheibe (74) je aus einem wärmedämmenden Material hergestellt sind, das dazu ausgewählt wird, die Übertragung von Wärme von dem Fahrzeug (1100) an die Antennenbaugruppe (25) zu minimieren.

7. Wärmeableitende Antennenbaugruppe nach Anspruch 1, wobei die erste und die zweite Wärmeübertragungsplatte (72, 73) je aus einem Material hergestellt sind, das aus der Liste ausgewählt wird, die aus Kupfer, Aluminium, Graphit, Diamantkohlenstoff, Magnesium, Gold, Silber, Aluminiumnitrid, Siliciumcarbid und Zink besteht.

Revendications

1. Système de dissipation thermique comprenant un ensemble d'antenne (25) pour un véhicule (1100), l'ensemble d'antenne (25) présentant un amplificateur (57) qui génère de la chaleur pendant le fonctionnement et un modem (50) qui génère de la chaleur pendant le fonctionnement, le système de dissipation thermique comprenant :

une base (60) comprenant un corps (61) et un dissipateur thermique (68), le dissipateur thermique (68) comprenant une pluralité d'éléments de dissipation thermique (66a-66e) et le corps (61) définissant un évidement (65) formant une surface de montage de composants (69) ;
une première plaque de transfert de chaleur (72) en contact thermique avec l'amplificateur (57) ;
une seconde plaque de transfert de chaleur (73) en contact thermique avec le modem (50) ; et
un matériau thermiquement isolant disposé entre le modem (50) et la base (60) configuré pour minimiser la chaleur transférée de l'amplificateur (57) au modem (50),
dans lequel le modem (50) et l'amplificateur (57) sont disposés à l'intérieur de l'évidement (65) sur la surface de montage de composants (69) ;
dans lequel la première plaque de transfert de chaleur (72) est en contact thermique avec une première zone du dissipateur thermique (68) et la seconde plaque de transfert (73) est en contact thermique avec une seconde zone du dissipateur thermique (68) séparée de la première partie du dissipateur thermique (68).

2. Système de dissipation thermique selon la revendication 1, comprenant en outre un matériau thermoconducteur (1302, 1303) disposé entre l'amplificateur (57) et la première plaque de transfert de chaleur (72) et entre le modem (50) et la seconde plaque de transfert de chaleur (73).

3. Système de dissipation de chaleur selon la revendication 1, dans lequel l'amplificateur (57) génère de la chaleur dans une certaine condition de fonctionnement, dans lequel le modem (50) est sensible aux conditions thermiques, et dans lequel le matériau isolant thermiquement (75) est configuré pour minimiser la chaleur transférée de l'amplificateur (57) au modem (50).

4. Système de dissipation thermique selon la revendication 1, dans lequel l'évidement (65) est sensiblement un rectangle et dans lequel la première zone du dissipateur thermique (68) se trouve d'un côté de l'évidement (65) et la seconde zone du dissipateur thermique (68) se trouve d'un côté différent de l'évidement (65).

5. Système de dissipation thermique selon la revendication 1, comprenant en outre :

un patin thermiquement isolant (75) ; et
un ensemble de câble ;
dans lequel le patin thermiquement isolant (75) est positionné entre la base (60) et le véhicule (1100), et dans lequel l'ensemble de câble est conçu pour fixer l'ensemble d'antenne (25) au véhicule (1100).

6. Système de dissipation thermique selon la revendication 5, l'ensemble de câble comprenant en outre :

un tube fileté (72) ;
un câble de communication (70) ;
un écrou de retenue d'ensemble de câble (71) conçu pour s'accoupler avec le tube fileté (72) ;
une douille de tube (76) conçue pour s'adapter autour du tube fileté (72) ; et
une rondelle (74), conçue pour s'adapter autour du tube fileté (72) et s'accoupler avec la surface du véhicule (1100) ;
dans lequel la douille de tube (76) et la rondelle (74) sont chacune constituées d'un matériau thermiquement isolant choisi pour minimiser le transfert de chaleur du véhicule (1100) à l'ensemble d'antenne (25).

7. Ensemble d'antenne dissipant la chaleur selon la revendication 1, dans lequel les première et seconde plaques de transfert de chaleur (72, 73) sont chacune constituées d'un matériau sélectionné dans la liste consistant en le cuivre, l'aluminium, le graphite, le diamant de carbone, le magnésium, l'or, l'argent, le nitrure d'aluminium, le carbure de silicium et le zinc.

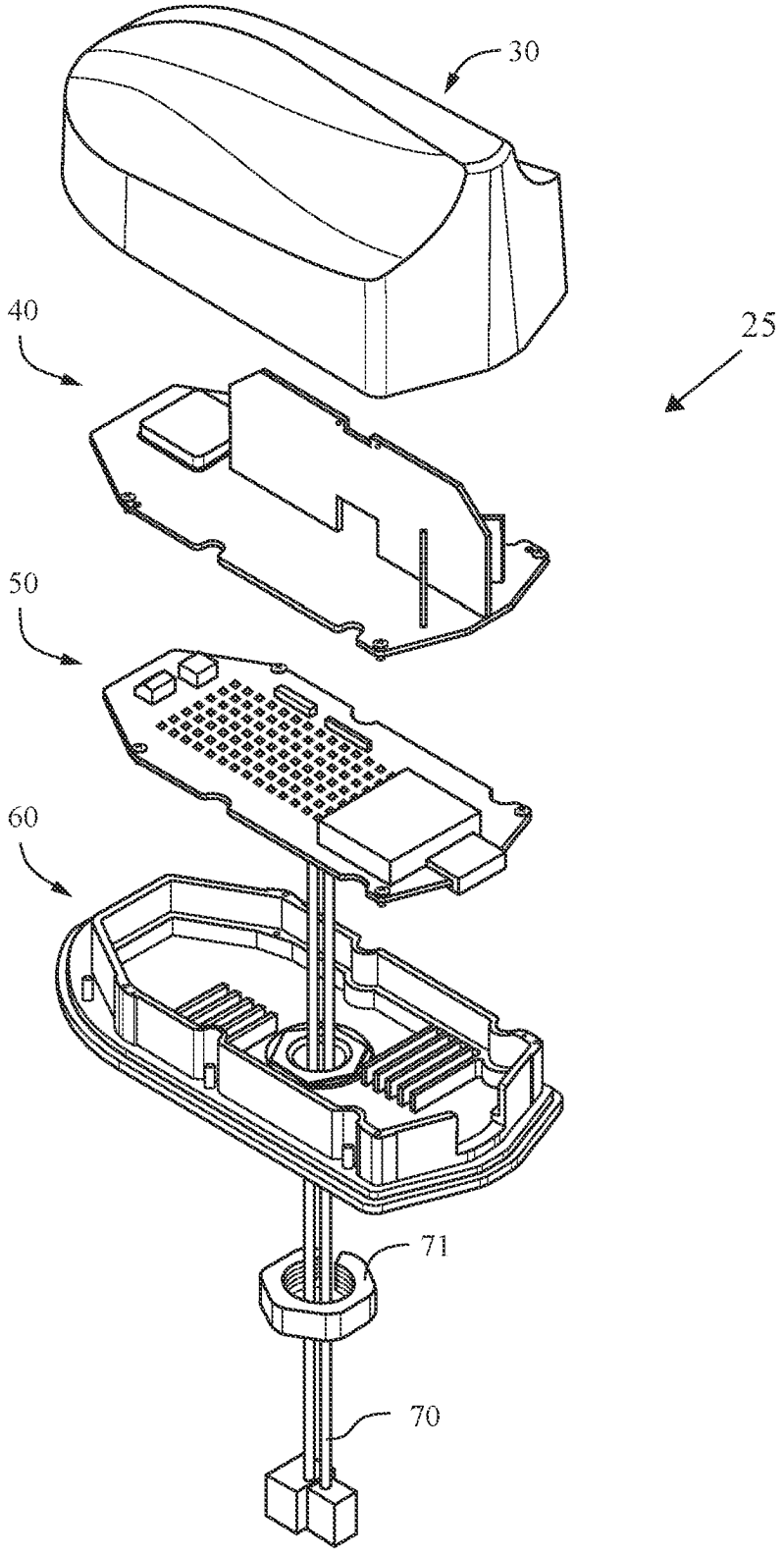

FIG. 1

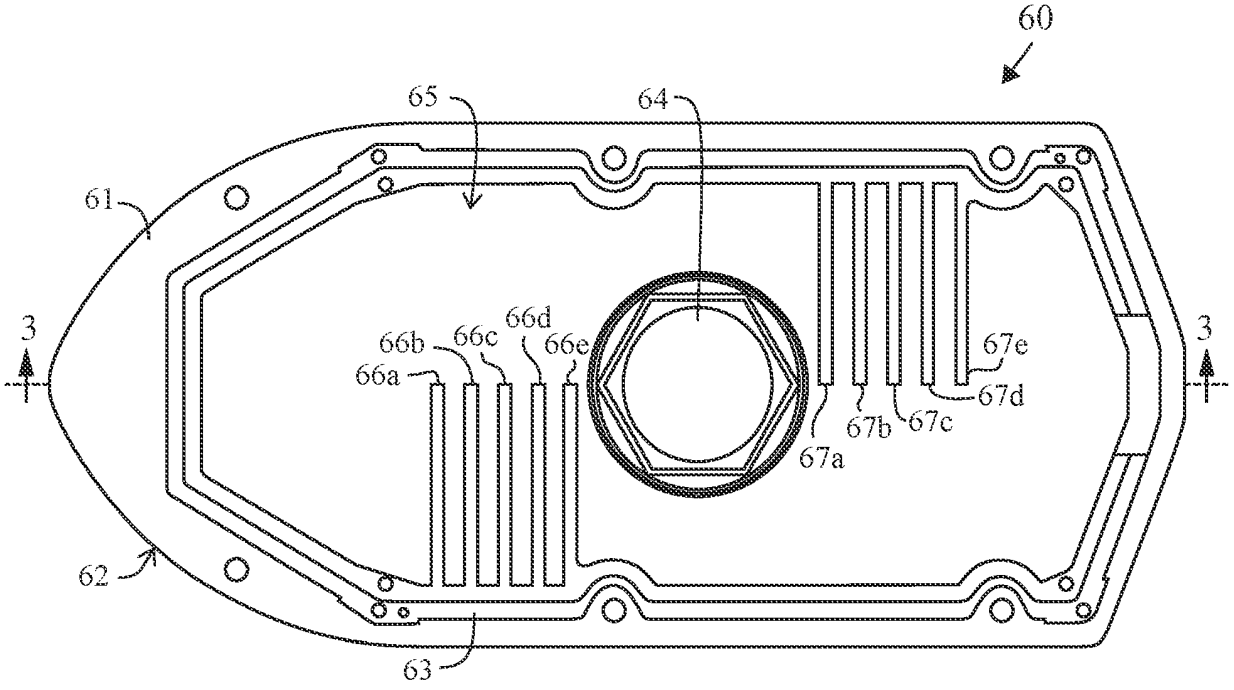
60
65
64
61
3
3
66b
66c
66d
66e
66a
67e
67d
67b
67c
67a
62
63

FIG. 2

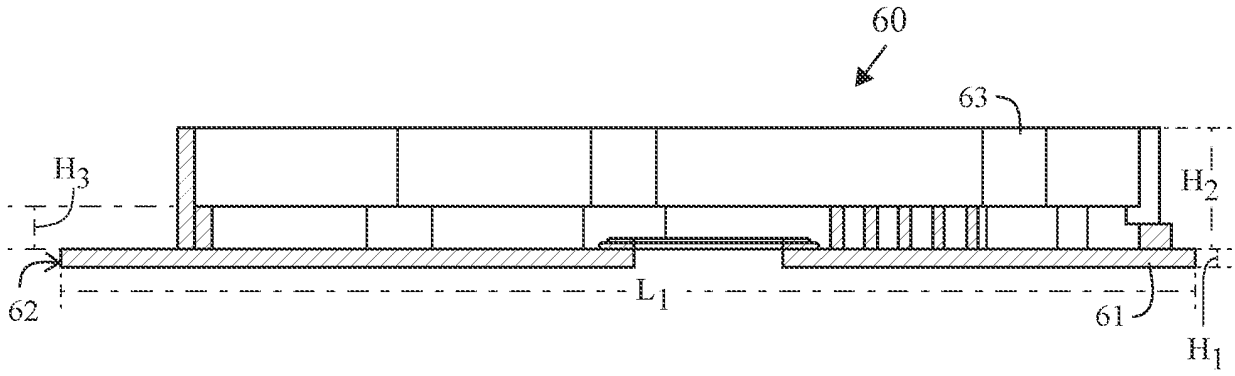
60
63
H_3
H_2
62
L_1
61
H_1

FIG. 3

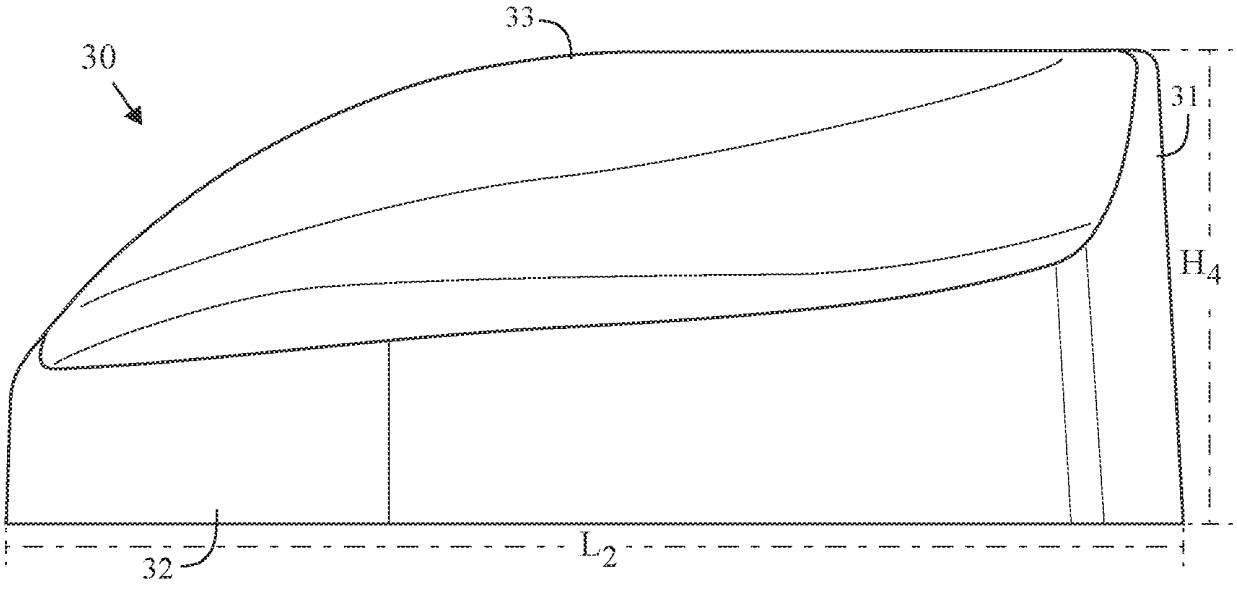

FIG. 4

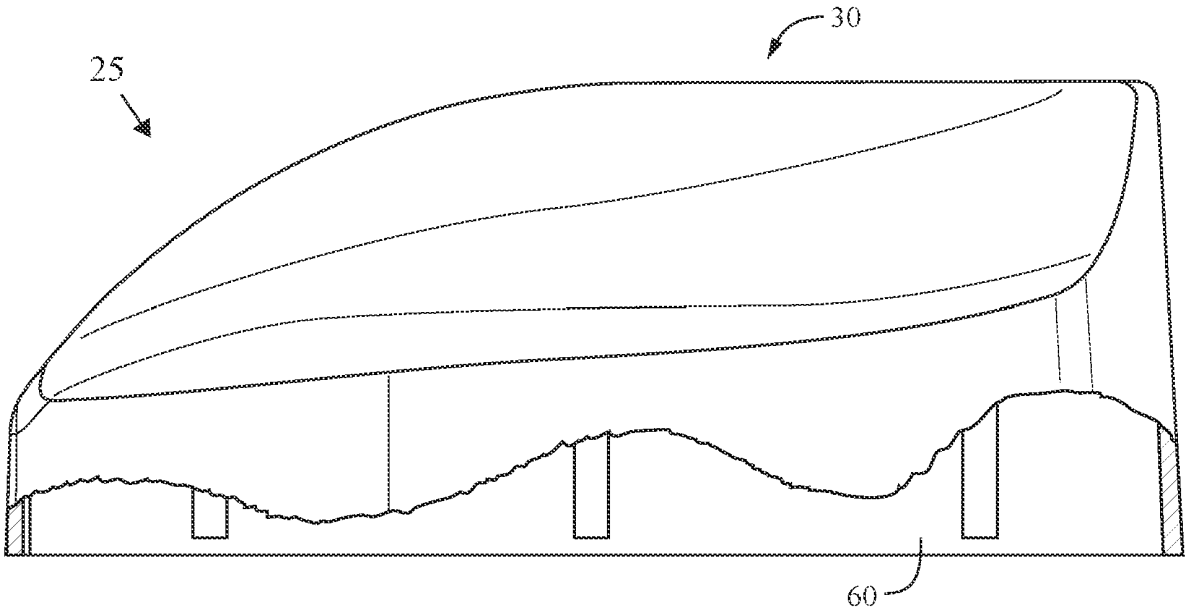

FIG. 5

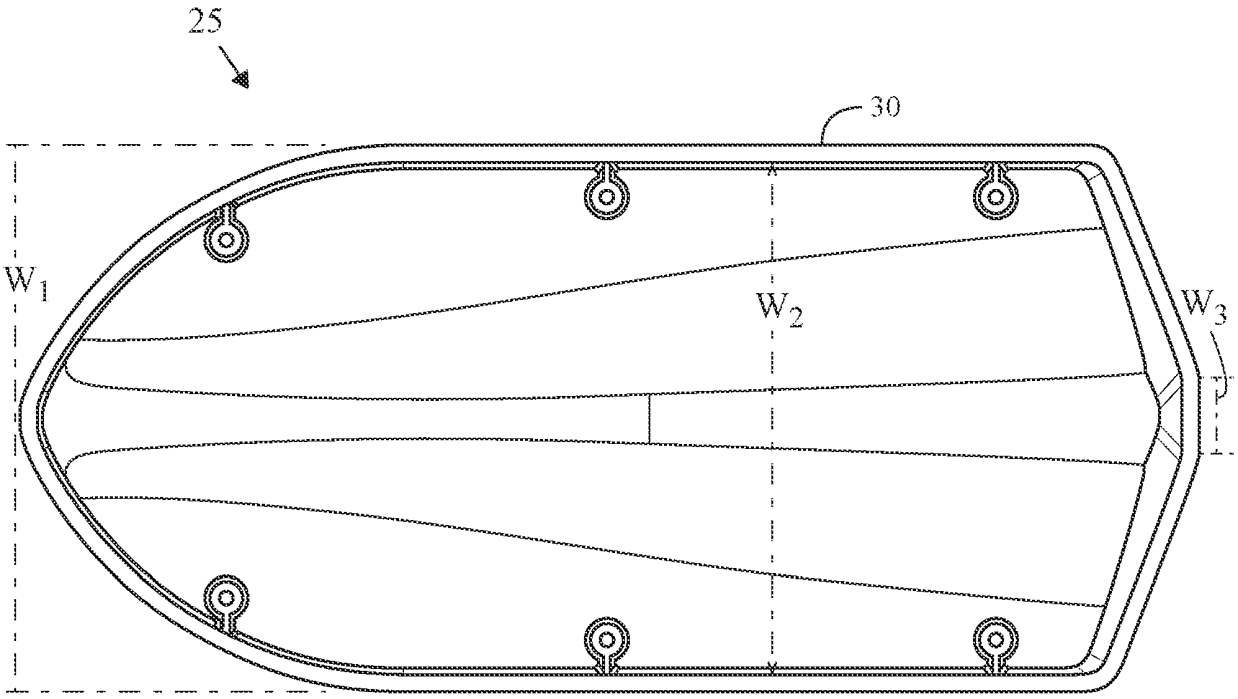

FIG. 6

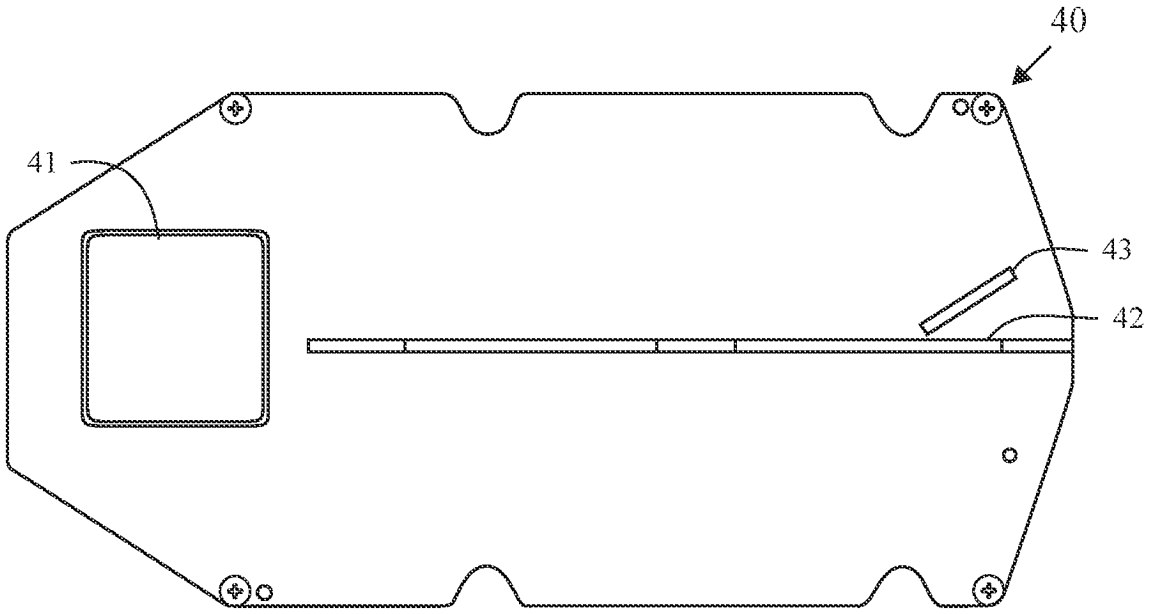

FIG. 7

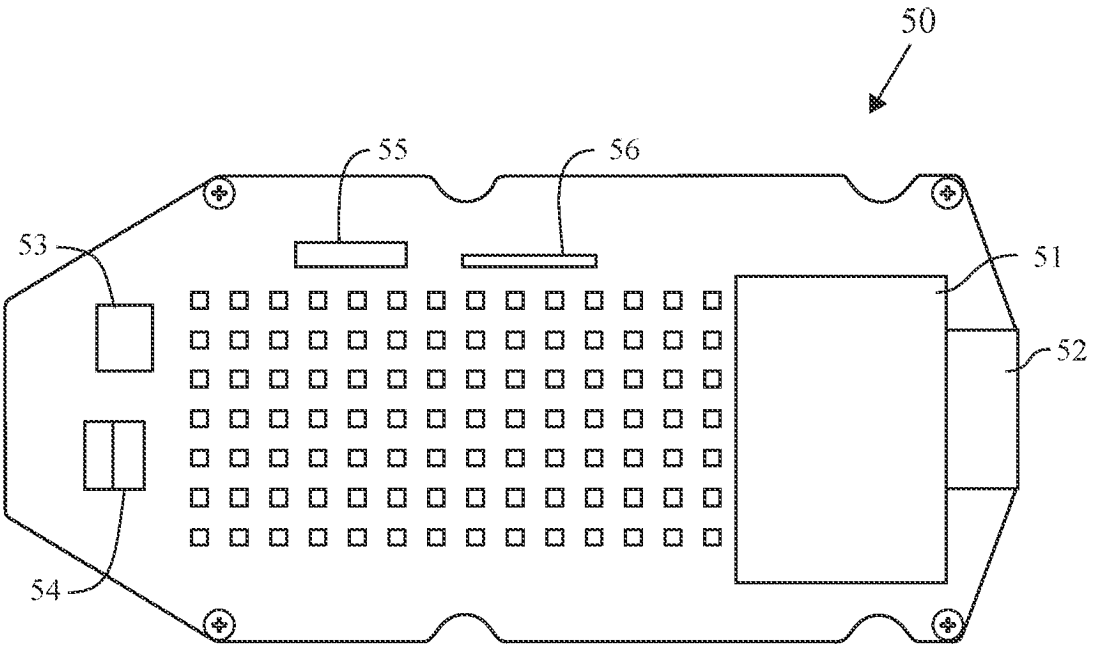

FIG. 8

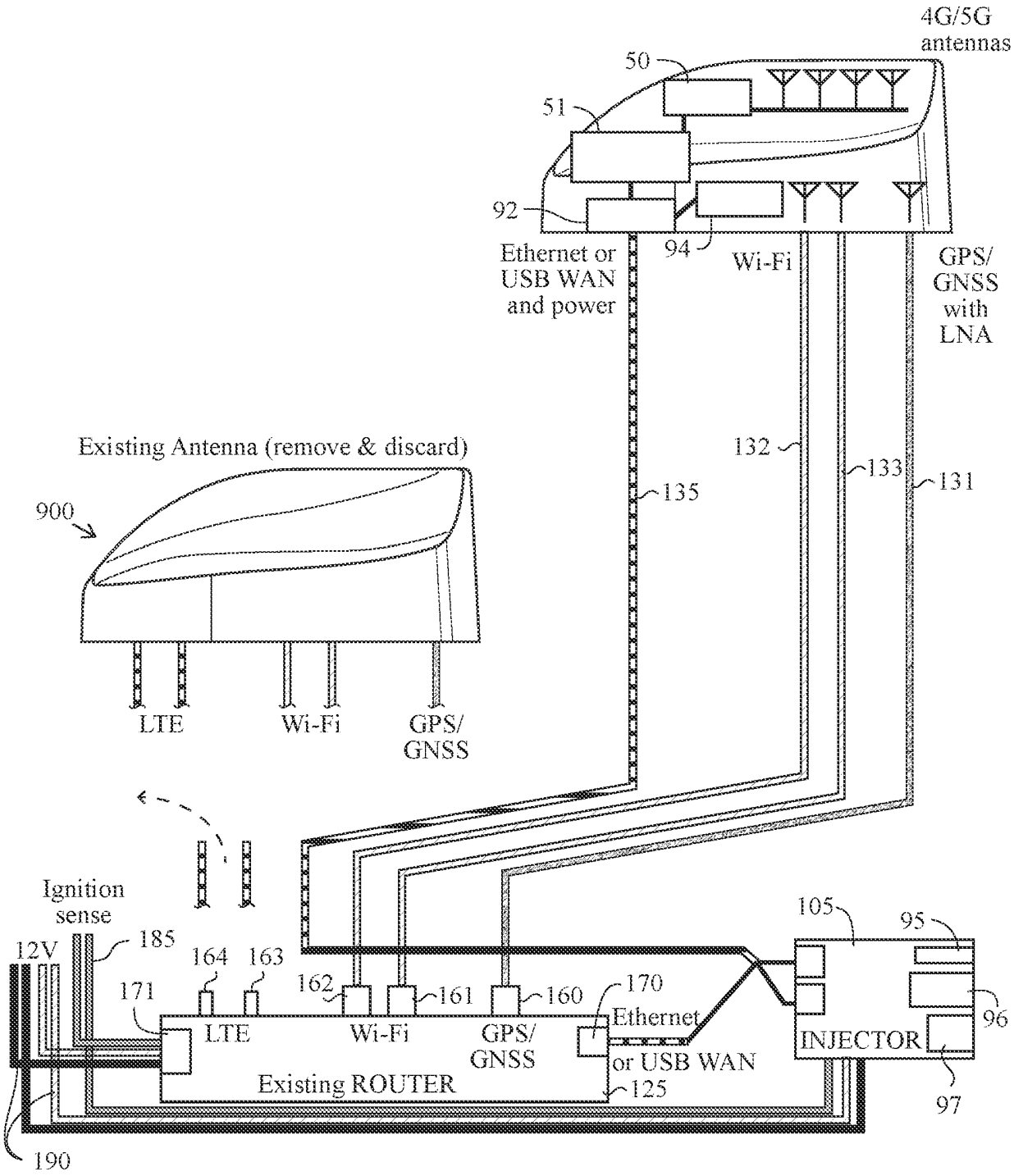
4G/5G
antennas
50
51
92
94
Ethernet or
USB WAN
and power
Wi-Fi
GPS/
GNSS
with
LNA
Existing Antenna (remove & discard)
900
LTE
Wi-Fi
GPS/
GNSS
132
133
131
135
Ignition
sense
12V
185
164
163
162
161
160
170
171
105
95
96
LTE
Wi-Fi
GPS/
GNSS
Ethernet
or USB WAN
INJECTOR
Existing ROUTER
125
97
190

FIG. 9

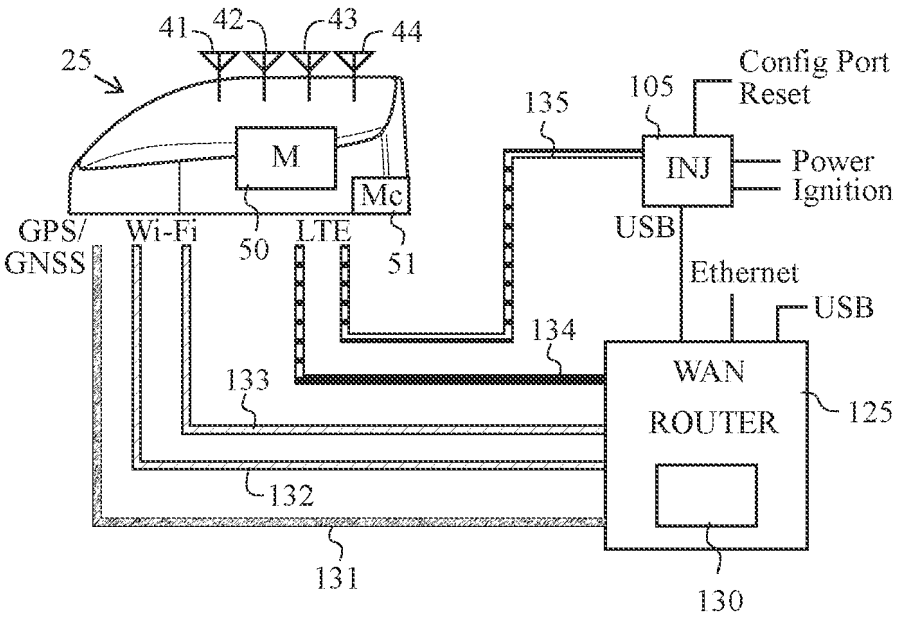
41
42
43
44
25
M
Mc
135
105
Config Port
Reset
INJ
Power
Ignition
USB
GPS/
GNSS
Wi-Fi
50
LTE
51
Ethernet
USB
134
WAN
ROUTER
125
133
132
131
130

FIG. 10

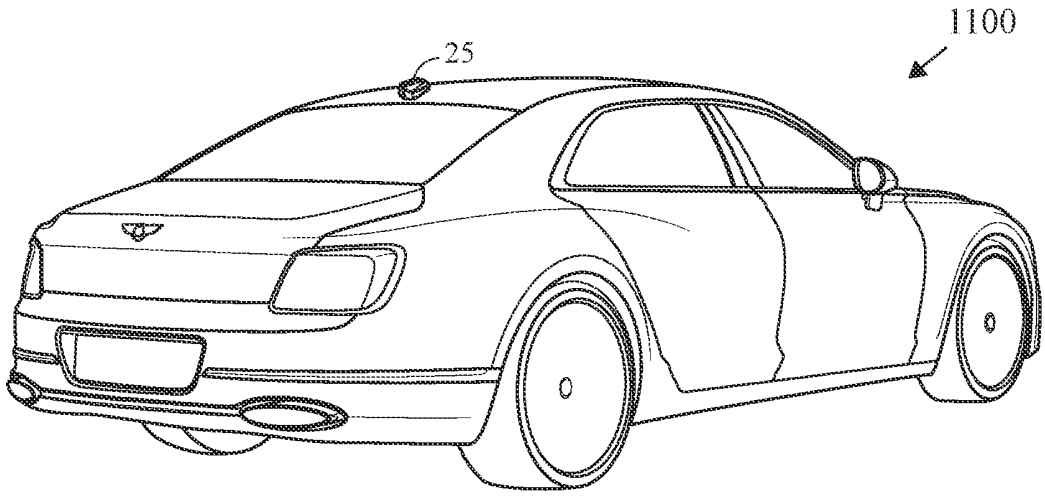

FIG. 11

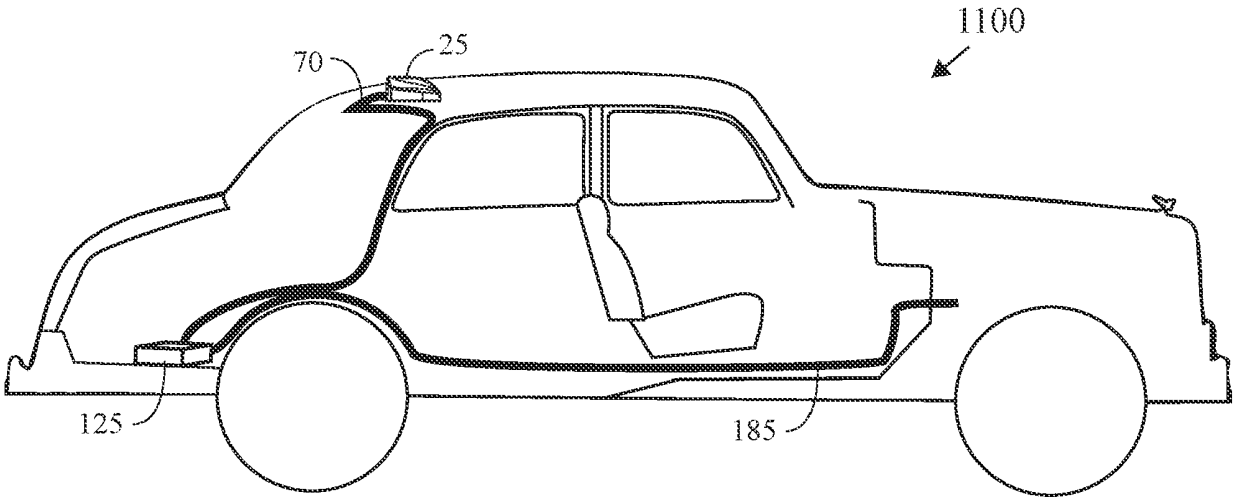

FIG. 12

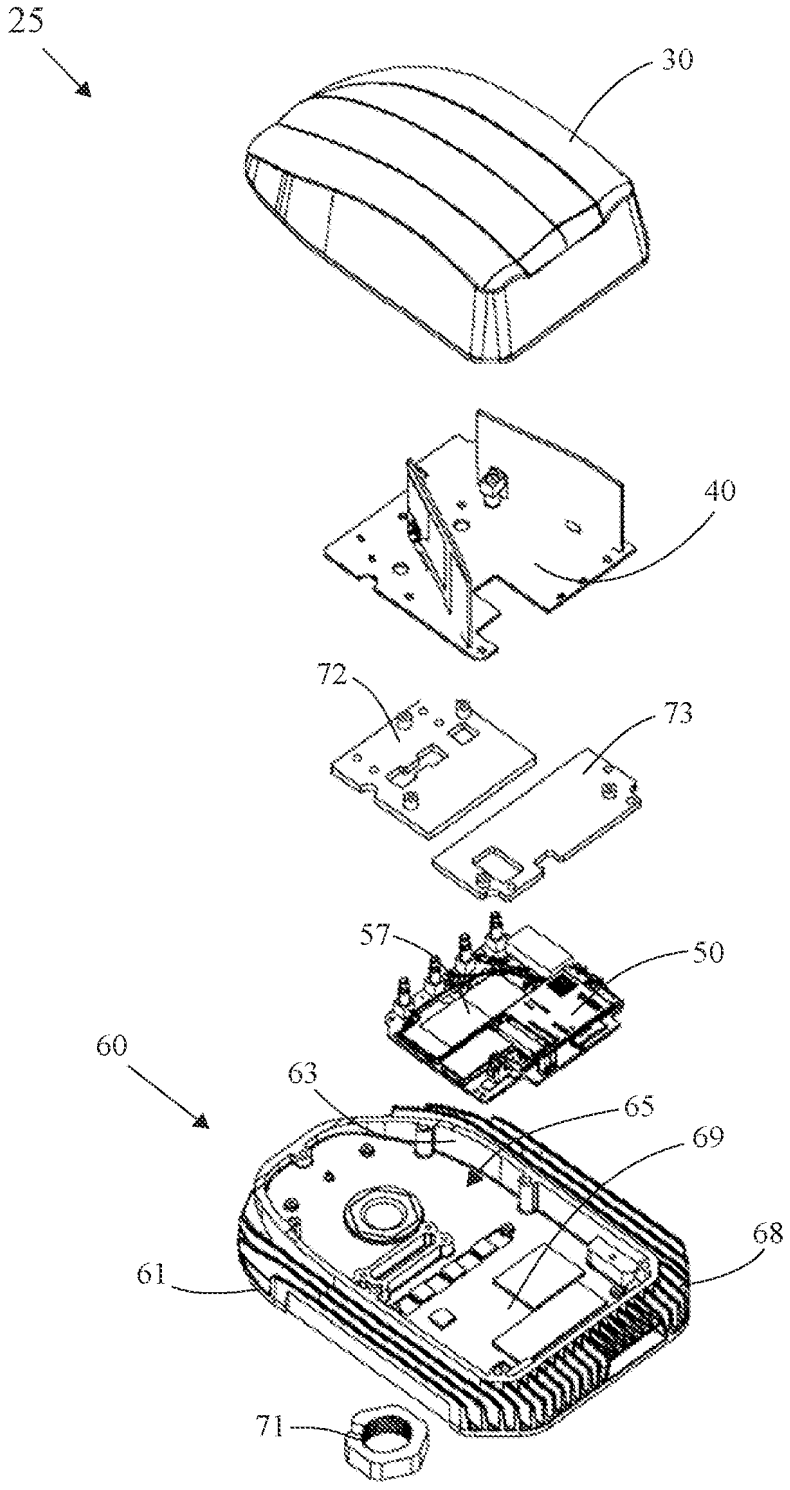

FIG. 13

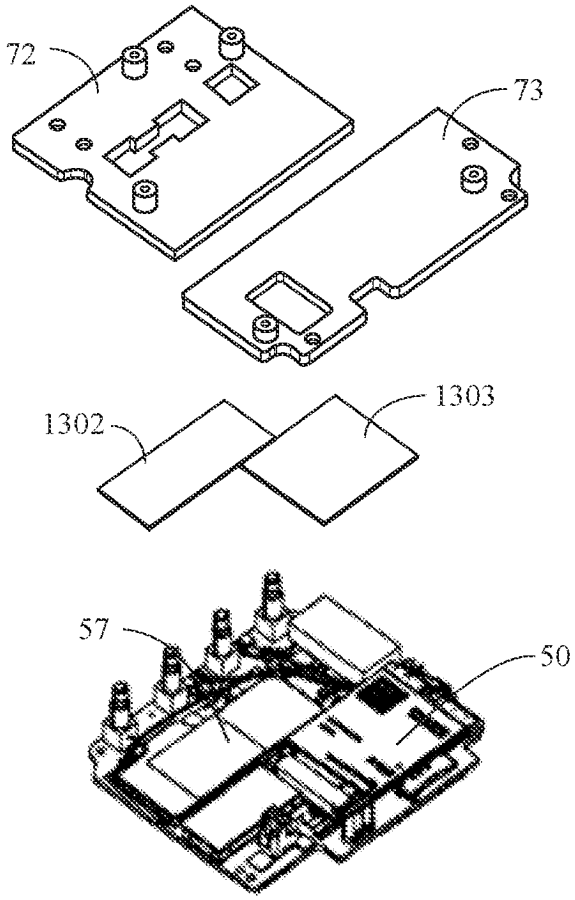

FIG. 13A

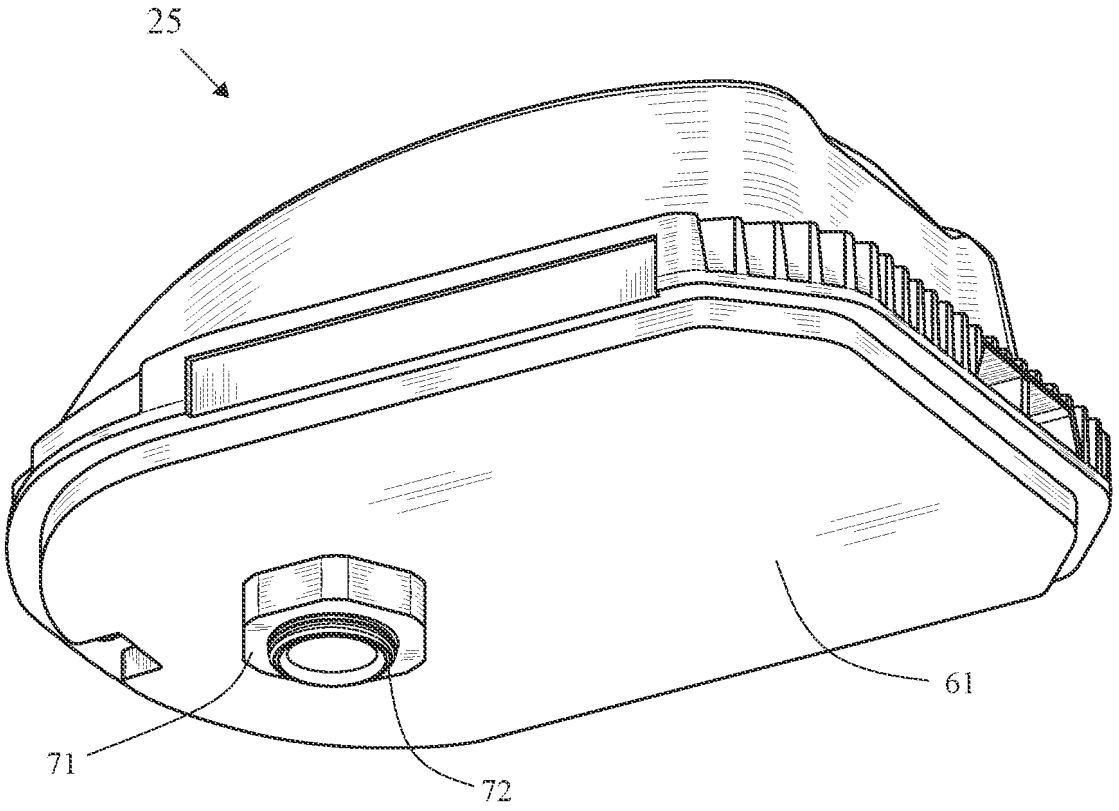

FIG. 14

REFERENCES CITED IN THE DESCRIPTION

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- US 2009231186 A1 **[0018]**