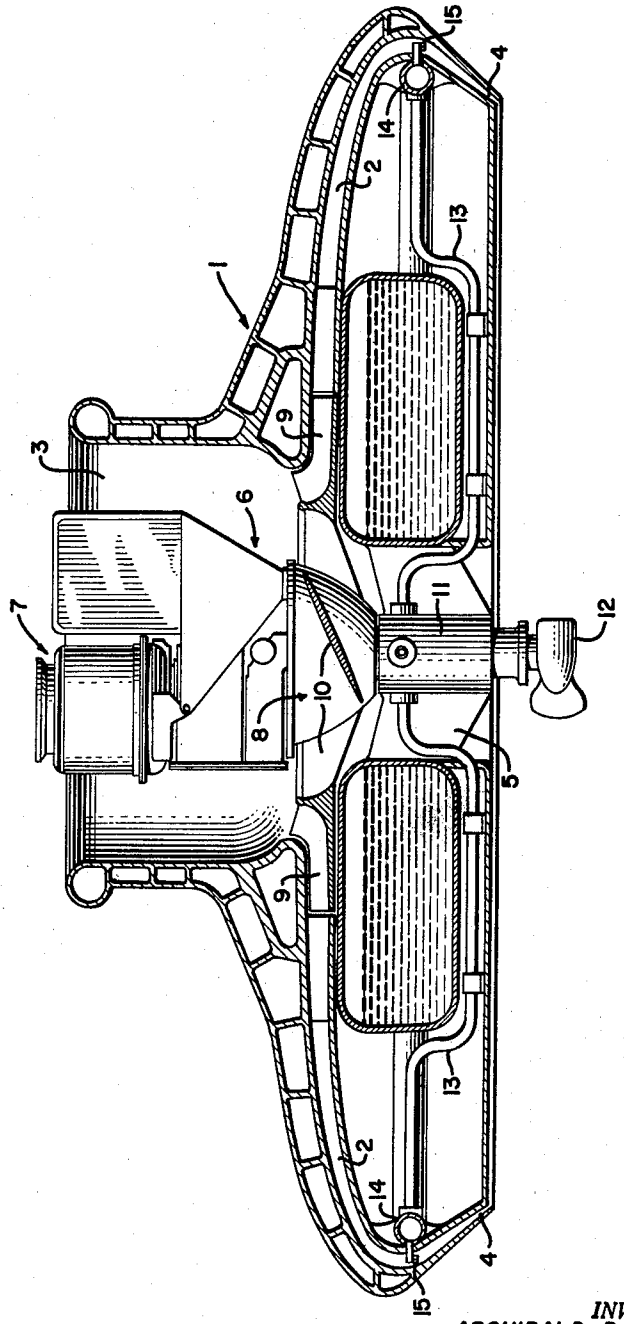
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LIFT AUGMENTATION MEANS FOR GROUND EFFECT MACHINES

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LIFT AUGMENTATION MEANS FOR GROUND EFFECT MACHINES

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The present invention relates to aircraft of the type having a body with air discharged in a downward direction through a peripheral outlet at the bottom of the machine, this air being used as a pneumatic seal to maintain a lift-producing mass of pressurized air between the underside of the aircraft and the surface over which it is supported. The invention more particularly relates to lift augmentation means for such aircraft which is particularly designed to be used over a body of water.

When the type of aircraft referred to above is in operation, the clearance between such machine and the surface thereunder depends on the pressure of the entrapped air and the ability of the pneumatic seal or "air curtain" to contain this pressure. Usually this clearance is only a small fraction of the diameter of the body, making it impossible to traverse rough surfaces.

If the machine is to be lifted any higher, means must be provided to increase the pressure of the entrapped air and strengthen the curtain enough to effectively retain this pressure.

It is, therefore, an object of the present invention to provide means in ground effect machines for increasing the pressure of air trapped under such machines.

Another object of the invention is to provide a more dense curtain of fluid, which curtain is capable of opposing greater lateral fluid pressure forces without an increase in velocity of the curtain fluid.

Another object of the invention is to augment the lift of ground effect machines to obtain greater clearance between such machines and the surfaces over which they travel.

A further object of the present invention is to provide a ground effect machine capable of operating over relatively rough surfaces.

A still further object of the invention is to provide a complete lift augmentation system for ground effect machines, the system having a water augmented curtain and means for producing higher fluid pressures within the confines of said curtain.

Other objects and advantages of the invention will become apparent to persons skilled in the art with an understanding gained by a perusal of the following detailed description and accompanying drawing wherein:

The single figure illustrates a ground effect machine constructed in accordance with the present invention, the drawing showing the device in vertical cross section with internal parts in elevation.

The reference numeral 1 generally indicates the body of a ground effect machine, such body being formed with inner and outer frame portions spaced to provide a passage 2. The outer frame portion of the body extends upwardly in a tubular projection which defines a centrally disposed circular opening 3 serving as an air inlet for the passage 2. A peripheral nozzle 4 is formed in the housing 1 at the outer end of the passage 2. It will be noted from the drawing that the passage 2 extends radially in all horizontal directions from the central portion of the body, and at the peripheral portion of the latter it turns downwardly and terminates in the nozzle 4 which is directed generally inwardly and downwardly at an angle. The inner frame portion of the body is provided with a

centrally disposed circular opening 5 forming another outlet for air admitted through the inlet opening 3. The opening 5 communicates directly with the space surrounded by the peripheral nozzle 4.

To provide for the flow of air into the inlet 3 and the discharge thereof through opening 5 and nozzle 4, the machine is equipped with a fan assembly designated generally by the numeral 6. This fan assembly includes a prime mover 7 of suitable type, such as a gas turbine which is disposed in the inlet 3 and serves to drive a composite fan 8 connected therewith. The composite fan has a radial flow component 9 and an axial flow component 10. The radial flow component 9 is provided to draw air through the inlet 3 and force it radially through the passage 2 and nozzle 4. The axial flow component 10 is provided to also draw air through the inlet 3 and force it axially through the opening 5 into the space surrounded by the nozzle 4.

It will be observed from the drawing that the air issuing under force from the nozzle 4 will flow downwardly and impinge on the ground or other surface under the body 1. The continuous flow of fluid generally inwardly and downwardly creates a peripheral curtain which tends to trap air beneath the body and increase the fluid pressure thereunder. This increased pressure applied to the under surface of the body tends to elevate it until the peripheral curtain is unable to retain the air. When an equilibrium between the ability of the curtain to retain the pressure and gravitational force is reached, the body will have assumed its natural elevated position above the ground surface.

To increase the elevation at which the body 1 will float above the supporting surface, it is proposed to augment the lift developed by increasing the ability of the peripheral curtain to retain air under the body. This objective is attained by supplying the air flowing from the nozzle 4 with moisture and thus increasing the mass flow and effectiveness. To supply such moisture, a pump 11 disposed in axial alignment with the fan 10 and driven thereby is provided to draw water through the inlet 12 and force it through conduits 13 to an annular header 14 disposed within the inner frame portion adjacent the periphery. The header 14 communicates with a plurality of jets 15 spaced peripherally around the body and extended into the passage 2 upstream of the nozzle 4. These jets are provided to disperse liquid from the header 14 into the air stream flowing through passage 2.

In operation the prime mover 7 drives the fan assembly 6 to draw air in through the inlet 3 and force it through the passage 2, the nozzle 4 and opening 5. Air ejected at high velocity from the nozzle 4 forms a pneumatic seal between the bottom of the body 1 and the water surface over which the machine is supported. The air which is driven through the opening 5 by the axial flow component 10 of the fan assembly 6 acts to increase the pressure of the air trapped by the air curtain.

The pump 11, which is also driven by the prime mover 7, will force a spray of water into the airstream of the passage 2. As the liquid is thus introduced to the airstream and discharged therewith through nozzle 4, it becomes a part of the curtain and adds considerably to the mass of such curtain. This increased mass greatly improves the ability of the curtain to contain the added pressure of the entrapped air.

We claim:

1. A ground effect machine comprising: a body forming passage means with an inlet and inner and outer downwardly directed outlets, said outer outlet being of restricted width and disposed to surround said inner outlet, means in said passage means for forcing air from said inlet through said outlets; and means carried by said body

and communicating with said passage means for supplying relatively dense fluid to a region of said passage means immediately upstream of and leading solely to said outer outlet.

2. A ground effect machine comprising: a body forming passage means with an inlet and inner and outer downwardly directed outlets, said outer outlet being narrow in width and disposed to surround said inner outlet; radial flow fan means disposed in a portion of said passage means leading to said outer outlet for forcing air from said inlet through said outer outlet; axial flow fan means disposed in a portion of said passage means leading to said inner outlet for forcing air from said inlet through said inner outlet; and means carried by said body and communicating with said passage means for supplying relatively dense fluid to said passage means between said radial flow fan means and said outer outlet.

3. A ground effect machine comprising: a body forming passage means with an inlet means and inner and outer downwardly directed outlets, said outer outlet being of narrow width and disposed to surround said inner outlet; radial flow fan means disposed in a portion of said passage means leading to said outer outlet for forcing air from said inlet through said outer outlet; axial flow fan means disposed in a portion of said passage means leading to said inner outlet for forcing air from said inlet through said inner outlet; pump means carried by said body for communication with a source of relatively dense fluid; and means leading from said pump means for conducting fluid from said pump to a region of said passage means between said radial flow fan means and said outer outlet.

4. A ground effect machine comprising: a body forming passage means with an inlet and inner and outer downwardly directed outlets, said outer outlet being of narrow width and disposed to surround said inner outlet; radial flow fan means in a portion of said passage means leading to said outer outlet for forcing air from said inlet through said outer outlet; axial flow fan means in a portion of said passage means leading to said inner outlet for forcing air from said inlet through said inner outlet; pump means carried by said body for communication with a source of relatively dense fluid; header means mounted on said body adjacent said outer outlet; conduit means for establishing communication between said pump and said header; and means in said passage means and communicating with said header for dispersing fluid from said header into a region of said passage means between said radial flow fan means and said outer outlet.

5. A ground effect machine comprising: a body forming passage means with an air inlet and inner and outer downwardly directed outlets, said outer outlet constituting a jet extending around the periphery of said body, said passage means having a first portion leading from said inlet to said peripheral jet and a second portion leading from said inlet to said inner outlet; an inlet for a density augmenting fluid; a first means carried by said body for moving air from the air inlet through said first and second passage portions for discharge from said peripheral jet and inner outlet; and a second means in said body for moving said density augmenting fluid from the inlet therefor to and discharging the same solely through said peripheral jet with air supplied thereto by said first means.

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