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(54) **Security locking device for the cowl of an engine pod**

(57) Security locking device (100) for an indication device (40), the indication device (40) providing a warning signal when the fan cowl doors (10, 20) on an aircraft power unit nacelle are not properly latched, the indication device (40) being latched to the fan cowl doors by a primary locking device (101), the security locking device (100) comprising security locking means (102) providing a security alternative latch of the indication device (40)

over the fan cowl doors (10, 20), such that the security locking means (102) are latched only by closing the indication device (40) over the fan cowl doors (10, 20), without the need of any further operation. The invention further relates to an aircraft comprising an indication device (40) providing a warning signal when the fan cowl doors (10, 20) on the aircraft power unit nacelle are not properly latched, such that it also comprises a security locking device (100) as the one described above.

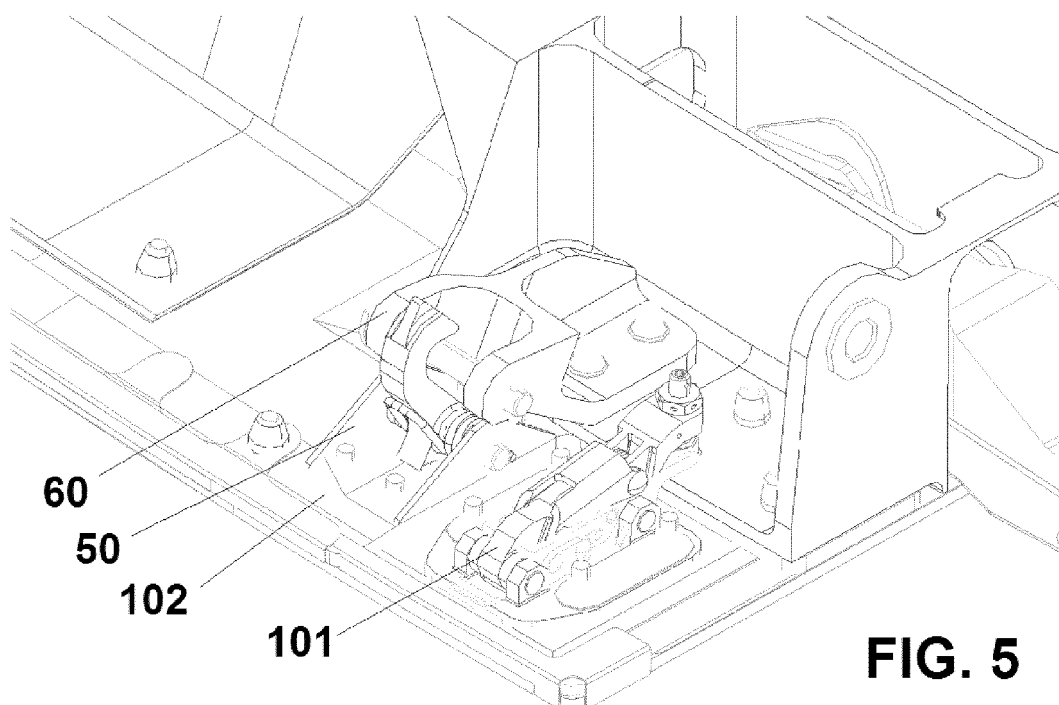


FIG. 5

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to a security locking device for assuring a correct closure of the fan cowl doors of an aircraft power unit nacelle.

BACKGROUND OF THE INVENTION

[0002] An aircraft having a power unit supported in the airframe mounted configuration comprises an engine and a nacelle structure housing said engine. The nacelle structure comprises two displaceable parts called fan cowl doors or cowlings which can be opened on the ground during maintenance operations to access the various items of the power unit, the cowlings or fan cowl doors being closed and properly latched during operational conditions of the aircraft, therefore providing aerodynamic continuity for the power unit in flight.

[0003] The nacelle usually comprises fan cowl locking means fixing and latching the fan cowl doors during operation of the aircraft.

[0004] The indication of fan cowl doors not being properly latched is not usually a signal that is sent to the cockpit to avoid false open-door signals. For this reason, a visual inspection of the nacelle is necessary to detect if fan cowl doors are not properly latched.

[0005] Therefore, it is necessary to provide a warning signal with high visibility when the fan cowl doors of an aircraft are not properly latched or locked. For this reason, apart from the fan cowl locking means that fix and latch the fan cowl doors, an indication device is also provided for indicating if these fan cowl locking means are not properly latched. This indication device comprises a panel fixed by rotating means on one of the two fan cowlings, the panel being closed on that one fan cowling by means of several primary locking means by rotating on said rotating means, therefore covering at least partially the fan cowl locking means of the fan cowl doors, such that all the fan cowl locking means have to be properly latched for the panel being closed. If the device is not closed, therefore being the fan cowl locking means not properly latched, the panel hangs vertically from the fan cowl door, providing a high visibility warning signal of the aircraft fan cowl doors not being properly latched or locked. This system is known from document EP 09784126.6, filed on 9 July, 2009.

[0006] However, sometimes the indication device (panel) is not properly latched by its primary locking means along its length, due to pollution (paint or stickers) on the primary locking means, therefore preventing a correct closure of said primary locking means, or because the maintenance personnel operating these latches (primary locking means) are not familiar with them, as these means are not easy to manipulate. Due to these reasons, the indication device (panel) hangs vertically during flight, therefore being blown or torn away in many occasions,

as it is not properly latched. It is therefore desirable to prevent the indication device from being lost.

[0007] It is known from document US 4,531,769 a latch for securing together a pair of hinged cowlings of an aircraft engine, this latch comprising a hook, a hook keeper and a safety lock, such that the safety lock engages the hook in the hook keeper when the latch is in a closed position, engaging the cowlings, and such that the safety lock engages the hook when the latch is in an open position, the cowlings being disengaged. The problem of this known solution is that it is difficult to manipulate and that, for the system to work properly, it is necessary to have an equilibrated and balanced position of the hook keeper and hook, occurring that sometimes, as the vibrations in these parts of the aircraft are very high, it may occur that a misalignment happens with the consequent default in the engaging of the latch, so the cowlings are not properly closed.

[0008] It is known from document US 5,620,212 a hook latch mechanism for joining two members of an engine cowl, comprising a hook latch mechanism on one of the members to be joined and a keeper together with a mounting bolt, carried in the second member engaged. This system has the problem of possible misalignment between the bolt and the hook, therefore causing that the latch mechanism is not properly secured. Besides, this mechanism can sometimes be not properly latched due to pollution in the mechanism or due to the maintenance personnel not being familiar with the operation of these systems.

[0009] The present invention is oriented to the solution of the above-mentioned drawbacks.

SUMMARY OF THE INVENTION

[0010] The present invention relates to a security locking device for assuring a correct closure of the fan cowl doors of an aircraft power unit nacelle.

[0011] The fan cowl doors of the nacelle structure of an aircraft housing an engine are closed when the aircraft is in flight by means of fan cowl locking means. Besides, in order to have a visual indication of these fan cowl doors being properly latched, an indication device, rotating over rotating means located in one of the two fan cowl doors, is provided, such that this indication device comprises a panel fixed on one of the two fan cowl doors by means of a primary locking device, such that, by rotating the panel on the rotating means the panel is latched over the fan cowl doors, covering at least partially the fan cowl locking means. According to the invention, a security locking device is provided, providing security alternative latching for the cited indication device.

[0012] The security locking device of the invention comprises security locking means providing the security alternative latch of the indication device, as these security locking means close automatically over the fan cowl locking means, without the need of further operation on the part of the maintenance personnel. Therefore, the indication device can be fixed by the primary locking device

and also by security locking means such that, even if the primary locking device does not properly latch the indication device over the fan cowl doors, the security locking means assure that the indication device is latched over the fan cowl doors, as the security locking means are latched without the need of being operated.

[0013] The primary locking device fixes the panel of the indication device on one of the fan cowl doors by rotating on the mentioned rotating means, such that the panel, once it is closed, covers at least partially the fan cowl locking means of the fan cowl doors. This primary locking device is designed having an equilibrated and aligned engaged status, also being of easy and friendly manipulation for the maintenance personnel. The security locking means give a further security latch for the indication device, preventing the detachment of the panel in the indication device in the case in which the primary locking device is not actuating properly, that is, in the case in which the primary locking device is not properly latched on the fan cowl door.

[0014] Other features and advantages of the present invention will be disclosed in the following detailed description of an illustrative embodiment of its object in relation to the attached figures.

DESCRIPTION OF THE DRAWINGS

[0015]

Figures 1 a and 1b show the location of the fan cowl doors in a typical aircraft nacelle configuration.

Figures 2a and 2b show schematically the location of the fan cowl locking means according to the prior art in the fan cowl configuration of an aircraft.

Figure 3 shows an indication device, according to the known prior art, being latched over the fan cowl doors by a primary locking device.

Figure 4 shows a perspective view from the inside of the fan cowl doors of the part of the primary locking device located on the panel of the indication device, according to the known prior art.

Figure 5 shows a perspective view from the inside of the fan cowl doors of the primary locking device and the security locking means when the indication device is in a closed position in an aircraft power unit nacelle according to the invention.

Figures 6a and 6b show perspective views of the inside of the fan cowl doors of the part of the security locking means located on the panel of the indication device and located on the fan cowl doors, respectively.

Figures 7a, 7b and 7c show different views of the part of the security locking means located in the indication device, for the fan cowl doors of an aircraft power unit nacelle according to the present invention.

Figures 8a and 8b show different views of the part of the security locking means located in the fan cowl

doors, for the fan cowl doors of an aircraft power unit nacelle according to the present invention.

Figure 9 shows a plan view of the panel of an indication device according to the known prior art.

Figure 10 shows a plan view of the panel of the indication device on which the security locking device of the present invention is located, this panel being thicker than the panel used in the prior art, as a primary locking device and a security locking device are comprised in it.

Figure 11 shows a plan view of the fan cowl door over which a panel with an indication device according to the known prior is engaged.

Figure 12 shows a plan view of the fan cowl door over which a panel with a security locking device according to the invention is engaged.

Figures 13 shows a schematic view of the indication device comprising a primary locking device and security locking means according to the invention, subjected to an air flow in flight.

Figure 14a shows a schematic view of the indication device according to the prior art closed by its primary locking device, in its nominal closed position.

Figure 14b shows a schematic view of the indication device according to the prior art closed by a security locking device according to the present invention, in the position in which the panel load is supported by said security locking device according to the present invention.

Figure 14c shows a schematic view of the indication device according to the present invention closed by the security locking device according to the present invention, in the position in which the panel load is supported by said security locking device according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0016] The present invention relates to a security locking device 100 for assuring a correct closure of the fan cowl doors 10, 20 of an aircraft power unit nacelle.

[0017] According to the known prior art, as it can be seen in Figures 1a, 1b, 2a 2b and 3, the fan cowl doors 10, 20 are closed by means of fan cowl locking means 30. Besides, in order to have a visual indication of these fan cowl doors 10, 20 being properly latched, an indication device 40 is provided, such that this indication device 40 comprises a panel 41 fixed by rotating means 42 on one of the two fan cowl doors 10 or 20. According to the known art, the panel 41 is fixed on one of the fan cowl doors 10 or 20 by a primary locking device 101.

[0018] According to the invention, a security locking device 100 is provided, providing security alternative latching for the correct latch of the cited indication device 40. The security locking device 100 of the invention comprises security locking means 102. The primary locking device 101 engages the panel 41 of the indication device 40 on one of the fan cowl doors 10 or 20 by rotating on

the mentioned rotating means 42, such that the panel 41, once it is engaged by the primary locking device 101, covers at least partially the fan cowl locking means 30. The primary locking device 101 is designed having an equilibrated and aligned engaged status, also being of easy and friendly manipulation for the maintenance personnel. The security locking means 102 of the invention give a further security latch, preventing the detachment of the panel 41 in the indication device 40 in the case in which primary locking device 101 is not properly latched on the fan cowl door 10 or 20.

[0019] The security locking means 102 of the invention act as a safety device, providing a positive lock or latch of the panel 41 over the fan cowl door 10 or 20, at the tip of the panel 41, when this panel 41 is slammed without any further operation or actuation. Therefore, the security locking device 100 of the invention avoids possible failures in cases where the fan cowl locking means 30 or the primary locking device 101 are not properly latched, as the security locking means 102 are latched automatically as the panel 41 in the indication device 40 is closed, without the need of further operation on the part of the maintenance personnel. The security locking means 102 comprise engaging means 50 located in the panel 41 engaging with receiving means 60 located in the fan cowl doors, 10 or 20 (see Figures 6a and 6b).

[0020] The primary locking device 101 will preferably have a design based on a pressure relief latch design, comprising an opening 6, typically a slot, than can be operated by means of a screwdriver, and adjusting means 7, typically a bolt, for setting the grip of the panel 41, preferably varying from 7 mm up to 12 mm. The kinematics of the primary locking device 101 is such that it ensures no contact in neither the opening nor in the closing sequences of operation of the panel 41 in the worst case of tolerances.

[0021] In a embodiment of the invention, the engaging means 50 in the security locking means 102 comprise a hook 51 rotating around a pin 52 by support bushings 53 and a spring 55, located on a support 54 installed in the panel 41 (see Figures 7a, 7b and 7c). This configuration allows a maximum mechanical rotation of the hook 51 that is calculated so that it is limited in such a way that an extra rotation from the operation personnel would not damage the engaging means 50. Typically, the maximum mechanical rotation of the hook 51 is of about 30°. The value of the elastic constant K of the spring 55 and the hook 51 inertia are selected such that the resonance frequency has a different value than the oscillation frequency of the engine, therefore avoiding coupling in frequencies with the engine. Preferably, the value of the elastic constant K of the spring 55 and the value of the hook 51 inertia are selected such that they avoid resonance frequencies under about 60 Hz.

[0022] The receiving means 60 located in the fan cowl doors, 10 or 20, comprise a catching element 61, preferably an axis or mounting bolt, over which the hook 51 engages, this catching element 61 being fixed to a brack-

et 63 by bushings 62 (see Figures 8a and 8b).

[0023] According to the invention, the cut-out of the fan cowl door 10 or 20 over which the panel 41 is engaged by means of the security locking device 100, has to be increased circumferentially in order to accommodate both the primary locking device 101 and the security locking means 102 (see Figures 11 and 12), the surrounding parts in the fan cowl being modified accordingly, and the attaching points for the lightning protection being also consequently relocated.

[0024] As it can be seen in Figure 10, the panel 41 comprises a new cut-out 205 for accommodating the security locking means 102. Furthermore, a new strip 200 is preferably provided, apart from the strip parts 201 and 202 in the known prior art being redesigned consequently, in such a way that the thickness of the panel 41 is locally increased, around the area where the security locking device 100 is located, avoiding possible gaps between the panel 41 and the fan cowl doors 10, 20, therefore avoiding that air enters through these gaps, tearing off the panel 41.

[0025] The security locking device 100 in the indication device 40 according to the invention is located next to the primary locking device 101 on the side of the panel 41 facing incoming airflow 90 during flight of the aircraft. The reason for this is that this security locking device 100 operates when the primary locking device 101 is not working properly (that is, when the primary locking device 101 is not properly latched), so that the security locking device 100 has to ensure that the airflow 90 which enters the region between the fan cowl doors 10, 20 and the panel 41 of the indication device 40 is minimized. This is achieved by ensuring that there is no space between the panel 41 in its closed position and the fan cowl doors 10, 20 on the side facing the incoming airflow 90.

[0026] Figure 14a, represents an indication device 40 with a panel 41 according to the known prior art, the panel 41 being closed by a primary locking device 101: this Figure shows the primary locking device 101 in its nominal closed position over the fan cowl doors 10, 20. There is no space, as it can be seen in this Figure, between the panel 41 and the fan cowl doors 10, 20 on the side facing the airflow 90.

[0027] The security locking device 100 of the invention is therefore designed so that it only supports the load of the panel 41 when the primary locking device 101 is not properly latching the panel 41, so the panel 41 is either supported by the primary locking device 101 or by the security locking means 102. As the security locking means 102 are a security measure, they are located in such a way that the hook 51 and the catching element 61 only enter into contact when the panel 41 falls from its nominal position (where it is latched to the fan cowl doors 10, 20 by the primary locking device 101) to the position where it is supported by the secondary locking means 102. This means that the closed position of the panel 41 of the indication device 40, when this panel 41 is supported by the security locking means 102, juts out

from the aerodynamic surface of the fan cowl doors 10, 20 slightly, as represented in Figure 14b. To avoid any flow of air from the airflow 90 from entering the space between the fan cowl doors 10, 20 and the panel 41, the panel 41 is thickened locally, around the area where the security locking device 100 is located, as it is clearly represented in Figure 14c.

[0028] The security locking means 102 are preferably located, together with the primary locking device 101, close to the edge of the indication device 40 (panel 41) facing the airflow 90. The reason is that the incorrect closure of the primary locking device 101 is what causes the existence of a gap between the panel 41 and the fan cowl doors 10, 20 through which air from the airflow 90 makes the panel 41 and the indication device 40 lift up and get lost in flight.

[0029] Modifications comprised within the scope defined by the following claims can be introduced in the preferred embodiments which have just been described.

Claims

1. Security locking device (100) for an indication device (40), the indication device (40) providing a warning signal when the fan cowl doors (10, 20) on an aircraft power unit nacelle are not properly latched, the indication device (40) being latched to the fan cowl doors by a primary locking device (101), **characterized in that** the security locking device (100) comprises security locking means (102) providing a security alternative latch of the indication device (40) over the fan cowl doors (10, 20), such that the security locking means (102) are latched only by closing the indication device (40) over the fan cowl doors (10, 20), without the need of any further operation.
2. Security locking device (100) according to claim 1, located close to the edge of the indication device (40) facing an airflow (90).
3. Security locking device (100) according to any of claims 1-2, wherein the security locking means (102) comprise engaging means (50) and receiving means (60), the engaging means (50) being located in the indication device (40) and engaging with the receiving means (60) located in the fan cowl doors (10, 20).
4. Security locking device (100) according to claim 3, wherein the engaging means (50) comprise a hook (51) and a spring (55), such that the value of the elastic constant (K) of the spring (55) and the value of the hook (51) inertia are selected such that they avoid the resonance frequencies of the aircraft engine.
5. Security locking device (100) according to claim 4, wherein the value of the elastic constant (K) of the
6. Security locking device (100) according to any of claims 4-5, wherein the maximum mechanical rotation of the hook (51) is calculated so that it is limited in such a way that an extra rotation from the operation personnel would not damage the engaging means (50).
7. Security locking device (100) according to claim 6, wherein the maximum rotation of the hook (51) is of 30°.
8. Security locking device (100) according to any of the preceding claims, wherein the indication device (40) comprises a panel (41) having increased thickness locally, around the area where the security locking device (100) is located.
9. Security locking device (100) according to any of claims 3-8, wherein the receiving means (60) comprise a catching element (61), over which the hook (51) engages, the catching element (61) being an axis or a mounting bolt.
10. Security locking device (100) according to any of the preceding claims, designed in such a way that it only supports the load of the indication device (40) in the case in which the primary locking device (101) is not properly latching the indication device (40).
11. Fan cowl doors for an aircraft power unit comprising a security locking device (100) according to any of claims 1-10.
12. Aircraft comprising an indication device (40) providing a warning signal when the fan cowl doors (10, 20) on the aircraft power unit nacelle are not properly latched, such that it also comprises a security locking device (100) according to any of claims 1-10.
13. Aircraft according to claim 12, wherein the security locking device (100) comprises a hook (51) and a spring (55), the elastic constant (K) of the spring (55) and the inertia of the hook (51) being selected such that they avoid the resonance frequencies of the aircraft engine.

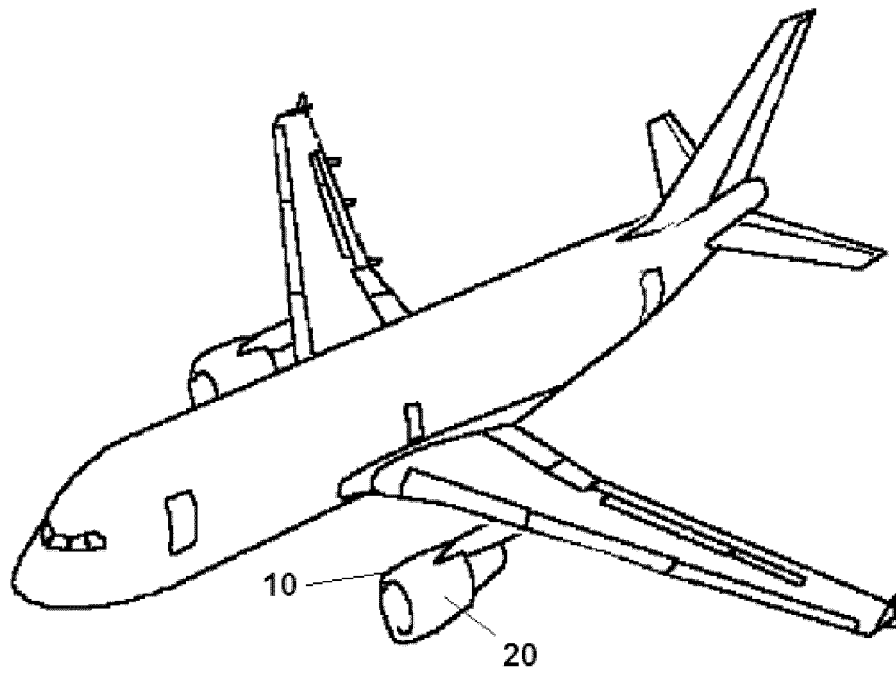


FIG. 1a

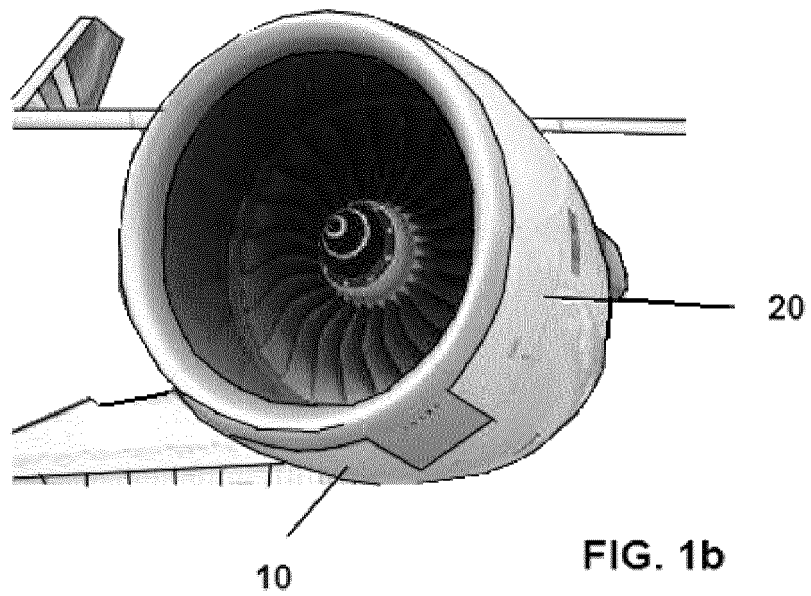


FIG. 1b

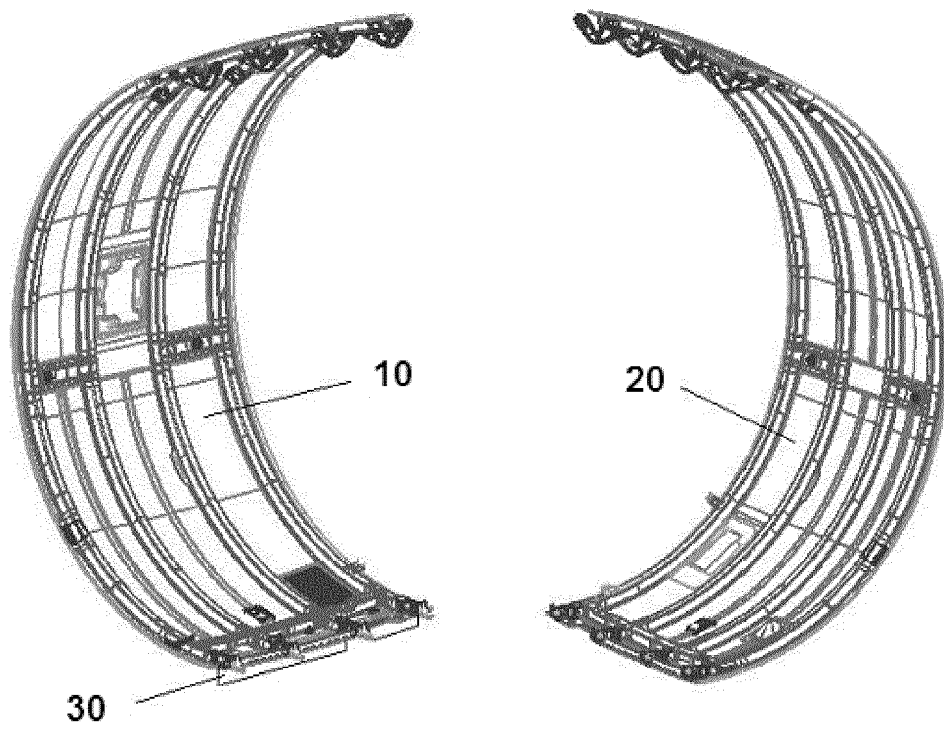


FIG. 2a

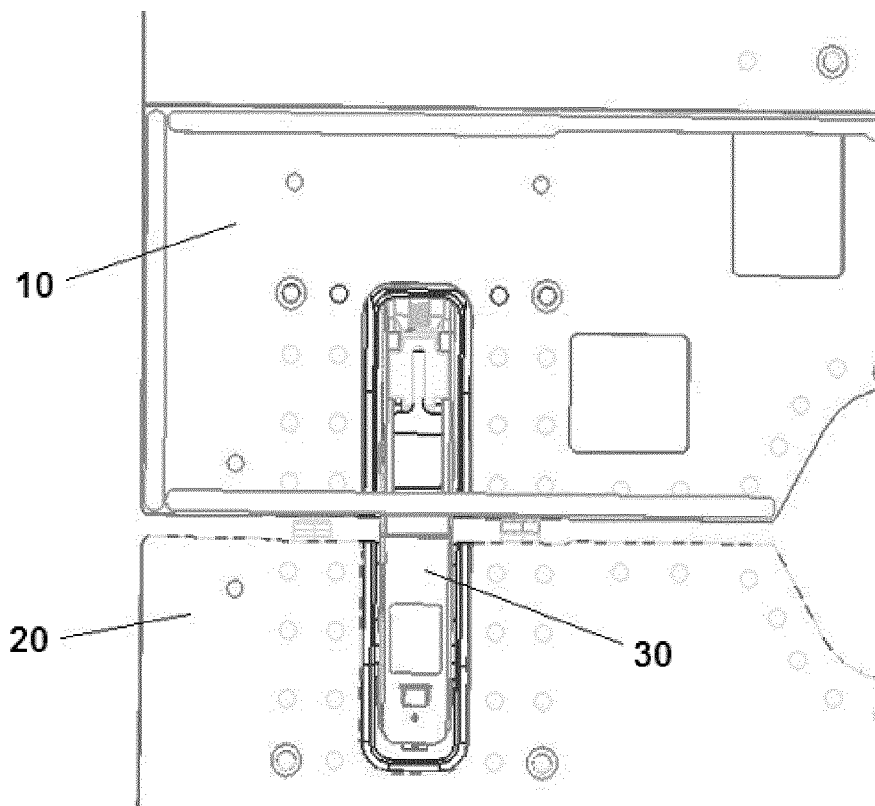


FIG. 2b

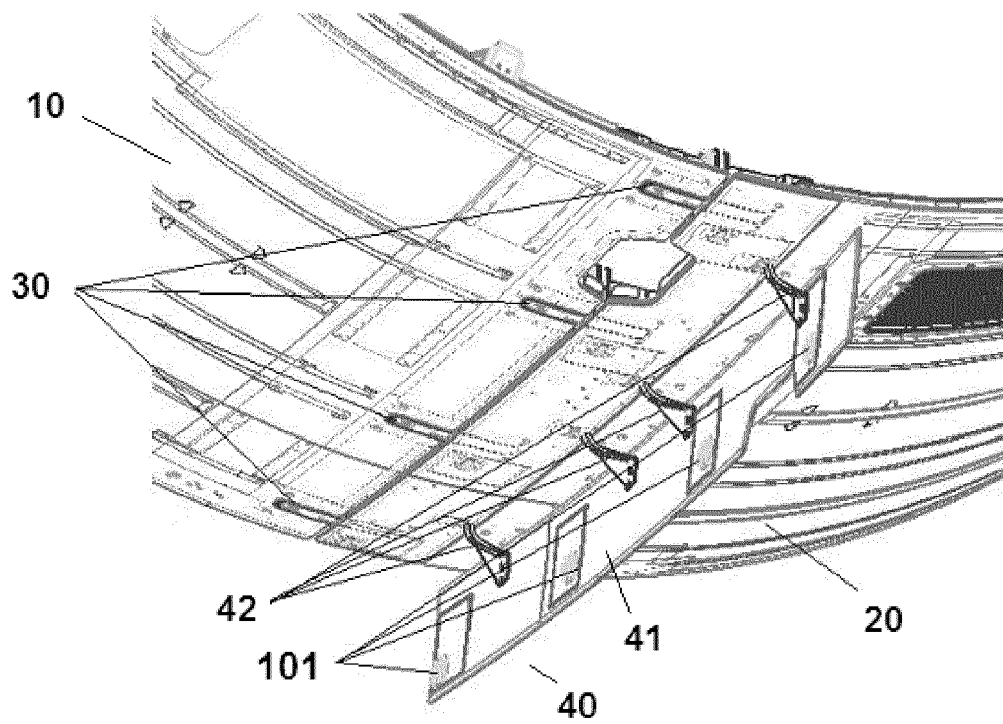


FIG. 3

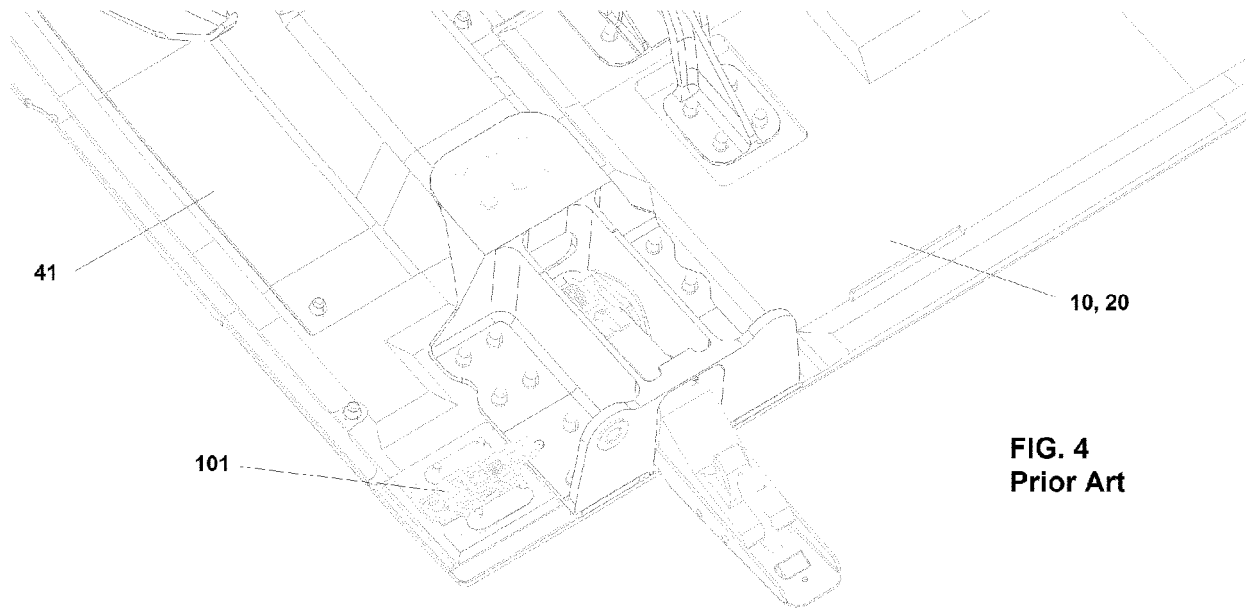


FIG. 4
Prior Art

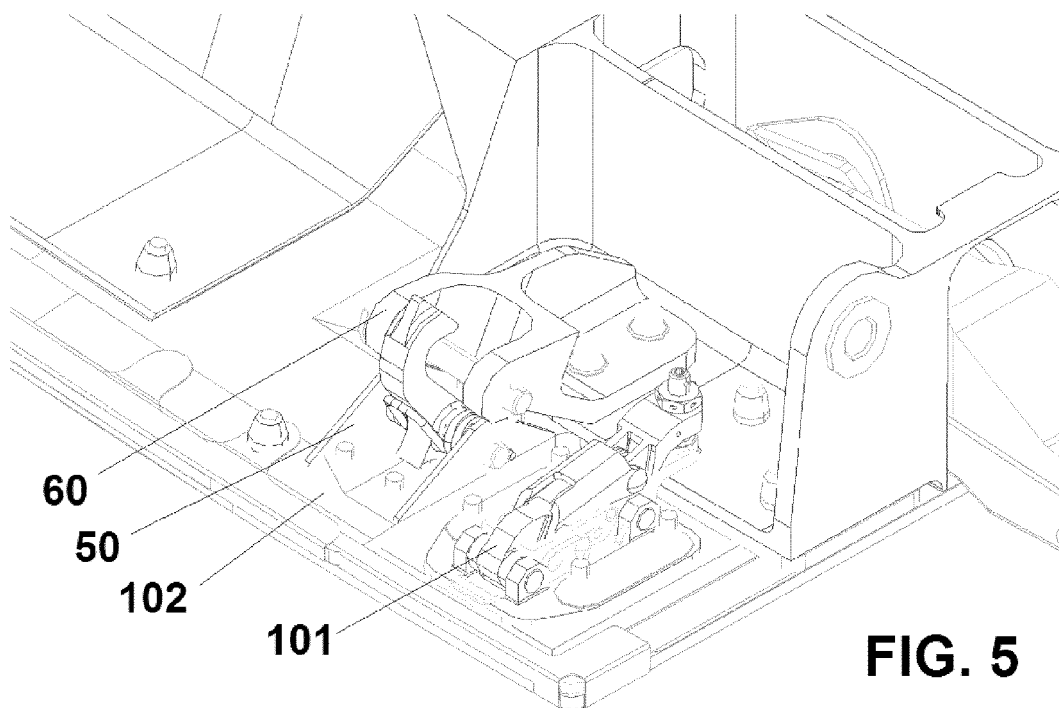


FIG. 5

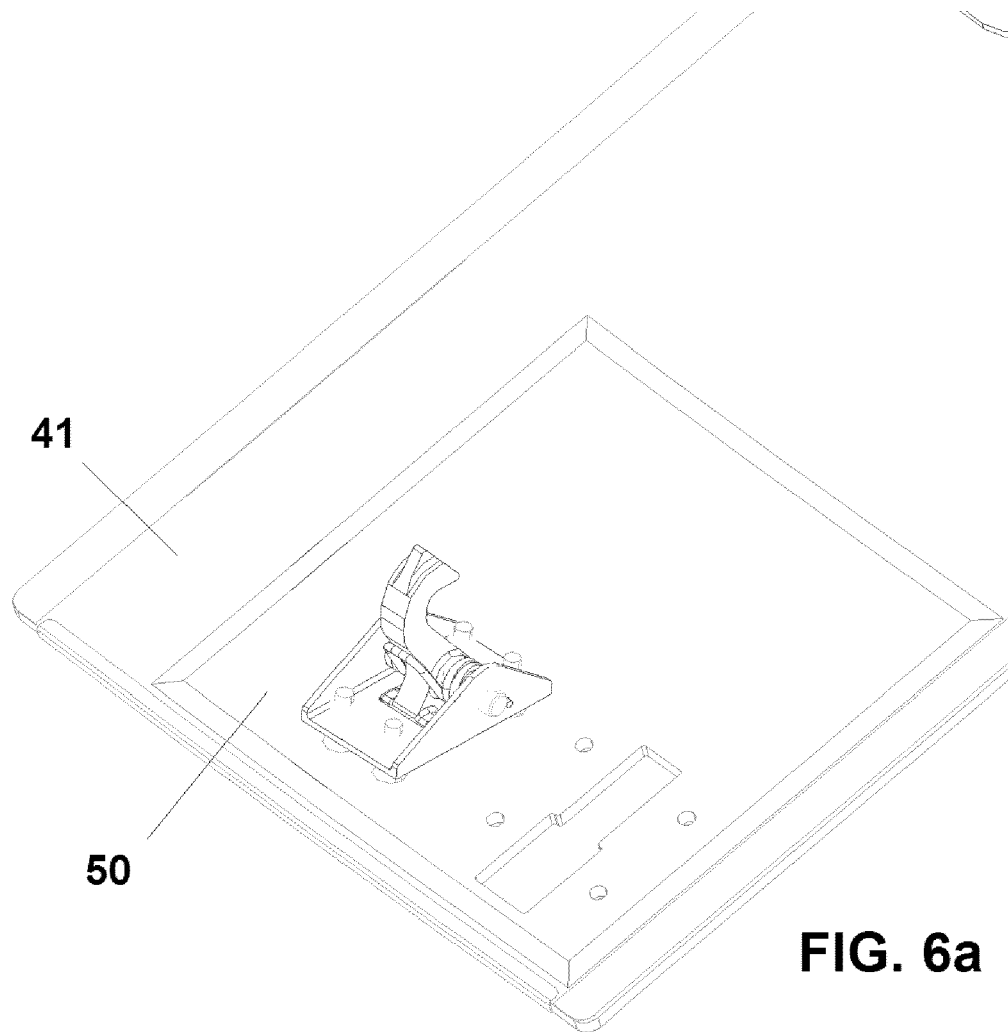


FIG. 6a

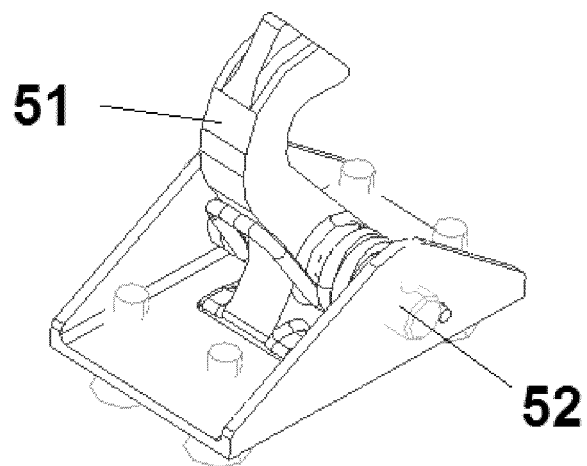
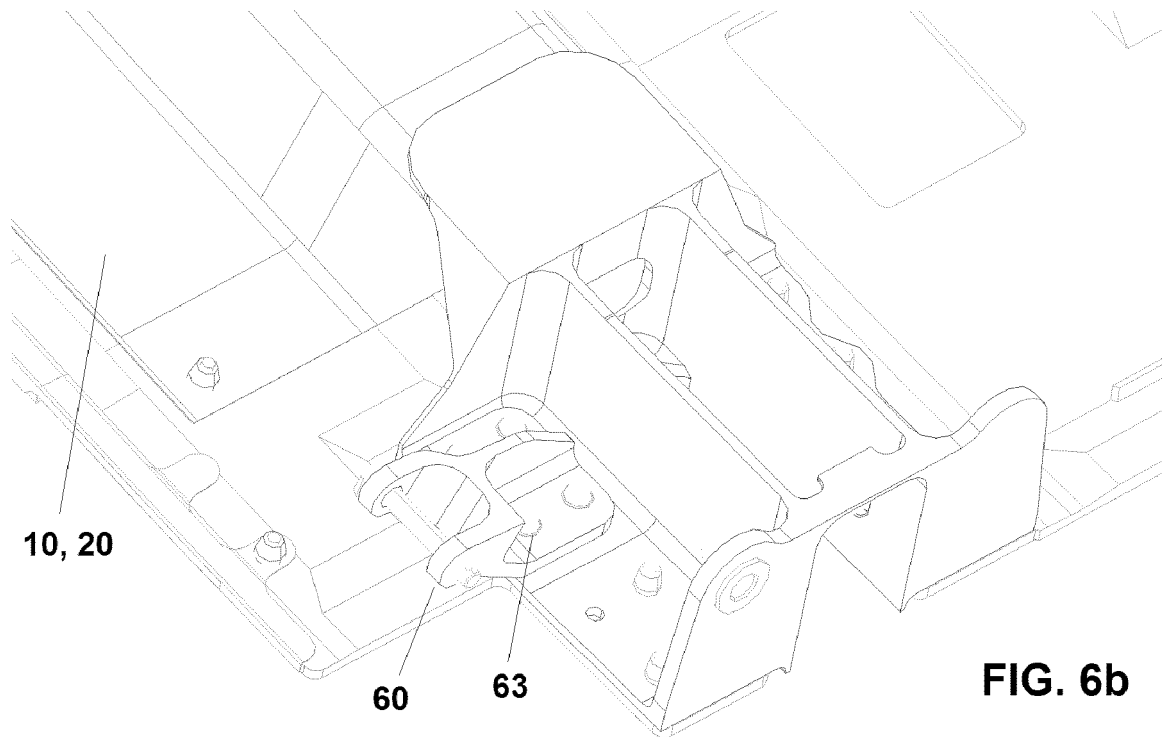


FIG. 7a

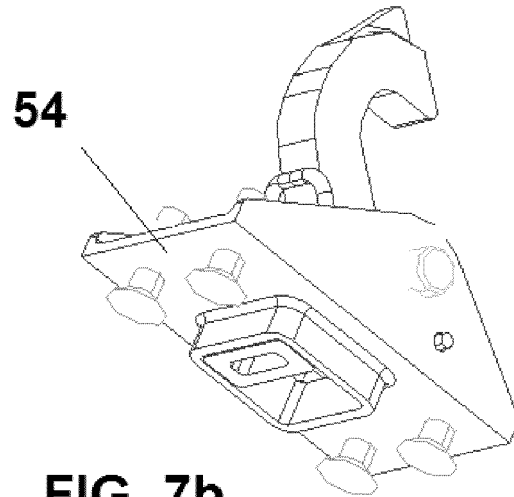


FIG. 7b

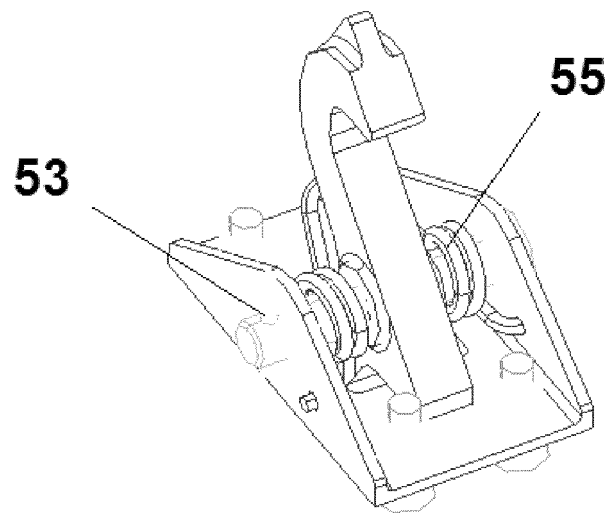
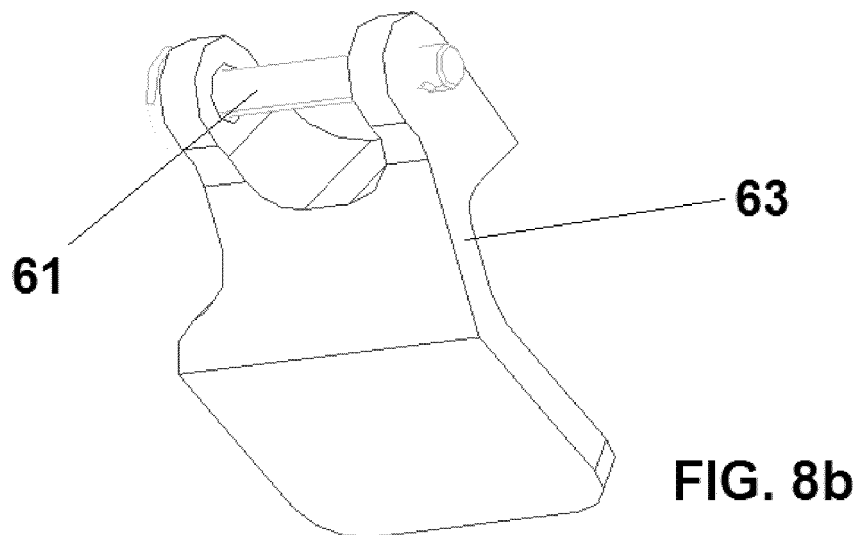
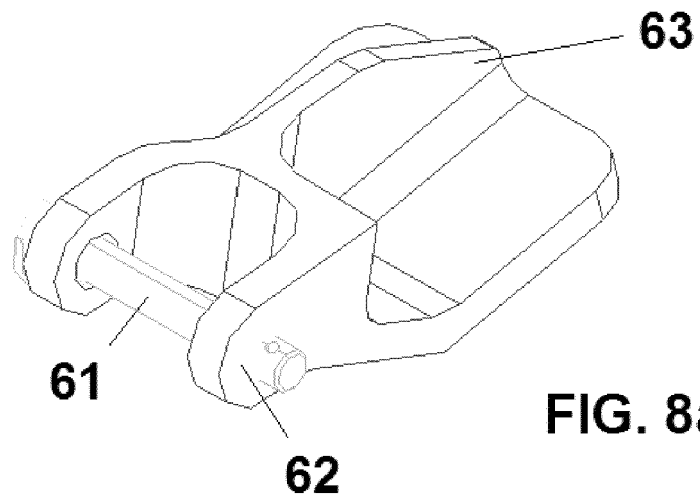


FIG. 7c



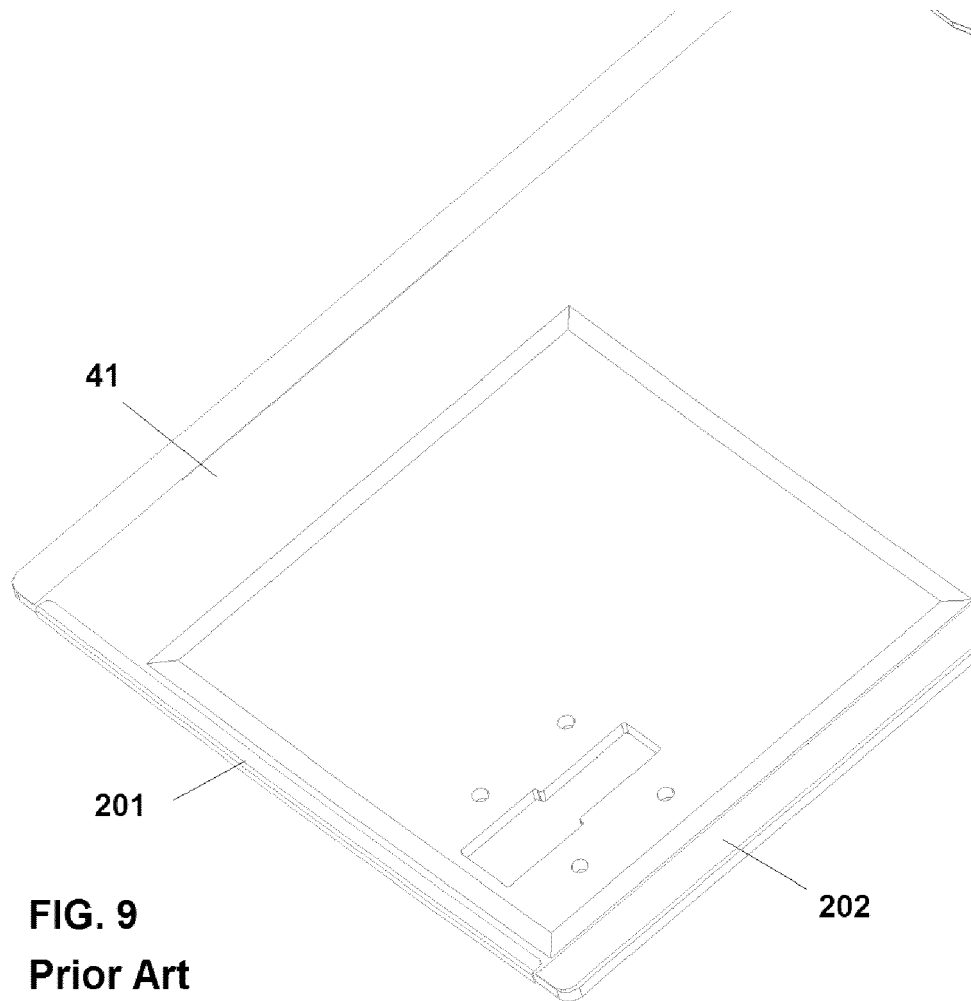
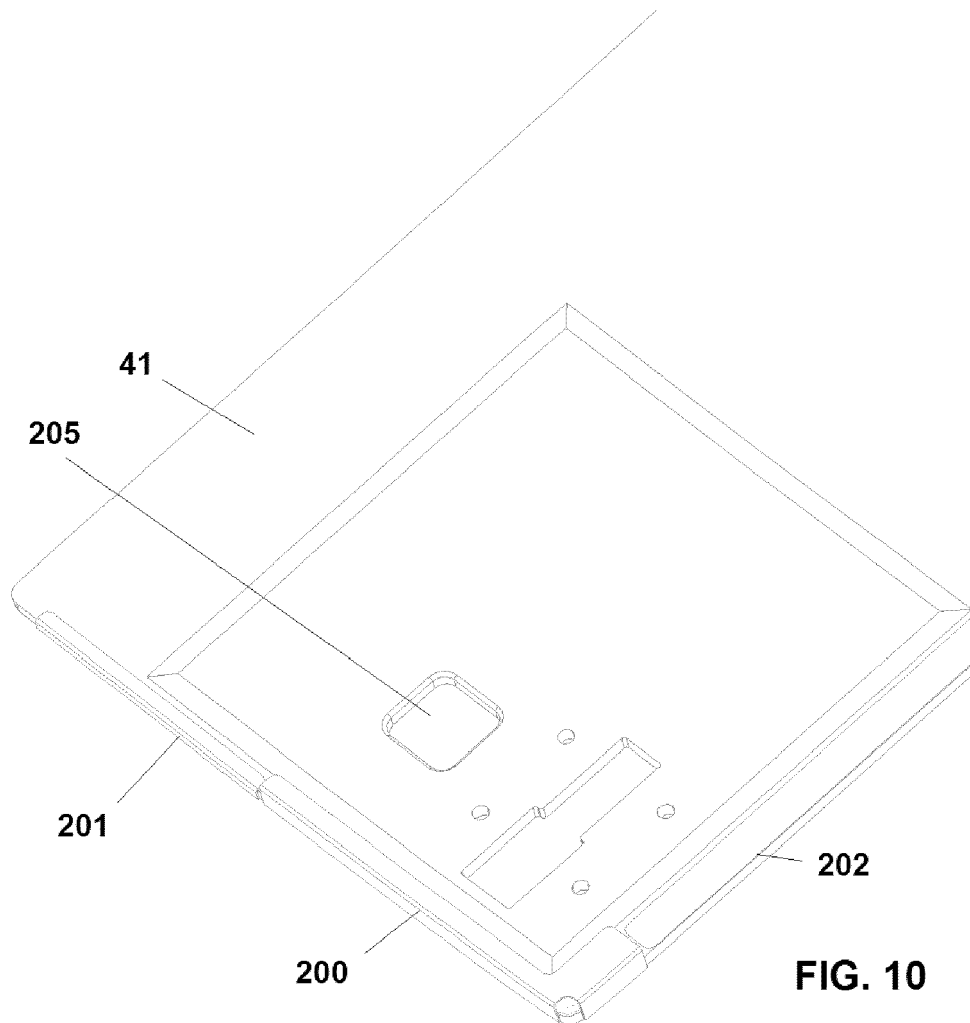


FIG. 9
Prior Art



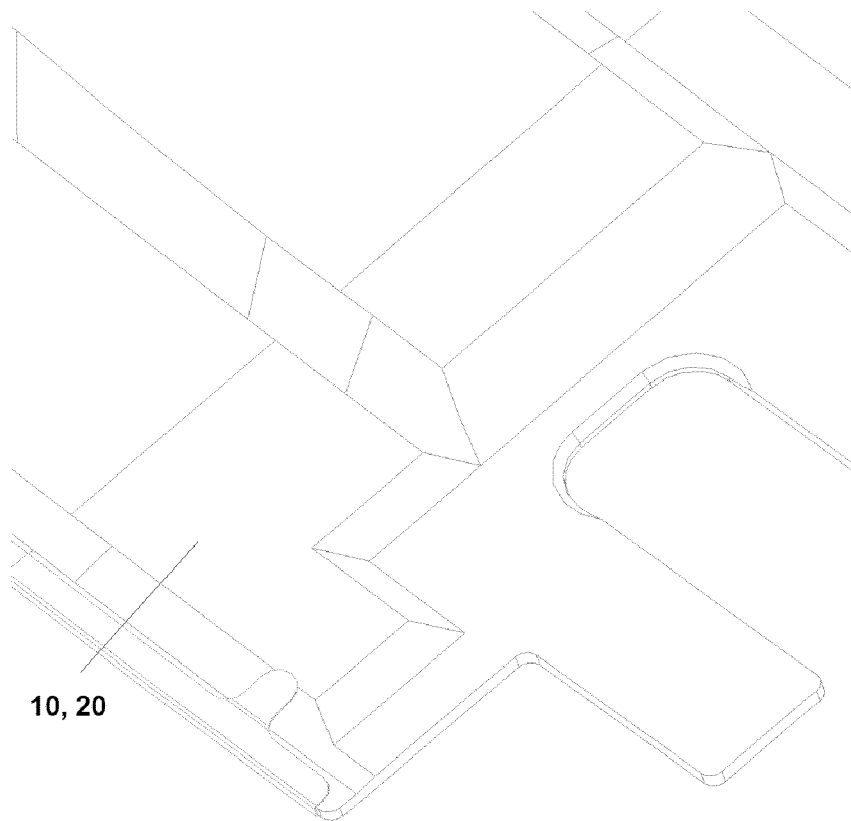


FIG. 11
Prior Art

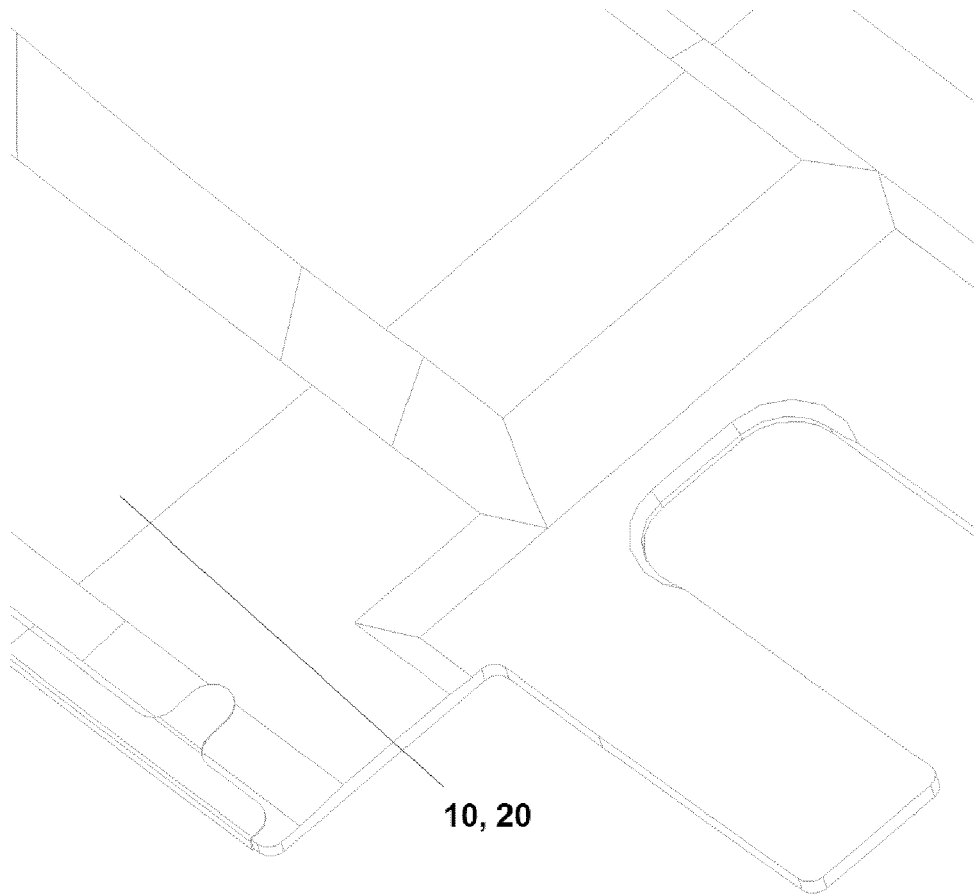


FIG. 12

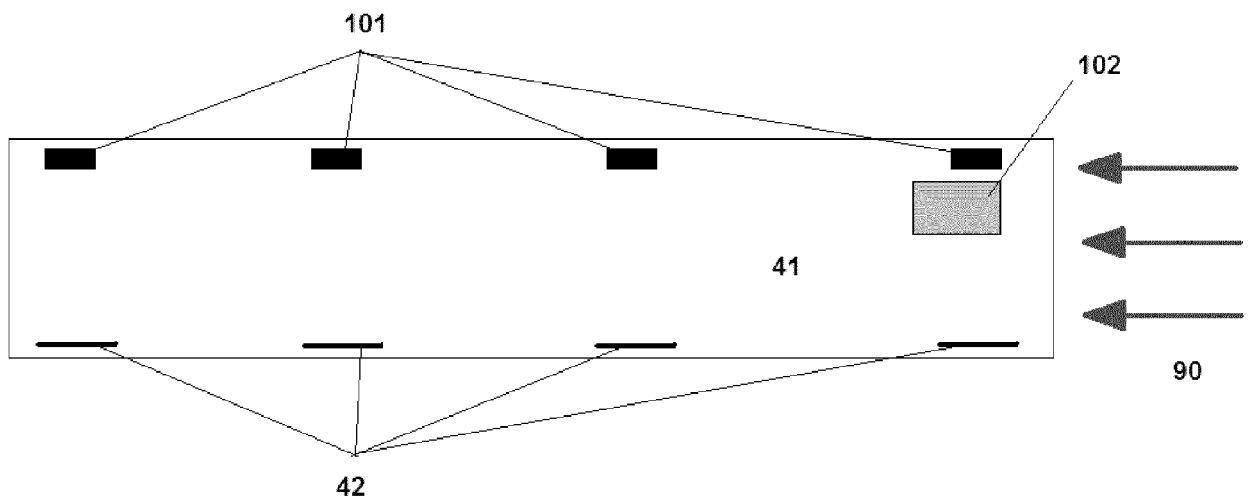


FIG. 13

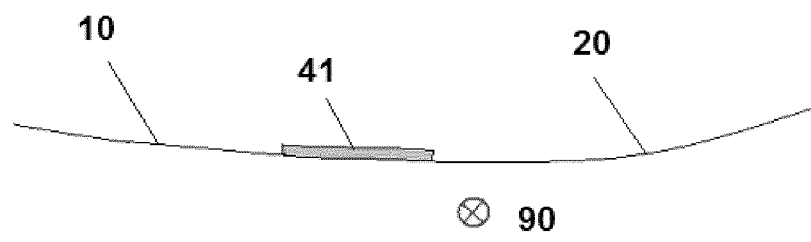


FIG. 14a

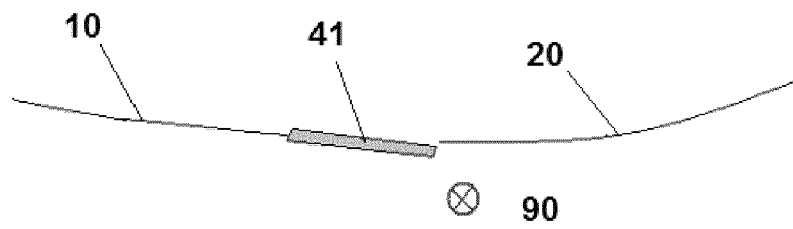


FIG. 14b

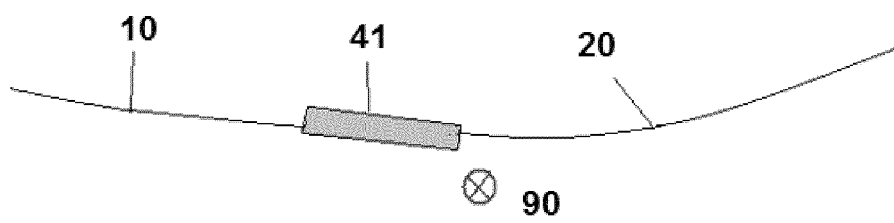


FIG. 14c



EUROPEAN SEARCH REPORT

Application Number
EP 11 38 2332

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 2 348 171 A1 (EUROCOPTER FRANCE [FR]) 27 July 2011 (2011-07-27) * paragraph [0045] - paragraph [0054]; figure 1 *	1-13	INV. B64D29/06 B64D45/00 E05B41/00
X	FR 2 916 425 A1 (AIRCELLE SA [FR]) 28 November 2008 (2008-11-28) * page 4, line 1 - page 9, line 14; figures 3-16 *	1-13	
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The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
			B64D E05C E05B B64C
Place of search		Date of completion of the search	Examiner
Munich		3 May 2012	Raffaelli, Leonardo
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 11 38 2332

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03-05-2012

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