United States Patent	12384548
Kind Code	B2
Date of Patent	August 12, 2025
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Cowl hoop latch assembly

Abstract

A nacelle for a gas turbine engine includes a fixed nacelle portion, a cowl panel, and a latch assembly. The fixed nacelle portion extends circumferentially about an axial centerline. The cowl panel is axially adjacent the fixed nacelle portion. The cowl panel is moveable relative to the fixed nacelle portion between an open position and a closed position. The latch assembly includes a first latch portion and a second latch portion. The first latch portion is mounted to the cowl panel. The first latch portion includes a pin configured for translation along a pin axis between an extended pin position and a retracted pin position. The second latch portion is mounted to the fixed nacelle portion. The second latch portion includes a pin guide. The pin guide is configured to receive and engage the pin with the pin in the extended position and the cowl panel in the closed position.

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Appl. No.: **18/241697**

Filed: **September 01, 2023**

Prior Publication Data

Document Identifier	Publication Date
US 20240076911 A1	Mar. 07, 2024

Foreign Application Priority Data

IN	202211050200	Sep. 02, 2022

Publication Classification

Int. Cl.: **B64D29/06** (20060101); **E05B81/08** (20140101); **E05B81/18** (20140101); **F01D25/24** (20060101); B64D29/08 (20060101)

U.S. Cl.:

CPC **B64D29/06** (20130101); **E05B81/08** (20130101); **E05B81/18** (20130101); **F01D25/24** (20130101); B64D29/08 (20130101)

Field of Classification Search

USPC: None

References Cited

U.S. PATENT DOCUMENTS

Patent No.	Issued Date	Patentee Name	U.S. Cl.	CPC
8413346	12/2012	Vauchel	N/A	N/A
8757546	12/2013	Porte	N/A	N/A
9003810	12/2014	Porte	N/A	N/A
9239030	12/2015	Mercier	N/A	N/A
9643714	12/2016	Bulin	N/A	B64C 7/02
10556701	12/2019	Schrell	N/A	B64D 33/02
2011/0174930	12/2010	Porte	N/A	N/A
2012/0097261	12/2011	Porte	N/A	N/A
2015/0110619	12/2014	Bulin	415/213.1	B64D 29/06
2018/0297713	12/2017	Schrell	N/A	B64D 45/00
2020/0339272	12/2019	Shivarudrappa	N/A	N/A

FOREIGN PATENT DOCUMENTS

Patent No.	Application Date	Country	CPC
1764499	12/2016	EP	N/A

OTHER PUBLICATIONS

IQS Directory (Accessed on Sep. 3, 2024—Available since Aug. 12, 2021—https://www.iqsdirectory.com/articles/electric-coil/solenoid-coils.html) (Year: 2021). cited by examiner

Masaeli (Robot Mechanisms and Mechanical Devices Illustrated—McGraw Hill; Jul. 2012) (Year: 2012). cited by examiner

EP Search Report for EP Patent Application No. 23194953.8 dated Dec. 20, 2023. cited by applicant

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Background/Summary

(1) This application claims priority to Indian Patent Appln. No. 202211050200 filed Sep. 2, 2022 which is hereby incorporated herein by reference in its entirety.

BACKGROUND

1. Technical Field

(2) This disclosure relates generally to cowl panels for a propulsion assembly nacelles, and more particularly to hoop latch assemblies for securing moveable nacelle cowl panels.

2. Background Information

(3) A propulsion assembly, such as that used for aircraft propulsion, may include a nacelle configured to provide an exterior housing for the propulsion assembly. The nacelle may include one or more cowl sections (e.g., a fan cowl, a thrust reverser cowl, etc.). The cowl sections may include one or more movable cowl panels configured to provide access to internal propulsion assembly components. The cowl panels may experience radial movement during flight, which radial movement may impact operation of the propulsion assembly. Various types and configurations of cowl panels are known in the art. While these known cowl panels have various advantages, there is still room in the art for improvement.

SUMMARY

(4) It should be understood that any or all of the features or embodiments described herein can be used or combined in any combination with each and every other feature or embodiment described herein unless expressly noted otherwise.

(5) According to an aspect of the present disclosure, a nacelle for a gas turbine engine includes a fixed nacelle portion, a cowl panel, and a latch assembly. The fixed nacelle portion extends circumferentially about an axial centerline. The cowl panel is axially adjacent the fixed nacelle portion. The cowl panel is moveable relative to the fixed nacelle portion between an open position and a closed position. The latch assembly includes a first latch portion and a second latch portion. The first latch portion is mounted to the cowl panel. The first latch portion includes a pin configured for translation along a pin axis between an extended pin position and a retracted pin position. The second latch portion is mounted to the fixed nacelle portion. The second latch portion includes a pin guide. The pin guide is configured to receive and engage the pin with the pin in the extended position and the cowl panel in the closed position.

(6) In any of the aspects or embodiments described above and herein, the first latch portion may include a frame and a spring. The frame may extend circumferentially about the pin axis and surround the pin. The spring may be positioned between the frame and the pin. The spring may be configured to bias the pin in the extended position.

(7) In any of the aspects or embodiments described above and herein, the first latch portion may include a solenoid coil surrounding the pin. The solenoid coil may be configured to effect translation of the pin along the pin axis from the extended position to the retracted position with the solenoid coil in an energized condition.

(8) In any of the aspects or embodiments described above and herein, the pin guide may include pin guide body including a front surface and a rear surface. The pin guide body may form a pin aperture extending through the front surface. The pin aperture may be configured to receive the pin. The front surface may be configured as a curved surface.

(9) In any of the aspects or embodiments described above and herein, the first latch portion may include an axial locator portion and the second latch portion may include an axial locator receptacle. The axial locator receptacle may be configured to engaged the axial locator portion to maintain an axial position of the cowl panel, in the closed position, relative to the fixed nacelle portion.

(10) In any of the aspects or embodiments described above and herein, the latch assembly may be one of a plurality of latch assemblies. The plurality of latch assemblies may be circumferentially distributed along the fixed nacelle portion and the cowl panel.

(11) In any of the aspects or embodiments described above and herein, the fixed nacelle portion may be an air inlet of the nacelle, the cowl panel may be a fan cowl panel, and the fixed nacelle portion may be disposed axially forward of the cowl panel.

(12) In any of the aspects or embodiments described above and herein, the pin may include a head and a shaft. The head may be circumferentially enlarged relative to the shaft.

(13) According to another aspect of the present disclosure, a latch assembly includes a bracket and a pin assembly. The bracket includes a bracket body including a mount portion, a pin support portion, and an axial locator portion. The pin support portion and the axial locator portion extend outward from the mount portion. The axial locator portion is disposed adjacent the pin support portion. The pin assembly includes a pin control device and a pin. The pin control device is mounted to the pin support portion. The pin control device surrounds the pin. The pin control device is configured to effect translation of the pin along a pin axis between an extended position and a retracted position.

(14) In any of the aspects or embodiments described above and herein, the pin control device may include a solenoid coil surrounding the pin. The solenoid coil may be configured to effect translation of the pin along the pin axis from the extended position to the retracted position with the solenoid coil in an energized condition.

(15) In any of the aspects or embodiments described above and herein, the pin control device may include a spring surrounding the pin. The spring may be configured to bias the pin in the extended position.

(16) In any of the aspects or embodiments described above and herein, the mount portion may extend between and to a first axial end and a second axial end. The mount portion may further extend between and to a first circumferential end and a second circumferential end. The pin support portion may be disposed at the first circumferential end. The axial locator portion may be disposed circumferentially between the pin control device and the second circumferential end.

(17) In any of the aspects or embodiments described above and herein, the axial locator portion may extend along the second axial end.

(18) In any of the aspects or embodiments described above and herein, each of the pin support portion and the axial locator portion may extend substantially orthogonally from the mount portion.

(19) In any of the aspects or embodiments described above and herein, the pin support portion may form a pin aperture and the pin may be configured to translate within the pin aperture along the pin axis.

(20) According to another aspect of the present disclosure, a nacelle for a gas turbine engine includes an air inlet, a cowl panel, and a latch assembly. The air inlet extends circumferentially about an axial centerline. The air inlet extends axially between and to a leading inlet end and a trailing inlet end. The air inlet includes an inner barrel panel, an outer barrel panel, and a bulkhead. The bulkhead extends radially between and connects the inner barrel panel and the outer barrel panel at the trailing inlet end. The cowl panel extends axially between and to a leading panel end and a trailing panel end. The leading panel end is axially adjacent the trailing inlet end. The cowl panel is moveable relative to the air inlet between an open position and a closed position. The latch assembly includes a first latch portion and a second latch portion. The first latch portion is mounted to the cowl panel. The first latch portion includes a pin configured for translation along a pin axis between an extended pin position and a retracted pin position. The second latch portion is mounted to the air inlet. The second latch portion is configured to receive and engage the pin with the pin in the extended position.

(21) In any of the aspects or embodiments described above and herein, the second latch portion may be mounted to the bulkhead.

(22) In any of the aspects or embodiments described above and herein, the second latch portion may include a pin guide. The pin guide may include a pin guide body and a pin aperture. The pin guide body may include a front surface and a rear surface opposite the front surface. The front

surface may be configured as a curved surface. The rear surface may be mounted to the bulkhead.
(23) In any of the aspects or embodiments described above and herein, the front surface may have a convex curved shape.
(24) In any of the aspects or embodiments described above and herein, the latch assembly may be configured such that the pin, in the extended position, slides along the front surface to the pin aperture as the cowl panel is moved from the open position to the closed position.
(25) The present disclosure, and all its aspects, embodiments and advantages associated therewith will become more readily apparent in view of the detailed description provided below, including the accompanying drawings.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
(1) FIG. **1** illustrates a perspective view of an aircraft propulsion assembly, in accordance with one or more embodiments of the present disclosure.
(2) FIG. **2** illustrates an exploded view of an aircraft propulsion assembly, in accordance with one or more embodiments of the present disclosure.
(3) FIG. **3** illustrates a front cutaway view of portions of an aircraft propulsion assembly, in accordance with one or more embodiments of the present disclosure.
(4) FIG. **4** illustrates a flattened view of portions of a nacelle for an aircraft propulsion assembly, in accordance with one or more embodiments of the present disclosure.
(5) FIG. **5** illustrates a perspective view of a portion of a latch assembly, in accordance with one or more embodiments of the present disclosure.
(6) FIG. **6** illustrates a schematic cutaway view of the portion of the latch assembly of FIG. **5** in an engaged condition, in accordance with one or more embodiments of the present disclosure.
(7) FIG. **7** illustrates a schematic cutaway view of the portion of the latch assembly of FIG. **5** in a disengaged condition, in accordance with one or more embodiments of the present disclosure.
(8) FIG. **8** illustrates a perspective view of another portion of the latch assembly, in accordance with one or more embodiments of the present disclosure.
(9) FIG. **9** illustrates a perspective view of the latch assembly, in accordance with one or more embodiments of the present disclosure.
(10) FIG. **10** illustrates a side cutaway view of the latch assembly, in accordance with one or more embodiments of the present disclosure.
DETAILED DESCRIPTION
(11) FIGS. **1-2** illustrate a propulsion assembly **10** for an aircraft. The propulsion assembly **10** of FIGS. **1** and **2** includes a gas turbine engine **20** and a nacelle **22**. The gas turbine engine **20** of FIGS. **1** and **2** is configured as a multi-spool turbofan gas turbine engine for the aircraft propulsion system **10**. However, it should be understood that aspects of the present disclosure may be equally applicable to other configurations of gas turbine engine propulsion systems (e.g., those including a turboshaft gas turbine engine, a turboprop gas turbine engine, a turbojet gas turbine engine, a propfan gas turbine engine, an open rotor gas turbine engine, etc.) as well as other types of propulsion systems which do not include gas turbine engines (e.g., an electric-fan propulsion system, an electric-prop propulsion system, etc.).
(12) The gas turbine engine **20** of FIGS. **1** and **2** includes a fan **24**, a compressor section **26**, a combustor section **28**, a turbine section **30**, and an exhaust section **32** disposed along an axial centerline **34** of the propulsion assembly **10**. In operation, the fan **24** draws and directions ambient air into the propulsion system **10**. The air may be divided into a core flow path and a bypass flow path. Each of the core flow path and the bypass flow path may be annular flow paths extending circumferentially about (e.g., completely around) the axial centerline **34**. The core flow path

extends through the core of the gas turbine engine **20**. Air flow along the core flow path is directed through the compressor section **26**, the combustor section **28**, the turbine section **30**, and the exhaust section **32**. The compressor section **26** increases the pressure of the air along the core flow path and directs the air into the combustor section **28** where the air mixed with fuel and ignited. The combustion gas resulting from the combusted fuel and air mixture flows through the turbine section **30** causing one or more bladed turbine rotors to rotate and drive one or more rotors (e.g., bladed compressor rotors) and the fan **24** via one or more shafts. Exhaust gases exiting the turbine section **30** are directed out of the gas turbine engine **20** through the exhaust section **32**. The bypass flow path extends through the propulsion assembly **10** outside of the core of the gas turbine engine **20**. Air flow along the bypass flow path may be directed through the propulsion assembly **10** by one or more bypass ducts.

(13) The nacelle **22** is configured to house and provide an aerodynamic cover for the gas turbine engine **20**. The nacelle **22** extends axially along the axial centerline **34** between and to an upstream end **40** of the nacelle **22** and a downstream end **42** of the nacelle **22**. The nacelle **22** extends circumferentially about (e.g., completely around) the axial centerline **34**. The nacelle **22** may form at least a portion (e.g., an outer radial portion) of the bypass flow path through the propulsion assembly **10**.

(14) The nacelle **22** of FIGS. **1** and **2** includes a fan cowl **44**, a thrust reverser **46**, and an air inlet **48**. The nacelle **22** may be coupled to a pylon **50**, which pylon **50** may be configured to mount the nacelle **22**, and thereby the propulsion assembly **10**, to an aircraft wing or aircraft body. The air inlet **48** of FIGS. **1** and **2** extends between (e.g., axially between) and to the upstream end **40** and the fan cowl **44**. The thrust reverser **46** of FIGS. **1** and **2** extends between (e.g., axially between) and to the downstream end **42** and the fan cowl **44**.

(15) The fan cowl **44** is configured to generally surround the fan **24**. The fan cowl **44** of FIGS. **1** and **2** includes a first cowl panel **52** and a second cowl panel **54**. Each of the first cowl panel **52** and the second cowl panel **54** include a leading end **56**, a trailing end **58**, a first circumferential end **60**, and a second circumferential end **62**. The first cowl panel **52** and the second cowl panel **54** may be hingedly coupled to the pylon **50** or to a fixed portion of the fan cowl **44** at (e.g., on, adjacent, or proximate) the first circumferential end **60**. For example, the first cowl panel **52** and the second cowl panel **54** may each include one or more hinges **64** (e.g., gooseneck hinges). Each of the first cowl panel **52** and the second cowl panel **54** are configured to move (e.g., rotate) relative to the pylon **50** or a fixed portion of the fan cowl **44** between an open position and a closed position. As used herein, the term “closed position” will be used to refer to the first cowl panel **52** and/or the second cowl panel **54** in a position so as to form a portion of a substantially continuous exterior surface of the nacelle **22** (e.g., the first cowl panel **52** and/or the second cowl panel **54** are positioned for flight). As used herein, the term “open position” will be used to refer to the first cowl panel **52** and/or the second cowl panel **54** in a position other than the closed position (e.g., the first cowl panel **52** and/or the second cowl panel **54** are partially open, fully open, etc.). In the open position, each of the first cowl panel **52** and the second cowl panel **54** are configured to allow access (e.g., for maintenance) to internal components of the propulsion assembly **10**, for example, components of the gas turbine engine **20**.

(16) In the closed position, the first cowl panel **52** and the second cowl panel **54** may be secured to one another, thereby preventing the first cowl panel **52** and the second cowl panel **54** from moving to the open position. For example, each of the first cowl panel **52** and the second cowl panel **54** may include one or more latches **66** at the second circumferential end **62**. The latches **66** may be configured to fixedly engage the first cowl panel **52** with the second cowl panel **54** at the respective second circumferential ends **62** of the first cowl panel **52** and the second cowl panel **54**.

(17) The thrust reverser **46** of FIGS. **1** and **2** extends between (e.g., axially between) and to a leading end **68** of the thrust reverser **46** and a trailing end **70** of the thrust reverser **46**. The thrust reverser **46** may be formed by a plurality of circumferential portions (e.g., thrust reverser cowls).

The thrust reverser **46** may include one or more moveable (e.g., translatable, rotatable, etc.) components configured to redirect gas flow along the bypass flow path and/or the core flow path to provide deceleration (e.g., reverser thrust) for an aircraft associated with the propulsion assembly **10**.

(18) FIG. **3** illustrates a cutaway view of a circumferential portion of the air inlet **48**. The air inlet **48** extends between (e.g., axially between) and to a leading end **72** of the air inlet **48** and a trailing end **74** of the air inlet **48**. The leading end **72** may be coincident with the upstream end **40** (see FIG. **1**). The air inlet **48** of FIG. **3** includes a lip skin **76**, an outer barrel panel **78**, an inner barrel panel **80**, a forward bulkhead **82**, and an aft bulkhead **84**. The lip skin **76** is arcuately shaped (e.g., elliptically shaped, oval shaped, U-shaped, etc.) to form the leading end **72** for the air inlet **48**. The lip skin **76** extends between and connects the outer barrel panel **78** and the inner barrel panel **80**. The outer barrel panel **78** and the inner barrel panel **80** extend from the lip skin **76** to the trailing end **74**. The outer barrel panel **78** forms an outer radial portion (e.g., an exterior portion) of the air inlet **48**. The inner barrel panel **80** is radially spaced inward of the outer barrel panel **78**. The outer barrel panel **78** and the inner barrel panel **80** form a cavity **86** (e.g., an annular cavity) radially between the outer barrel panel **78** and the inner barrel panel **80**. The inner barrel panel **80** forms an inner radial portion (e.g., an interior portion) of the air inlet **48**. The inner barrel panel **80** may, therefore, form a portion of the bypass flow path through the propulsion assembly **10** (see FIG. **2**). The forward bulkhead **82** may be configured as an annular bulkhead which extends between (e.g., radially between) and connects the outer barrel panel **78** and the inner barrel panel **80** at (e.g., on, adjacent, or proximate) the lip skin **76**. The aft bulkhead **84** may be configured as an annular bulkhead which extends between (e.g., radially between) and connects the outer barrel panel **78** and the inner barrel panel **80** at (e.g., on, adjacent, or proximate) the trailing end **74**.

(19) FIG. **4** illustrated a flattened view of portions of the nacelle **22** including the first cowl panel **52** (e.g., in the closed position), the thrust reverser **46**, and the air inlet **48**. The leading end **56** of the first cowl panel **52** is positioned adjacent the trailing end **74** of the air inlet **48**. The trailing end **58** of the first cowl panel **52** is positioned adjacent the leading end **68** of the thrust reverser **46**. As previously discussed, the first cowl panel **52** is configured to move (e.g., rotate) between the open position and the closed position about one or more hinges (see FIG. **2**) disposed at (e.g., on, adjacent, or proximate) the first circumferential end **60**. The first cowl panel **52** may also, therefore, be configured to move relative to the adjacent thrust reverser **46** and air inlet **48**. While FIG. **4** illustrates the first cowl panel **52**, the description herein with respect to FIG. **4** should be understood to also apply to the second cowl panel **54**.

(20) During operation of conventional propulsion assemblies, it has been observed that moveable cowl panels (e.g., cowl panels of a fan cowl) may experience deformation, radial displacement, and/or other movement (e.g., “scooping”) relative to adjacent portions of the nacelle. Scooping movement of the cowl panels may cause or enlarge air gaps between the cowl panels and adjacent portions of the nacelle (e.g., an air inlet, a thrust reverser, etc.), which air gaps may allow external air (e.g., air radially outward of the nacelle) to enter the nacelle. This external air flow into the nacelle may result in increased fluid pressure in portions of the propulsion assembly (e.g., a fan cowl compartment). Additionally, scooping movement of the cowl panels may lead to erosion of the cowl panel leading ends due to increased exposure to external air flow.

(21) The nacelle **22** of FIG. **4** includes one or more hoop latch assemblies **88** (hereinafter “latch assemblies”) configured to prevent or reduce radially outward movement of the first cowl panel **52** and/or the second cowl panel **54** relative to surrounding portions of the nacelle **22**. The latch assemblies **88** of FIG. **4** are disposed at (e.g., on, adjacent, or proximate) an interface between the leading end **56** and the trailing end **74**. The latch assemblies **88** of FIG. **4** are circumferentially distributed along the interface between the leading end **56** and the trailing end **74**. The latch assemblies **88** of FIG. **4** are configured to radially secure the first cowl panel **52** and/or the second cowl panel **54** to the axially adjacent air inlet **48**. The nacelle **22** of FIG. **4** includes three latch

assemblies **88**, however, the present disclosure is not limited to any particular number of latch assemblies **88** for the first cowl panel **52** and/or the second cowl panel **54**. Although FIG. **4** illustrates the latch assemblies **88** disposed at the interface of the leading end **56** and the trailing end **74**, it should be understood that the latch assemblies **88** may additionally or alternatively be disposed at (e.g., on, adjacent, or proximate) an interface between the trailing end **58** and the leading end **68**, to radially secure the first cowl panel **52** and/or the second cowl panel **54** to the axially adjacent thrust reverser **46**.

(22) Each latch assembly **88** includes a first latch portion **90** and a second latch portion **92**. The first latch portion **90** of FIG. **4** is mounted to the first cowl panel **52** at (e.g., on, adjacent, or proximate) the leading end **56**. The second latch portion **92** of FIG. **4** is mounted to the air inlet **48** at (e.g., on, adjacent, or proximate) the trailing end **74**. As will be discussed in further detail, the first latch portion **90** is configured to selectively engage the second latch portion **92** to radially secure the first cowl panel **52** and/or the second cowl panel **54** to the axially adjacent air inlet **48**.

(23) FIG. **5** illustrates a perspective view of the first latch portion **90**. The first latch portion **90** includes a bracket **94** and a pin assembly **96**.

(24) The bracket **94** of FIG. **5** includes a bracket body **98**. The bracket body **98** extends between and to a first axial end **100** of the bracket body **98** and a second axial end **102** of the bracket body **98**. The bracket body **98** further extends between and to a first circumferential end **104** of the bracket body **98** and a second circumferential end **106** of the bracket body **98**. The bracket body **98** includes a mount portion **108** and a pin support portion **110**. The bracket body **98** may additionally include an axial locator portion **112**.

(25) The mount portion **108** of FIG. **5** extends (e.g., axially extends) between and to the first axial end **100** and the second axial end **102**. The second axial end **102** may be disposed at (e.g., on, adjacent, or proximate the leading end **56**. The mount portion **108** of FIG. **5** further extends (e.g., circumferentially extends) between and to the first circumferential end **104** and the second circumferential end **106**. The mount portion **108** of FIG. **5** is configured to be mounted to the first cowl panel **52** and/or the second cowl panel **54** (e.g., an interior surface of the first cowl panel **52** and/or the second cowl panel **54**) at the leading end **56**. The mount portion **108** of FIG. **5** is mounted to the first cowl panel **52** and/or the second cowl panel **54**, for example, by one or more fasteners **114**, however, the present disclosure is not limited to any particular mounting configuration for the mount portion **108**.

(26) The pin support portion **110** of FIG. **5** extends outward (e.g., orthogonal or substantially orthogonal (e.g., +/−ten degrees (10°) from orthogonal)) from the mount portion **108** to a distal end **116** of the pin support portion **110**. The pin support portion **110** of FIG. **5** extends (e.g., circumferentially extends) between a first end **118** of the pin support portion **110** and a second end **120** of the pin support portion **110**. The pin support portion **110** may extend from the first end **118** to the second end **120** in a direction extending between the first circumferential end **104** and the second circumferential end **106**. The first end **118** may be disposed at (e.g., on, adjacent, or proximate) the first circumferential end **104**. The second end **120** may be disposed between the first circumferential end **104** and the second circumferential end **106**. The pin support portion **110** may be disposed between the first axial end **100** and the second axial end **102**. The pin support portion **110** may form a pin aperture **122** which extends through the pin support portion **110**.

(27) The axial locator portion **112** of FIG. **5** extends outward (e.g., orthogonal or substantially orthogonal) from the mount portion **108** to a distal end **124** of the axial locator portion **112**. The axial locator portion **112** of FIG. **5** extends (e.g., circumferentially extends) between a first end **126** of the axial locator portion **112** and a second end **128** of the axial locator portion **112**. The axial locator portion **112** may extend between the first end **126** and the second end **128** at (e.g., on, adjacent, or proximate) and along the second axial end **102**. The second end **128** may be disposed at (e.g., on, adjacent, or proximate) the second circumferential end **106**. The axial locator portion **112** may, therefore, extend from the second circumferential end **106** a portion of a circumferential

distance from the second circumferential end **106** to the first circumferential end **104**.

(28) The pin assembly **96** of FIG. **5** includes a pin **130** and a pin control device **132**. The pin **130** is configured for translation (e.g., linear translation), relative to the pin control device **132**, between an extended position and a retracted position. The pin control device **132** of FIG. **5** surrounds and supports the pin **130**. The pin control device **132** is mounted to the pin support portion **110**. The pin control device **132** may be mounted to the pin support portion **110**, for example, by one or more fasteners **134**, however, the present disclosure is not limited to any particular mounting configuration for the pin control device **132**. The pin control device **132** extends outward from the pin control device **132** in a direction (e.g., an axial direction) toward or past the leading end **56**. The pin control device **132** may be mounted to the pin support portion **110** at (e.g., on, adjacent, or proximate) the pin aperture **122** such that the pin **130** may extend through and move within the pin aperture **122**.

(29) FIGS. **6** and **7** illustrate schematic views of the pin assembly **96** including the pin **130** and the pin control device **132**. FIG. **6** illustrates the pin **130** in an extended position. FIG. **7** illustrates the pin **130** in a retracted position. The pin control device **132** of FIGS. **6** and **7** includes a frame **136**, a spring **138**, a solenoid coil **140**, and a power source **142**.

(30) The pin **130** extends between and to a first end **144** of the pin **130** and a second end **146** of the pin **130** along a pin axis **148**. The pin **130** is configured for translation along the pin axis **148** between the extended position and the retracted position. The pin **130** includes a head **150** and a shaft **152**. The head **150** is disposed at (e.g., on, adjacent, or proximate) the first end **144**. The head **150** may be enlarged (e.g., circumferentially enlarged) relative to the shaft **152**. The shaft **152** extends from the head **150** to the second end **146**. The shaft **152** may be configured as an armature for the solenoid coil **140** and may be made from or otherwise include a ferromagnetic material (e.g., iron, nickel, and/or cobalt).

(31) The frame **136** is configured to house and support the pin **130**, the spring **138**, and the solenoid coil **140**. The frame **136** may be mounted to the pin support portion **110**, for example, by the fasteners **134** (see FIG. **5**). The frame **136** extends along the pin axis **148** between and to a first end **154** of the frame **136** and a second end **156** of the frame **136**. The frame **136** extends circumferential about (e.g., completely around) the pin axis **148**. The frame **136** forms a pin aperture **158** which extends through the frame **136** from the first end **154** to the second end **156**. The pin **130** is disposed within the pin aperture **158** and the pin **130** is configured for translation along the pin axis **148** within the pin aperture **158**. The frame **136** may include one or more bushings configured to contact the pin **130**, to facilitate reduced friction between the pin **130** and the frame **136** as the pin **130** translates within the frame **136**.

(32) The spring **138** is positioned within the pin aperture **158** and surrounds the shaft **152**. The spring **138** extends axially along the pin axis **148** between and in contact with the frame **136** and the head **150**. The spring **138** is configured to bias the pin **130** in the extended position, which extended position may, therefore, be a default position of the pin **130**.

(33) The solenoid coil **140** of FIGS. **6** and **7** is retained within the frame **136**. The solenoid coil **140** surrounds the pin aperture **158** and the shaft **152**. The solenoid coil **140** is configured as an electrically-conductive coil (e.g., a helical coil of wire), which electrically-conductive coil may generate a magnetic field in response to a flow of electrical current through the electrically-conductive coil. The solenoid coil **140** of FIGS. **6** and **7** is in electrical communication with the power source **142**. Examples of the power source **142** may include, but are not limited to, a battery, an electrical generator, an auxiliary power unit (APU), and the like. The power source **142** is configured to selectively energize or deenergize the solenoid coil **140** to control a position of the pin **130**. The power source **142** of FIGS. **6** and **7** includes actuator **192**. The actuator **192** is configured to cause the power source **142** to selectively apply an electrical current to the solenoid coil **140** (e.g., to energize the solenoid coil **140**) and/or to cause the power source **142** to selectively secure electrical current to the solenoid coil **140** (e.g., to deenergize the solenoid coil **140**.

Examples of the actuator **192** may include, but are not limited to, a push button, a switch, a breaker, or other suitable electrical control device. The actuator **192** may be located on the nacelle **22** (e.g., the first cowl panel **52** and/or the second cowl panel **54**) or another suitable location of the propulsion assembly **10** or associated aircraft. The present disclosure, however, is not limited to any particular location or configuration of the actuator **192**.

(34) In the deenergized condition of the solenoid coil **140**, the spring **138** may bias the pin **130** in the extended position such that the pin **130** extends outward from the frame **136** along the pin axis **148** (see FIG. **6**). In the energized condition of the solenoid coil **140**, the magnetic field generated by the solenoid coil **140** may cause the pin **130** (e.g., the shaft **152**) to retract against the biasing force of the spring **138** along the pin axis **148**. With the solenoid coil **140** in the energized condition, the pin **130** may, therefore, be retained in the retracted position (see FIG. **7**). While the pin control device **132** of the present disclosure is described herein as including the solenoid coil **140** to effect translation of the pin **130**, it should be understood that the present disclosure is not limited to any particular configuration of the pin control device **132** for controlling translation of the pin **130**. For example, translation of the pin **130** along the pin axis **148** may alternatively be effected by a mechanical linkage system, a pneumatic system, a hydraulic system, an electro-mechanical actuation system, and the like.

(35) FIG. **8** illustrates the second latch portion **92**. The second latch portion **92** of FIG. **8** includes a pin guide **160**. The second latch portion **92** may additionally include an axial locator receptacle **162**.

(36) The pin guide **160** of FIG. **8** includes a pin guide body **164** and a pin aperture **166**. The pin guide body **164** extends (e.g., circumferentially extends) between and to a first circumferential end **168** of the pin guide body **164** and a second circumferential end **170** of the pin guide body **164**. The pin guide body **164** further extends (e.g., radially extends) between and to a first radial end **172** of the pin guide body **164** and a second radial end **174** of the pin guide body **164**. The pin guide body **164** of FIG. **8** includes a front surface **176** and a rear surface **178** opposite the front surface **176**. The front surface **176** may be configured as a curved surface. For example, the pin guide body **164** of FIG. **8** has a convex curved shape extending from the first radial end **172** to the second radial end **174**. The pin guide body **164** of FIG. **8** forms the pin aperture **166** through the pin guide body **164** from the front surface **176** toward or through the rear surface **178**. As the cowl panel **52**, **54** (see FIG. **1**) is moved from the open position to the closed position, the pin **130** in the extended position (e.g., biased by the spring **138** (see FIGS. **6** and **7**)) may slide along the curved front surface **176** to the pin aperture **166**. The pin aperture **166** may be sized to provide a gap (e.g., a radial gap relative to the pin axis **148** (see FIGS. **6** and **7**) between the pin **130** and the pin guide body **164**, which the pin **130** inserted in the pin aperture **166**. The gap may be sized to accommodate installation and/or manufacturing tolerances of the latch assembly **88** while allowing the pin **130** to be moved into or out of the pin aperture **130** with minimal or no friction.

(37) The pin guide **160** of FIG. **8** is mounted to the air inlet **48** at (e.g., on, adjacent, or proximate) the trailing end **74**. The pin guide **160** may be mounted on or proximate the aft bulkhead **84** at (e.g., on, adjacent, or proximate) an outer radial end of the aft bulkhead **84**. For example, the pin guide **160** of FIG. **8** is mounted with the rear surface **178** contacting the aft bulkhead **84**. The pin guide **160** may be mounted to the aft bulkhead **84** using any suitable mounting configuration including, but not limited to, one or more fasteners, bonding, welding, and the like. In some embodiments, the aft bulkhead **84** may include or otherwise form the pin guide **160**.

(38) The axial locator receptacle **162** of FIG. **8** includes a receptacle body **180** and an axial locator slot **182**. The receptacle body **180** extends (e.g., circumferentially extends) between and to a first circumferential end **184** of the receptacle body **180** and a second circumferential end **186** of the receptacle body **180**. The axial locator receptacle **162** further extends (e.g., radially extends) between and to a first radial end **188** of the receptacle body **180** and a second radial end **190** of the receptacle body **180**. The receptacle body **180** forms the axial locator slot **182**. The axial locator

slot **182** of FIG. **8** is formed through the receptacle body **180** from the first radial end **188** toward the second radial end **190**. The axial locator slot **182** may be configured as a circumferentially-extending slot which extends from the first circumferential end **184** toward the second circumferential end **186**.

(39) The axial locator receptacle **162** of FIG. **8** is mounted to the air inlet **48** at (e.g., on, adjacent, or proximate) the trailing end **74**. The axial locator receptacle **162** of FIG. **8** is further mounted to the air inlet **48** adjacent (e.g., circumferentially adjacent) the pin guide **160**. For example, the first circumferential end **184** may be mounted at (e.g., on, adjacent, or proximate) the second circumferential end **170**. The axial locator receptacle **162** may be mounted on or proximate the aft bulkhead **84**. For example, the axial locator receptacle **162** of FIG. **8** is mounted to the aft bulkhead **84** using one or more fasteners **194**. The axial locator receptacle **162** of FIG. **8** is mounted so that the first radial end **188** is positioned radially outward of the second radial end **190**, such that the axial locator slot **182** faces a radial exterior of the air inlet **48**. For example, the first radial end **188** may be positioned at (e.g., on, adjacent, or proximate) a radial exterior of the air inlet **48**.

(40) FIGS. **9** and **10** illustrate the first latch portion **90** engaged with the second latch portion **92**, with the cowl panel **52**, **54** in the closed position. As shown in FIG. **10**, the pin **130**, in the extended position, is positioned within the pin aperture **166**. The spring **138** (see FIGS. **6** and **7**) biasing of the pin **130** in the extend position facilitates engagement of the pin **130** with the pin guide **160**. With the pin **130** positioned within the pin aperture **166**, radial movement of the respective cowl panel **52**, **54** relative to the air inlet **48** is prevented or reduced at the circumferential location of the latch assembly **88**. The axial locator portion **112** and corresponding axial locator receptacle **162** may facilitate axial retention of the cowl panel **52**, **54** relative to the air inlet **48**, thereby maintaining the engagement between the pin **130** and the pin guide **160** (e.g., maintaining the pin **130** within the pin aperture **166**). The aft bulkhead **84** of FIG. **10** includes a pin aperture **184** coincident with the pin aperture **166**, however, the present disclosure is not limited to the inclusion of a pin aperture in the aft bulkhead **84**.

(41) It is noted that various connections are set forth between elements in the preceding description and in the drawings. It is noted that these connections are general and, unless specified otherwise, may be direct or indirect and that this specification is not intended to be limiting in this respect. A coupling between two or more entities may refer to a direct connection or an indirect connection. An indirect connection may incorporate one or more intervening entities. It is further noted that various method or process steps for embodiments of the present disclosure are described in the following description and drawings. The description may present the method and/or process steps as a particular sequence. However, to the extent that the method or process does not rely on the particular order of steps set forth herein, the method or process should not be limited to the particular sequence of steps described. As one of ordinary skill in the art would appreciate, other sequences of steps may be possible. Therefore, the particular order of the steps set forth in the description should not be construed as a limitation.

(42) Furthermore, no element, component, or method step in the present disclosure is intended to be dedicated to the public regardless of whether the element, component, or method step is explicitly recited in the claims. No claim element herein is to be construed under the provisions of 35 U.S.C. 112(f) unless the element is expressly recited using the phrase “means for.” As used herein, the terms “comprises”, “comprising”, or any other variation thereof, are intended to cover a non-exclusive inclusion, such that a process, method, article, or apparatus that comprises a list of elements does not include only those elements but may include other elements not expressly listed or inherent to such process, method, article, or apparatus.

(43) While various aspects of the present disclosure have been disclosed, it will be apparent to those of ordinary skill in the art that many more embodiments and implementations are possible within the scope of the present disclosure. For example, the present disclosure as described herein includes several aspects and embodiments that include particular features. Although these particular

features may be described individually, it is within the scope of the present disclosure that some or all of these features may be combined with any one of the aspects and remain within the scope of the present disclosure. References to “various embodiments,” “one embodiment,” “an embodiment,” “an example embodiment,” etc., indicate that the embodiment described may include a particular feature, structure, or characteristic, but every embodiment may not necessarily include the particular feature, structure, or characteristic. Moreover, such phrases are not necessarily referring to the same embodiment. Further, when a particular feature, structure, or characteristic is described in connection with an embodiment, it is submitted that it is within the knowledge of one skilled in the art to effect such feature, structure, or characteristic in connection with other embodiments whether or not explicitly described. Accordingly, the present disclosure is not to be restricted except in light of the attached claims and their equivalents.

Claims

1. A nacelle for a gas turbine engine, the nacelle comprising: a fixed nacelle portion extending circumferentially about an axial centerline; a cowl panel axially adjacent the fixed nacelle portion, the cowl panel moveable relative to the fixed nacelle portion between an open position and a closed position; and a latch assembly including a first latch portion and a second latch portion, the first latch portion mounted to the cowl panel, the first latch portion including a pin configured for translation along a pin axis between an extended pin position and a retracted pin position, the second latch portion mounted to the fixed nacelle portion, the second latch portion including a pin guide, the pin guide configured to receive and engage the pin with the pin in the extended position and the cowl panel in the closed position; wherein the first latch portion includes an axial locator portion and the second latch portion includes an axial locator receptacle, the axial locator receptacle configured to engaged the axial locator portion to maintain an axial position of the cowl panel, in the closed position, relative to the fixed nacelle portion.
2. The nacelle of claim 1, wherein the first latch portion includes a solenoid coil surrounding the pin, the solenoid coil configured to effect translation of the pin along the pin axis from the extended position to the retracted position with the solenoid coil in an energized condition.
3. The nacelle of claim 1, wherein: the pin guide includes pin guide body including a front surface and a rear surface, the pin guide body forming a pin aperture extending through the front surface, the pin aperture configured to receive the pin; and the front surface is configured as a curved surface.
4. The nacelle of claim 1, wherein the first latch portion includes a frame and a spring, the frame extending circumferentially about the pin axis and surrounding the pin, the spring positioned radially between the frame and the pin, the spring configured to bias the pin in the extended position.
5. The nacelle of claim 1, wherein the latch assembly is one of a plurality of latch assemblies, the plurality of latch assemblies circumferentially distributed along the fixed nacelle portion and the cowl panel.
6. The nacelle of claim 1, wherein: the fixed nacelle portion is an air inlet of the nacelle; the cowl panel is a fan cowl panel; and the fixed nacelle portion is disposed axially forward of the cowl panel.
7. The nacelle of claim 1, wherein the pin includes a head and a shaft, the head being circumferentially enlarged relative to the shaft.
8. A nacelle for a gas turbine engine, the nacelle comprising: an air inlet extending circumferentially about an axial centerline, the air inlet extending axially between and to a leading inlet end and a trailing inlet end, the air inlet including an inner barrel panel, an outer barrel panel, and a bulkhead, the bulkhead extending radially between and connecting the inner barrel panel and the outer barrel panel at the trailing inlet end; a cowl panel extending axially between and to a

leading panel end and a trailing panel end, the leading panel end axially adjacent the trailing inlet end, the cowl panel moveable relative to the air inlet between an open position and a closed position; and a latch assembly including a first latch portion and a second latch portion, the first latch portion mounted to the cowl panel, the first latch portion including a pin configured for translation along a pin axis between an extended pin position and a retracted pin position, the second latch portion mounted to the air inlet, the second latch portion configured to receive and engage the pin with the pin in the extended position, the second latch portion mounted to the bulkhead, the second latch portion including a pin guide, the pin guide including a pin guide body and a pin aperture, the pin guide body including a front surface and a rear surface opposite the front surface, the front surface configured as a curved surface, and the rear surface mounted to the bulkhead; wherein the latch assembly is configured such that the pin, in the extended position, slides along the front surface to the pin aperture as the cowl panel is moved from the open position to the closed position.

9. The nacelle of claim 8, wherein the front surface has a convex curved shape.