United States Patent [19]

Morgan

[11] **3,730,456**

[45] **May 1, 1973**

[54] **AIRCRAFT WITH LIFT ENGINES**

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[22] Filed: **Apr. 14, 1971**

[21] Appl. No.: **133,964**

[30] **Foreign Application Priority Data**

Apr. 14, 1970 Great Britain.....17,803/70

[52] **U.S. Cl.** .....**244/12 B,** 244/129 D

[51] **Int. Cl.** **B64c 29/00,** B64c 1/14

[58] **Field of Search** .....244/129 D, 12 B, 244/23 A, 23 B, 53 B

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[57] **ABSTRACT**

A VSTOL aircraft with lift engines disposed in rows along either side of the fuselage in sponsons, the sponsons having top intake doors and bottom efflux doors which doors comprise mutually articulated inboard and outboard sections so as to fold inward toward the fuselage when opened. Opening and closing movements of the doors are controlled by radius rods pivotally connected to the outer edges of the outboard door sections, the radius rods of the upper doors having the opposite ends carried on swinging links so that the center of movement of the radius rods changes during opening in order to avoid full opening of the doors being prevented by the fuselage side wall.

7 Claims, 2 Drawing Figures

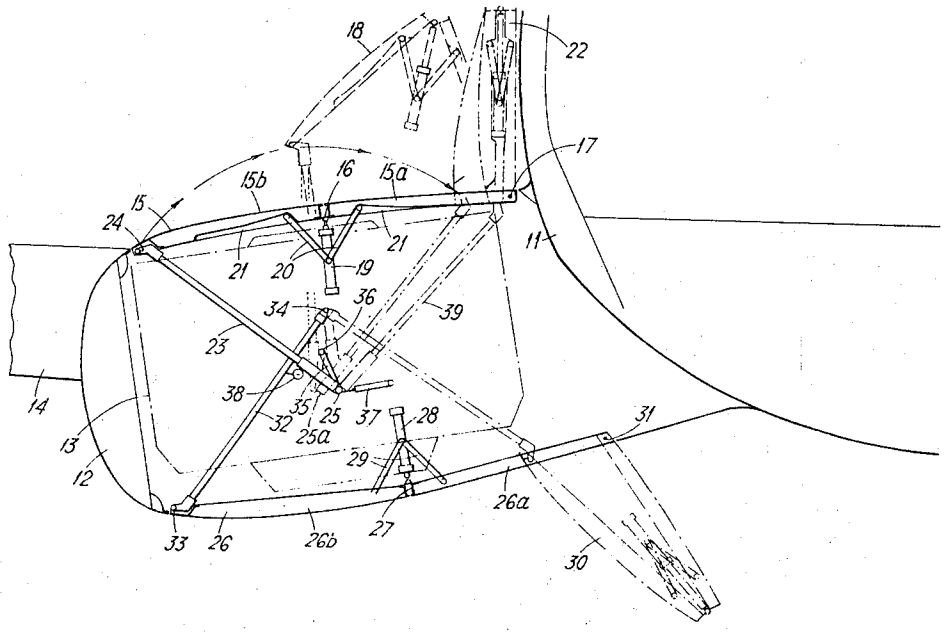

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Fig. 1.

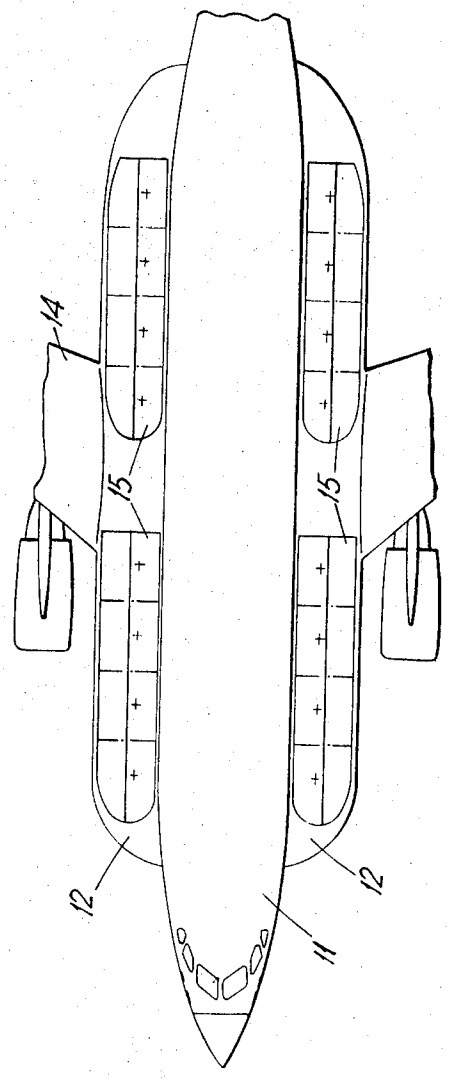

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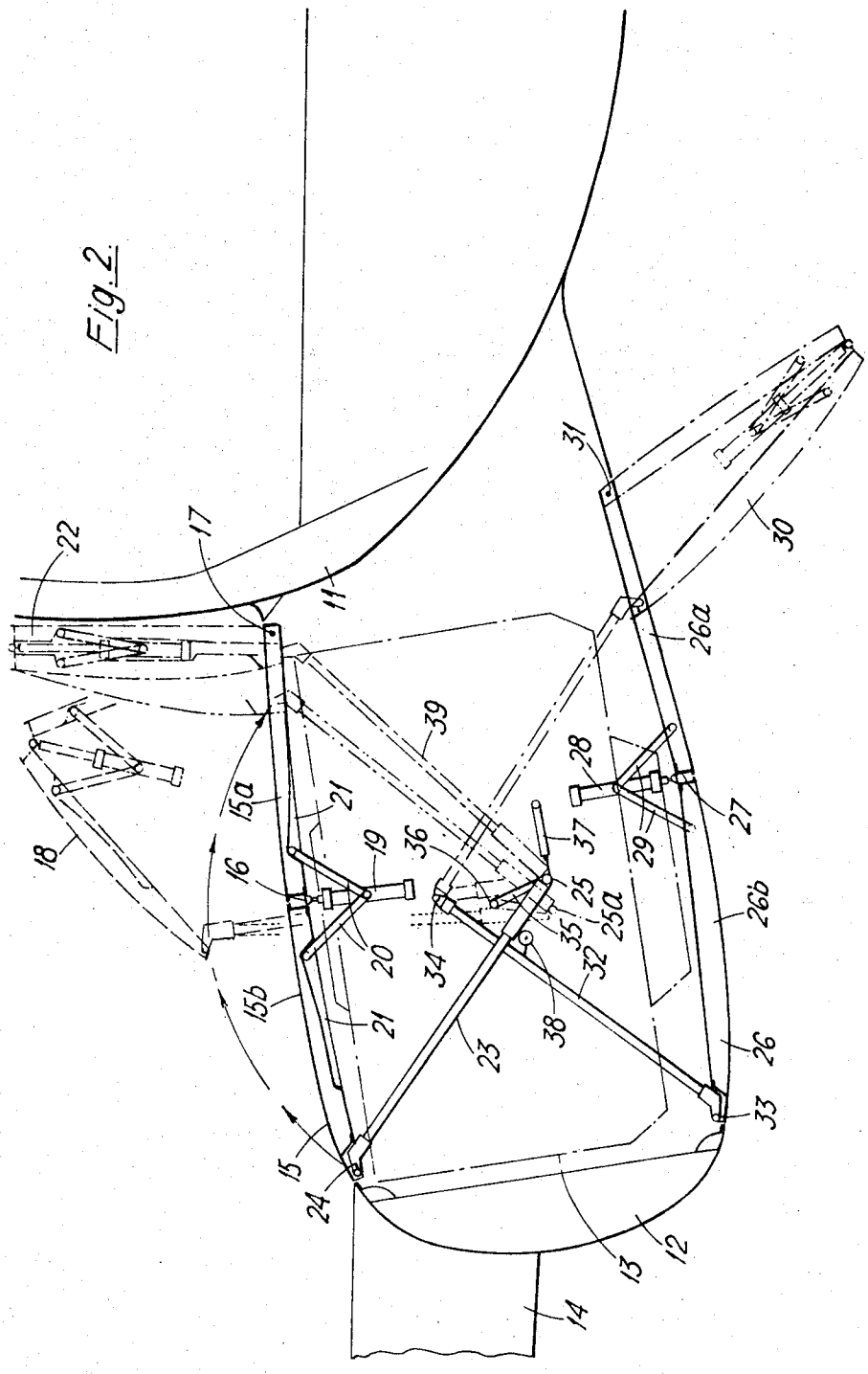
Fig. 2



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AIRCRAFT WITH LIFT ENGINES

This invention relates to VSTOL aircraft with lift engines, for example fan lift engines, and more particularly to the case where the lift engines are disposed in rows in sponsons along opposite sides of the fuselage.

Such sponsons need upper and lower doors that are closed when the lift engines are not in use but are open when the lift engines are operating to allow intake of air to the engines from above and outflow of the engine efluxes below. It is an object of the invention to provide a sponson door system which gives a good air intake, with turbulence reduced to a minimum. A badly designed door and operating mechanism can cause unacceptable turbulence and drag.

According to the present invention, each door is articulated for folding and comprises an inboard section hinged at a fixed point close to the side of the fuselage and an outboard section hinged on the outer edge of the inboard section, and a radius rod determines the position of the outer edge of the outboard section during opening and closing of the door.

The effort for opening and closing the door may be applied by means of a piston-and-cylinder unit or jack, either hydraulic or pneumatic, acting at the point of articulation to cause the door to fold and unfold.

Whereas the lay-out of the upper and lower doors of the sponson can be broadly similar, it may be advantageous for the radius rod of each upper or intake door to be so arranged that it changes its center of movement during opening or closing, as will be hereinafter discussed, in order to prevent the opening movement of the intake doors from being hindered by the fuselage side wall.

One arrangement in accordance with the invention will now be described by way of example and with reference to the accompanying drawings, in which:

FIG. 1 is a diagrammatic plan view of aircraft sponson pods housing lift fan engines, and

FIG. 2 is a diagrammatic cross sectional elevation on the line 2—2 of FIG. 1.

The drawings show a civil aircraft fuselage 11 along opposite sides of which are sponsons 12 each containing a fore-and-aft row of eight lift fan engines 13 in two groups of four with a gap between groups at the roots of the wings 14. The sponsons project laterally outward, and to a small degree downward, from the bottom regions of the fuselage sides and the lift engines are mounted with their axes generally upright but leaning out to some extent away from the fuselage, matching the degree of downward cant of the sponsons.

Above and below the engines there are air intake and engine efflux outlet doors fitted at the top and bottom of the sponson, respectively. Each inlet door 15 has an inboard section 15*a* and an outboard section 15*b* hinged together at an articulation point 16. The inner edge of the inboard section is hinged on the sponson at 17 close to the fuselage side and when the door opens the inboard section rises about this fixed hinge 17 while the outboard section folds down about the hinge 16, as illustrated at 18. This folding takes place under the action of hydraulic (or pneumatic) jacks 19 the cylinder of each of which is carried by a pair of pivotal links 20 connected one to each door section while the jack rod is coupled to the hinge connection 16. The underside of each door section is recessed at 21, to accomodate the jack body and the links 20 when the door is fully folded as shown at 22.

During folding and unfolding of the intake door 15 the paths of the door sections are controlled by radius rods 23 each pivotally connected at 24 to the outer edge of the outboard section 15*b* and swinging in a plane transverse to the aircraft fore and aft axis about a pivot point 25 within the sponson.

Each outlet door 26 similarly consists of an inboard section 26*a* and an outboard section 26*b* hinged to one another at 27 and actuated by jacks 28 carried by links 29, the door folding to the position shown at 30 as the inboard section swings down about a hinge connection 31 to the sponson at its inner edge. The paths of the sections of the outlet door are controlled by a radius rod 32 pivotally connected to the outer edge of the outboard section 26*b* at 33 and turning about a pivot point 34 within the sponson.

Since the underside of the sponson 12 is at or about the same level as the underside of the fuselage 11 it is possible for the fixed hinge 31 of each outlet door 26 to be spaced well in from the inboard extremities of the lift engines. The outboard door section 26*b* can thus move far enough to leave the engine exits clear without having to fold close up to the inboard section 26, and the folded door section lie in a triangular configuration which gives stability to resist flutter.

However, in the case of the intake door 15 the proximity of the upper parts of the engines to the fuselage wall means that the door sections must fold close to each other and to the fuselage. In order to achieve the desired result each radius rod 23 does not have a fixed center but its center of turn changes during the opening and closing of the intake doors. When the cabin control switch is selected to open the intake doors 15 a mechanical lock in the jack 19 is released. The initial travel at the articulated joint 16 breaks the outer seal and lock at 24 and the doors 15*a* and 15*b* start to lift, the outer edge being controlled by the radius rod 23. The pivot 25 at the inner end of the radius rod itself swings on a short depending link 35 about a fixed point 36. A spring strut 37 (which could alternatively by hydraulic or pneumatic) pushes the pivot point 25 of the radius rod so that the radius rod bears on a roller stop 38 during the initial door-opening sequence. The center of turn of the rod 23 changes during the door opening sequence, the geometry being arranged to prevent the intake doors fouling the fuselage side. The pivot point at 25 moves traversely as the doors 15 reach the point in their travel shown at 18. During the remaining opening sequence the bottom pivot 25 moves to the position at 25*a*. In the fully open position at 22 the radius rod 23 moves to position 39 with the engagement of mechanical locks on the fuselage side, giving a smooth intake for air into the engine and stabilizing the doors in the fully open position. The pivot center of the rod 23 has now shifted back to point 25.

The arrangement described has, in addition to the beneficial features already discussed, further advantages as follows:

1. A small short-stroke lightweight jack will open and close the doors rapidly, which jack occupies the minimum of space in either the open or closed positions.

2. The radius rods will fit easily between the lift fan engines, thus enabling the engines to be closely pitched.

3. In the fully open position the frontal cross sectional area is kept low.

4. With the doors fully open, the outer surfaces of the upper doors are contoured to give a smooth intake to the engines and the lift fan engine intakes are unaffected by any door. structures.

5. The intakes are unaffected by cross winds.

What I claim is:-

1. A VSTOL aircraft with lift engines disposed in rows in sponson structures along opposite sides of the aircraft fuselage, each sponson structure having upper and lower door assemblies opening to allow intake of air to the engines from above and outflow of the engine effluxes below, said upper door assembly comprising at least one upper door articulated for folding and having an inboard section hinged at a fixed point close to the fuselage and an outboard section hinged on the outer edge of said inboard section, at least one swinging upper radius rod controlling the opening and closing movement of said upper door which upper radius rod has an upper end pivotally connected to the outboard edge of said outboard section of said upper door, and a link member movably mounted on the sponson structure at a substantially central region of said structure for limited movement in the inboard-outboard direction to which link member the lower end of the upper radius rod is pivotally connected, the center of swinging of said upper radius rod shifting outboard on said link member during opening of said upper door in order to prevent the full opening movement from being hindered by the fuselage sidewall.

2. An aircraft according to claim 1, wherein said lower door assembly comprises at least one lower door articulated for folding and having an inboard section hinged at a fixed point near the fuselage and an outboard section hinged on the outer edge of said inboard section, and at least one swinging lower radius rod controlling the opening and closing movement of said lower door which lower radius rod has a lower end pivotally connected to the outboard edge of said outboard section of said lower door and an upper end pivotally connected to the sponson structure at a substantially central region of said structure.

3. An aircraft according to claim 1, wherein said link member is a short depending swinging link having its upper end pivotally mounted on the sponson structure and its lower end pivotally connected to the lower end of said upper radius rod.

4. An aircraft according to claim 2, wherein the effort for opening and closing each door is applied by means of a piston-and-cylinder unit acting at the point of articulation to cause the door to fold and unfold.

5. An aircraft according to claim 3, wherein (in the closed position of the upper door) the upper radius rod has its lower end spring-urged in the outboard direction against a stop that engages the upper radius rod at a point near its lower end.

6. An aircraft according to claim 1, wherein, in the fully open position, said folded upper door becomes locked to the side of the fuselage.

7. An aircraft according to claim 4, wherein the cylinder of the unit operating each door is carried at the inside of the door by a pair of pivotal links connected one to each door section, and the piston rod is coupled to the point of articulation of the door.

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