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**F2R RB**  
**U1S S1833 S1839**

(56) Documents Cited  
**GB 2264475 A**      **GB 2236293 A**      **GB 2167831 A**  
**GB 2084690 A**      **GB 2030674 A**      **GB 1551500 A**  
**GB 1465412 A**      **WO 88/05011 A1**

(58) Field of Search  
UK CL (Edition O ) **B7W WPF WWK , F2R RB**

(54) **Vehicle with lift producing arrangement**

(57) A vehicle, such as an aircraft or submarine, comprises a member which produces lift when a fluid flows over it, and means to produce a flow over at least part of the member irrespective of the vehicle forward or reverse motion. In the case of an aircraft, a ducted fan 22, supplies air via toroidal vanes 25, to a duct having an elongate outlet 24 that distributes flow over a spanwise extent of a leading edge of the wing. The wing has strakes 16 and slats 15 for controlling flow over the wing, and flaps 19. In the case of a submarine a vaned member could direct a fluid flow over a hydrofoil.

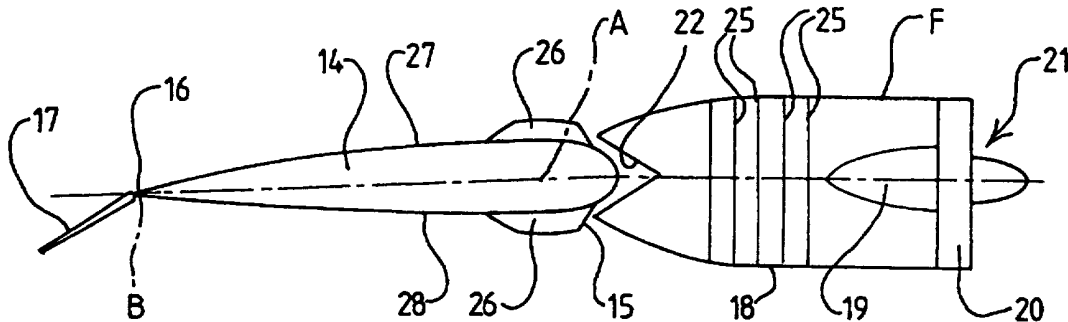


FIG 2

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FIG 1

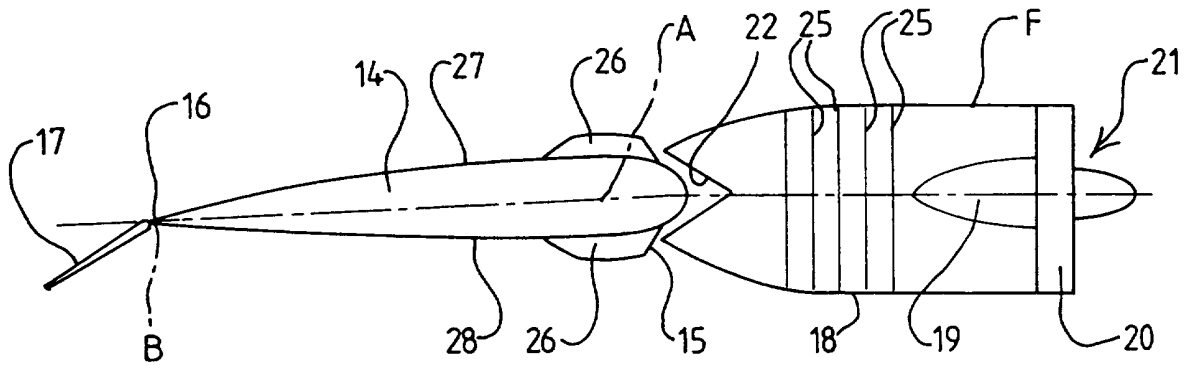
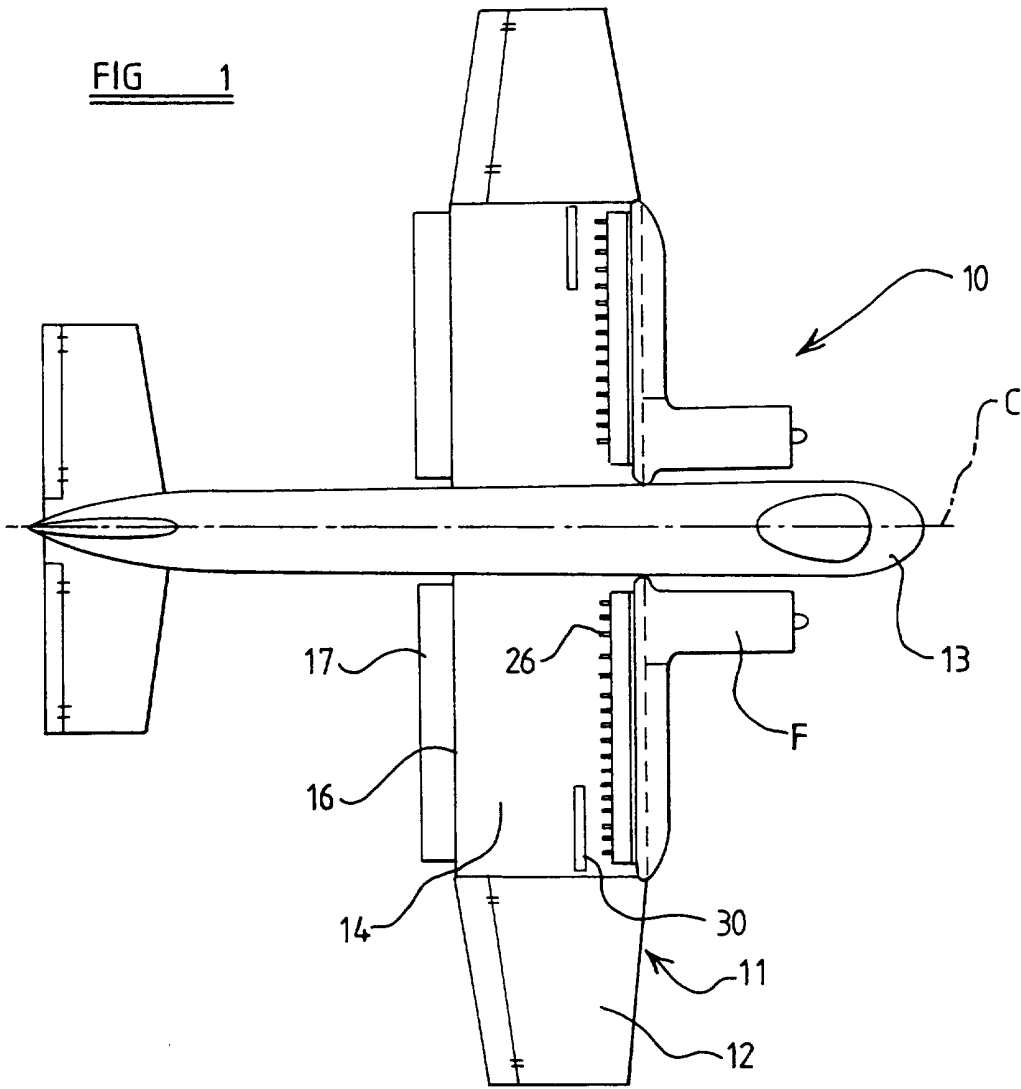


FIG 2

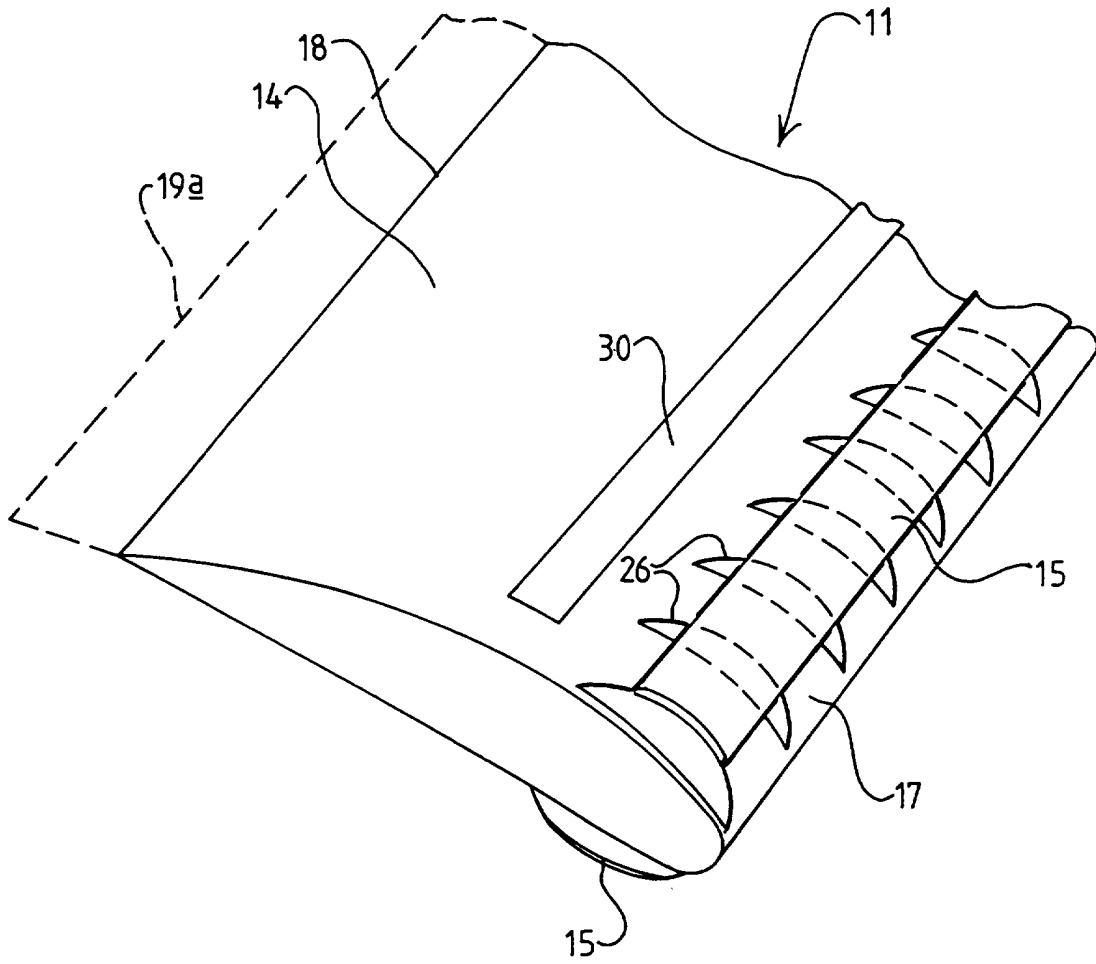


FIG 3

Title: A Vehicle

Description of Invention

This invention relates to a vehicle and more particularly but not exclusively to a vehicle comprising an aircraft or a submarine.

An aircraft is caused to lift by virtue of a flow of fluid over a wing thereof. To achieve a sufficient flow of fluid, conventional practice in a fixed wing aircraft is to provide a propulsion means to move the aircraft through the air. This means that an aircraft can only be caused to lift when moving forwardly through the air at a sufficient speed.

In a rotary wing aircraft the blades (wings) are moved in the air to produce the necessary air flow over the wings.

Conventionally, a submarine is caused to lift in water by means of hydrofoils in conjunction with buoyancy tanks but again it is necessary for the hydrofoils to have any effect, for the submarine to be moved by some propulsion means through the water.

The object of the invention is to provide a new or improved vehicle.

According to one aspect of the invention we provide a vehicle comprising a member which produces lift when fluid flows over the member, means to produce a flow of fluid over at least part of the member irrespective of vehicle forward motion.

By such an arrangement, it is thus not necessary to move a vehicle through the fluid in order to achieve lift, or otherwise to move the member in the fluid.

In one arrangement, the member comprises a main body which is generally fixed relative to a body of the vehicle, and an inner part spanwise which has one or more spanwise extending slot elements which are retractable at least in part, into the main body of the member.

Motion of the vehicle in the fluid can be controlled to achieve different lift characteristics by altering the flow of fluid over the member.

If desired, to provide yaw and pitch control, at least one flap may be attached at or adjacent to a trailing edge portion of the member, the flap being moveable relative to the second part about an axis or axes which is or are generally transverse to the forward direction of movement of the vehicle.

One means of producing a flow of fluid over the at least part of the member irrespective of vehicle forward or reverse motion may comprise a vaned member which is rotated by some appropriate power operated means about an axis generally parallel with the forward direction of movement. Alternatively the means which produce the fluid flow may comprise a gas turbine engine. Of course if desired, more than one such vaned member or gas turbine engine may be provided to achieve sufficient fluid flow over a substantial area of the at least part of the member.

In one arrangement, the means which produces the flow of fluid over the member comprises means to adjust the proportion of the fluid which flows over the member. Thus where it is desired to provide thrust to move the vehicle through the fluid in the forward direction, the means which otherwise produce the flow of fluid over the member may be utilised more efficiently as a thrust means if less fluid is directed to flow over the member.

If necessary, some means such as strakes for example may be provided to constrain the flow of fluid over the member from a leading edge of the member to a trailing edge of the member for maximum lift efficiency and to restrict non laminar fluid flow which could affect vehicle control.

If necessary, one or more spoilers may be provided on the member for use in controlling roll of the vehicle about a roll axis which is generally parallel with the forward direction.

The invention is particularly but not exclusively applicable to a vehicle comprising an aircraft in which case the member over which the fluid flows may comprise a wing of the aircraft. The aircraft may comprise other flight control

elements such as ailerons provided on the wing and for a rudder/aileron on a tail plane of the aircraft.

In each case the means which produce the flow of fluid over the wing may be adapted to produce generally laminar fluid flow. Thus for example, vanes may be provided within a housing of the fan means so that, particularly where the fan means comprises a vaned member, fluid is constrained to flow from the fan means in a laminar flow.

The invention will now be described with reference to the accompanying drawings in which:-

FIGURE 1 is a plan illustrative view of a vehicle in accordance with the invention.

FIGURE 2 is an illustrative side view of part of the vehicle of Figure 1.

FIGURE 3 is a fragmentary perspective view of a portion of the part of the vehicle of Figure 2.

Referring to the drawings, a vehicle 10 in accordance with the invention comprises an aircraft having a lifting member being a wing 11 of generally aerofoil cross section. The wing 11 comprises a main part 12 which is fixed relative to a body (fuselage 13) and at least over an inner part 14 of the wing 11, located adjacent to fuselage 13, an airflow may be created by means of a ducted fan means F. The inner part 14 comprises slats 15 spaced above and below the wing 11, by a plurality of strakes 16, which slats 15 and strakes 16 are moveable relative to the remainder of the wing 11, so as to be retractable into the wing 11 for a purpose hereinafter explained. The wing 11 comprises a leading edge 17, and a trailing edge 18, and attached to the trailing edge 18 of inner part 14, for movement about an axis such as axis B which is generally transverse to the direction of fluid flow over the member 12, is a flap 19<sup>a</sup>. The flap 19<sup>a</sup> provides for control of the fluid flow over the inner part 14 of the member 11. The wing 11 also comprises an aileron for further control of fluid flow over the wing 11, the aileron 19<sup>b</sup> being positioned outwardly spanwise, of the inner part 14 of the wing

11 on which the slats 15 are provided.

The aircraft 10 has of course a pair of wings 11, one on each side of the fuselage 13, the wings being substantially identical but oppositely handed and hence only wing 11, being the lower wing indicated in figure 1 is described herein.

The ducted fan means F includes an outer housing 20 in which is located a power unit 21 which is able to drive a vaned member 22 so as to draw air into an inlet 23, move the air through the housing 20, and produce a fluid flow at an outlet 24 in ducts 29 and hence over the inner part 14 at least, of the wing 11. Within the housing 20 there are provided a plurality of toroidal vanes 25 which are operative to ensure that the fluid which flows from the outlet 24 of the fan F is generally laminar. The ducts 29 essentially funnel the air flow over the leading edge 17 of the wing 11.

The strakes 16 on the upper 27 and lower 28 surfaces of the wing 11 are operative when not retracted into the wing 11 to constrain the fluid to flow from the leading edge 17 towards the trailing edge 18 of the wing 11, rather than flowing spanwise over the wing 11.

The aircraft 10 may thus achieve lift without there being any, or being virtually no, forward motion of the aircraft 10 in the direction of the airflow D through the air, by virtue of lift being achieved as fluid is caused to flow over the aerofoil section wing 11 by the fan F. Thus at least, an aircraft 10 would be able to achieve lift-off from a runway say, and vertically ascend, with minimal forward motion.

The fan F will of course provide thrust also and tend to move the aircraft 10 in forward direction D and when the aircraft 10 has achieved a desired altitude and forward speed, so that the aircraft 10 is supported in part by the air flow over the wing 11 caused by the movement of the aircraft 10 in the air, if desired the outlet 24 from the fan F and/or the duct means 29 may be adjusted so that a lesser proportion of the fluid which flows from the fan F, flows over the wing 11 so as to achieve more efficiency of thrust.

It can be seen from figure 1, that preferably the ducts 29 are provided

so that the fluid which flows from the fan F is distributed over at least the inner part 14 of the wing 11 before being constrained by the strakes 26 to flow from the leading edge 17 to the trailing edge 18 of the wing 11. If desired, a plurality of fans F may be provided along the wing 11 to achieve sufficient fluid flow over the wing 11 to obtain lift which is not dependent or substantially dependent upon forward motion of the aircraft 10 through the air.

To achieve variation of the proportion of fluid flowing over the wing 11, either the ducts 29 and engine outlet 24 may be closed/opened but in another arrangement, the ducts 29 may detach from the housing 18 and form part of the leading edge 17 of the wing 11 in normal flight. If desired a cowling flap (not shown) may open from the housing 18 so as more efficiently to direct air for thrust in normal flight.

The wing 11 may be provided with one or more spoilers 30 which may be used to control roll of the aircraft about general central axis C. These are used particularly in a transition phase before the aircraft 10 has achieved sufficient forward motion for the flow of fluid over the wing 11 due to the movement of the aircraft 10 through the air, to be sufficient to sustain lift.

The size and power of the ducted fan F will need to be calculated considering the weight and performance requirements of the aircraft 10. It is expected that an airflow of at least 45 metres per second over the second part 14 of the wing 11 will be required to achieve lift of a modest aircraft.

If desired, in place of a fan means F and vaned member 22, a jet-type engine may be provided to produce fluid flow over the wing but preferably there is provided a gas turbine engine with total or virtually total wasted exhaust.

Additional thrust engines maybe provided if desired.

Although the invention has been described with particular reference to a vehicle comprising an aircraft 10 it will be appreciated that the principle of the invention may be applied to a vehicle such as a submarine in which case the fluid would not be air but would be water, in order to achieve lift of the submarine by means of a hydrofoil, which is not dependent on movement of the



submarine through the water. In this event, the means which produces the flow of fluid over the hydrofoil need not comprise a ducted fan, but may comprise a vaned member of another suitable type and configuration.

The features disclosed in the foregoing description, or the following claims, or the accompanying drawings, expressed in their specific forms or in terms of a means for performing the disclosed function, or a method or process for attaining the disclosed result, as appropriate, may, separately or in any combination of such features, be utilised for realising the invention in diverse forms thereof.

## Claims

1. A vehicle comprising a member which produces lift when fluid flows over the member, means to produce a flow of fluid over at least part of the member irrespective of vehicle forward or reverse motion.
2. A vehicle according to claim 1 wherein the member comprises a main body which is generally fixed relative to a body of the vehicle, and an inner part spanwise which has one or more spanwise extending slat elements which are retractable at least in part, into the main body of the member.
3. A vehicle according to claim 1 or claim 2 wherein at least one flap is attached at or adjacent to a trailing edge portion of the of the member, the flap being movable relative to the member about an axis or axes which is or are generally transverse to the direction of fluid flow over the member.
4. A vehicle according to any one of the preceding claims wherein the means which produce the flow of fluid over at least part of the member irrespective of vehicle forward or reverse motion comprises a vaned member which is rotated by power operated means about an axis generally parallel with the forward direction of movement of the vehicle.
5. A vehicle according to any one of claims 1 to 3 wherein the means which produce the flow of fluid over at least part of the member irrespective of vehicle forward or reverse motion comprises a gas turbine engine.
6. A vehicle according to any one of the preceding claims wherein the means which produce the flow of fluid over the member comprises means to adjust the proportion of the fluid which flows over the member.

7. A vehicle according to any one of the preceding claims wherein means are provided to constrain the fluid to flow over the member from a leading edge of the member to a trailing edge of the member.
8. A vehicle according to any one of the preceding claims wherein the member is provided with one or more spoilers for use in controlling roll of the vehicle about a roll axis which is generally parallel with the direction of fluid flow over the member.
8. A vehicle according to any one of the preceding claims wherein the vehicle comprises an aircraft and the member over which fluid flows comprises a wing of the aircraft.
9. A vehicle according to claim 8 wherein the wing comprises one or more ailerons.
10. A vehicle according to any one of the preceding claims wherein the means which produce the flow of fluid over the wing is adapted to produce a generally laminar fluid flow in the fan means.
11. A vehicle substantially as hereinbefore described with reference to and as shown in the accompanying drawings.
12. Any novel feature or novel combination of features herein described and/or shown in the accompanying drawings.



Application No: GB 9622096.7  
Claims searched: 1-11

Examiner: C B VOSPER  
Date of search: 2 December 1996

**Patents Act 1977**  
**Search Report under Section 17**

**Databases searched:**

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK CI (Ed.O): B7W(WPF,WWK; F2R(RB)

Int CI (Ed.6):

Other:

**Documents considered to be relevant:**

Category	Identity of document and relevant passage	Relevant to claims
X	GB2264475A FOREMAN (whole document)	1
X	GB2236293A ADIMORA (whole document)	1
X	GB2167831A KEYAYAS (page 1, line 84 et seq.)	1,4,5,6,8
X	GB2084690A WALMSLEY (whole document, but page 1, lines 61 to 87, and 114 to 122, in particular)	1,3,4,8
X	GB2030674A RUNGE (whole document, but page 1, lines 95-125 in particular)	1,2,7,8,10
X	GB1551500 BALL (page 3, lines 33-59)	1,3,4,5,6,7,8
X	GB1465412 COXON (whole document)	1,3,4,7,8,9
X	WO88/05011A1 TARAMASCO (whole document)	1,4,8,9

X Document indicating lack of novelty or inventive step  
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