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(54) **COUNTER-UNMANNED AERIAL SYSTEM (C-UAS) PROTECTION DEVICE**

(57) The invention relates to a counter-unmanned aerial system (C-UAS) protection device, for use in both civilian and military vehicles and ships, which is positioned at the top of the vehicle, ship or entity to be protected, and comprises one or several panels, attached to the vehicle or turret, making it possible to modify or

conceal the system signature or signatures (radar, LIDAR, sonar, electro-optical, visual or multispectral signature, visible and infrared spectral signature, thermal signature, acoustic signature, magnetic signature or others).

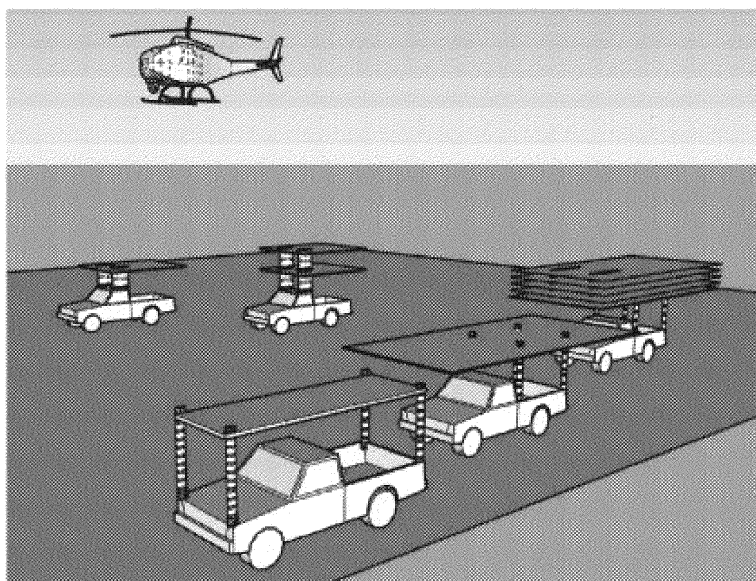


FIGURE 5

Description

TECHNICAL FIELD

[0001] The present invention belongs to the sector for the protection and safety of vehicles against an attack by means of aerial systems or C-UAS (Counter-Unmanned Aircraft Systems).

[0002] The present invention relates to a protection device for both civil and military vehicles and ships. This system is applicable to all configurations of land, sea, and aerial vehicles and assures their protection in a short period of time against manned and unmanned aerial systems.

BACKGROUND OF THE INVENTION

[0003] There are currently a number of systems, such as unmanned aerial vehicles, loitering munition, guided munition and both man-in-the-loop and man-out-of-the-loop missile systems which can be launched from land, aerial, space, naval or underwater platforms and allow attacking vehicles from the air. These systems have evolved and combine technology such as artificial intelligence, machine vision and object recognition systems, and sensor fusion systems which use information coming from multiple sensors such as radar, LIDAR, sonar, electro-optical systems, multispectral systems, cameras in different parts of the electromagnetic spectrum (visible, infrared, etc.), acoustic sensors, magnetic sensors, Global Navigation Satellite System (GNSS), Inertial Navigation System (INS), etc. The purpose of all these systems is to acquire one or several targets (the vehicles that the present system seeks to protect) to later implement different measures, including identification, guidance towards the target, neutralization and/or destruction in the case of military targets.

[0004] Some of these systems can be interfered with in different ways by means of electronic warfare systems, GNSS denial in an area, etc., but it can generally be observed how the lethality of different systems, particularly unmanned systems, cause them to be light years ahead of technologies for controlling their use, which makes it very difficult to protect infrastructures, people, and vehicles against attacks of this type.

[0005] Different counter-unmanned aerial system (C-UAS or counter-UAS) protection and defense systems are currently known. These systems usually include both passive systems (networks launched from other aerial vehicles to capture the attacking system, for example) and active systems (detection systems using radar, cameras, RF sensors, etc.), which allow the detection, identification, capture, deactivation, neutralization, retreat, and/or destruction of the attacking systems.

[0006] However, and although there are a number of commercial systems against attacks of this type, there is no definitive solution that allows eliminating all the risks and offer a high degree of security. Among the multiple

limitations and deficiencies of current protection systems is the difficulty in preventing or at least minimizing attacks by loitering munition systems targeting units and vehicles that are scattered outside of the protective umbrella of complex C-UAS systems which are usually present in high security areas, critical infrastructures, and highly protected building complexes.

[0007] The different systems and sensors incorporated in aerial vehicles (UAS) and in any other system such as recognition and surveillance satellites, perform an essential task in reference to target detection. For example, object recognition systems capture the signature of said objects to be identified by means of machine vision and cameras, process them to extract their most important characteristics (referred to as features in the literature in the field of artificial intelligence, data science and machine learning) which are stored (whether in a database or as part of the coefficients or weights of a neural network or another type of network). These characteristics or features are subsequently used by onboard systems of the UAS, satellites, or other surveillance elements for comparison with the received data flows (in real time or to be later processed) from the onboard cameras or sensors.

[0008] If the recognition system decides (depending on its internal logic and on several minimum levels) that the system detected by the onboard sensors and systems is one of the previously stored targets, the UAS makes the decisions previously defined in the design of the UAS system or of its (software or hardware) components. Some examples of decisions to be made can simply be to loiter above the target, taking further data, or attack it.

[0009] Many C-UAS systems are based on storing in a database all the signatures and characteristics or features of the different known types of UAS, loitering munition, aircraft, etc. This means that a thorough observation work of said UAS must have previously been performed with the set of sensors used for collecting and storing the signature of said UAS (radar, LIDAR, sonar, electro-optical, visual or multispectral signature, visible and infrared spectral signature, thermal signature, acoustic signature, magnetic signature, GNSS position, or others). This also means that these C-UAS systems are not prepared for a new type of UAS or for a type of UAS that has not previously been identified as its features have not been previously stored.

DISCLOSURE OF THE INVENTION

[0010] The system proposed by the patent overcomes the aforementioned drawbacks in a fully satisfactory manner, allowing the protection of vehicles, people, troops and other elements against attack by aerial systems.

[0011] To that end, the system of the present invention comprises different layers of protection and concealing against systems and sensors currently present in aerial platforms and satellites that perform target identification,

acquisition, and tracking.

[0012] The objective of the different concealing and protection layers is to prevent the UAS and the systems onboard same to be able to have the signature of the vehicles, people, troops, and other elements to be protected, where, first of all, they cannot be captured and stored, and at the same time allowing vehicles to modify their different signatures (radar, LIDAR, sonar, electro-optical, visual or multispectral signature, visible and infrared spectral signature, thermal signature, acoustic signature, magnetic signature, GNSS position, or others in any band or of any type) in a quick and simple manner.

[0013] To that end, any vehicle must be provided with the system of the present invention when it leaves the factory to prevent the capture and storage of its signature (visual, etc.). However, if this were not possible, it is essential for all the vehicles or entities to be protected have the system of the present invention when they are in operation so that the surveillance UAV, satellites, etc., cannot distinguish among the different vehicles. That is, protection is first achieved by means of concealing and secondarily by means of modifying the signature when changing the order and type of panels making up the system of the present invention.

[0014] The system object of the invention, which is positioned at the top of the vehicle, ship or entity to be protected, comprises a first panel, which can arranged parallel or not with respect to an upper wall of the vehicle or with respect to the surface of a turret if the vehicle is a military vehicle, and at least one attachment element for attaching the first panel to any wall, surface or attachment of the vehicle or turret.

[0015] The system further comprises a second panel which is attached to the first panel, and at least one attachment element between the first panel and the second panel. The passive security system further comprises an additional number of panels and attachment elements between panels, depending on the level of protection needed) attached to the second panel. That is, the system of the present invention comprises a set of panels attached to one another and said set in turn being attached to the vehicle.

[0016] The panels can be of any shape, material, dimensions, and thickness, being positioned at different distances from one another, either maintaining a layer of air between them or not, and said panels can also be painted or decorated on their faces for camouflage purposes or simply for advertising purposes in civil vehicles which are to present a given visual signature (for example, a drawing). The combination of these characteristics allows the coupling of metallic panels (with a signature and given radar section), panels made of a material or with a coating or paint that minimizes the signature in one part of the spectrum or thermal emission, plastic panels, or panels made of an anti-reflective material, or of any material or shape that allows concealing or modifying the signature of the assembly before sensors available in the UAS or satellites, and it can even be a panel on

which complex systems for modifying the signature and camouflage are placed, such as ADAPTIV system by BAE SYSTEMS, for example.

[0017] An important feature of the invention is that it allows the disassembly of the panel structure such that the position of each panel can be interchanged, for example, changing the position of the panel farthest from the upper surface of the vehicle in order to place it in the position closest to the upper surface of the vehicle, effectively modifying the signatures of the C-UAS protection system-vehicle assembly.

[0018] Furthermore, the system allows the protection of the vehicle as it allows the disassembly of several panels from the panel structure, maintaining on the vehicle one or several of the panels and installing the disassembled panels on the ground, on poles or supports, on other surfaces far from the vehicle or on other nearby vehicles. This minimizes the probability of sustaining an attack since the guidance system of any attack device (whether it is an unmanned aerial vehicle, loitering munition, guided munition, missile, etc.) will have to decide which of the different structures is the one that effectively covers the vehicle to be protected. This is an important aspect when protecting parked vehicles (whether on the front lines of combat or on advanced or retreated lines), stationed troops (in trenches, etc.).

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] To complement the description being made and for the purpose of helping to better understand the features of the invention, a set of drawings in which the following has been depicted in an illustrative and non-limiting manner has been attached as an integral part of said description:

Figure 1 shows a side view of the device of the invention.

Figure 2 shows a front view of the device of the invention.

Figure 3 shows a top view of the device of the invention.

Figure 4 shows a view of the device of the invention with several panels disassembled from the vehicle and placed on supports near the vehicle to be protected.

Figure 5 shows a perspective view of several embodiments of the device of the invention with panels of different sizes, with a different number of attachments for attaching to the vehicles, with different numbers of panels, and with panels of different materials and characteristics.

[0020] A list of the different elements depicted in the

figures integrating the invention is provided below:

- 1 = First panel.
- 2 = Attachment device for attaching the first panel to the vehicle.
- 3 = Second panel.
- 4 = Attachment device for attaching the second panel to the first panel.
- 5 = Third panel.
- 6 = Attachment device for attaching the third panel to the second panel.
- 7 = Fourth panel.
- 8 = Attachment device for attaching the fourth panel to the third panel.
- 9 = Fifth panel.
- 10 = Attachment device for attaching the fifth panel to the fourth panel.
- 11 = Attachment devices for attaching panels to the floor or to another surface.
- 12 = Counter-unmanned aerial system (C-UAS) protection device.
- 13 = Vehicle.

PREFERRED EMBODIMENT OF THE INVENTION

[0021] As indicated above and as can be seen in Figures 1, 6, 7 and 8, the preferred embodiment of the C-UAS security system (12) in vehicles, object of the invention, comprises a first panel (1), a second panel (3), a third panel (5), a fourth panel (7), a fifth panel (9), one or several attachment devices for attaching the first panel to the vehicle (2) which attach the system of the present invention to the vehicle (13), one or several attachment devices for attaching the second panel to the first panel (4), one or several attachment devices for attaching the third panel to the second panel (6), one or several attachment devices for attaching the fourth panel to the third panel (8), one or several attachment devices for attaching the fifth panel to the fourth panel (10), and one or several attachment devices for attaching a set of panels of the system to the floor or to another surface (11). In other embodiments, there can be a larger or smaller number of panels, with a different shape, with a surface that is larger or smaller than that of the vehicle to be protected and of a different thickness, and having zero, the same or different separation between panels.

[0022] The panels (1), (3), (5), (7) and (9) are manufactured with various materials (wood, plastic, metals, composites, etc.), can be coated with a material or paint by way of protection in order to achieve the properties of concealing and modifying the different features and signatures (radar, LIDAR, sonar, electro-optical, visual or multispectral signature, visible and infrared spectral signature, thermal signature, acoustic signature, magnetic signature, or others) required in each case.

[0023] Figure 4 shows a view of the device of the invention with several panels disassembled from the vehicle and these panels being placed on supports near the vehicle to be protected.

[0024] Figure 5 shows a perspective view of several embodiments of the device of the invention with panels of different sizes, with a different number of attachments for attaching to the vehicles, with different numbers of panels, and with panels of different materials and characteristics.

[0025] Figure 6 shows a perspective view of the different panels (1), (3), (5), (7), (9). Figure 7 shows a perspective view of the attachment devices between the panels (4), (6), (8), (10). Figure 8 shows a perspective view of the attachment devices for attaching to the vehicle (2). Figure 9 shows a perspective view of the attachment devices for attaching panels to the floor or to another surface (11).

Claims

1. A counter-unmanned aerial system (C-UAS) protection device (12), **characterized in that** it comprises:

- one or several panels (1), (3), (5), (7), (9),
- one or several attachment devices for attaching to the vehicle (2) of any type,
- one or several attachment devices between the panels (4), (6), (8), (10) of any type, allowing the assembly and disassembly of one panel on another, and the separation of a subset of panels with respect to the system as a whole.

2. The counter-unmanned aerial system (C-UAS) protection device (12) according to claim 1, **characterized in that** it comprises:

- one or several attachment devices for attaching panels to the floor or to another surface (11) to be able to distribute one or several panels of the system around the vehicle.

3. The counter-unmanned aerial system (C-UAS) protection device (12) according to claim 1, **characterized in that** it allows the change of location of some panels with respect to others for the purpose of modifying the signature or signatures (radar, LIDAR, sonar, electro-optical, visual or multispectral signature,

visible and infrared spectral signature, thermal signature, acoustic signature, magnetic signature or others) of the system.

4. The counter-unmanned aerial system (C-UAS) protection device (12) according to claim 1, **characterized in that** it allows removing or adding additional panels for the purpose of modifying the signature or signatures (radar, LIDAR, sonar, electro-optical, visual or multispectral signature, visible and infrared spectral signature, thermal signature, acoustic signature, magnetic signature or others) of the system. 5
5. The counter-unmanned aerial system (C-UAS) protection device (12) according to claim 1, **characterized in that** it allows the use of panels of different shapes, materials, dimensions and thicknesses, being positioned at the same or at different distances from one another, either maintaining a layer of air between them or not. 10
6. The counter-unmanned aerial system (C-UAS) protection device (12) according to claim 1, **characterized in that** it can be attached to a rotating turret of the vehicle such that the system rotates with said turret rather than rotating with the vehicle as a whole. 15

Amended claims under Art. 19.1 PCT

1. A counter-unmanned aerial system (C-UAS) concealing, camouflage and protection device (12), **characterized in that** it comprises: 20
 - one or several panels (1), (3), (5), (7), (9), 25
 - one or several attachment devices for attaching to a vehicle (2) of any type,
 - one or several attachment devices between the panels (4), (6), (8), (10) of any type, allowing the assembly and disassembly of one panel on another, and the separation of a subset of panels with respect to the system as a whole, and allowing the change of location of some panels with respect to others, which modifies the signature or signatures (radar, LIDAR, sonar, electro-optical, visual or multispectral signature, visible and infrared spectral signature, thermal signature, acoustic signature, magnetic signature or others) of the system captured by the different sensors used in the different aerial systems flying over the vehicle. 30
2. The counter-unmanned aerial system (C-UAS) concealing, camouflage and protection device (12) according to claim 1, **characterized in that** it comprises: 35
 - one or several attachment devices for attach-

ing panels to the floor or to another surface (11) not belonging to the vehicle to be able to distribute one or several panels of the system around the vehicle simulating the signature or signatures of the vehicle in another position different from that of the vehicle.

3. The counter-unmanned aerial system (C-UAS) concealing, camouflage and protection device (12) according to claim 1, **characterized in that** it allows removing or adding additional panels in any position for the purpose of modifying the signature or signatures (radar, LIDAR, sonar, electro-optical, visual or multispectral signature, visible and infrared spectral signature, thermal signature, acoustic signature, magnetic signature or others) of the system captured by the different sensors used in the different aerial systems flying over the vehicle. 40
4. The counter-unmanned aerial system (C-UAS) concealing, camouflage and protection device (12) according to claim 1, **characterized in that** it allows the use of panels of different shapes, materials, dimensions and thicknesses, being positioned at the same or at different distances from one another, maintaining a layer of air between them or no separation at all. 45
5. The counter-unmanned aerial system (C-UAS) concealing, camouflage and protection device (12) according to claim 1, **characterized in that** it can be attached to a rotating turret of the vehicle such that the system rotates with said turret rather than rotating with the vehicle as a whole. 50

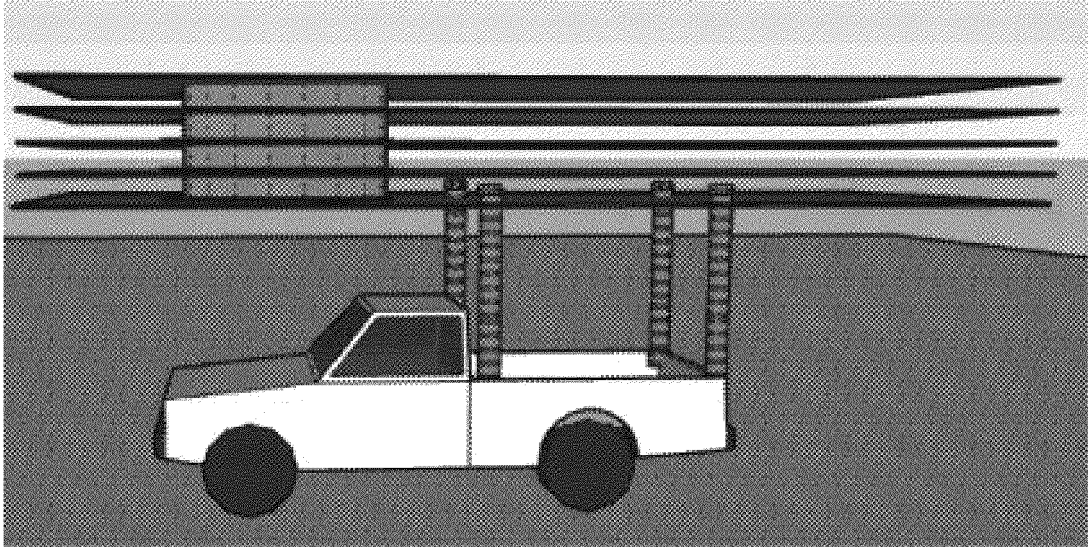


FIGURE 1

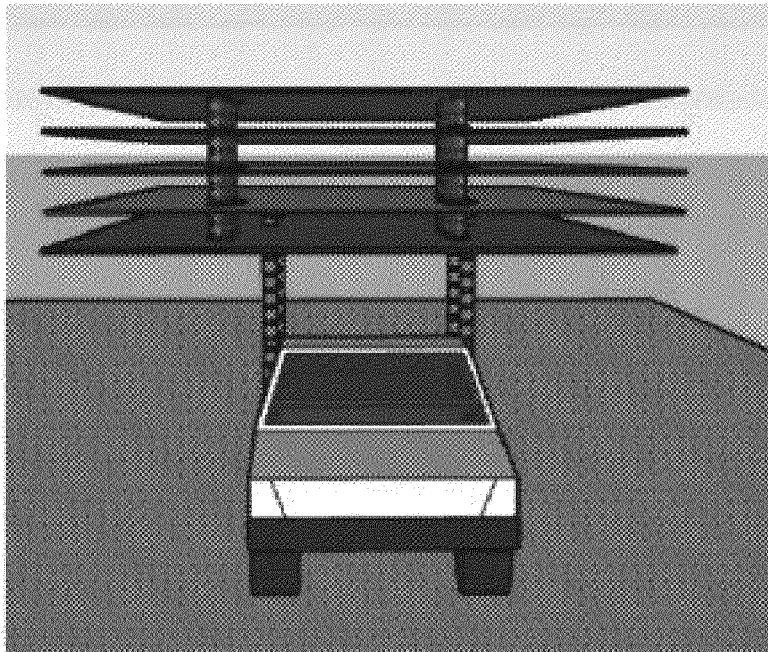


FIGURE 2

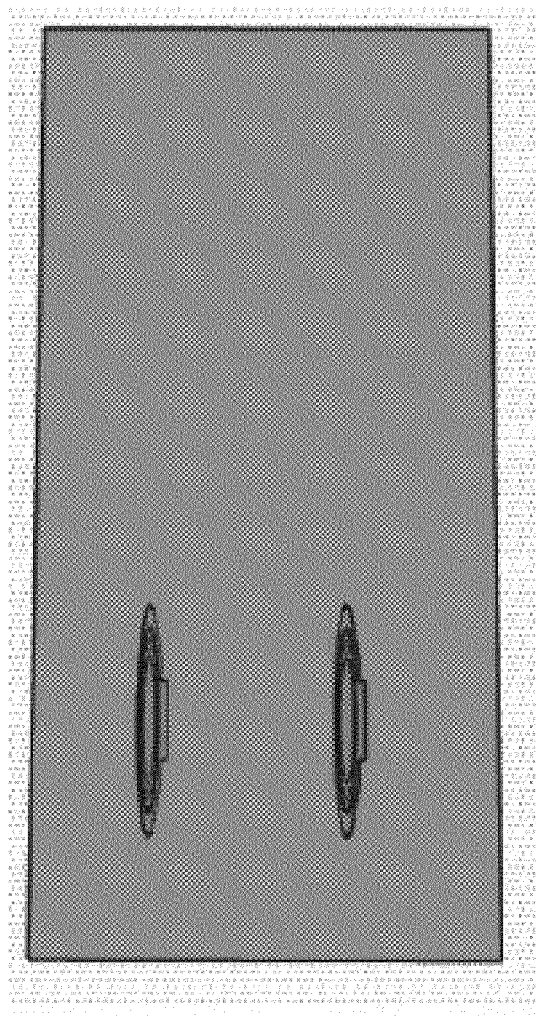


FIGURE 3

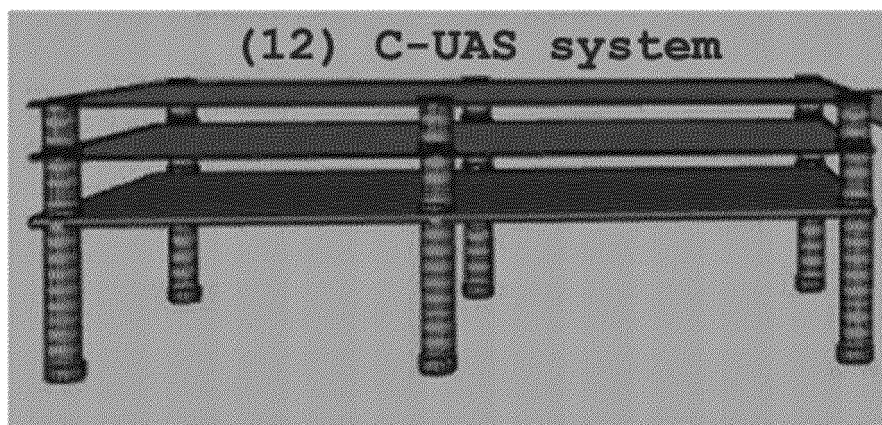


FIGURE 4

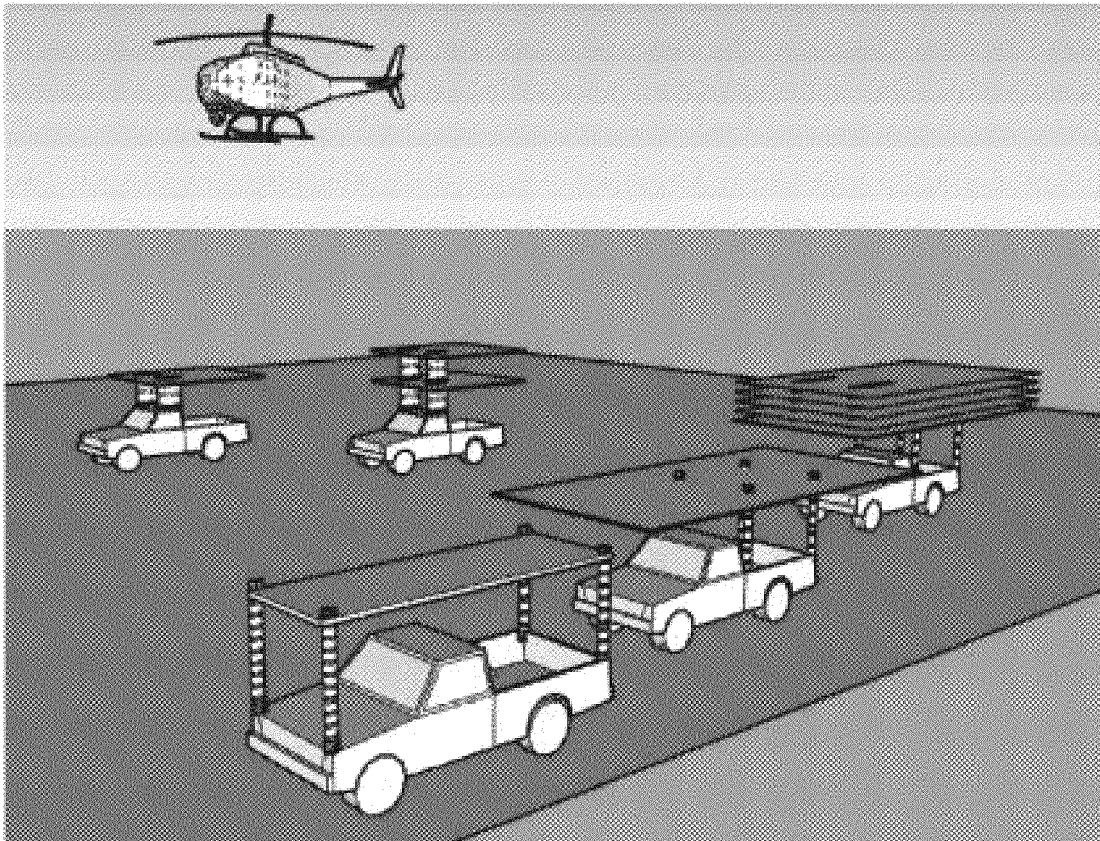


FIGURE 5

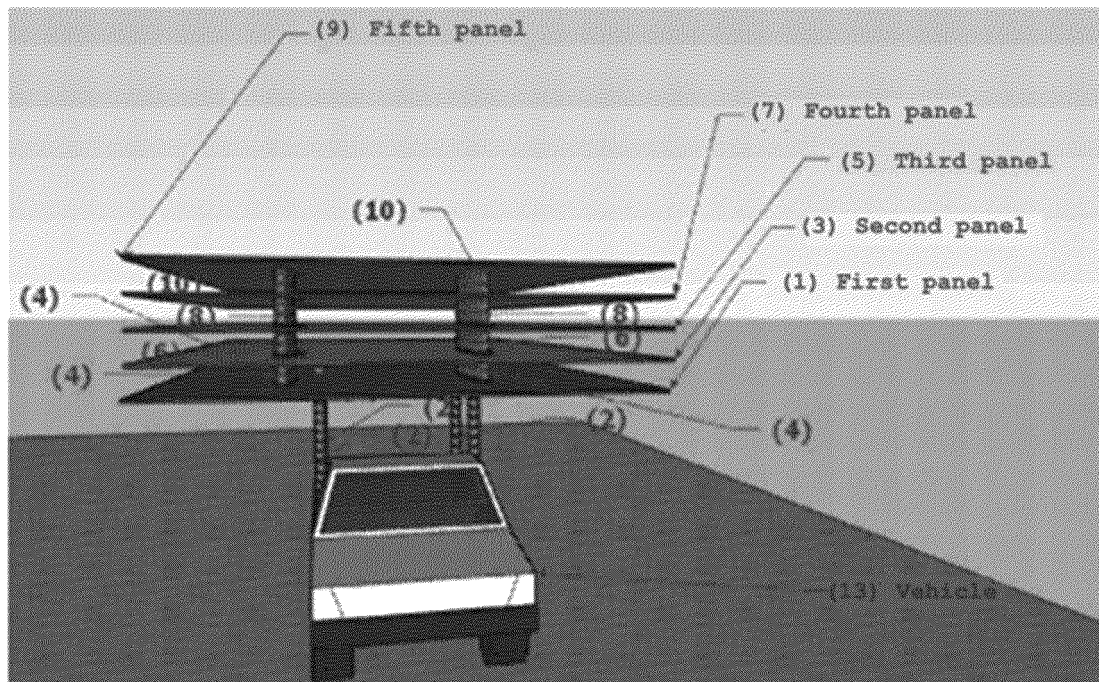


FIGURE 6

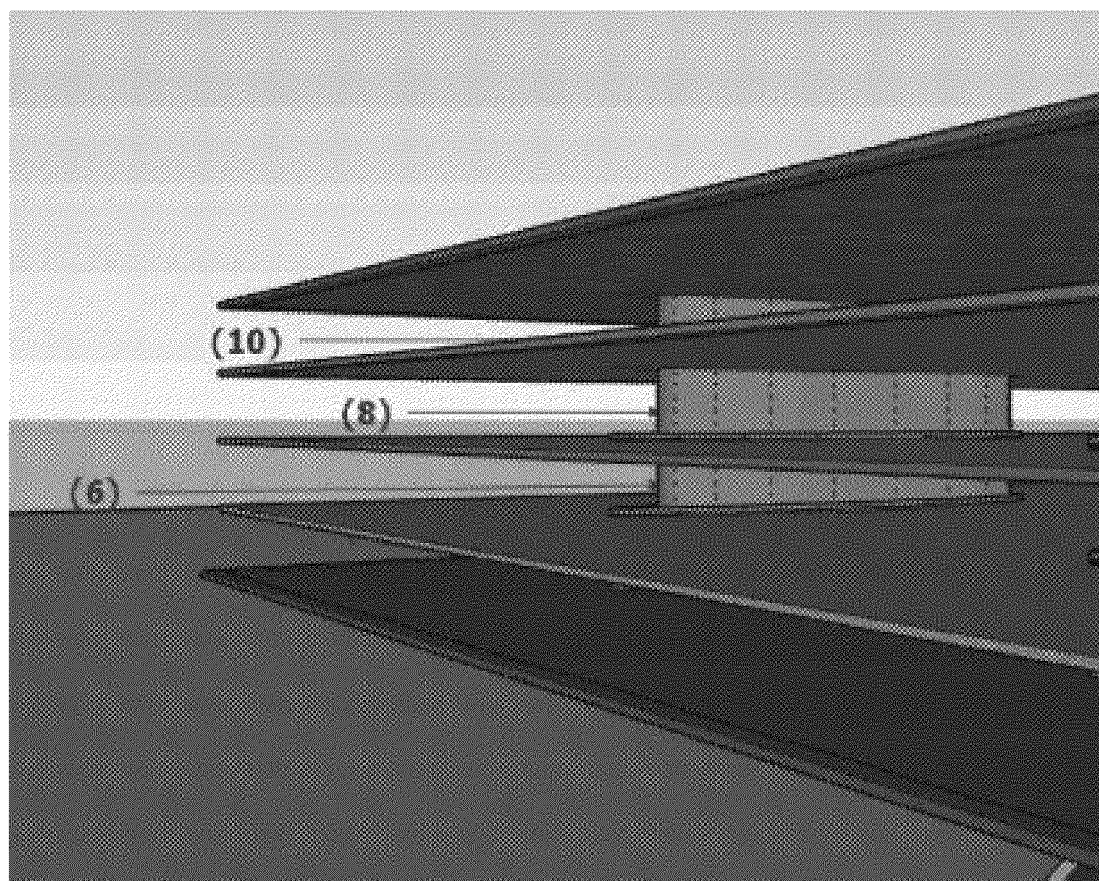


FIGURE 7

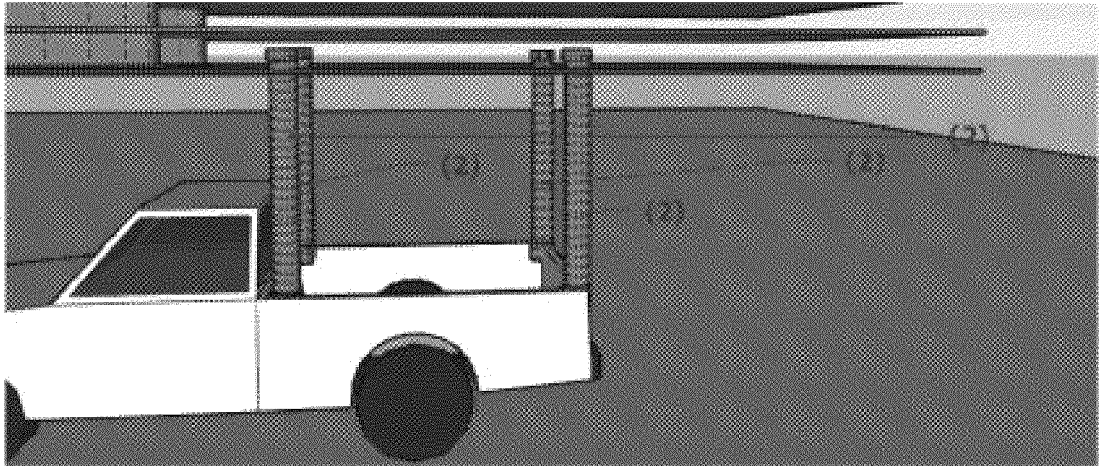


FIGURE 8

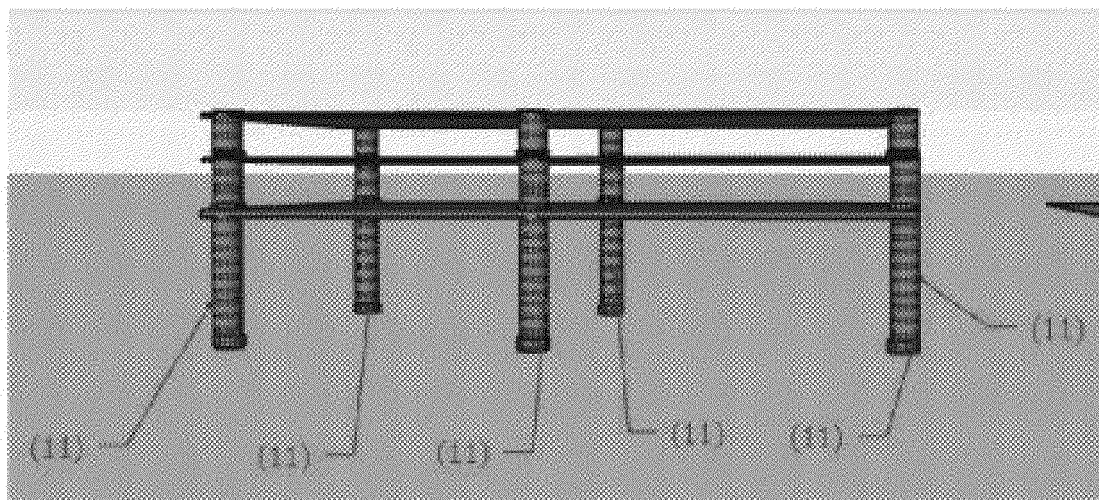


FIGURE 9

INTERNATIONAL SEARCH REPORT

International application No.
PCT/ES2021/070666

A. CLASSIFICATION OF SUBJECT MATTER

See extra sheet

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F41H, F42D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPODOC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6082240 A (MIDDIONE MARK ALBERT ET AL.) 04/07/2000, abstract; column 1, lines 6 - 25; figures.	1-6
X	DE 2556722 C1 (KRAUSS MAFFEI AG) 28/07/1988, abstract; figures.	1-6
A	US 2004112240 A1 (STATON VERNON ERIC) 17/06/2004, the whole document.	1-6
A	US 6187451 B1 (BOOS STEPHEN J E) 13/02/2001, abstract; figures.	1-6

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents: "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"A" document defining the general state of the art which is not considered to be of particular relevance.

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"O" document referring to an oral disclosure use, exhibition, or other means.

"P" document published prior to the international filing date but later than the priority date claimed

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search
13/06/2022

Date of mailing of the international search report
(14/06/2022)

Name and mailing address of the ISA/

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Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/ES2021/070666

Information on patent family members

Patent document cited in the search report	Publication date	Patent family member(s)	Publication date
US6082240 A	04.07.2000	US5670734 A	23.09.1997
DE2556722 C1	28.07.1988	NONE	
US2004112240 A1	17.06.2004	NONE	
US6187451 B1	13.02.2001	NONE	

Form PCT/ISA/210 (patent family annex) (January 2015)

INTERNATIONAL SEARCH REPORT

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PCT/ES2021/070666

CLASSIFICATION OF SUBJECT MATTER

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F41H7/02 (2006.01)

F41H5/013 (2006.01)

F42D5/045 (2006.01)