Aug. 30, 1966 D. JONES 3,269,476

METHOD TO ENABLE A GROUND EFFECT MACHINE TO LEAP OVER OBSTACLES

Filed Dec. 2, 1963 2 Sheets-Sheet 1

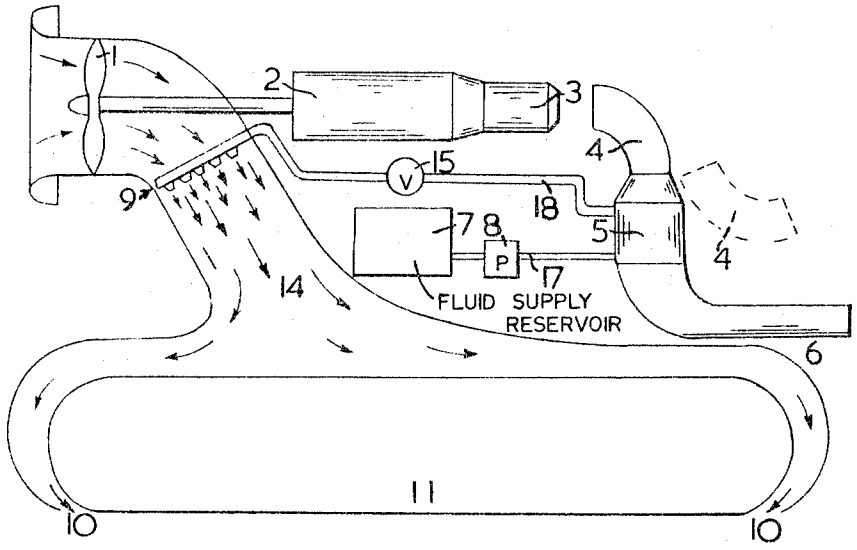


FIG. 1

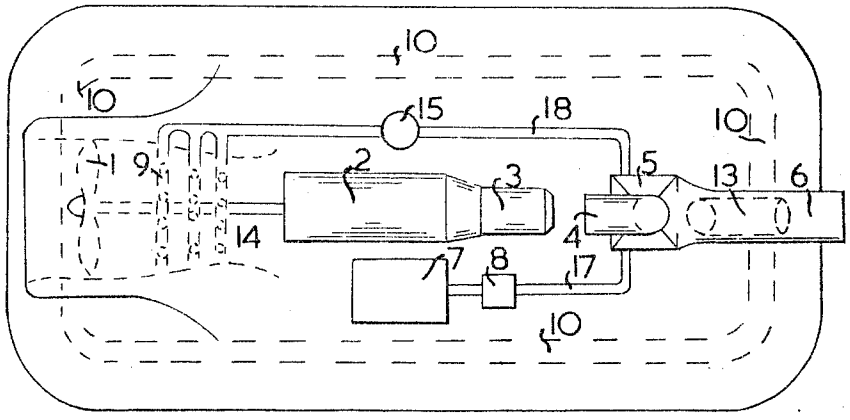


FIG. 2

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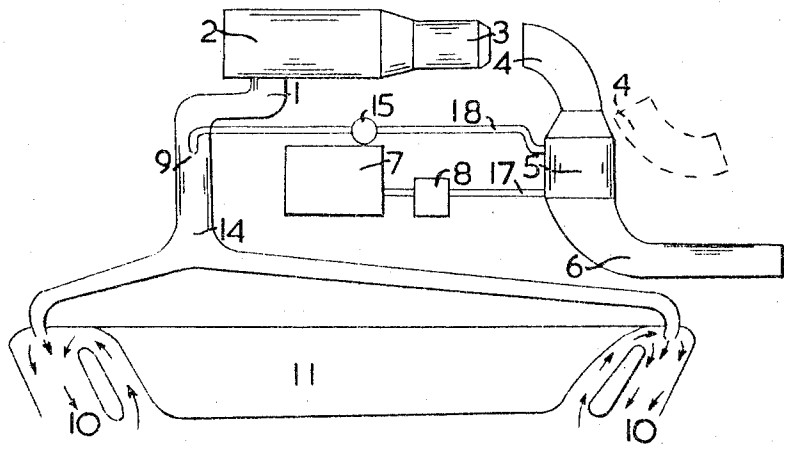


FIG. 3

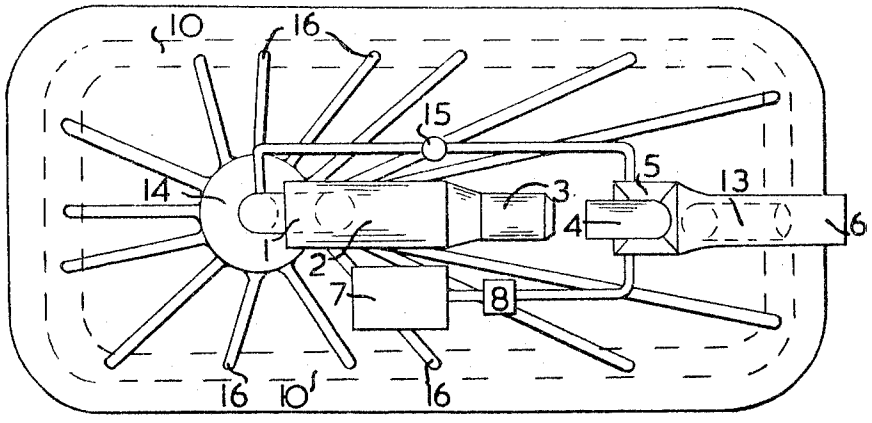


FIG. 4

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METHOD TO ENABLE A GROUND EFFECT MACHINE TO LEAP OVER OBSTACLES

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7 Claims. (Cl. 180—7)

This invention relates to a ground effect machine and particularly to improvements therein incorporating means to increase the energy of the vehicle sustaining media.

Conventional ground effect machines hover above land or water on an air bubble or cushion of air disposed within a peripheral air curtain exhausted from the base of the machine. The peripheral air curtain can contain the bubble at an economical power level only when the vehicle is operating close to the ground or water. Consequently the operating height of the ground effect machine is normally low. The vehicle can not travel over land which has obstacles, the height of which exceeds the operating height of the machine, without navigating around them. Such detours may be extremely difficult, and the extra time and fuel consumption involved may seriously limit the operating range of the vehicle.

It has been found that the above disadvantage can be largely overcome and a leaping effect imparted to the vehicle by suddenly applying an increase in energy to the annular peripheral curtain. This energy is generated by water under pressure converted into steam by a flash boiler and then ejected downward into the peripheral air curtain. Other fluids may be used if desired. The extra weight imparted to the machine by this adaption is insignificant.

According to the invention, the improvement in a ground effect machine adapted to hover over a surface such as land or water on a curtain of air comprises, a fluid supply, means for converting a pre-determined quantity of said fluid into vapour under pressure, and means for delivering said vapour under pressure to said air curtain whereby the distance separating the bottom of said machine from said surface is suddenly and temporarily increased.

The invention is illustrated by way of example in the accompanying drawings wherein,

FIGURE 1 is a diagrammatic sectional side elevation view, of a ground effect machine constructed in accordance with the present invention.

FIGURE 2 is a plan view of the ground effect machine shown in FIG. 1.

FIGURE 3 is a side elevation view, in section, of the ground effect machine with a gas turbine compressor.

FIGURE 4 is a plan view of a ground effect machine utilizing a gas turbine compressor.

Referring particularly to FIG. 1, the ground effect machine comprises a fan **1** disposed within a duct **14** adjacent the entrance thereof. The duct **14** terminates in a peripheral or annular outlet portion **10** which surrounds a base **11** of the ground effect machine. The fan **1**, when driven, forces air through the duct **14** and discharges from the duct portion **10** thereby creating a curtain of air peripherally disposed around the base **11** to trap a bubble which sustains the ground effect machine in spaced relation with respect to the ground.

The fan **1** is driven by a motor **2**, which may be a turbine internal combustion engine or other suitable power source, gas turbine being preferred. The exhaust from the motor discharges from an exhaust pipe **3** and adjacent the outlet thereof is disposed a pivotally mounted pipe **4** in the form of an elbow. The pipe **4** effectively forms a scoop for directing the exhaust gases from the motor and has a vertically operative position, shown in

full lines in FIG. 1 and, an inoperative position, shown by dotted lines. In its operative position the scoop directs exhaust gases from pipe **3** to a heat exchanger **5**, and is thereafter discharged to atmosphere through an exhaust duct **6**. In the inoperative position, the exhaust gases are discharged directly to atmosphere from the exhaust pipe **3**.

Also connected to the heat exchanger is a fluid supply duct **17** which through a pressure pump **8** is connected to a fluid supply reservoir **7**. The fluid circulating portion of the heat exchanger has the outlet thereof connected to a conduit **18** which through a valve **15** is connected to an outlet **9**. The outlet **9** is disposed within the conduit **14** between the fan **1** and the discharge **10** and consists of an apertured tube which may or may not include detachable nozzles.

FIGURES 1 and 2 illustrate the vehicle in a normal hovering position and the scoop **4** is in a normal inoperative position (i.e., the position illustrated in phantom in FIGURE 1) until such time as the jump characteristic is required. The scoop **4** is swung into a vertical or operative position directing the exhaust gases from the gas turbine **3** through the heat exchanger **5**. Water from tank **7** is supplied under pressure by the driven pump **8** to the heat exchanger **5**. The water is vaporized in the heat exchanger **5** by the high temperature exhaust gas and the high pressure steam is injected into the air stream in conduit **14** under the control of on-off valve **15**. The vapour injected into the air stream causes the machine to increase hovering height.

The pressure increase in the peripheral curtain is immediate due to the high pressure steam being applied instantaneously to the nozzles through the action of a quick action opening valve **15**. The sudden increase in curtain energy at the normal hovering height causes a considerable upward momentum to the vehicle, sufficient to enable it to leap over surface obstacles. Upon dissipation of the instantaneous high pressure steam, the vehicle returns to its normal hovering height.

FIGURE 3 illustrates a ground effect machine which has a gas turbine compressor. A portion of the high pressure air from the compressor acts as the peripheral air curtain. The remainder of the air exhausts to atmosphere or is directed to the heat exchanger as shown in FIGURE 2, the method of operation being the same as described with respect thereto.

In this embodiment the discharge duct **14** also comprises a number of separate channels **16** which project into the peripheral outlet duct **10** (see FIG. 4).

I claim:

1. In a ground effect machine having a primary power supply that produces hot gases and directs them into one channel means and that produces air flow in another channel means having an air outlet substantially beneath the machine, and adapted to hover over a surface such as land or water on a cushion of air retained by a fluid curtain at least partly supplied through said air outlet, the improvement comprising: a heat exchanger, a water supply communicating through input ducting with said heat exchanger, means for pumping water from said water supply through said input ducting to said chamber, a scoop mounted on said ground effects machine and adapted to selectively direct the hot exhaust gases from said primary power supply to said heat exchanger to convert a predetermined quantity of said water into high pressure steam by being constructed and arranged to be alternatively disposed in an operative mode and an inoperative mode, in only the former of which said hot gases are both captured by said scoop and pass through said scoop to said heat exchanger, an output ducting from said heat exchanger communicated therewith so as to receive said high pressure steam, said output ducting

terminating in at least one nozzle interposed in said other channel means, an on-off valve interposed in the fluid path defined in said input ducting and output ducting, whereby said steam under pressure is delivered through said nozzle, other channel means and air outlet to said air cushion only when said scoop is in said operative mode and said on-off valve is on, and whereby the distance separating the bottom of the said machine from said surface is suddenly and temporarily increased for the duration of the delivery of steam under pressure to said air cushion.

2. In a ground effect machine according to claim **1** in which the scoop is pivotable between a first operative position in which it is disengaged from the exhaust of the said primary power supply, and a second operative position in which it engages the said exhaust and captures the hot exhaust gases and directs them to the heat exchanger.

3. In a ground effect machine adapted to hover over a surface such as land or water on a cushion of air provided by a primary power source having an exhaust for the discharge of hot gases therefrom, the improvement comprising means for temporarily and intermittently injecting a media of greater density than air into said cushion momentarily to increase the distance separating the bottom of the machine from said surface and sustain it thereat for the duration of said injection, said means comprising a heat exchanger mounted on said machine adjacent said exhaust, a liquid supply connected to said heat exchanger, deflector means disposed intermediate said exhaust and heat exchanger and having a first position directing the hot gases from said primary power source to said heat exchanger to convert a selected quantity of liquid in said heat exchanger into vapour under pressure and movable to a second position permitting said hot gases to bypass said heat exchanger, conduit means connected to said heat exchanger and terminating at the opposite end in at least one nozzle disposed in an air supply for said cushion, and an on/off valve in said conduit selectively to inject vapour under pressure from said heat exchanger into said air cushion and thereby suddenly and temporarily raise said machine vertically to provide said greater clearance.

4. The improvement as defined in claim **3** wherein said deflector comprises a scoop pivotally mounted on said machine and pivotable from a first position where it directs the hot gases from the power source to said heat exchanger and to a second position permitting said hot gases to bypass the heat exchanger.

5. The improvement as defined in claim **4** wherein said on/off valve is a quick opening valve.

6. The improvement as defined in claim **5** including a pump for increasing the pressure of the fluid in the heat exchanger.

7. The improvement as defined in claim **6** wherein said conduit terminates in a plurality of apertures disposed in the air supply for said cushion.

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