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LOT #171

VTOL Anti-Stall Ducted Fan System

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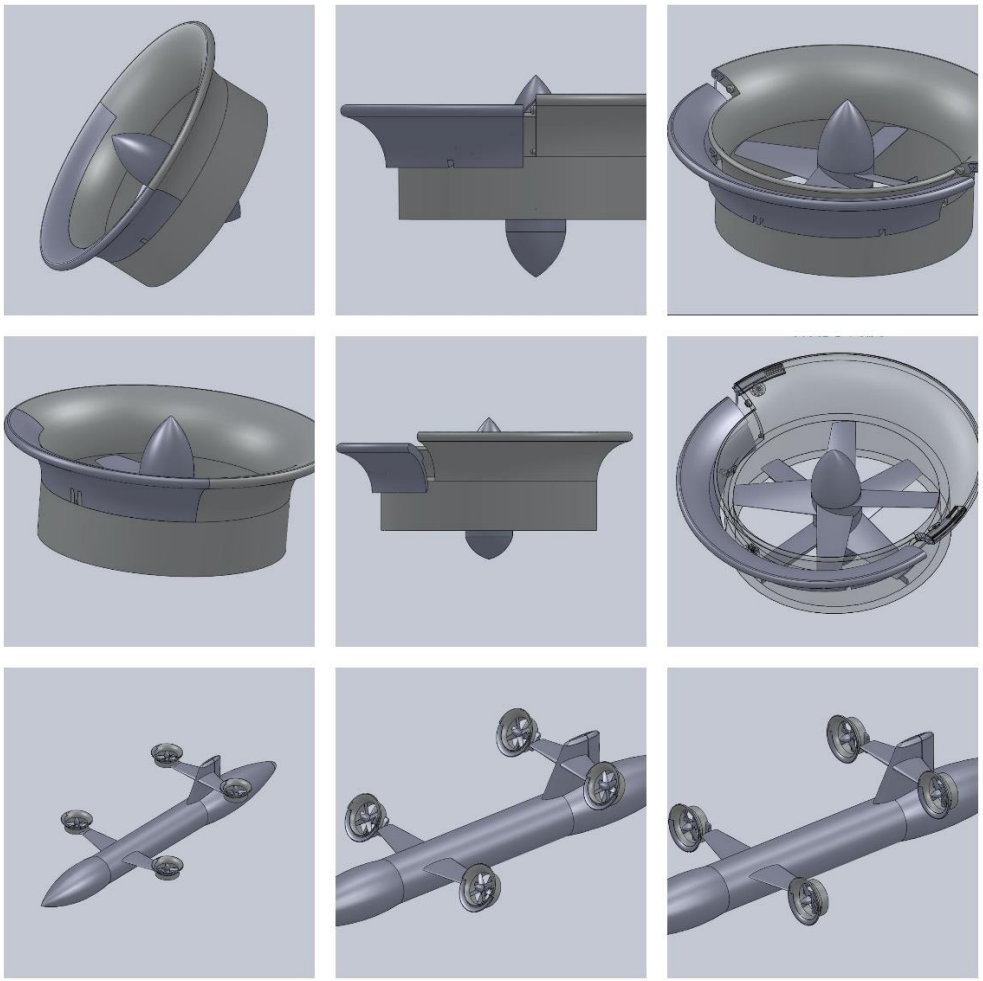
SUPRA LUMINA TECHNOLOGIES INC.

Portfolio Prospectus

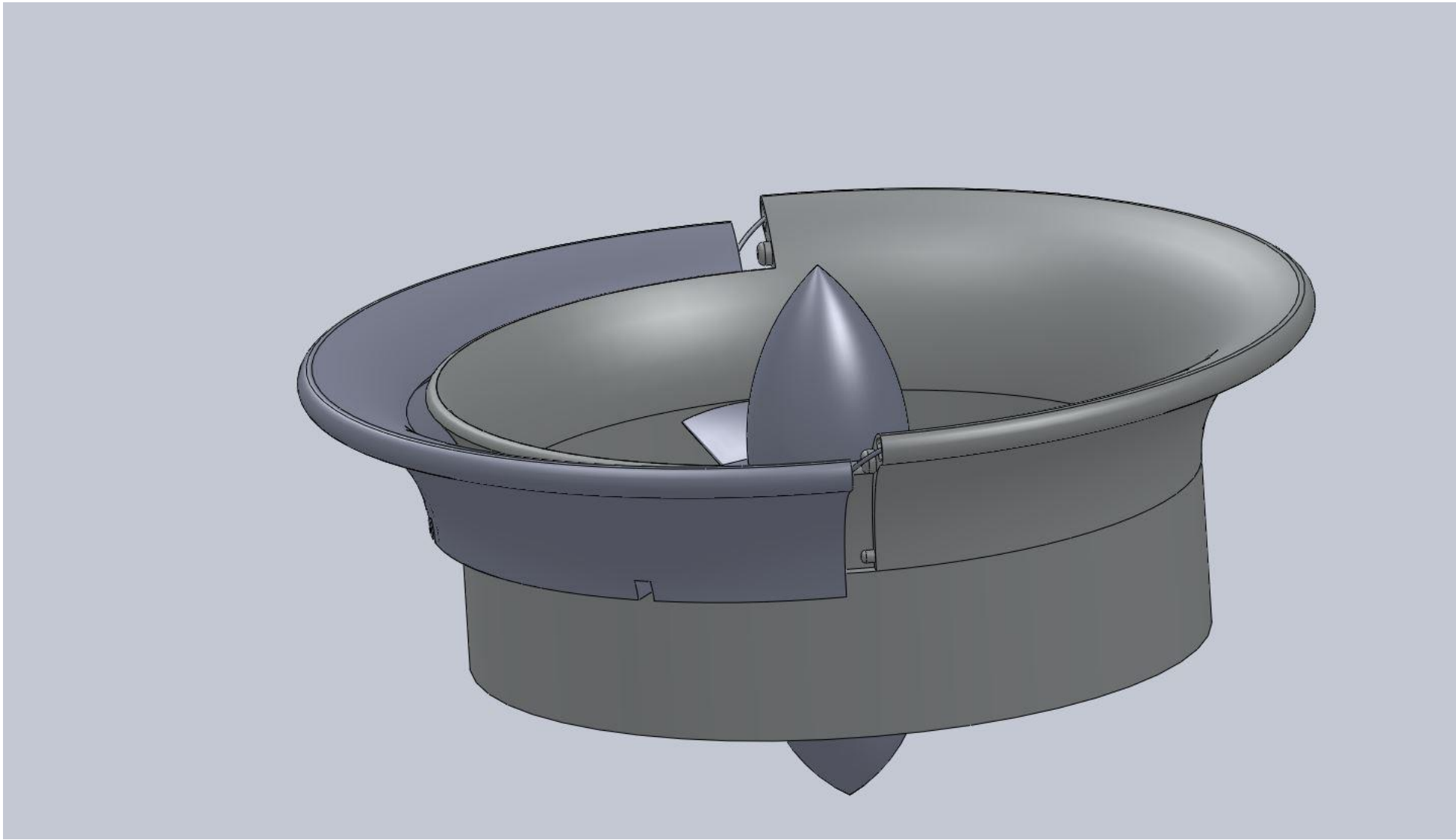
This portfolio covers technology for the next-generation Ducted Fans for use in e-VTOL, VTOL and Aerospace technology in general

DUCTED FAN WITH MOVABLE SECTION

U.S. Patent No. 11,584,509 and Continuation 18/110,391



Axial Flow Ducted Fan with Movable Section: U.S. Patent No. 11,584,509 and Continuation 18/110,391



SUPRA LUMINA TECHNOLOGIES INC.

Executive Summary

The invention covered by this portfolio easily solves known flow separation issues that have plagued ducted fans in VTOL operation for decades.

Ducted fans as used in the aerospace sector are known to provide some very notable advantages over exposed propellers, such as providing higher static thrust than free rotating propellers of the same diameter, lower operating noise levels, safety for ground crew as well as containment of projectile debris during catastrophic propeller failure among other advantages.

However, when used in vertical take-off and landing (VTOL) vehicles where they are configured as 'tilting ducts", a major problem arises. They are known to stall, at the leading-edge lip of the ducted fan, under certain conditions.

When ducted fans provide powered lift to aircrafts in VTOL(vertical take-off and landing) mode and have to transition from VTOL mode to forward flight , by tilting the ducted fan from facing generally vertically upward to horizontal position needed for efficient forward level fight, a combination of a critical angle of attack and forward velocity is reached during some crucial phase of the tilting process, during which flow separation occurs at the leading-edge lip of the duct. That air flow behavior Leads to violent vibrations and noise, loss of thrust despite sudden increase in power requirements, unpredictable handling and compromised safety in general.

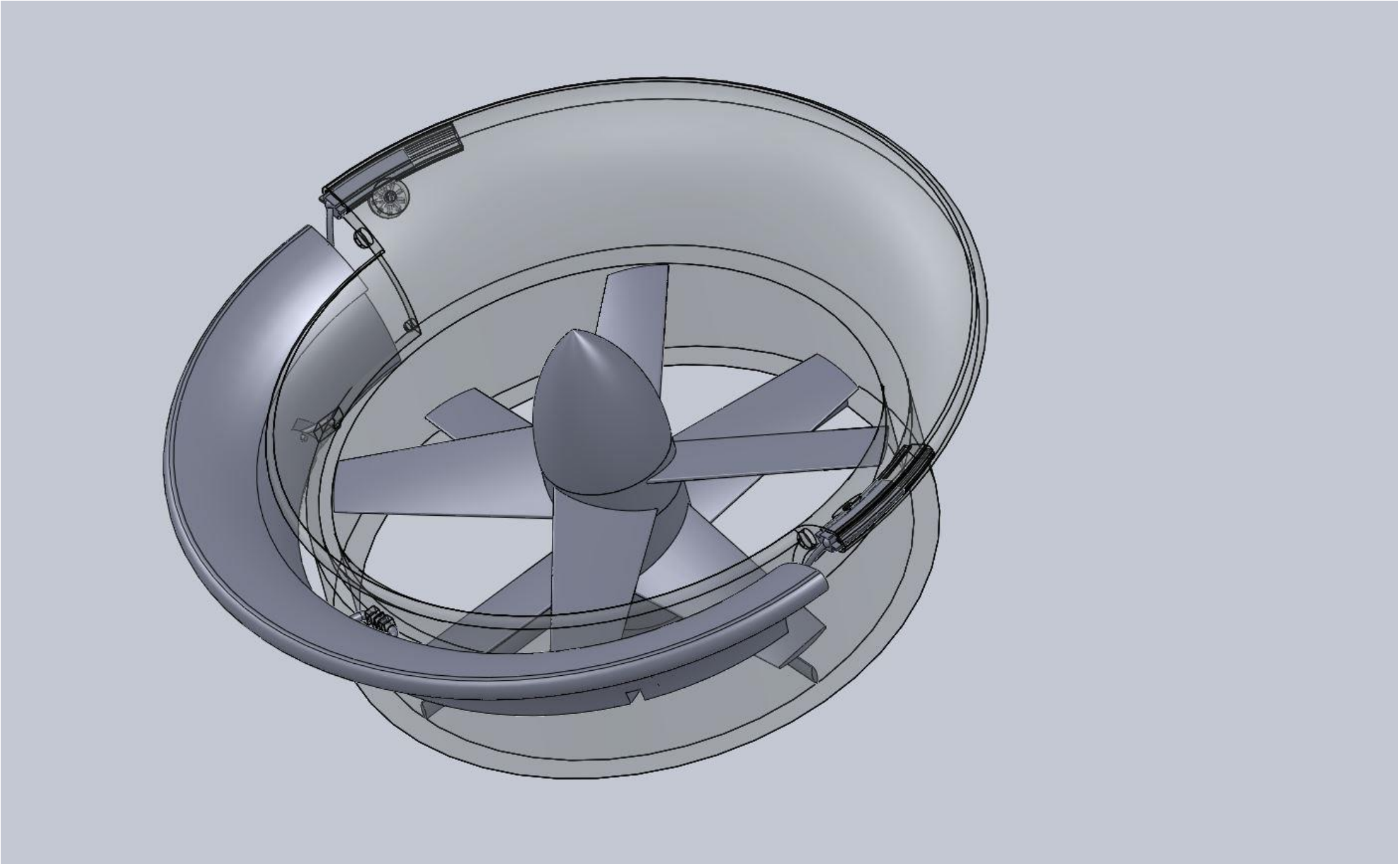
There is a lot of research into this issue with ducted fans by NASA/NACA, several researchers and institutions over the last 70 years.

There are numerous proposed solutions to this issue over the years, many of which solve part of the problem but create other issues of their own. A typical example of a recent proposal is: Double ducted fan system(patented), which solves the flow separation issue. However, once the ducted fan is tilted to the horizontal position, the second duct outside of the main ducted fan, which helped to solve the flow separation issues, gets in the way and becomes an aerodynamic and mass hinderance as well as encumbrance.

Our Axial Flow Ducted Fan with Movable Section solves such problems in one sweep. Instead of having separate members around or on the outside of the ducted fan, our system uses part or parts of the duct itself, movable and detachable in such a manner that once the flow control process is completed, the detached section is returned to its retracted position where it is blends into the whole ducted fan structure.

U.S. Patent No. 11,584,509 for a "Ducted Fan with movable section," and U.S. Patent application No. 18/110,391would enable any VTOL aircraft to overcome the flow separation issues that have plagued ducted fans in VTOL mode for decades without introducing drawbacks.

Axial Flow Ducted Fan with Movable Section: U.S. Patent No. 11,584,509 and Continuation 18/110,391



SUPRA LUMINA TECHNOLOGIES INC.

Patent

Abstract and Independent Claims

This patent has three Independent Claims and 18 Dependent Claims.

This patent is valid and enforceable through 2042.

The Patent Number is a link to this patent's listing at Google Patents.

U.S. Patent No. 11,584,509: Axial Flow Ducted Fan with Movable Section

Priority Date: December 26, 2019
Filing Date: June 26, 2020
Publication Date: December 31, 2020
Patent Grant: February 21, 2023
Patent Application #: 16/913,174
Patent Expiration: October 1, 2043
Claims: 21
Forward Citations: 10

ABSTRACT

A ducted fan propulsion comprises a duct with a cutout and a movable duct section that is moved between a retracted position within the cutout and an extended position relative to the duct. An actuator is disposed within the duct wall and is connected to the movable duct section with actuating linkage. A control linkage connects the movable duct section to the cutout edges. The movable duct section is extended when the ducted fan propulsion transitions from vertical takeoff to a level flight or transitions from level flight to a vertical landing. The movable duct section is retracted into cutout an becomes integrated with the duct during level flight.

1. An apparatus configured to move a movable duct section of a propulsion, the propulsion including a duct with a hollow interior and a cutout in the duct at a leading edge thereof, the leading edge being disposed radially to a flow axis of the propulsion, the movable duct section being sized and shaped to fit within the cutout, said apparatus comprising:

an actuator, said actuator being disposed in a cavity in the duct during use of said apparatus, the cavity being disposed, in an open communication with the cutout; and

a linkage, said linkage coupling, during said use of said apparatus, the movable duct section to each of said actuator and the duct;

said apparatus configured to selectively move the movable duct section between a fully retracted position where the movable duct section being disposed within the cutout and being integrated with the duct where a leading edge of the movable duct section completes a leading edge of the duct and a fully extended position where the movable duct section being separated from the duct to fully expose the cutout while being completely moved outside of the cutout, where the leading edge of the movable duct section interrupts the leading edge of the duct and where an edge of the movable duct section opposite the leading edge of the movable duct section being disposed outwardly from an exterior surface of the duct.

2. The apparatus of claim 1, wherein in said fully retracted position an exterior surface of the movable duct section completes an exterior surface of the duct.

3. The apparatus of claim 1, wherein said actuator comprises two actuators and the cavity comprises two cavities, each actuator from said two actuators being disposed in a respective cavity from said two cavities, the respective cavity being further disposed, in an open communication with a side edge of the cutout, the side edge being disposed in a direction of the flow axis.

4. The apparatus of claim 3, wherein said linkage comprises:

two actuating links, each actuating link from said two actuating links being coupled, at one end thereof, to a respective actuator from said two actuators and being coupled, at an opposite end thereof, to one end of the movable duct section, the one end being disposed adjacent a respective side edge of the cutout when the movable duct section being in the fully retracted position; and

a control link, said control link coupling the movable duct section, mediate ends thereof, to a leading edge of the cutout, the leading edge being disposed normal to the flow axis.

5. The apparatus of claim 3, wherein said linkage comprises:

two actuating links, each actuating link from said two actuating links being coupled, at one end thereof, to a respective actuator from said two actuators and being coupled, at an opposite end thereof, to one end of the movable duct section, the one end being disposed adjacent a respective side edge of the cutout when the movable duct section being in the fully retracted position; and

two control links, each control link from said two control links coupling the movable duct section, mediate ends thereof, to a leading edge of the cutout, the leading edge of the cutout being disposed normal to the flow axis.

6. The apparatus of claim 3, wherein said linkage comprises:

two actuating links, each actuating link from said two actuating links being coupled,

at one end thereof, to a respective actuator from said two actuators and being coupled, at an opposite

end thereof, to one end of the movable duct section, the one end being disposed adjacent a respective side edge of the cutout when the movable duct section being in the fully retracted position; and

three control links, one control link from said three control links couples a middle of an interior edge of the movable duct section to a leading edge of the cutout, the leading edge of the cutout being disposed normal to the flow axis, and remaining two control links from said three control links couple the interior edge of the movable duct section to the leading edge of the cutout adjacent the respective side edge of the cutout.

7. The apparatus of claim 6, wherein each control link from said remaining two control links comprises one end that engages a link seat in the movable duct section and comprises another end that engages a link seat in the duct.

8. The apparatus of claim 7, wherein each control link from said remaining two control links comprises a variable length.

9. The apparatus of claim 6, wherein each control link from said remaining two control links comprises a telescoping mechanism.

10. The apparatus of claim 9, wherein said telescoping mechanism comprises a movable member with an internal thread, a stationary member with an external thread, said external thread operatively meshing with said internal thread, and an actuator being coupled to said stationary member and configured to rotate said stationary member so as to reciprocally move said movable member along a length of said stationary member.

11. The apparatus of claim 6, wherein each control link from said three control links engages a link seat in the movable duct section and comprises another end that engages a link seat in the duct.

12. The apparatus of claim 1, wherein said actuator comprises:

a rack, each actuating link in said linkage being pivotally attached to one end of said rack.

a pinion, said pinion being in a meshed engagement with said rack; and

a drive, said drive configured to rotate said pinion.

said rack movable between a first position corresponding to said fully retracted position of said movable duct section and a second position corresponding to said fully extended position of said movable duct section.

13. The apparatus of claim 1, wherein said cavity being in an open communication with a leading edge of the cutout and wherein said linkage comprises:

an actuating link, said actuating link being coupled, at one end thereof, to said actuator and being coupled, at an opposite end thereof, to an interior edge of the movable duct section; and three control links, two control links from said three control links couple ends of the movable duct section to side edges of the cutout and a remaining third links couples said interior edge of the movable duct section to a leading edge of the cutout.

14. The apparatus of claim 13, wherein each control link from said two control links comprises a damper, said damper being disposed, during said use of said apparatus, in a cavity, the cavity being disposed in an open communication with the cutout and adjacent the leading edge.

15. A ducted fan propulsion, comprising:

a duct with a hollow interior, said duct defining each of a leading edge and a discharge edge of said duct:

a rotor mounted within said hollow interior, said rotor comprising a rotatable propeller assembly mounted for a rotation; a cutout in a wall of said duct, a leading edge of said cutout being disposed inwardly at a distance from said leading edge of said duct ;

a movable duct section, said movable duct section being shaped and sized to fit within said cutout;

two actuators, each actuator from said two actuators being disposed in a cavity in

said duct, said cavity being in an open communication with said cutout;

two actuating links, each actuating link from said two actuating links being coupled, at one end thereof, to a respective actuator and being coupled, at an opposite end thereof, to one end of said movable duct section; and

a control linkage, said control linkage coupling said movable duct section, mediate ends thereof, to said duct ;

said two actuators are operable to selectively move, through said two actuating links and said control linkage, said movable duct section between a retracted position where said movable duct section is disposed within said cutout so that a leading edge of said movable duct section completes said leading edge of said duct and an exterior surface of said movable duct section completes an exterior surface of said duct and an extended position where said movable duct section is separated from said duct and where said leading edge of said movable duct section interrupts said leading edge of said duct.

16. The ducted fan propulsion of claim 15, wherein said each actuator comprises:
a rack, each actuating link being pivotally attached to one end of said rack;
a pinion, said pinion being in a meshed engagement with said rack; and
a drive, said drive configured to rotate said pinion;
said rack movable between a first position corresponding to said retracted position of said movable duct section and a second position corresponding to said extended position of said movable duct section.

17. The ducted fan propulsion of claim 16, wherein said one end of said rack is disposed within said cutout when said rack moved into said second position.

18. The ducted fan propulsion of claim 15, further comprising a projection on a side edge of said cutout and another cavity in a respective end of said movable duct section, said cutout being sized and shaped to receive said projection when said movable duct section being disposed in said retracted position.

19. The ducted fan propulsion of claim 15, wherein said leading edge of said movable duct

section comprises a curved surface.

20. The ducted fan propulsion of claim 15, wherein said duct comprises a first reduced thickness portion adjacent said leading edge of said cutout, wherein said movable duct section comprises a second reduced thickness portion adjacent an edge being opposite to said leading edge of said cutout and wherein said first reduced thickness portion and said second reduced thickness portion are disposed adjacent each other when said movable duct section being disposed in said retracted position.

21. An apparatus configured to move a movable duct section of a propulsion, the propulsion including a duct with a hollow interior and a cutout in the duct at a leading edge thereof, the leading edge being disposed radially to a flow axis of the propulsion, the movable duct section being sized and shaped to fit within the cutout, the apparatus comprising:

two actuators, each actuator from the two actuators being disposed in a cavity within the duct, the cavity being further disposed, in an open communication with a side edge of the cutout, the side edge of the cutout being disposed in a direction of the flow axis; and

a linkage, the linkage configured to couple the movable duct section to each of the two actuators and the duct, the linkage comprising:

two actuating links, each actuating link from the two actuating links being coupled, at one end thereof, to a respective actuator from the two actuators and being coupled, at an opposite end thereof, to one end of the movable duct section, the one end being configured to be disposed adjacent a respective side edge of the cutout, and

three control links, one control link from the three control links couples a middle of an interior edge of the movable duct section to a leading edge of the cutout, the leading edge of the cutout being disposed normal to the flow axis, and remaining two control links from the three control links couple the interior edge of the movable duct section to the leading edge of the cutout adjacent the respective side edge of the cutout, each control link from the remaining two control links comprises a telescoping mechanism;

the apparatus configured to move the movable duct section between a fully retracted position where the movable duct section being disposed within the cutout and being integrated with the duct and where a leading edge of the movable duct section completes a

leading edge of the duct and a fully extended position where the movable duct section being separated from the duct and where the leading edge of the movable duct section interrupts the leading edge of the duct.

SUPRA LUMINA TECHNOLOGIES INC.

Patent
(continuation)

Abstract and Independent Claims

This patent application has 2 Independent Claims and 17 Dependent Claims.

This patent is valid and enforceable through 2043.

The Patent Number is a link to this patent's listing at Google Patents

U.S. Patent Continuation Appl. No. 18/110,391: Axial Flow Ducted Fan With Movable Section

Priority Date: December 26, 2019
Filing Date: February 16, 2023
Publication Date: NA
Patent Grant: NA

Patent Application #: 18/110,391
Patent Expiration: October 1, 2043
Claims: 21
Forward Citations: 10

ABSTRACT

A ducted fan propulsion comprises a duct with a cutout and a movable duct section that is moved between a retracted position within the cutout and an extended position relative to the duct. An actuator is disposed within the duct wall and is connected to the movable duct section with actuating linkage.
A control linkage connects the movable duct section to the cutout edges. The movable duct section is extended when the ducted fan propulsion transitions from vertical takeoff to a level flight
or transitions from level flight to a vertical landing. The movable duct section is retracted into cutout an becomes integrated with the duct during level flight.

What is Claimed is:
1. An apparatus configured to move a movable duct section of a propulsion, the propulsion including a hollow housing with a duct and a cutout in the duct at a leading edge thereof, the leading edge being disposed radially to a flow axis of the propulsion, the movable duct section being sized and shaped to fit within the cutout, said apparatus comprising:

an actuator, said actuator being disposed in a cavity in the duct during use of said apparatus, the cavity being disposed, in an open communication with the cutout; and
a linkage, said linkage coupling, during said use of said apparatus, the movable duct section to each of said actuator and the duct;

said apparatus configured to selectively move the movable duct section between a retracted position where the movable duct section being integrated with the duct and an extended position
where the movable duct section being separated from the duct.

2. The apparatus of claim 1, wherein in said retracted position, said movable duct section is disposed within the cutout, an exterior edge of said movable duct section completes
the leading edge and an exterior surface of the movable duct section completes an exterior surface of the duct.

3. The apparatus of claim 1, wherein said actuator comprises two actuators and the cavity comprises two cavities, each actuator from said two actuators being disposed in a

respective cavity from said two cavities, the respective cavity being further disposed, in an open communication with a side edge of the cutout, the side edge being disposed in a direction of the flow axis.

4. The apparatus of claim 3, wherein said linkage comprises:

two actuating links, each actuating link from said two actuating links being coupled, at one end thereof, to a respective actuator from said two actuators and being coupled, at an opposite end thereof, to one end of the movable duct section, the one end being disposed adjacent a respective side edge of the cutout when the movable duct section being in the retracted position; and

a control link, said control link coupling the movable duct section, mediate ends thereof, to a leading edge of the cutout, the leading edge being disposed normal to the flow axis.

5. The apparatus of claim 3, wherein said linkage comprises:

two actuating links, each actuating link from said two actuating links being coupled, at one end thereof, to a respective actuator from said two actuators and being coupled, at an opposite end thereof, to one end of the movable duct section, the one end being disposed adjacent a respective side edge of the cutout when the movable duct section being in the retracted position; and

two control links, each control link from said two control links coupling the movable duct section, mediate ends thereof, to a leading edge of the cutout, the leading edge being disposed normal to the flow axis.

6. The apparatus of claim 3, wherein said linkage comprises:
Two actuating links, each actuating link from said two actuating links being coupled, at one end thereof, to a respective actuator from said two actuators and being coupled, at an opposite end thereof, to one end of the movable duct section, the one end being disposed adjacent a respective side edge of the cutout when the movable duct section being in the retracted position; and

three control links, one control link from said three control links couples a middle of an inner edge of the movable duct section to a leading edge of the cutout, the leading edge being disposed normal to the flow axis,
and remaining two control links from said three control links couple the inner edge of the movable duct section to the leading edge of the cutout adjacent the side edges of the cutout.

7. The apparatus of claim 6, wherein each control link from said two remaining control links comprises one

end that engages a link seat in the movable duct section and comprises another end that engages a link seat in the duct.

8. The apparatus of claim 7, wherein each control link from said two remaining links comprises a variable length.

9. The apparatus of claim 6, wherein each control link from said two remaining links comprises a telescoping mechanism.

10. The apparatus of claim 9, wherein said telescoping mechanism comprises a movable member with an internal thread, a stationary member with an external thread, said external thread operatively meshing with said internal thread, and a drive casing, said drive casing being coupled to said stationary member and configured to rotate said movable member so as to reciprocally move said movable member along a length of said stationary member.

11. The apparatus of claim 6, wherein each control link from said three control links engages a link seat in the movable duct section and comprises another end that engages a link seat in the duct.

12. The apparatus of claim 1, wherein said actuator comprises:

a rack, said each actuating link being pivotally attached to one end of said rack; a pinion, said pinion being in a meshed engagement with said rack; and a drive, said drive configured to rotate said pinion; said rack movable between a first position corresponding to said retracted position of said movable duct section and a second position corresponding to said extended position of said movable duct section.

13. The apparatus of claim 1, wherein said cavity being in an open communication with a leading edge of the cutout and wherein said linkage comprises: an actuating link, said actuating link being coupled, at one end thereof, to said actuator and being coupled, at an opposite end thereof, to inner edge of the movable duct section; and

three control links, two control links from said three control links couple ends of the movable duct section to side edges of the cutout and a remaining third links couples an inner edge of the movable duct section to a leading edge of the cutout.

14. The apparatus of claim 13, wherein each control link from said two control links comprises a damper, said damper being disposed, during said use of said apparatus, in a duct cavity, the duct cavity being disposed in an open communication with the cutout and adjacent the leading edge.

15. A ducted fan propulsion, comprising:

a duct with a duct and a hollow interior, said duct
defining each of a leading edge and an outlet edge of said duct;

a rotor mounted within said hollow interior, said rotor comprising a propeller blade mounted for a rotation;

a drive assembly configured to rotate said propeller blade;

a cutout in said duct at said leading edge;

a movable duct section, said movable duct section being shaped and sized to fit within said cutout;

two actuators, each actuator from said two actuators being disposed in a cavity in said duct, said cavity being in an open communication with said cutout;

two actuating links, each actuating link from said two actuating links being coupled, at one end thereof, to a respective actuator and being coupled, at an opposite end thereof, to one end of said movable duct section; and

a control linkage, said control linkage coupling said movable duct section, mediate ends thereof, to a remaining portion of said duct;

said two actuators are operable to selectively move, through said actuating and control linkages, said movable duct section between a retracted position where said movable duct section is disposed within said cutout so that an exterior edge of said movable duct section completes said leading edge and an exterior surface of said movable duct section completes an exterior surface of said duct and an extended position where said movable duct section is separated from each of said leading edge and said duct.

16. The ducted fan propulsion of claim 15, wherein said each actuator comprises:

a rack, said each actuating linkage being pivotally attached to one end of said rack;

a pinion, said pinion being in a meshed engagement with said rack; and

a drive, said drive configured to rotate said pinion;

said rack movable between a first position corresponding to said retracted position of said movable duct section and a second position corresponding to said extended position of said

movable duct section.

17. The ducted fan propulsion of claim 16, wherein said one end of said rack is disposed within said cutout when said rack moved into said second position.

18. The ducted fan propulsion of claim 15, further comprising an abutment on an end of said cutout and a cavity in a respective end of said movable duct section, said cutout being
sized and shaped to receive said abutment when said movable duct section moved into said retracted position.

19. The ducted fan propulsion of claim 15, wherein said exterior edge of said movable duct section comprises a curved surface.

Axial Flow Ducted Fan with Movable Section: U.S. Patent No. 11,584,509 and Continuation 18/110,391

SUPRA LUMINA TECHNOLOGIES INC.

Commercializing the Invention Covered by This Portfolio

The acquirer of this portfolio will have a product that has multiple benefits over the current design proposals for flow control in Ducted fan system

The advantage of the Axial flow ducted fan with movable section stems mainly from the fact that when compared to effective existing proposals that can solve the flow separation issues that plague ducted fans used in VTOL mode,(during transition to level flight and back) is that it is designed in such a manner that the flow control member is an integral part of the duct itself instead of being a separate component which is external to the ducted fan . It can then be retracted into the ducted fan when it is no longer needed.

Applications for the Axial flow ducted fan with movable section.
There are several commercialization opportunities for the company that acquires this portfolio.

- ***Conventional VTOL aircrafts***
- ***The emerging e-VTOL (electric VTOL aircrafts) in development***
- ***Flying car proposals***
- ***Drones***
- ***Unmanned Aerial Vehicles (UAVs)***

SUPRA LUMINA TECHNOLOGIES INC.

Acquiring or Licensing This Portfolio

Here is some additional information about this portfolio, as well as guidelines for its acquisition or licensing.

Toroidal Traction Transmission: U.S. Patent No. 11,584,509 and 18/110,391

The inventor and assignee of this portfolio has put it up for licensing or a cash sale assigning the patent, and all right associated with the patent, to the acquiring entity.

The patent is unencumbered. There are no licenses or liens.

A copy of the patent's file history is available on the USPTO website.

The assignee reserves the right to accept a bid and sell the portfolio at any time.

SUPRA LUMINA TECHNOLOGIES INC.

About Supra Lumina Technologies Inc.

Supra Lumina Technologies Inc. is a technology company

Overview: Founded in 2010, the goal of **Supra Lumina Technologies Inc.** is to develop new, efficient and innovative technology solutions in the industrial, automotive, aerospace, marine and robotics sector. To this end, patented solutions have been developed by Supra Lumina Technologies Inc., some of which are part of this patent portfolio.

SUPRA LUMINA TECHNOLOGIES INC.

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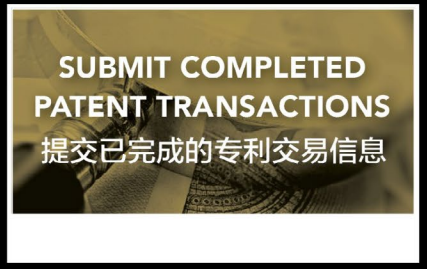

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12-LEO-169-22		Global	Toxic Agent Detection System 毒剂检测系统	US8664604	3/5/2010	12/6/2022			$400,000 ¥2,835,520	4/5/2023		17	Sale 交易	Various	
12-JOH-168-22	12-JOH-168-22	US	Transaction Prompting System 交易提示系统	US2020021908o A1	11/28/2012	11/29/2022			$1,400,000 ¥9,997,260	3/29/2023		5	Sale 交易	Various	
11-INN-167-22	11-INN-167-22	Global	Semiconductor Manufacturing Test 半导体制造测试	US10088520 B1	10/27/2015	11/3/2022			$2,500,000 ¥18,072,000	4/03/2023		18	Sale 交易	Various	

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