



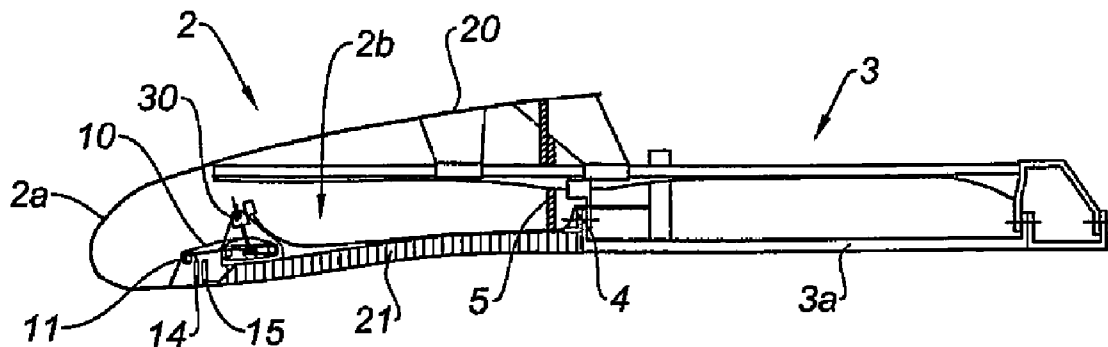
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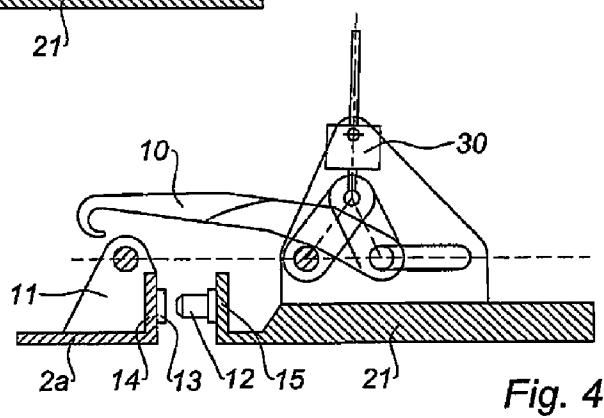
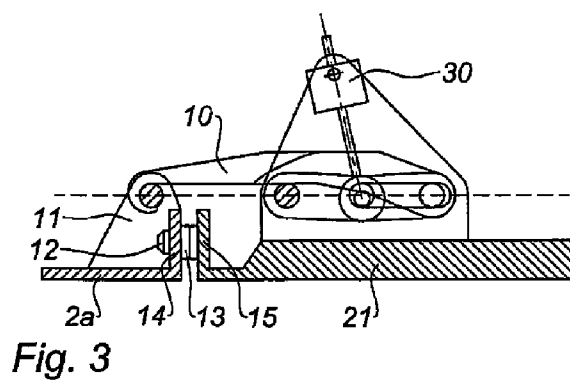
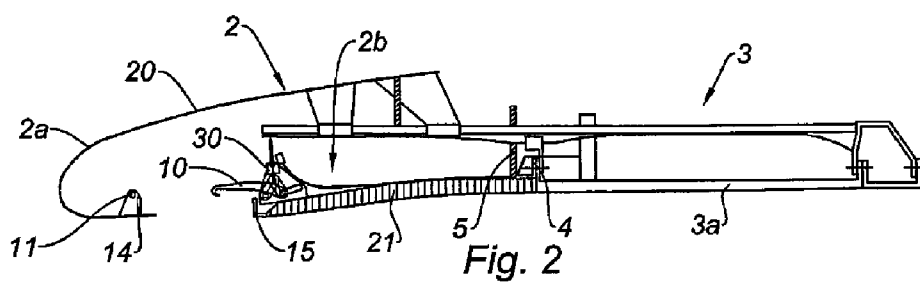
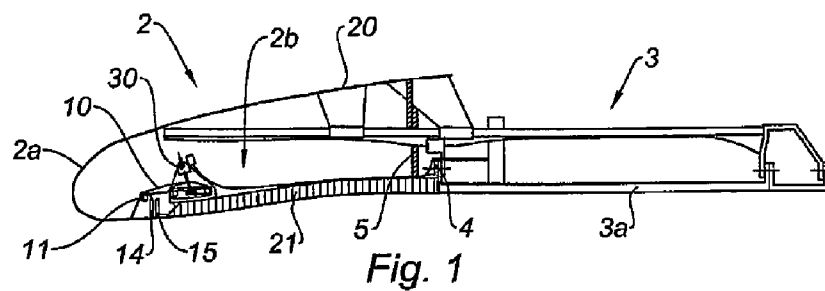
(19) **United States**(12) **Patent Application Publication**
Vauchel et al.(10) **Pub. No.: US 2011/0014044 A1**(43) **Pub. Date: Jan. 20, 2011**(54) **LOCKING SYSTEM FOR AIR INTAKE
STRUCTURE FOR TURBOJET ENGINE
NACELLE**(30) **Foreign Application Priority Data**

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Beilliard, Toulouse (FR)(51) **Int. Cl.**
F04D 29/40 (2006.01)(52) **U.S. Cl.** **415/214.1**(57) **ABSTRACT**Correspondence Address:
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The invention relates to a nacelle for a turbojet engine that comprises an air intake structure (2) capable of directing an air flow towards a fan of the turbojet engine, and an intermediate structure for surrounding said fan and to which the air intake structure is attached in order to ensure aerodynamic continuity, wherein the air intake structure includes, on the one hand, at least one inner panel (21) attached to the intermediate structure and defining with the latter a fixed nacelle structure and, on the other hand, at least one longitudinal outer panel (20) removably attached to the fixed structure and including an air intake lip (2a) in order to form a removable air intake structure, characterised in that the air intake structure is provided with peripheral locking means including at least one locking means (10) attached to the inner panel or to the air intake lip and each capable of interacting with an additional retaining means (11) respectively attached to the air intake lip or to the inner panel.

(73) Assignee: **AIRCELLE, GONFREVILLE**
L'ORCHER (FR)(21) Appl. No.: **12/865,842**(22) PCT Filed: **Nov. 21, 2008**(86) PCT No.: **PCT/FR2008/001631**§ 371 (c)(1),
(2), (4) Date: **Aug. 2, 2010**



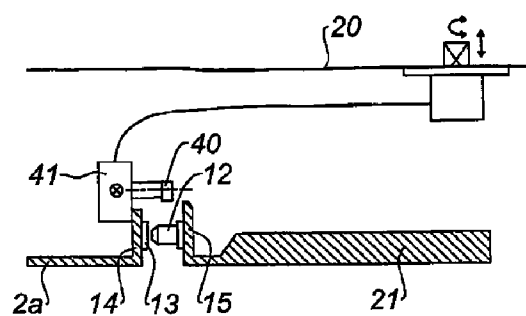


Fig. 5

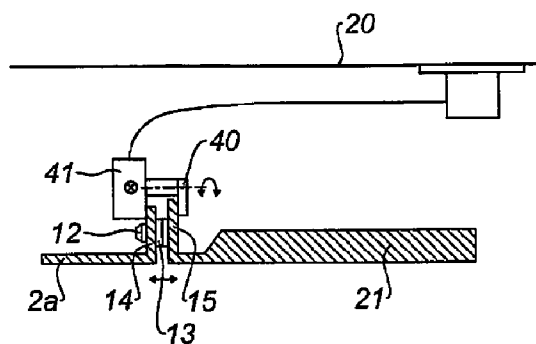


Fig. 6

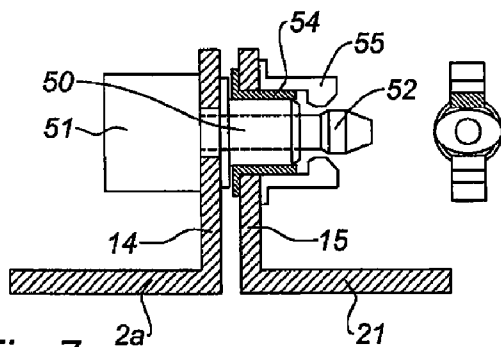


Fig. 7

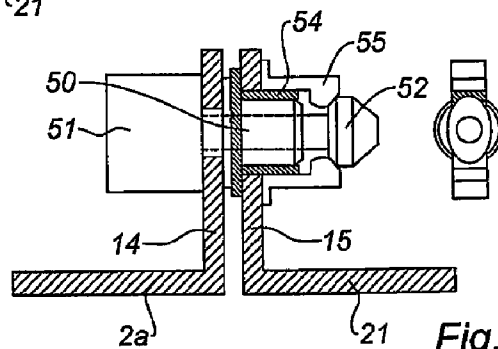
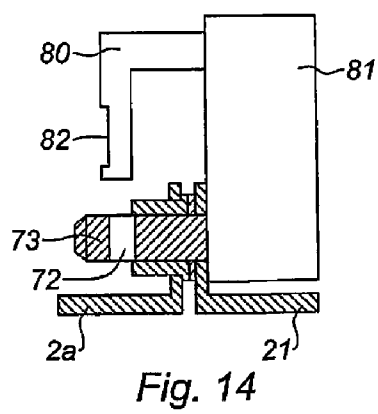
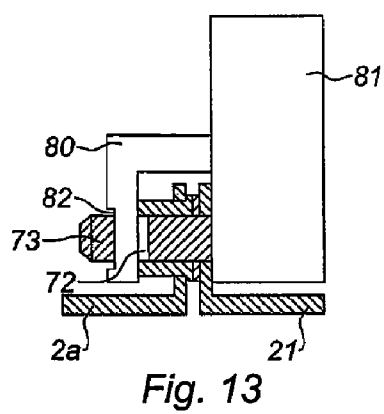
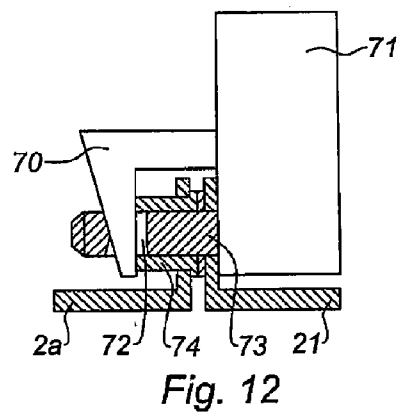
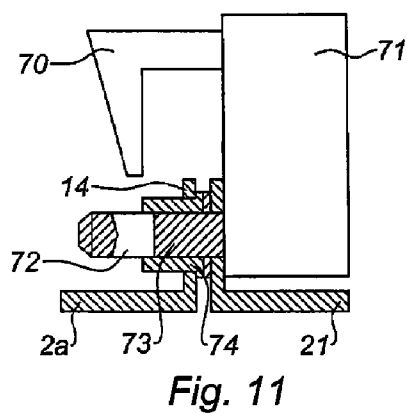
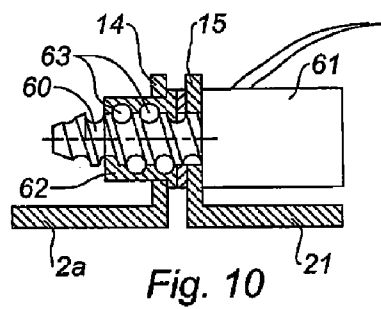
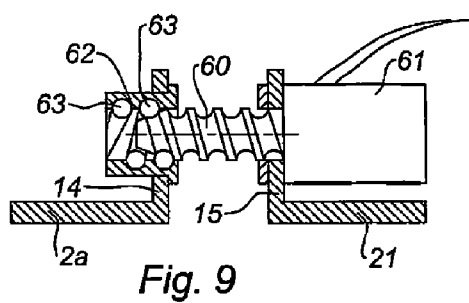


Fig. 8



LOCKING SYSTEM FOR AIR INTAKE STRUCTURE FOR TURBOJET ENGINE NACELLE

TECHNICAL FIELD

[0001] The present invention concerns a locking device for a translatable air intake structure equipping a turbojet engine nacelle.

BACKGROUND

[0002] An airplane is propelled by one or several propeller assemblies comprising a turbojet engine housed in a tubular nacelle. Each propeller assembly is attached to the airplane by a mast situated generally under a wing or at the fuselage.

[0003] A nacelle generally has a structure comprising an air intake upstream from the engine, a middle section designed to surround a fan of the turbojet engine, and a downstream section intended to surround the combustion chamber of the turbojet engine and housing thrust reverser means.

[0004] The air intake comprises, on one hand, an intake lip adapted to allow optimal collection toward the turbojet engine of the air necessary to supply the fan and the internal compressors of the turbojet engine, and on the other hand, a downstream structure on which the lip is attached and designed to suitably channel the air toward the blades of the fan, said downstream structure comprising an outer shroud and an inner acoustic panel. The assembly is attached upstream from a case of the fan belonging to the middle section of the nacelle.

[0005] The middle structure surrounds the fan and generally breaks down into an inner wall forming said fan case and an outer wall assuming the form of removable cowls mounted pivotably around a longitudinal axle forming a hinge in the upper portion (at 12:00) of the nacelle in order to allow access to the inside of the nacelle.

[0006] The assembly of these various elements (mobile cowls, case, air intake lip, outer shroud, acoustic panel) creates many aerodynamic breaks due to the presence of offsets and gaps between these elements inherent to their fastening together. Moreover, the mobile cowls are mounted on hinges, also generating aerodynamic disturbances.

[0007] One solution to improve the aerodynamic continuity of the outer surface of a nacelle was the object of French patent applications no. 06/08599 and no. 07/01256, not yet published.

[0008] This solution consists of integrating the air intake lip into the outer shroud, including all or part of the cowl there surrounding the fan case so as to form a single-piece structure. The whole of the wall thus formed is mounted mobile in translation.

[0009] The French patent application, not yet published, registered under number 07/03699 describes a manual locking system of said air intake structure and an associated manual system for helping the translation.

[0010] In a turbojet engine nacelle having such a translatable structure, the inner edge of the air intake lip comes, when said translatable structure is in closed position, into contact with a zone upstream from an inner wall of the air intake structure, inner wall generally realized in the form of an acoustic panel.

[0011] The translatable structure is guided and maintained on a fixed structure, comprising the inner wall of the air intake structure, by a plurality of rails.

[0012] The interface is made sealed by a joint system and is reinforced by a system of centering pins arranged on the periphery of the air intake lip/acoustic shroud junction and making it possible to improve its resistance to radial movements.

[0013] The maintenance of the mobile structure along longitudinal directions is done primarily by bolting the mobile structure on a fixed structure in a zone close to an installation interface of the acoustic shroud on the fan case.

[0014] Such a locking system therefore requires a large number of fixing means, the assembly and disassembly of which are long and tedious.

[0015] Moreover, the interface between the air intake lip and the inner acoustic panel is of particular importance, because said interface must penalize the internal aerodynamic continuity of the nacelle as little as possible and avoid any deformation of the interface as much as possible during load stresses undergone by the air intake or the inner acoustic panel.

[0016] Also known is a manual locking system comprising a system for gripping the mobile structure by the handle at the end of maneuver of the structure. This technique makes it possible to avoid a long and tedious assembly/disassembly with a system of maintenance by bolting. However, such a system is not suited to motorized driving of the mobile structure since the manual drive system and the locking are coupled. One will also note that adjusting the prestressing of the bolts is also long and tedious.

[0017] Because of this, there is a need for a locking system of such a mobile structure making it possible to resolve all or part of these problems.

BRIEF SUMMARY

[0018] To do this, the present invention concerns a nacelle for a turbojet engine comprising an air intake structure capable of directing an air flow towards a fan of the turbojet engine and a middle structure for surrounding said fan and to which the air intake structure is attached in order to provide aerodynamic continuity, the air intake structure comprising, on one hand, at least one inner panel attached to the middle structure and defining, with the latter, a nacelle fixed structure and, on the other hand, at least one longitudinal outer panel removably attached to the fixed structure and including an air intake lip in order to define a removable air intake structure, characterized in that the removable air intake structure is provided with peripheral locking means including at least one electric lock attached to the inner panel or to the air intake lip and each capable of interaction with a complementary retaining means attached to the air intake lip or to the inner panel, respectively.

[0019] Thus, by equipping the junction between the air intake structure and the inner panel with discrete locking means, easy to actuate remotely, it is possible to thus easily ensure optimal resistance of a junction capable of resisting deformation stresses.

[0020] According to a first embodiment of the invention, the locking means comprises a hook. Advantageously, the hook is a hook with three-point projection system.

[0021] According to a second embodiment, the hook is a rotating hook.

[0022] Preferably, the complementary retaining means is a yoke. Also preferably, the complementary retaining means assumes the form of a return presented by one end of the air intake lip or of the inner panel.

[0023] Advantageously, the inner panel or the air intake lip comprises at least one centering pin capable of cooperating with a corresponding bore of the air intake lip or of the inner panel, respectively.

[0024] According to a first alternative, the centering pin is mounted rotatably mobile and has a first end in the form of a cam capable of passing alternately between an unlocking position in which the cam-type end can be removed from the complementary retaining means and a locking position in which the cam-type end abuts against the complementary retaining means and cannot be removed from it.

[0025] According to a second alternative, the centering pin is mounted rotatably mobile and has an outer thread capable of cooperating with an inner tapping of the corresponding bore. Advantageously, the tapped bore comprises a ball bearing system.

[0026] Advantageously, the centering pin has a transverse bore capable of forming a complementary retaining means.

[0027] According to another alternative, the locking means is an electric locking means capable of being remotely controlled.

[0028] According to still another embodiment, the locking means is a manual locking means capable of being remotely controlled by a manual drive means of the cable type or cardan mechanical return type.

[0029] Advantageously, the control means of the locking means are centralized.

[0030] Also advantageously, the control member is a handle, preferably retractable, capable of allowing the driving of the air intake structure in motion.

[0031] Preferably, the electric bolt(s) is/are associated with at least one means for detecting the locking and/or unlocking position.

[0032] Advantageously, the prestressing of the locking means is adjustable.

BRIEF DESCRIPTION OF THE DRAWINGS

[0033] The implementation of the invention will be better understood with the detailed description below in light of the appended drawing, in which:

[0034] FIG. 1 is a partial diagrammatic illustration of an air intake structure of a nacelle according to the invention, the air intake structure being in the closing position.

[0035] FIG. 2 is a partial diagrammatic illustration of the air intake structure of FIG. 1, the air intake structure being in the opening position.

[0036] FIG. 3 is an enlarged diagrammatic illustration of a three-point bolt in the locking position.

[0037] FIG. 4 is an enlarged diagrammatic illustration of the bolt of FIG. 3 in the opening position.

[0038] FIG. 5 is a diagrammatic illustration of a locking method by rotating hook, said hook being in the opening position.

[0039] FIG. 6 is an illustration of the rotating hook of FIG. 5 in the locking position.

[0040] FIG. 7 is an illustration of a locking mode by rotating pin having an end forming a cam, said pin being in the unlocking position.

[0041] FIG. 8 is an illustration of the pin of FIG. 7 in the locking position.

[0042] FIGS. 9 and 10 show a locking mode via threaded rotating pin.

[0043] FIGS. 10 to 14 show two locking modes by hooking of a centering pin, by a beveled hook, respectively, and a hook having a cavity corresponding to the pin.

DETAILED DESCRIPTION

[0044] A nacelle according to the invention as partially illustrated in FIGS. 1 and 2 constitutes a tubular housing for a turbojet engine (not shown) for which it serves to direct the air flows it generates by defining inner and outer aerodynamic lines necessary to obtain optimal performance. It also houses different components necessary to the operation of the turbojet engine as well as related systems such as a thrust reverser.

[0045] The nacelle is intended to be attached to a fixed structure of an airplane, such as a wing, via a pylon.

[0046] More precisely, the nacelle has a structure comprising a front section forming an air intake 2, a middle section 3 (partially visible) comprising a case 3a surrounding a fan (not visible) of the turbojet engine, and a rear section (not visible) surrounding the turbojet engine and able to house a thrust reverser system (not shown).

[0047] The air intake 2 is divided into two zones, i.e. on one hand, an intake lip 2a adapted to allow optimal collection toward the turbojet engine of the air necessary to supply the fan and inner compressors of the turbojet engine, and on the other hand, a downstream structure 2b comprising an outer panel 20 and an inner panel 21, generally acoustic.

[0048] According to the nacelle of the prior art, to which the present invention is applicable, the lip 2a is integrated into the outer panel 20 so as to form a single disassemblable piece, the inner panel 21 being attached upstream from the case 3a of the fan belonging to the middle section 3 of the nacelle via fastening flanges 4, integral with an inner panel 21 and the case 3a, respectively.

[0049] The air intake structure 2 can be modular and comprise a plurality of outer panels 20 each defining a corresponding air intake lip portion 2a.

[0050] The inner panel 21 is made from an acoustic shroud and is connected via flanges 4 to the case 3a of the middle section 3. This inner panel 21 therefore constitutes a fixed part of the air intake structure 2 on which the outer panel 20, integrating the air intake lip 2a, is designed to be removably attached and fixed.

[0051] It will be noted that alternatively, the outer panel 20 can also comprise all or part of an outer panel of the middle structure.

[0052] To do this, each flange 4 can support a radial peripheral partition 5.

[0053] This partition 5 can support center finders and secondary center finders extending perpendicularly to said partition 5 toward the upstream of the nacelle.

[0054] It will also be noted that the air intake structure 2 can extend axially via its outer panel 20 beyond a valve guide plate of an inner plate 21 to the fixed structure of the nacelle 1 to be close to an outer structure of a thrust reverser structure belonging to the downstream section of the nacelle and possibly to cover the cowls. A system of bolts can then be provided to maintain the air intake structure on the partition 5 integral with the structure of the case or a structure upstream from the downstream structure.

[0055] It will also be noted that the radial peripheral partition 5 can be supported directly by the very structure of the fan case in order to provide a maximum inner envelope for the air intake 2.

[0056] The outer panel 20 integrating the air intake lip 2a therefore forms, according to the prior art, a removable portion designed to be attached on the fixed portion and more particularly on the peripheral partition 5.

[0057] Inner reinforcements of the existing inner and outer panels are not shown and depend on the stiffness desired by the person skilled in the art.

[0058] More particularly, the removable structure can be mounted, for example, on a rail/guideway sliding system comprising a plurality of rails/guideways distributed on the periphery of the air intake structure 2 and/or the case 3a.

[0059] According to the invention, the removable structure is maintained at the junction between the air intake lip using discrete locking means comprising at least one hook 10, in this case mounted on the inner panel 21, capable of cooperating with a complementary retaining means 11 of the yoke type, itself attached to the air intake lip 2a.

[0060] FIGS. 1 and 2 show the removable structure in the closed and open positions, respectively.

[0061] FIGS. 3 and 4 are an enlarged view of the locking hook 10 cooperating with the yoke 11. It will be noted that the interface between the air intake lip 2a and the inner panel 21 is completed by centering pins 12, arranged essentially at each hook 10 and supported by a peripheral return 15 of the inner panel 21, each cooperating with a corresponding bore 13 arranged in a return 14 of the air intake lip.

[0062] The described example uses a hook 10 with three-point locking system. Such a locking system is known in particular from document FR 2 857 400.

[0063] The lower shape of the hook 10 serves as a release ramp of the yoke 11 during the unlocking maneuver. In particular, the proper release of the hook 10 relative to the yoke 11 is ensured through the shape given to the hook 10 in contact with a fixed axis of rotation of a rod of the three-point system.

[0064] The projection of the three-point system makes it possible to ensure the security of the locking and be assured of the latter in all flight cases and in case of break of the drive system of the locking rods.

[0065] The hook 10 and the three-point locking system are actuated by an electric motor 30.

[0066] The locking and unlocking controls for the electric locking means are grouped together at an external control means of the nacelle and/or at the cockpit of the airplane.

[0067] The retaining means 11, of the yokes type, are positioned on the air intake lip 2a of the nacelle in a zone guaranteeing the best structural rigidity in order to avoid any deflection of that interface.

[0068] FIGS. 5 and 6 present a second embodiment of the locking comprising a rotating hook 40 driven by an electric motor 41 capable of engaging with the return 15 of the inner panel 21, which then serves as complementary retaining means.

[0069] The centering pins can also be used directly in the locking means.

[0070] Thus, FIGS. 7 and 8 show a third embodiment in which the centering pin 50 is passed through by a blocking cam 52 capable of being driven in rotation by an electric motor 51 supported by the return 14 of the air intake structure 2a.

[0071] The pin 50 is capable of cooperating with a bore 54 formed in the return 15 of the inner panel 21.

[0072] The return 21 also supports retaining means 55 of the cam 52 designed such that said cam 52 has an unblocking

position in which it can be removed from the retaining means 55 through the bore 54 and a blocking position in which it abuts against the retaining means 55, which then prevent its removal.

[0073] Of course, the cam 52 can be an integral part of the pin 50, which is then itself driven in rotation. Advantageously, the pin shall, however, be kept fixed in rotation.

[0074] FIGS. 9 and 10 present a screw locking system.

[0075] To do this, the return 15 of the inner panel 21 supports a threaded centering pin 60 capable of being driven in rotation by an electric motor 61. The centering pin 60 is capable of cooperating with a tapped bore 62 supported by the return 14 of the air intake lip 2a. The rotation can be improved by the presence of ball bearings 63.

[0076] FIGS. 11 to 14 illustrate a locking mode by wedging.

[0077] FIGS. 11 and 12 show a locking mode by wedging with beveled cam. In this case the inner panel 21 supports a hook 70 capable of being actuated essentially perpendicularly to the inner panel 21 by an electric motor 71. When the hook 70 is actuated in the direction of the inner panel 21, it is intended to penetrate a bore 72 arranged in a centering pin 73 when the latter has been inserted through a corresponding bore 74 of the air intake structure 2a.

[0078] The beveled form of the hook 70 allows adjustment of the prestressing of the locking system depending on the penetration depth of the hook 70.

[0079] FIGS. 13 and 14 illustrate a locking system by wedging and rectilinear retraction of the pin or cam.

[0080] In this case the inner panel 21 supports a straight hook 80 capable of being actuated essentially perpendicularly to the inner panel 21 by an electric motor 81. When the hook 80 is actuated towards the inner panel 21, it is intended to penetrate the bore 72 formed in the centering pin 73 when the latter has been inserted through a corresponding bore 74 of the air intake structure 2a.

[0081] A cavity 82 can be formed near one end of the hook 80. Once the hook 80 is brought into the locking position, the centering pin 73 can be actuated in the downstream direction so as to be placed in the cavity 82 of the hook 80 and block the latter.

[0082] For the unlocking phase, the pin 73 will then be maneuvered first so as to release the cavity 82 and allow the distancing of the hook 80.

[0083] In such a case, the prestressing stress is done by the pin 73 during the closing of the system.

[0084] All of the locking systems described in this application may include means for signaling the locking and/or unlocking position, the information from which may be escalated to the cockpit, for example. For greater reliability of that signaling function, the signaling means could be positioned relative to an active locking element guaranteeing an "all or nothing" signal. The signaling means is preferably placed on the inner panel 21 constituting a fixed portion of the nacelle in order to reduce the disconnection interfaces, which is one of the factors reducing the reliability of the system.

[0085] The prestressing of the described locking systems can also be adjusted.

[0086] In the case of the hook 10 shown in FIGS. 1 to 4, the adjustment of the prestressing may be done by fastening of the locking means on an adjustable platen (for example by screw) allowing a slight translation along the inner panel 21. The adjustment of the yoke 11 may be done in the same way.

[0087] Concerning the bolt with rotating hook 40 illustrated in FIGS. 5 and 6, the adjustment of the prestressing may be done by adjusting the position of the bolt by wedging of the housing of the motor 41 or by action on an axis of the hook 40.

[0088] Advantageously, the electric and/or manual control means of the locking means may be centralized, said control being able to be, for example, situated inside the middle structure and accessible after opening of an outer panel of that structure, or apparent to the structure and directly accessible from the outside of the nacelle.

[0089] In the case of a direct accessibility, the control can, for example, assume the form of an appendix not aerodynamically protected, or be protected by a hatch or a switchbox allowing outer aerodynamic smoothing.

[0090] It will be noted that the presented examples show an electric motor with bolt, but it is obviously possible to provide a reduced number of electric motors, or even a single electric motor, the propelling force of which is sent to the different bolts by a mechanical driving system.

[0091] Also advantageously, one will provide a centralized mechanical unlocking system of the electric bolts in case of breakdown of one or several electric motors. Indeed, normally, each bolt should be accessed individually by a dedicated access hatch. These hatches would then generate significant aerodynamic disturbances in addition to being heavy, costly and disrupting the structural integrity of the outer structure.

[0092] Each electric motor can then advantageously be equipped with a manual drive unit (MDU) capable of being actuated by a mechanical drive system with centralized manual control.

[0093] Lastly, one may also provide a mechanical inhibition system of the locking means, preferably visible from the outside. Such a mechanical inhibition may assume the form of a locking lug having an appendage introduced into the manual drive member and capable of blocking the latter.

[0094] Although the invention has been described with a particular embodiment, it is of course in no way limited thereto and includes all technical equivalents of the means described as well as their combinations if they fall within the scope of the invention. One will also note that most of the locking modes presented can be used for other nacelle interfaces, in particular the upstream interface between the removable air intake structure and the fan case.

1. A nacelle for turbojet engine comprising:
an air intake structure capable of directing an air flow towards a fan of the turbojet engine, and
a middle structure for surrounding said fan and to which is attached the air intake structure in order to provide aerodynamic continuity,
wherein the air intake structure includes at least one inner panel attached to the middle structure and defining, with the latter, a nacelle fixed structure and at least one outer longitudinal panel removably attached to the fixed structure and including an air intake lip in order to define a removable air intake structure,

the air intake structure is provided with peripheral locking means including at least one locking means attached to the inner panel or to the air intake lip and each capable of cooperating with a complementary retaining means attached to the air intake lip or the inner panel, respectively.

2. The nacelle according to claim 1, the locking means comprises a hook.

3. The nacelle according to claim 2, the hook is a hook with three-point projection system.

4. The nacelle according to claim 3, the hook is a rotating hook.

5. The nacelle according to 2, the complementary retaining means is a yoke.

6. The nacelle according to 2, the complementary retaining means assumes form of a return presented by one end of the air intake lip or of the inner panel.

7. The nacelle according to 1, the inner panel or the air intake lip comprises at least one centering pin capable of cooperating with a corresponding bore of the air intake lip or of the inner panel, respectively.

8. The nacelle according to claim 7, the centering pin is mounted rotatably mobile and has one end in form of a cam capable of going alternately between an unlocking position in which the cam-type end can be removed from the complementary retaining means and a locking position in which the cam-type end abuts against the complementary retaining means and cannot be removed therefrom.

9. The nacelle according to claim 7, the centering pin is mounted rotatably mobile and has an outer thread capable of cooperating with an internal tapping of the corresponding bore.

10. The nacelle according to claim 9, the tapped bore comprises a ball bearing system.

11. The nacelle according to claim 7, that the centering pin has a transverse bore capable of forming a complementary retaining means.

12. The nacelle according to 1, the locking means is an electric locking means capable of being remotely controlled.

13. The nacelle according to 1, the locking means is a manual locking means capable of being remotely controlled by a manual driving means of the cable or cardan mechanical return type.

14. The nacelle according to 12, the control means of the locking means are centralized.

15. The nacelle according to claim, the control member is a handle, preferably retractable, capable of allowing driving of the air intake structure in motion.

16. The nacelle according to 1, electric bolt(s) is/are associated with at least one means for detecting the locking and/or unlocking position.

17. The nacelle according to 1, prestressing of the locking means can be adjusted.

* * * * *