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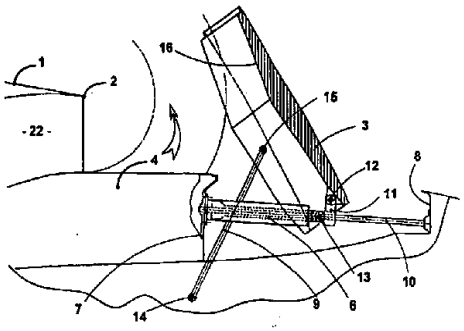

(57) Abstract

The invention concerns a turboblower thrust reverser comprising obstacles (3) retracted, in direct thrust, in the turboblower primary cowling wall (4) and unfolded to form a ring-shaped flux-deviating assembly providing thrust reversal by the action of actuators (6) arranged inside the primary cowling (4). Each obstacle (3) is driven in rotation by a linking element (9) about a mobile pivot (12) which is driven in translation by at least an assembly consisting of said actuator (6) and a guide element (10), the actuator (6) drives the obstacle (3) by its downstream part towards an upstream direction parallel to the turboblower axis and is located in the guide element (10) alignment.

TURBOBLOWER THRUST REVERSER

The present invention relates to a thrust reverser for use with a turboblower preferably at high dilution rates.

Some turbojet engines which comprise a primary channel for circulating gases, called hot flow gases, consisting of an ejection stream and an annular channel, which is co-axial with the primary channel, in which gases, called cold flow gases, circulate to the outlet, for example, from a blower situated at the inlet of the turbojet engine to form a secondary ejection stream. For such engines the thrust reversal mainly or solely uses the deviation of the secondary flow, particularly when the dilution rate is high.

It is known that in these applications, movable elements or obstacles can, in the unfolded position, form a continuous annular assembly which obturates said secondary channel so as to deviate the secondary flow and to direct the lamellae of the flow to produce a thrust reversal. When operating in direct thrust, on the contrary, said obstacles must be withdrawn and retracted to leave the secondary channel free and cleared so that the secondary flow can circulate. In certain known types of thrust reversers, said obstacles are retracted into the wall which is radially external to the secondary channel.

Other solutions provide that said obstacles be retracted at the level of the wall which is radially external to the secondary channel or the wall which envelopes the internal or central part of the engine, which is also called the primary cowling. Solutions of this type are particularly described in FR-A-1 479 131. Diverse improvements have been proposed in FR-A-2 625 261 and FR-A-2 650 861.

This solution is particularly applicable when the dilution rates are high and when the wall which is radially external to the secondary channel is shorter than the wall which is radially internal to said secondary channel.

According to US 3 280 561 and FR 2 625 261, the movable elements or obstacles are, in this case, mounted on the fixed structure which surrounds the gas generator of the engine by means of fixed pivots. The pivot joint of the obstacles can be placed on the

downstream side, but in this case, the movement of the obstacle leads to a position of obstruction of the secondary channel which hinders the operation of the engine. Safety problems subsist since the obstacles are not self-closing. In the case where the joint is placed on the upstream side the deviation of the jet is obtained by the external face of the obstacles, which does not allow optimisation of shapes which is adapted to both the deviation and the direct jet. Another major disadvantage in this case is that it would be necessary to provide a retractable front spoiler or deflector on the end of the obstacle which must be carefully designed to assure efficiency and is subjected to high stresses.

The patent US 4 216 923 shows a system for driving flap shutters by synchronisation which requires that the whole have complicated mutually parallel guiding and driving elements.

Thus, there are still problems concerning the adaptation of a thrust reverser of this type to a motive power unit having very high dilution rates, taking the conditions of installation on an aeroplane and particularly mass reduction into account, while maintaining the spatial requirement of the engine in terms of its external diameter and the ground clearance. The installation of a thrust reverser on a turboblower nacelle having a dilution rate equal to or greater than 4 must also remain possible. The thrust reverser must also assure the efficiency required for reversing performance as well as, when operating in direct thrust, an aerodynamically continuous internal wall without introducing harmful perturbation into the flows. The invention aims to particularly minimise the obstruction of the secondary channel by the upstream side of the obstacle during the opening phase of the latter. An objective of the invention is to facilitate the movement of the obstacle while taking large

axial and radial stresses into account and assuring operational safety. Another objective of the invention is to obtain a simplicity of definition which facilitates implementation and maintenance.

A turboblower thrust reverser conforming to the invention and enabling results mentioned above to be obtained without incurring the disadvantages of known previous solutions is characterised in that each movable element or obstacle is brought into a reverse thrust position by rotating at least one linking element around a movable pivot which is moved by at least one assembly consisting of said control means and a guiding element, said control means driving said obstacle by its downstream part in an upstream direction which is substantially parallel to a turboblower axis, and the control means being aligned with the plane of the guiding element.

According to the preferred applications, said elements are placed in the longitudinal direction, which can be parallel or not in relation to the axis of the engine, the guiding element being rectilinear or comprising one or several bends.

The other characteristics and advantages of the invention will be better understood on reading the following description of an embodiment of the invention in reference to the accompanying drawing in which:

- Figure 1 shows a half view of a longitudinal section cut by a plane passing through the axis of rotation of a turboblower and the centre of the movable element, a reverser according to an embodiment of the invention in a direct jet position;

- Figure 2 illustrates the embodiment described in Figure 1 in a reversed jet position;

- Figure 3 illustrates, in a front view, the perspective of the embodiment shown in Figures 1 and 2 in a position intermediate between the direct jet position and the reversed jet position;

- Figure 4 shows, in a view similar to that shown in Figure 3, an obstacle provided with two assemblies for controlling and guiding;

- Figures 5 and 6 show, in a reversed jet mode and direct jet mode, another embodiment of the invention in which the lateral connecting rods are replaced with one or several jacks;

- Figures 7 and 8 show, in a reversed jet mode and direct jet mode, another embodiment of the invention in which the obstacle is axially guided in a chute situated around the jack;

- Figure 9 shows, in a front view, a perspective of the embodiment described in Figures 7 and 8 in a position intermediate between the direct jet position and the reversed jet position;

- Figures 10 and 11 show, in perspective, details of two possibilities for guiding the translating part, assuring the obstacle/jack link;

- Figures 12 and 13 show, in a view similar to that shown in Figure 9, two examples of an obstacle provided with a single central control mechanism, and two guiding devices installed on both sides of the control mechanism;

According to an embodiment illustrated in Figure 1, the invention is installed downstream from the secondary channel 22 beyond the downstream end or trailing edge 2 of the radially external wall 1 of the channel 22. The fixed structure of the primary cowling 4 which envelops the central engine body comprises a thrust reverser 19 whose movable part consists of one or several movable elements or obstacles 3 numbered two, three, four or greater.

Each obstacle 3 comprises a principal panel whose radially external surface 5, whose retracted position corresponds to a direct jet operation as shown, is connected at its edges to the surface of the primary cowling 4, thereby avoiding all aerodynamic perturbations of the secondary flow of the secondary channel 22. The fixed structure 4 can have an upstream wall 7 and a downstream wall 8, between which is installed a guiding element 10 whose ends can be linked respectively to the upstream wall 7 and downstream wall 8, or to any other structural element, the upstream end being raised in relation to the downstream end. This element assures the axial guiding of the translating part 11, said translating part being linked, on the one hand, to the obstacle 3 by means of a steering pivot pin or a pot type joint 12, and, on the other, to the end of the shank of the jack 6 at the pivot point 13.

In the example shown in Figure 1, the jack 6, which is mounted in an articulated manner or fixed in relation to the upstream wall 7, is a hollow jack which can be coaxially mounted in relation to the guiding element 10. The jack can be simple, telescopic, electric, pneumatic or mechanical.

It should be noted that a screw, ball screw or roller screw system can be used instead and in place of the jack 6; depending on the technology used, the translating part 11 must then be provided with a screw pitch, balls or rollers.

Moreover, in Figure 6, while said control jack 6 is placed upstream from the drive point 12 of the obstacle 3 between the upstream wall 7 and the downstream wall 8, it is also possible to install the jack 6 downstream from said drive point, which implies, in this case, a movement of the obstacle being thrust.

At least one connecting rod 9 is integrated with the movable element by one of its ends at the pivot point 15 on the lateral part or at any intermediate point of the movable element, its other end being integrated with the fixed structure of the primary cowling at the pivot point 14, the latter being installed either on the upstream wall 7, or on a lateral wall or beam situated between the movable elements 3, or any other point of the fixed structure 4.

It can be seen that the kinematics of the opening of the obstacles 3 obtained by associating the rotation of the connecting rod 9 with the driving of the downstream side of the obstacle 3 toward the upstream makes it possible to assure, between the upstream edge of the obstacle 3 and the trailing edge 2 of the external nacelle a distance equal to at least twice the stream height between the trailing edge 2 and the primary cowling 4, thereby minimising the obstruction of the secondary channel 22.

The inclination of the guiding element 10 makes it possible to optimise the dimensioning of the passage which must be capable of allowing the flow 22 to pass without compromising the operation of the engine. It is to be noted that, for reasons relating to the aerodynamic effects sought for, the guiding element can be inclined in the other direction, namely, the downstream end can be raised in relation to the upstream end or have an intermediate position.

The guiding element 10 can be rectilinear or comprise one or several bends.

Figure 2 shows the jack 6 driving the movable element 3 from the downstream toward the upstream, the rotation of the latter around the pivot axis 12 being controlled by the connecting rod(s) 9. It is to be noted that an appropriate shape of the internal wall 16 of the movable element can optimise the guiding of the flow in a reversed jet position. A front spoiler and lateral obstacles having the shape and dimensions adapted to the aerodynamic effects sought for can be joined to it.

Figure 3 shows a front view, in perspective, of the previously described embodiment in a position intermediate between the direct jet position and the reversed jet position, on which the control jack 6 and the guiding element 10 are installed in a plane passing through the engine axis and the centre of the movable element 3.

Figure 4 shows, in a view identical to that of Figure 3, a movable element 3 provided with two elements for guiding 10 and controlling 6 installed on both sides of the central plane, between the central plane and the lateral end of each movable element 3.

Figures 5 and 6 show the kinematics of opening of an obstacle which are different from those described previously because the lateral connecting rods 9 are replaced with one or several jacks 20. Said jack 20 has one of its ends connected to the obstacle 3 at the pivot point 21, the other being connected to the fixed structure at the pivot point 22. It can be of an electric, pneumatic or hydraulic type.

During the opening phase, the latter drives the obstacle from the position 3a to the position 3b by a rotation around the axis 12. As soon as the jack 20 completes its course, which corresponds to the position 20b, the principal control jack 6 is activated, driving the obstacle 3 from the position 3b to the position 3c. It is to be noted that opening kinematics in which the jacks 2 and 20 are simultaneously activated can be envisaged. Moreover, it is possible to use the jack 20 as a control rack for the jack 6 in order not to complicate the control system.

Figures 7, 8 and 9 illustrate another embodiment of the invention, the main difference lying at the level of the guiding element. In this embodiment, a chute 30, which is connected to the fixed structure 4 at the level of the walls 7 and 8 has openings 31 on its lateral walls 33 and 35, which assure the guiding of the translating part 11, for ex-

ample, to one or several rollers 24. This embodiment makes it possible to particularly facilitate the movement of the movable element 3 when there are large radial stresses, and one or two chutes can be applied per obstacle. The use of a hollow jack optimises the operation under very large axial stresses. The lateral end of the obstacle can also comprise roller(s), the grooves being, in this case, located in the lateral beams.

Figures 10 and 11 show the details of two embodiments which can assure the guiding of the translating part 11 into the chute 30. Figure 10 corresponds to the guiding mode described above, and Figure 11 shows a possible version in which the translating part 11 has cuttings or grooves 37 which assure the guiding of said translating part on and between the hooks 36 integrated in the lateral walls 33 and 35.

These two guiding modes are two possibilities among numerous others known to the person skilled in the art which depend on male part(s) guided into female part(s) and can be applied to the present invention.

According to Figure 9, the jack 6 and the chute 30 are installed in a plane passing through the engine axis and the centre of the movable element 3, but other installations can also be envisaged as shown in Figures 12 and 13.

In Figure 12, the movable element 3 is controlled by a single jack 6 installed in its median plane, and is axially guided by two sliding rails 38 provided with grooves 39 which receive the chutes 40 situated on both sides of said jack. The pivot point 6 on the movable element 3 can be aligned or not with the axes of articulation 12 of the chutes 40 with the movable element 3.

Figure 13 illustrates a version of the embodiment of the sliding link in which two guiding elements 42 identical to those shown in Figures 1 to 4 are installed on both sides of the central jack 6.

Naturally, certain systems or/and certain configurations can be separately used in combination with one another, allowing the following possibilities:

- the connecting rods 9 can be lateral as shown in the Figures and can also have a position which is intermediate between the previously defined position and the centre of the movable element;

- depending on the point of rotation 12 in a zone upstream from the movable element 3, the downstream of the obstacle can comprise a cutting per hooking point to allow the movable element 3 to be completely freed;

- said hooking point 12 can project beyond the downstream of the structure of the movable element 3;

- the body of the jack 6 can be completely inserted upstream from the upstream wall 7 of the fixed structure 4;

- depending on the kinematics retained and the disposition of the control devices, physical contact can be applied between the movable element 3 and the fixed structure 4, leading to tightness between said elements in the reversed jet mode according to the aerodynamic effect sought for.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A turboblower thrust reverser comprising movable elements or obstacles located beyond the downstream end of a radially external wall of a secondary flow channel, the obstacles being adapted to be retracted in a direct thrust position into the wall of a primary cowling that envelopes the central body of an engine, and adapted to be unfolded into a reverse thrust position under the action of a control means having jacks disposed in the interior of said primary cowling, the unfolded obstacles capable of forming an annular assembly for producing thrust reversal by deviating secondary flow from the secondary flow channel, characterized in that each movable element or obstacle is brought into a reverse thrust position by rotating at least one linking element around a movable pivot which is moved by at least one assembly consisting of said control means and a guiding element, said control means driving said obstacle by its downstream part in an upstream direction which is substantially parallel to a turboblower axis, and the control means being aligned with the plane of the guiding element.

2. A turboblower thrust reverser according to claim 1 characterised in that the ends of the guiding element are respectively fixed on an upstream wall and a downstream wall integrated with the fixed structure of the primary cowling.

3. A turboblower thrust reverser according to any one of claims 1 and 2 characterised in that the upstream end of the guiding element is raised in relation to the downstream end.

4. A turboblower thrust reverser according to any one of claims 1 and 2 characterised in that the downstream end of the guiding element is raised in relation to the

upstream end.

5. A turboblower thrust reverser according to claim 1 characterised in that the guiding element consists of a chute whose lateral walls have openings which guide the movement of rollers integrated with the obstacle.

6. A turboblower thrust reverser according to any one of claims 1 to 5 characterised in that the guiding element is rectilinear.

7. A turboblower thrust reverser according to any one of claims 1 to 5 characterised in that the guiding element comprises at least one bend.

8. A turboblower thrust reverser according to any one of claims 1 to 5 characterised in that the linking element that links the obstacle to the fixed structure of the primary cowling is a connecting rod.

9. A turboblower thrust reverser according to any one of claims 1 to 5 characterised in that the linking element that links the obstacle to the fixed structure of the primary cowling is a jack.

10. A turboblower thrust reverser comprising movable elements or obstacles located beyond the downstream end of a radially external wall of a secondary flow channel, the obstacles being adapted to be retracted in a direct thrust position into the wall of a primary cowling that envelopes the central body of an engine, and adapted to be unfolded into a reverse thrust position under the action of a control means having jacks disposed in the interior of said primary cowling, the unfolded obstacles capable of forming an annular assembly for producing thrust reversal by deviating secondary flow from the secondary flow channel, characterized in that each movable element or

obstacle is brought into a reverse thrust position by rotating at least one linking element around a movable pivot which is moved by at least one assembly consisting of a control means and two guiding elements, said control means driving said obstacle by its downstream part in an upstream direction which is essentially parallel to a turboblower axis, and said control means being located in the plane of the guiding element.

11. A turboblower thrust reverser substantially as herein described with reference to and as illustrated by the accompanying drawings.

Dated this XX day of XX
HISPANO-SUIZA AEROSTRUCTURES
By their Patent Attorneys
GRIFFITH HACK
Fellows Institute of Patent and
Trade Mark Attorneys of Australia

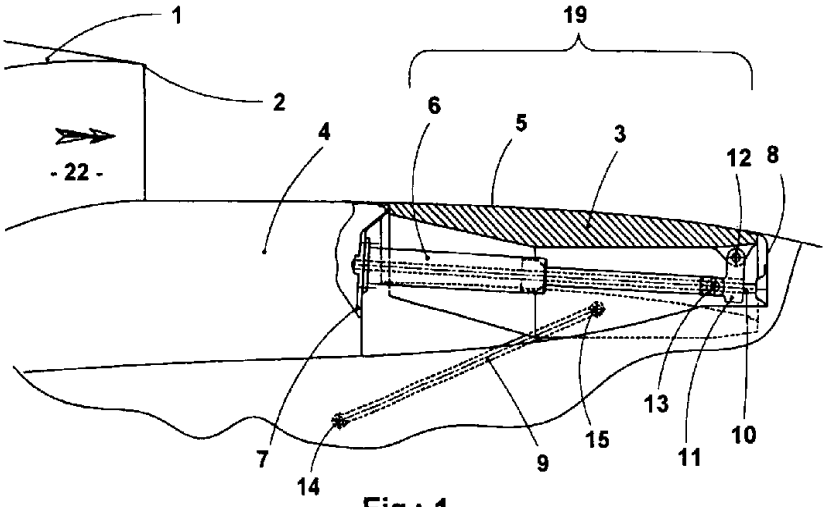

Fig : 1

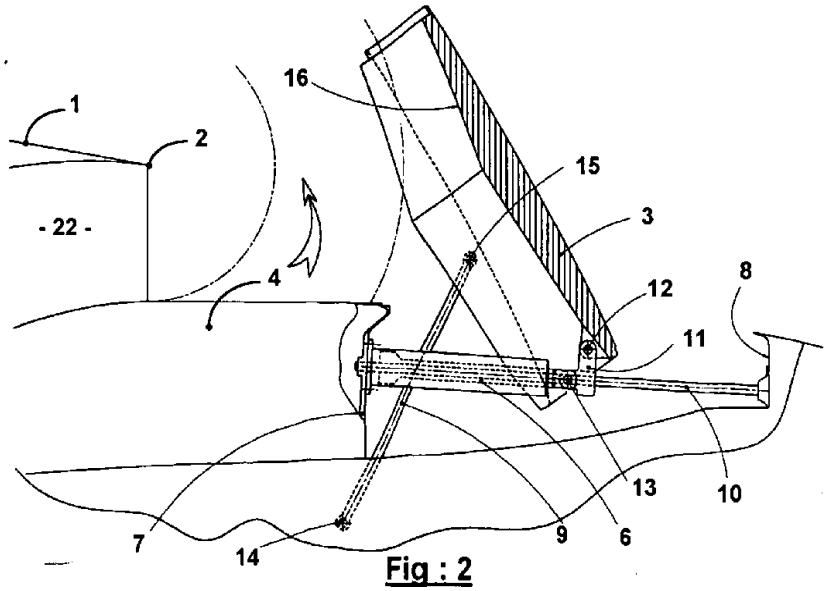

Fig : 2

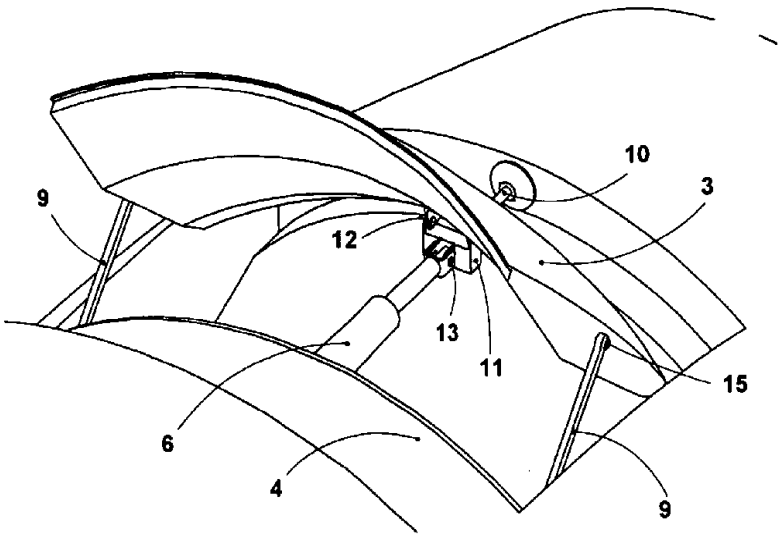

Fig : 3

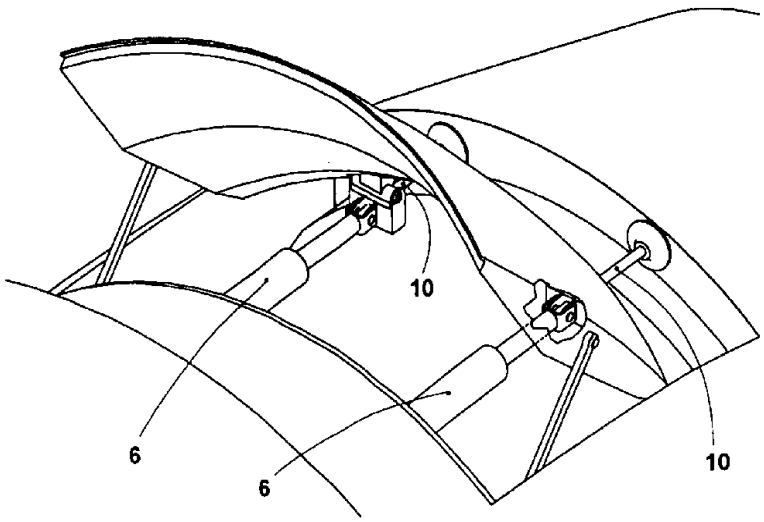

Fig : 4

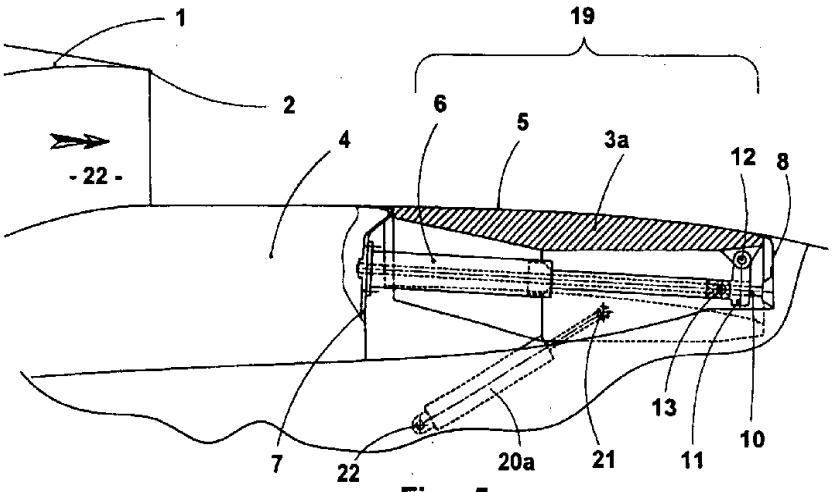

Fig : 5

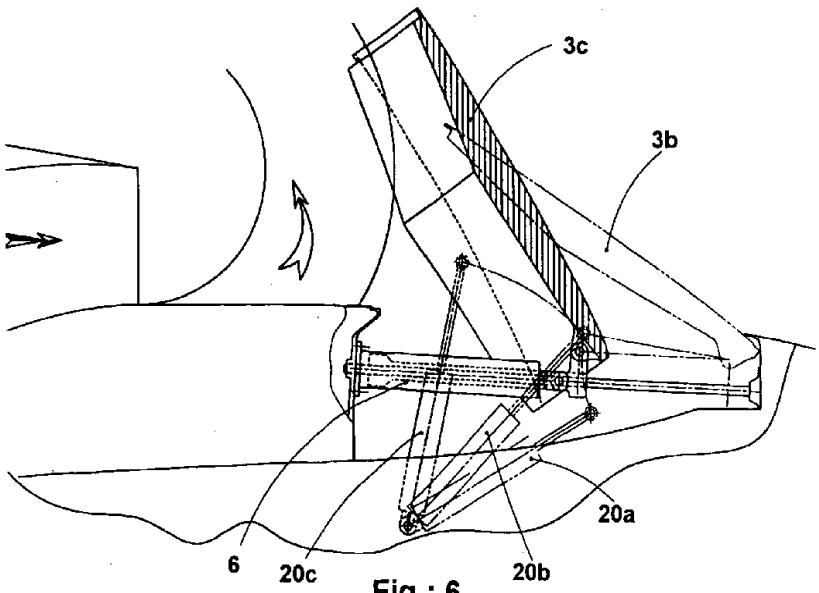

Fig : 6

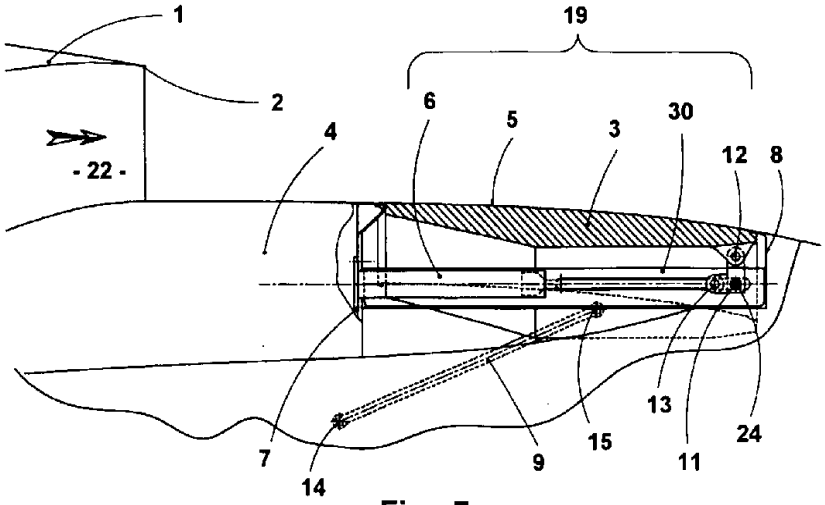

Fig : 7

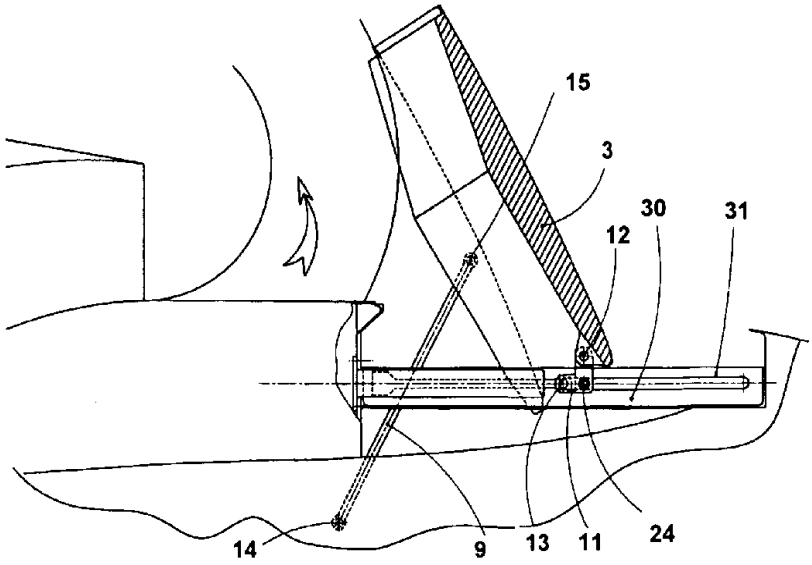

Fig : 8

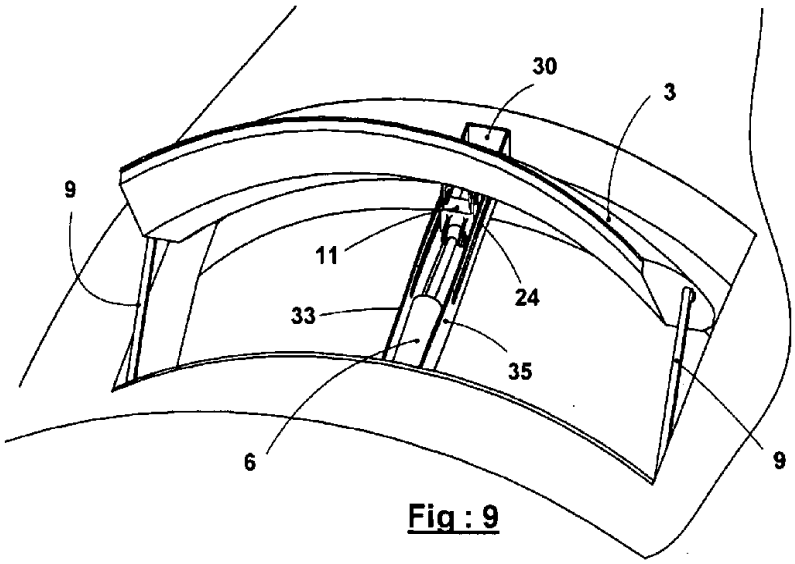

Fig : 9

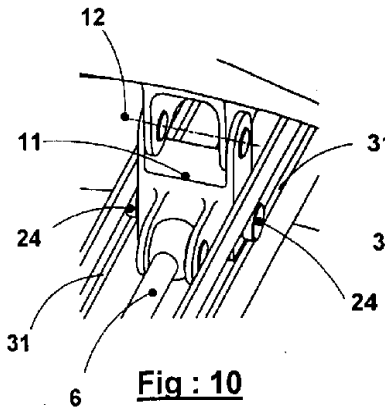

Fig : 10

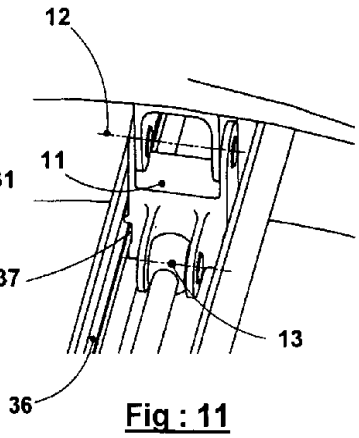

Fig : 11

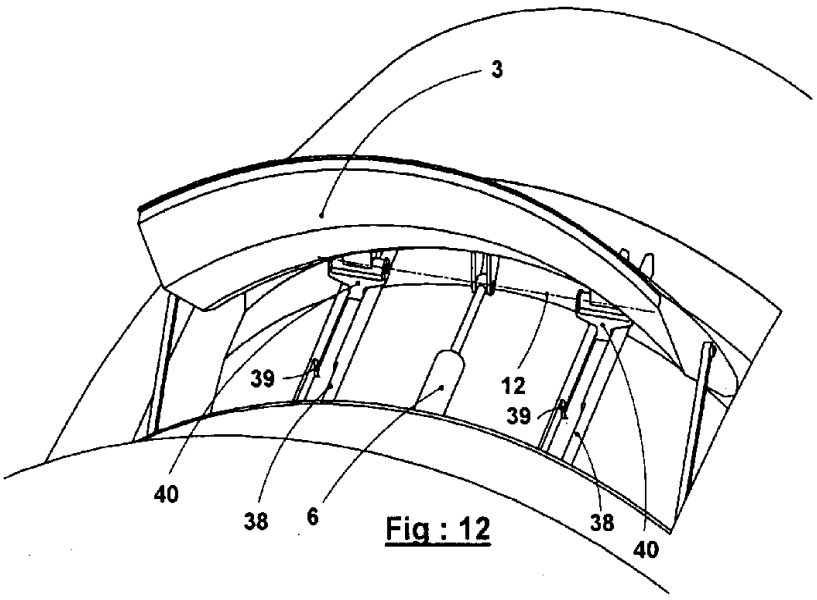

Fig : 12

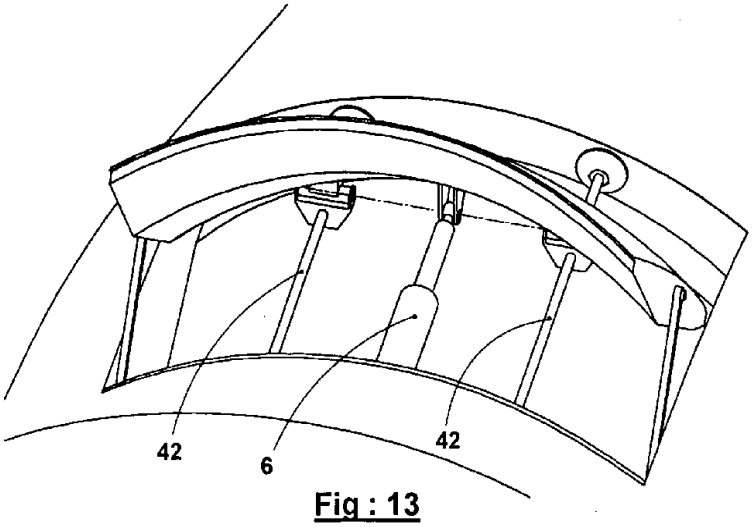

Fig : 13