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(54)

DEVICE, KIT AND METHOD FOR ELECTROMAGNETICALLY SHIELDING A REMOTE COMMAND DEVICE OF A CRANE

(57)

The present invention refers to a device (1), a kit and a method of electromagnetically shielding a remote command device (101) of a crane comprising a command panel (102) having one or more levers and one or more pushbuttons and one or more knobs for managing the operations of the crane, and a transmission unit configured for a by-wire and/or wireless communication with a control unit (201) of the crane. The shielding device (101) comprises a container (2) made of an electrically conductive material and adapted to internally receive the remote command device (101) of the crane in order to form a Faraday cage. The container (2) comprises one or more openings (21, 22) for gaining access to said one or more levers and/or one or more pushbuttons and/or one or more knobs of the remote command device (101) of the crane from the outside of the container (2). Said one or more openings having dimensions so that the Faraday cage shields the electromagnetic radiations generated inside the remote command device (101) of the crane and enables the electromagnetic waves generated by the transmission unit to pass through the Faraday cage when the transmission unit wirelessly communicates with the control unit (201) of the crane.

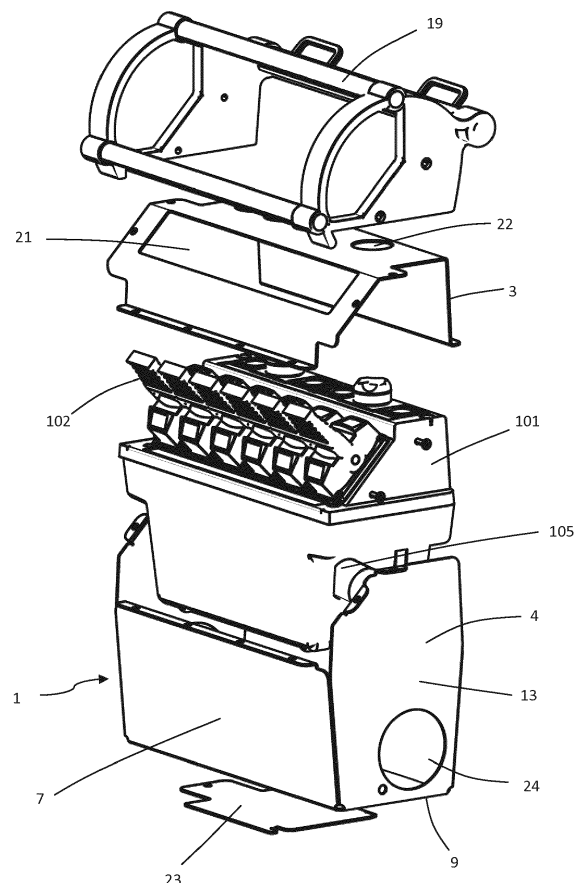


FIG. 3

Description

Technical field of the invention

[0001] The present invention refers to the technical field of remotely commanding a crane, such as loading cranes.

Prior art

[0002] The modern cranes have a plurality of degrees of freedom, particularly a plurality of motions which are performed by an extendable arm or components thereof. Such motions are usually commanded by an operator through a remote command device, which can be by-wire or wirelessly connected to the crane, typically by radio waves. The remote command device typically comprises a plurality of levers actuatable by the operator, to each of them a specific motion and direction thereof of the crane for example correspond, and one or more push-buttons having particular functions, for example the emergency stop.

[0003] In particular circumstances, there is the necessity to limit the electromagnetic emissions generated by the remote command device in order to prevent undesired interferences in the surrounding environment, for example interferences with other machines present in the environment where the crane operates, and also to limit the electromagnetic interferences with the remote command device possibly generated by external devices. It is observed that the electromagnetic emissions of the command device do not comprise just the radio waves in case it wirelessly operates, but also emissions caused by the internal electric/electronic arrangement of the remote command device, present also when the remote command device is used in a by-wire mode.

Summary of the invention

[0004] The object of the present invention consists of providing a device, a kit, and a method of electromagnetically shielding a remote command device of a crane, without requiring to introduce substantial modifications to this latter.

[0005] This and other objects are obtained by a device for electromagnetically shielding a remote command device of the crane according to claim 1, by a kit for electromagnetically shielding a remote command device of the crane according to claim 10, and by a method of electromagnetically shielding a device for remotely commanding a crane according to claim 14.

[0006] The dependent claims define possible advantageous embodiments of the invention.

Brief description of the figures

[0007] In order to better understand the invention and appreciate the advantages thereof, some exemplifying

embodiments of it will be described in the following with reference to the attached figures, wherein:

Figure 1 is a partially exploded perspective view of a remote command device for a crane, provided with an electromagnetic shielding device according to the invention, and of a crane portion provided with a further electromagnetic shielding container;

Figure 2 is a perspective view of a remote command device of a crane according to the prior art;

Figure 3 is an exploded perspective view of a remote command device of a crane provided with an electromagnetic shielding device according to a possible embodiment of the invention;

Figures 4 and 5 are assembled perspective views of the remote command device of the crane provided with an electromagnetic shielding device shown in Figure 3;

Figures 6 and 7 are perspective views of the electromagnetic shielding device according to a possible embodiment of the invention;

Figure 8 is an exploded perspective view of the electromagnetic shielding device shown in Figures 6 and 7.

Detailed description of the invention

[0008] Referring to the attached figures, a remote command device of a crane, particularly a hydraulic crane, is generally indicated by reference 101. The device 101 enables an operator to move the movable parts of a crane. For example, the available motions of a crane can comprise: rotating the column, raising and lowering the arms, extending and retracting the extensions, actuating the capstan, if this latter is provided. Such motions are provided by corresponding actuators, usually of the hydraulic and/or electric type, associated to respective crane portions. The crane comprises in turn a control unit 201 managing such motions. Sometimes the crane itself is provided with an on-site command device.

[0009] The device 1, in order to communicate with the control unit 201 of the crane, comprises a dedicated transmission unit, which establishes a communication between the device 101 and the crane control unit 201. The transmission unit can be configured so that the remote command device of the crane 101 could communicate by-wire or/and wirelessly with the crane control unit. In the first case, an outlet 105 to connect a cable 106 can be for example provided. In the second case, the transmission unit can for example comprise a radio transmission module, so that the device 101 could operate by a remote command, in other words could communicate with the crane control unit 201 by radio signals. The radio connection module comprises an antenna, not shown in the figures, which can for example be housed inside the device 101 itself, adapted to communicate with a corresponding antenna 203 associated to the crane control unit.

[0010] Preferably, the device 101 comprises a battery, still more preferably of the rechargeable type, so that it can be used also without power sources. Alternatively or in addition, the device 1 can be directly connected to an electric power source and supplied by wire. If the by-wire communication is provided with the crane control unit 201, the wire 106 can act also as a power supply for the command device 101.

[0011] The remote command device of the crane 101 comprises a command panel 102 having, for example, levers and/or pushbuttons and/or knobs (for example a joystick) for managing the operations of the crane. The command panel 102 can comprise, for example, pushbuttons 103, such as pushbuttons for turning on the device, alarm pushbuttons, audible signals emitting pushbuttons, default pushbuttons, etcetera. Moreover, the command panel 102 comprises a plurality of manual command members 104, each of them is responsible of a particular one of the above cited crane motions and the direction thereof. The manual command members 104 can be for example shaped as forwardly actuatable (for a first motion direction) or backwardly actuatable (for a second motion direction, opposite to the first one) levers.

[0012] According to a possible embodiment, the crane remote command device 101 comprises a handle 19 which makes easier transporting it. Advantageously, the handle 19 is shaped so that a user can gain access to the pushbuttons 103 and manual command members 104.

[0013] During the operation, the device 101 generates electromagnetic waves mainly produced by its internal electric and electronic components. It is observed that such electromagnetic waves are produced also if the device 101 communicates with the crane control unit 201 by the wire 106, in other words without radio waves. In the following of the description, the term "internal electromagnetic waves" will be used for defining such waves and distinguishing them from the electromagnetic waves produced in the presence of a wireless communications of the transmission unit, and also from the external electromagnetic waves produced by further devices possibly present in the environment wherein the remote command device is placed. In some operative fields of the crane, desirably the internal electromagnetic waves are shielded as much as possible, so that they do not propagate (or their propagation is limited) in the environment near the device 101. Moreover, desirably possible external electromagnetic waves should not interfere with the remote command device 101.

[0014] For this purpose, according to the invention, a device 1 for electromagnetically shielding the remote command device 101 is provided, particularly for shielding it from the internal electromagnetic waves. Advantageously, the device 1 is configured to be applied to a conventional remote command device 101, without necessarily completely or partially requiring to modify it.

[0015] The shielding device 1 comprises a container 2 adapted to surround the remote command device 101

and to receive it in the interior thereof. Such container 2 is made of an electric conductive material, in order to form a Faraday cage. For example, the container 2 can be made of galvanized steel, preferably having a thickness of about 1 mm.

[0016] According to a possible embodiment, the container comprises a first 3 and second 4 semi-shells separable and connectable to each other, shaped so that the remote command device 101 can be housed inside the container 2 once these are connected. Preferably, the first semi-shell 3 is destined to cover the command panel 102, for example on the top, while the second semi-shell 4 is destined to cover the remaining portion of the device 101, for example, the lower portion thereof. It is observed that in the present description and in the attached claims, terms as "top" and "lower" or similar refer to the normal conditions of use of the crane remote command device 101.

[0017] According to a possible embodiment, the first 3 and second semi-shells 4 are respectively made of a first 5 and second suitable bent sheets 6.

[0018] Particularly, the second sheet 6 of the second semi-shell 4 forms part of the front 7 and rear walls 8, and also the lower wall 9 and two lateral walls 12 and 13 opposite to the container 2. Preferably, the two lateral walls 12 and 13 have a substantially trapezoidal profile, so that the upper portions thereof comprise a horizontal segment and a downwardly sloped segment. The sheet 5 forming the first semi-shell 3, in turn, is preferably bent in order to abut said horizontal sloped segments of the lateral walls 12 and 13, and therefore comprises a substantially horizontal upper portion 14 and a sloped front portion 15 joining with the front wall 7 formed by the second sheet 6. The first sheet 5 forming the first semi-shell 3 further preferably comprises a rear portion 16 joining with the rear wall 8 formed by the second sheet 6.

[0019] Advantageously, in order to connect the first semi-shell 3 to the second semi-shell 4, they comprise a plurality of preferably outwardly protruding fins 17, shaped so that they match with each other and having for example holes 18 for reciprocally connecting the former by connecting members, for example threaded members (not shown in the figures). Advantageously, it is observed that the holes 18 are sized and spaced so that the shielding action of the shielding device 1 is not jeopardized.

[0020] According to a possible embodiment, the first sheet 5 can be shaped in order to define two lateral grooves 20 with the lateral walls 12 and 13, in which corresponding portions of the handle 19 can be positioned and fixed.

[0021] According to a possible embodiment, the container 2 comprises a removable cover 23 in order to enable to gain access to the battery of the remote command device 101. Preferably, the removable cover 23 is positioned in the lower wall 9.

[0022] The container 2 comprises one or more openings to enable to gain access to the pushbuttons 103 and

manual command members 104. For example, the container 2 can comprise a first elongated opening 21 enabling the command levers of the device 101 to outwardly protrude from the container 2, the levers being preferably juxtaposed and aligned, and one or more further openings 22 for the pushbuttons 103 and/or knobs of the device 101. For example, the elongated opening 22 can be formed in the front portion 15 of the sheet 5, while the further openings 22 can be formed in the upper portion 14 of the sheet 5. According to a possible embodiment, one of the further openings 22 can be formed in one of the lateral wall 12 or 13, for enabling to gain access to a pushbutton 107 for the emergency stop of the remote command device 101.

[0023] According to an embodiment, the container 2 comprises a further opening 24 enabling the passage of a wire 106 and to connect this latter to the outlet 105 of the remote command device 101.

[0024] By assembling the container 2 with the remote command device 101 and using a shielded cable 106, it is possible to shield the internal electromagnetic waves of the device 101 and also other electrostatic and electromagnetic interference sources generated by the communication between the remote command device 101 and the crane control unit 201. For the purpose of shielding also this latter and also the terminal part of the wire 106, preferably it is provided a second container 202 adapted to surround this latter and configured to form, in turn, a second Faraday cage. In turn, the second container 202 can comprise openings 203 enabling levers or pushbuttons to protrude and a door 204 openable for gaining access to the interior of the second container 202 itself.

[0025] A kit comprising the shielding device 1, shielded wire 106 and second container 202 enables to effectively shield the electromagnetic waves in the presence of a communication between the device 1 and crane control unit 201 implemented by a wire, in other words through the shielded wire 106 itself. The above cited openings are subjected to dimensional constraints, as it will be explained in the following, such to ensure the shielding based on the characteristics of the remote command device 101 and crane control unit.

[0026] Surprisingly, the Applicant has observed that, despite the container 2 effectively shields the internal electromagnetic waves produced by the remote command device 101 (and further shields the remote command device 101 from the electromagnetic waves possibly produced by external devices), for some dimensions of the openings, it is not capable of shielding from radio waves produced by the same if this wirelessly communicates with the crane command unit 201. Consequently, the shielding device 1 can be held on the remote command device 101 both in case of a by-wire communication with the crane command unit (and in this case there is an effective shielding against the electromagnetic waves) and in case the communication is wireless (and in this case obviously there is no shielding against the

radio waves, however the removal of the shielding device 1 is not required).

[0027] The openings present in the container (with reference to the described embodiments: the openings 21, 22 and 24) should have suitable dimensions so that are shielded the electromagnetic internal waves and are not shielded the radio waves (or, more generally, the electromagnetic waves) produced by the transmission unit.

[0028] The Applicant has discovered that the electromagnetic waves caused by the wireless transmission are not shielded if at least one of the container 2 openings has a dimension equal to at least 1/6 the wavelength of these. In case of radio waves having a frequency of about 2.4 GHz, the wavelength is of about 12.5 cm. Consequently, at least one of the openings of the container 2 must have a dimension greater than about 2 cm, preferably greater than 2.5 cm.

[0029] Of course, also all the openings of the container are required to have a dimension such to shield the internal electromagnetic waves, which usually vary among frequencies comprised from about 1 MHz to 1GHz. Advantageously, all the openings of the container have a dimension less than at least 1/6, preferably less than at least 1/10 the smallest wavelength of the internal electromagnetic waves. For example, if the frequencies of the internal electromagnetic waves are comprised from about 1 MHz to 100 MHz, the smallest wavelength is equal to about 3 m, so that the greatest dimension of the openings should not be greater than about 30 cm. With reference to what was hereinbefore discussed, such dimension enables the passage of radio waves at 2.4 GHz, so that if all the openings of the container have dimensions less than 30 cm and at least one opening has at least one dimension greater than 2-2.5 cm, it is possible to obtain the desired effect, in other words shielding the internal electromagnetic waves and the passage of the radio waves through the Faraday cage made by the container 2. Naturally, a person skilled in the art can understand that the dimensions of the openings cannot be defined once and for all, but they should be selected as a function of the used remote command device and of the frequency of the radio waves used by it.

[0030] By above, it is assumed the antenna is integrated in the remote command device and consequently is housed inside the container. On the contrary, if the antenna, in the conditions of use, protrudes from the container 2, the minimum dimension constraint of at least one of the openings can be neglected.

[0031] With reference to the second container 202, the same arguments are still valid. Consequently, if the antenna 205 protrudes from the container 202, it is not required to provide openings having a minimum extension for avoiding to shield the radio waves. Obviously, if the antenna 205 were inside the second container 202 in conditions of use, at least one opening having a minimum dimension (for avoiding to shield the radio waves) and a maximum dimension (for shielding the internal electromagnetic waves of the crane control unit) calculated by

modes analogous to the ones described with reference to the container 2 of the remote command device 1, could be provided.

[0032] A person skilled in the art could appreciate from the above discussed description that by the shielding device according to the invention, it is possible to electromagnetically shield a remote command device of a crane if used in a by-wire transmission mode, maintaining at the same time the possibility of using it also in a wireless transmission mode, without requiring to remove the shielding device itself. The shielding device can be applied to a conventional existing remote command device or can be integrated in the remote command device itself. Using a kit comprising the shielding device, a shielded wire and possibly a second container to be applied to the crane control unit, enables to obtain an electromagnetic shielding of the crane-remote command device system if this is used in a by-wire mode, simultaneously maintaining the possibility of using the same system in the wireless mode without the necessity to remove any components of the kit.

[0033] A person skilled in the art in order to meet specific contingent needs, can introduce many additions, modifications, or substitutions of the elements with other operatively equivalent ones to the described embodiments of the device, kit and method of shielding a crane remote command device, without falling out of the scope of the attached claims.

Claims

1. Device (1) for electromagnetically shielding a remote command device (101) of a crane comprising a command panel (102) having one or more levers and/or one or more pushbuttons and/or one or more knobs for managing the operations of the crane, and a transmission unit configured for a by-wire and/or wireless communication with a control unit (201) of the crane, said shielding device (101) comprising a container (2) made of an electrically conductive material and adapted to internally receive the remote command device (101) of the crane in order to form a Faraday cage, wherein said container (2) comprises one or more openings (21, 22) for gaining access to said one or more levers and/or one or more pushbuttons and/or one or more knobs of the remote command device (101) of the crane from the outside of the container (2), said one or more openings having dimensions so that the Faraday cage shields the electromagnetic radiations generated inside the remote command device (101) of the crane and enables the electromagnetic waves generated by the transmission unit to pass through the Faraday cage when the transmission unit wirelessly communicates with the control unit (201) of the crane.
2. Shielding device (1) according to claim 1, wherein

said one or more openings of the container (2) further comprise an additional opening (24) enabling a wire (106) to pass through it and to connect the wire to a socket (105) of the transmission unit of the remote command device (101) of the crane when the communication unit communicates by wire with the control unit of the crane (201).

3. Shielding device (1) according to any of the preceding claims, wherein at least one of said one or more openings (21, 22, 24) of the container (2) has a dimension equal to at least $1/6$ the wavelength of the electromagnetic waves generated by the transmission unit when this latter wirelessly communicates with the control unit (201) of the crane.
4. Shielding device (1) according to any of the preceding claims, wherein said one or more openings (21, 22, 24) of the container (2) have dimensions less than at least $1/6$ the smallest wavelength of the electromagnetic waves generated inside the remote command device (101) of the crane.
5. Shielding device (1) according to any of the preceding claims, wherein said one or more openings (21, 22, 24) of the container (2) have dimensions less than at least $1/10$ the smallest wavelength of the electromagnetic waves generated inside the remote command device (101) of the crane.
6. Shielding device (1) according to any of the preceding claims, wherein the container (2) comprises a first (3) and a second half shells (4) separable and connectable to each other.
7. Remote command device (101) of a crane comprising a command panel (102) having one or more levers and/or one or more pushbuttons and/or one or more knobs for managing the operations of the crane, and a transmission unit configured for a by-wire or wireless communication with a control unit (201) of the crane, wherein said remote command device (101) of the crane comprises a shielding device (1) according to any of the claims from 1 to 6.
8. Remote command device (101) of a crane according to claim 7, wherein the transmission unit comprises an antenna integrated in the remote command device itself, so that the antenna is also received inside the container (2) of the shielding device (1).
9. Remote command device (101) of a crane according to claim 7 or 8, comprising a socket (105) for connecting the transmission unit to the control unit (201) of the crane by a wire (106).
10. Kit for electromagnetically shielding a remote command device (101) of a crane comprising a command

panel (102) having one or more levers and/or one or more pushbuttons and/or one or more knobs for managing the operations of the crane, and a transmission unit configured for a by-wire and/or wireless communication with a control unit (201) of the crane, said kit comprising a shielding device according to any of claims from 1 to 6 and a shielded wire (106) for connecting by wire the transmission unit of the remote command device (101) of the crane to the control unit (201) of the crane.

11. Kit according to the preceding claim, further comprising a second container (202) made of an electrically conductive material and adapted to surround the control unit (201) of the crane in order to form a second Faraday cage on this latter in order to shield the electromagnetic waves generated inside the control unit of the crane.
12. Kit according to the preceding claim, wherein said second container (202) comprises an opening such to enable said shielded cable (106) to pass through and to connect it to the control unit of the crane.
13. Kit according to claim 11 or 12, wherein said second container (202) comprises an opening such to enable an antenna (205) of the control unit of the crane to project outside the second Faraday cage.
14. Method for electromagnetically shielding a remote command device (101) of a crane comprising a command panel (102) having one or more levers and/or one or more pushbuttons and/or one or more knobs for managing the operations of the crane, and a transmission unit configured for a by-wire or wireless communication with a control unit (201) of the crane, said method comprising:
 - providing said remote command device (101) of the crane;
 - positioning it inside a shielding device according to any of claims from 1 to 6.

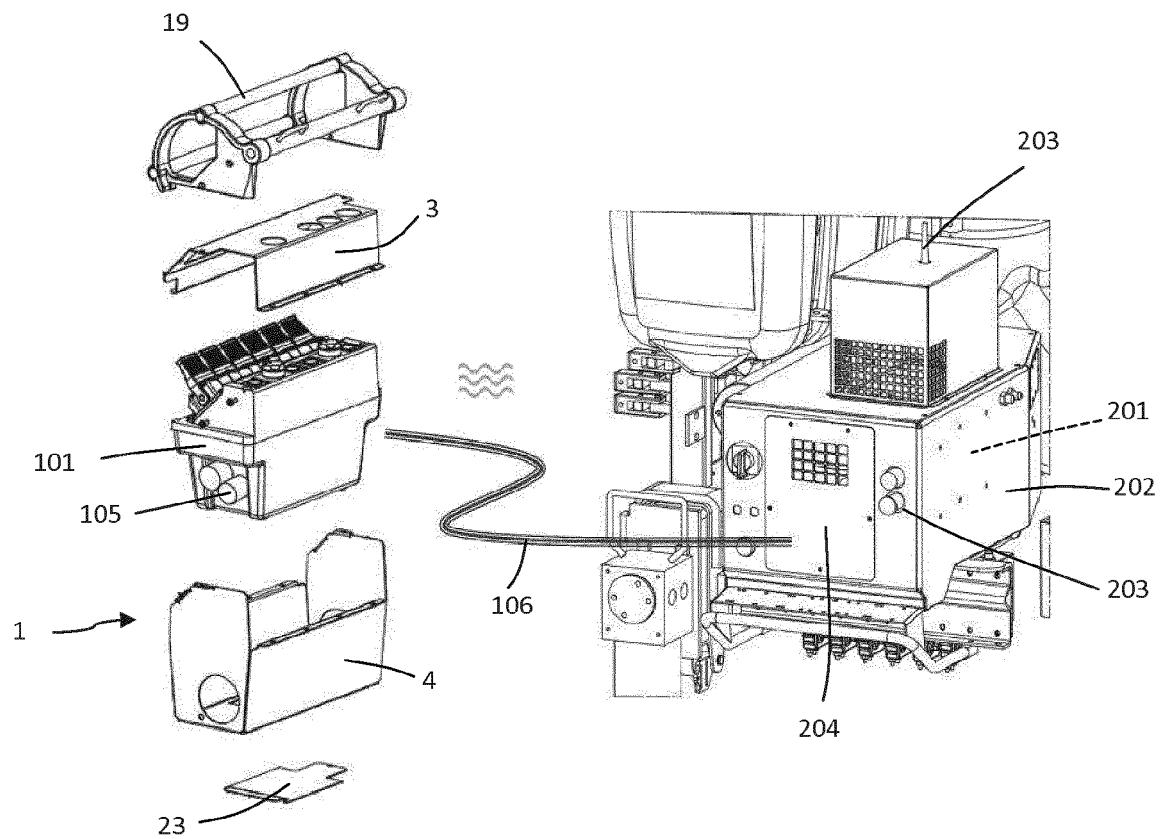


FIG. 1

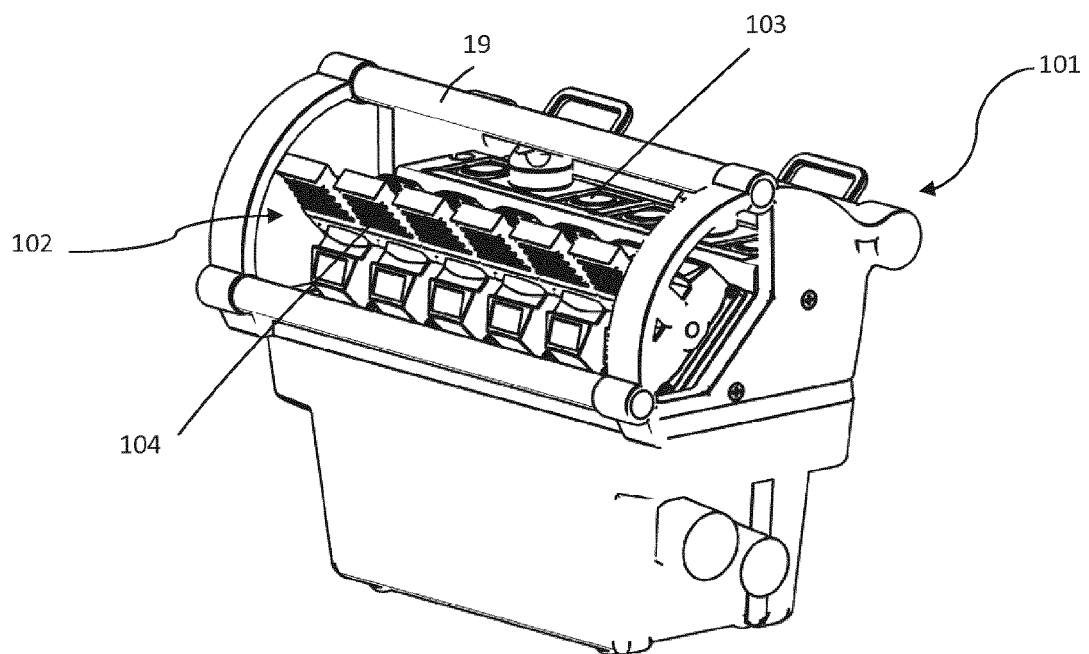


FIG. 2

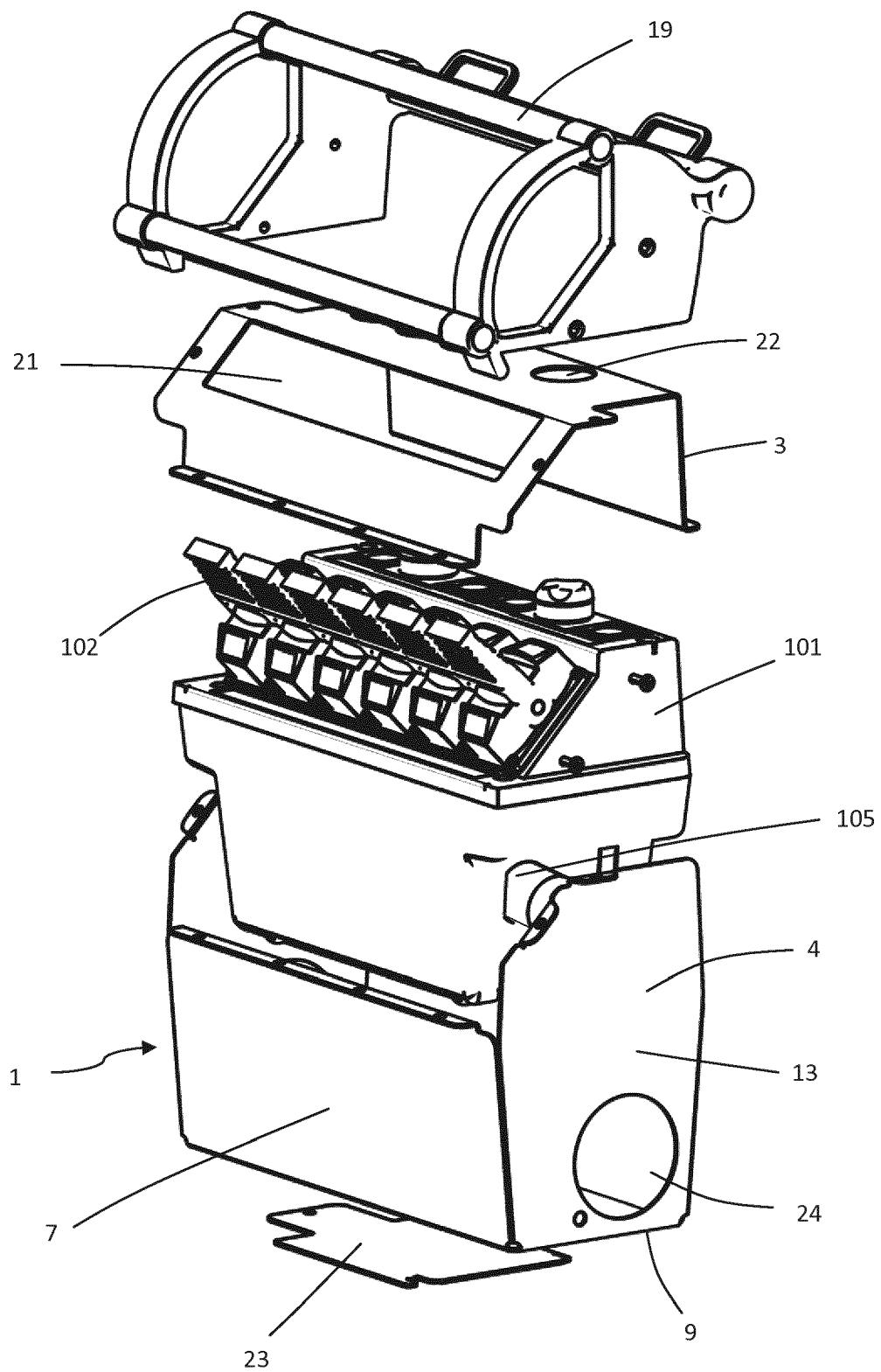


FIG. 3

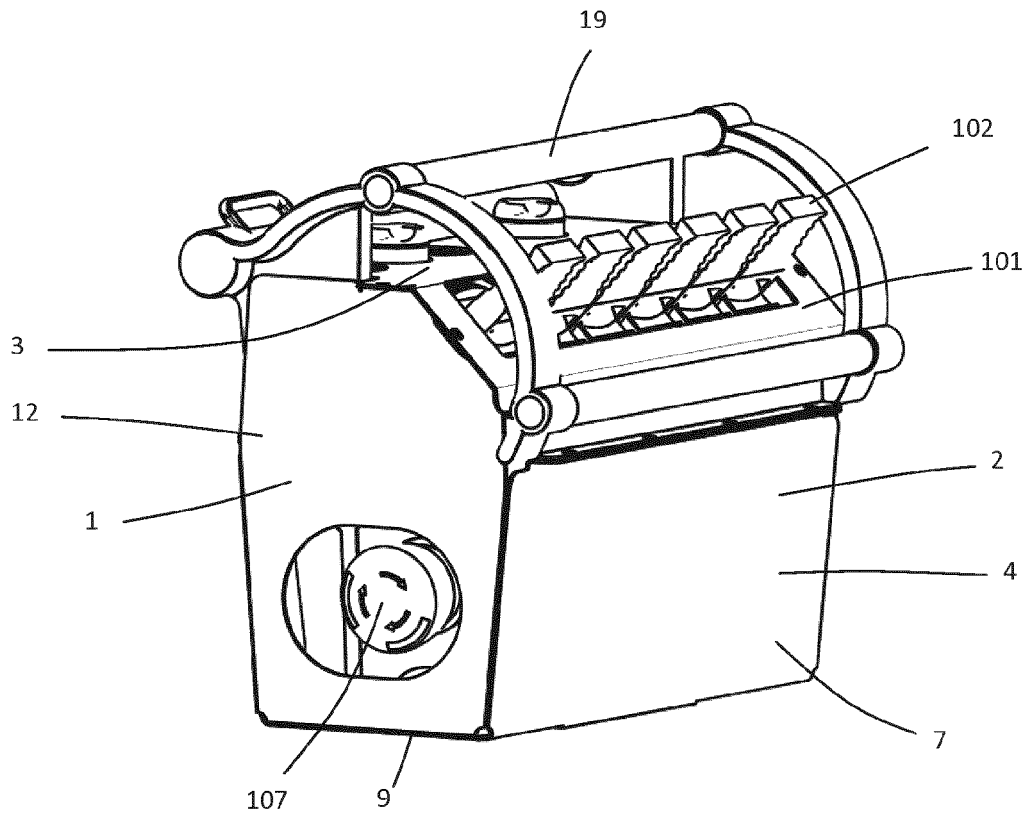


FIG. 4

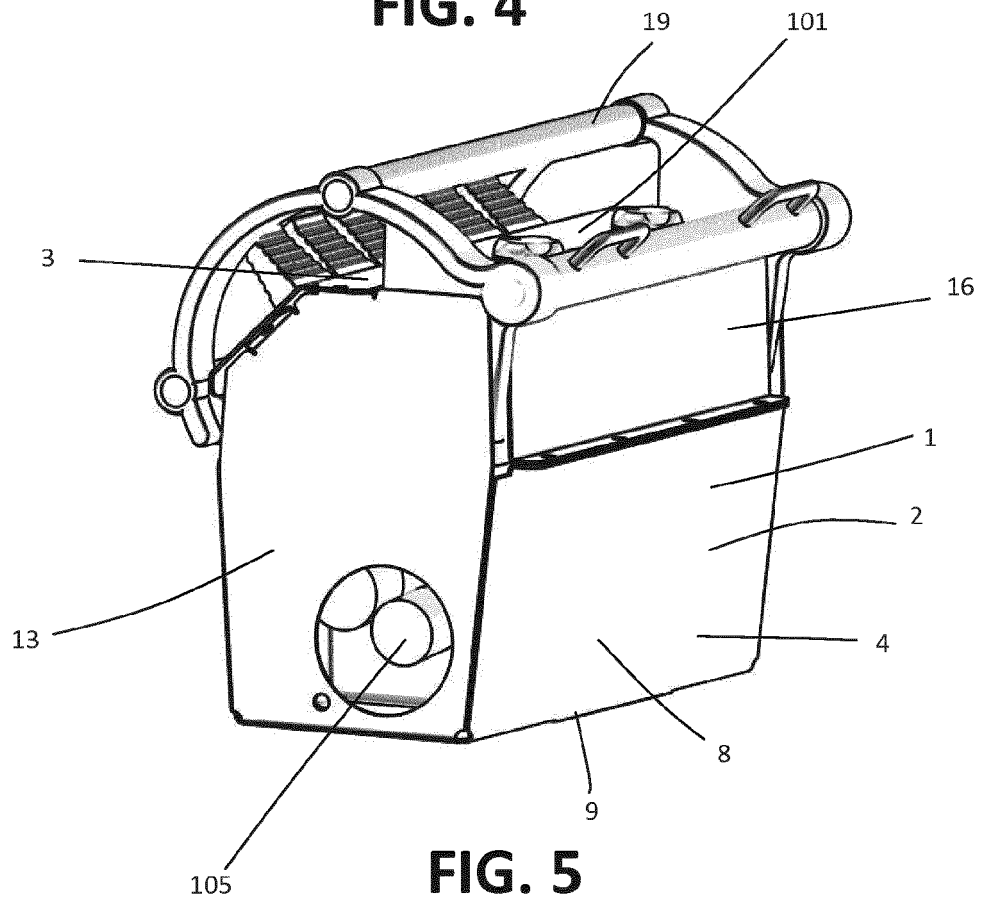
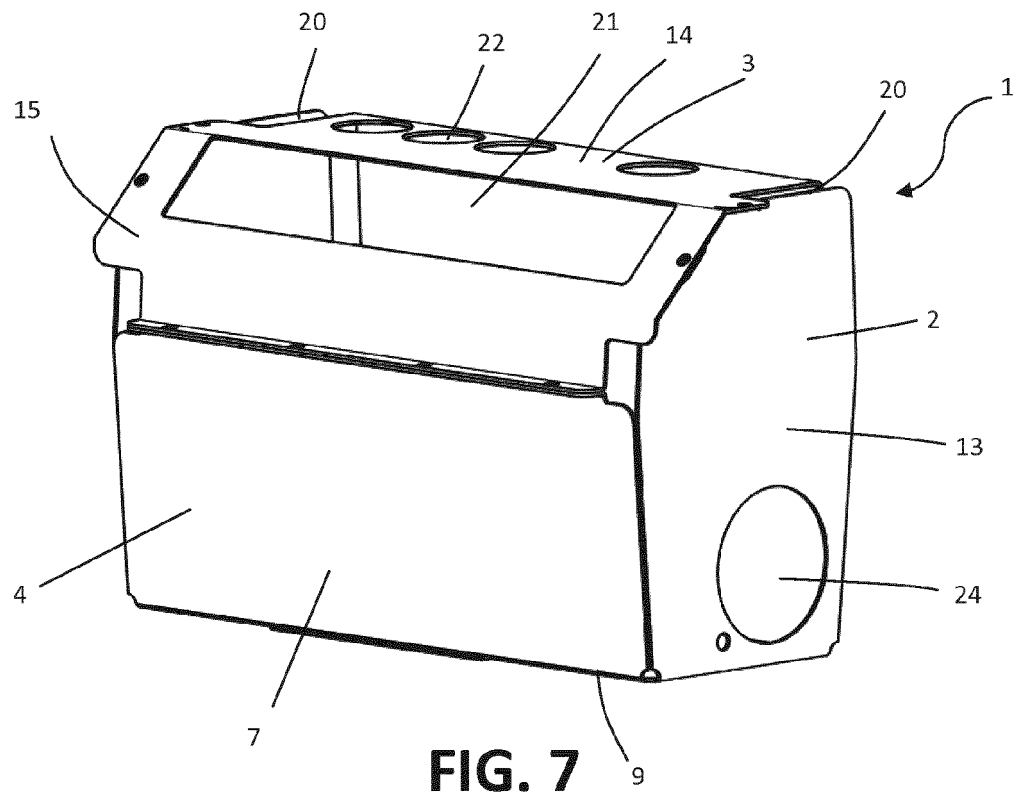
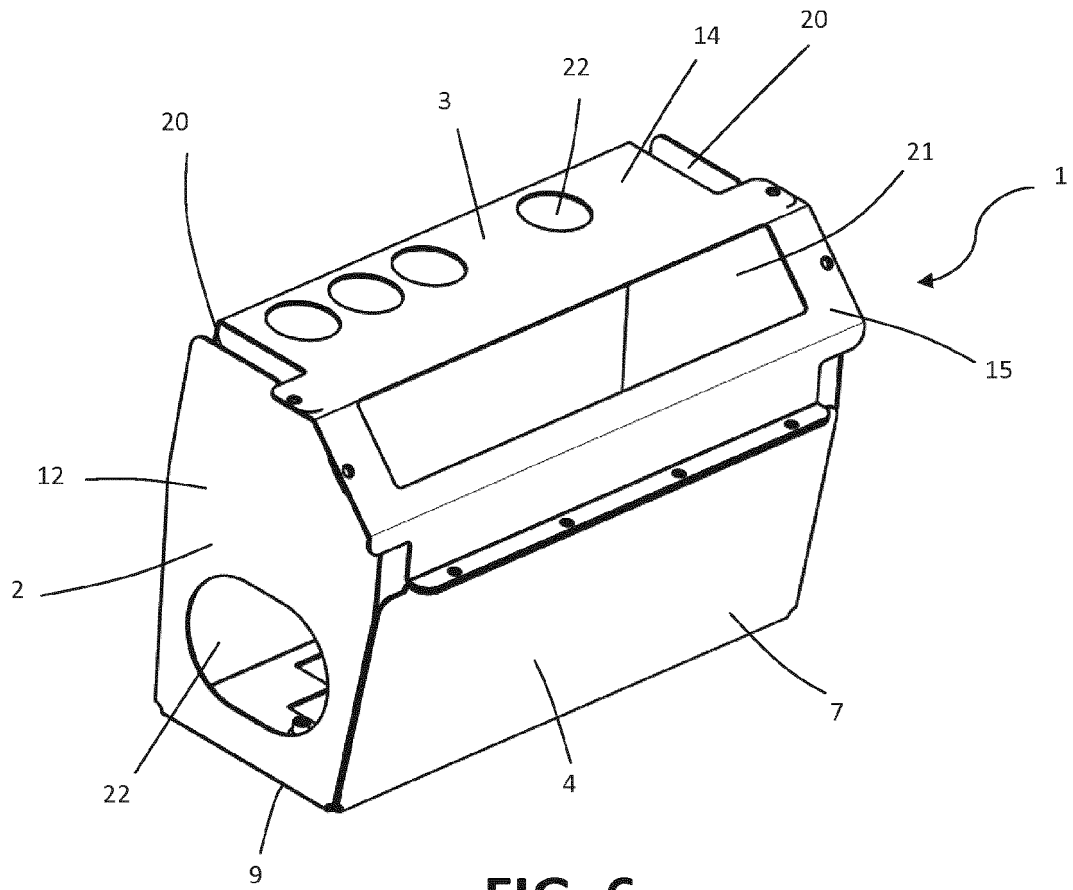


FIG. 5



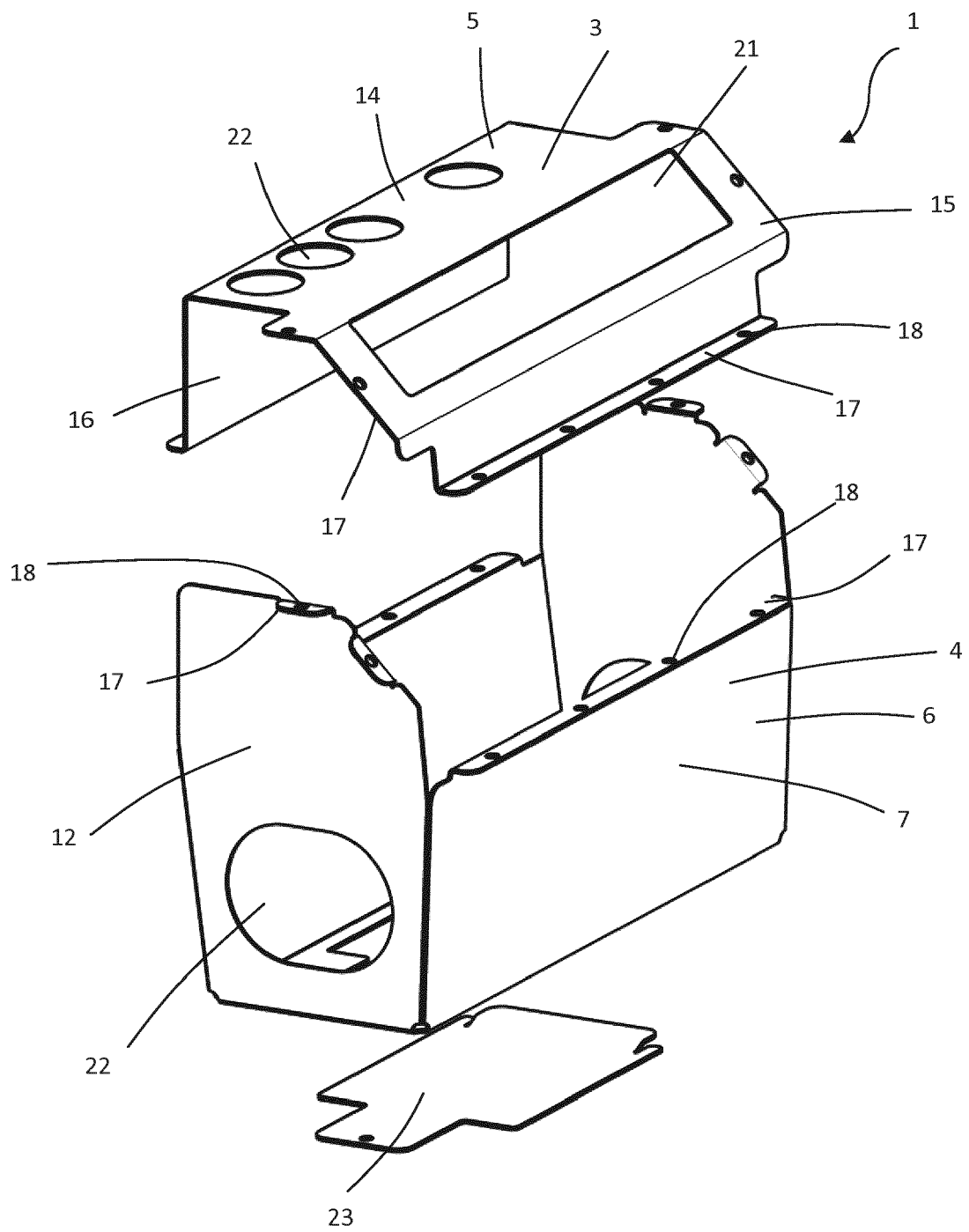


FIG. 8



EUROPEAN SEARCH REPORT

Application Number
EP 19 18 1226

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	DE 20 2010 007057 U1 (WEYHOFEN JUERGEN [DE]) 26 August 2010 (2010-08-26) * abstract * * figures *	1,7,10,14	INV. B66C13/40
A	US 2010/110620 A1 (HAUG THOMAS [DE]) 6 May 2010 (2010-05-06) * abstract * * paragraph [0002] * * paragraph [0020] * * figures *	1	
A	CN 201 746 235 U (CHINA CHANGJIANG ENERGY CORP GROUP) 16 February 2011 (2011-02-16) * abstract *	1	
T	Acculift: "Retrofitting Remote Controls For Overhead Cranes", 2 May 2019 (2019-05-02), XP055585254, Retrieved from the Internet: URL:https://acculift.com/remote-controls-for-overhead-cranes/ [retrieved on 2019-05-03] * page 2, last paragraph - page 3, paragraph 1 *		TECHNICAL FIELDS SEARCHED (IPC) B66C
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 11 December 2019	Examiner Sheppard, Bruce
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EP 19 18 1226

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 202010007057 U1	26-08-2010	NONE	

US 2010110620 A1	06-05-2010	DE 202006017127 U1	20-03-2008
		EP 2092814 A1	26-08-2009
		US 2010110620 A1	06-05-2010
		WO 2008055480 A1	15-05-2008

CN 201746235 U	16-02-2011	NONE	

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