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GROUND EFFECT VEHICLE

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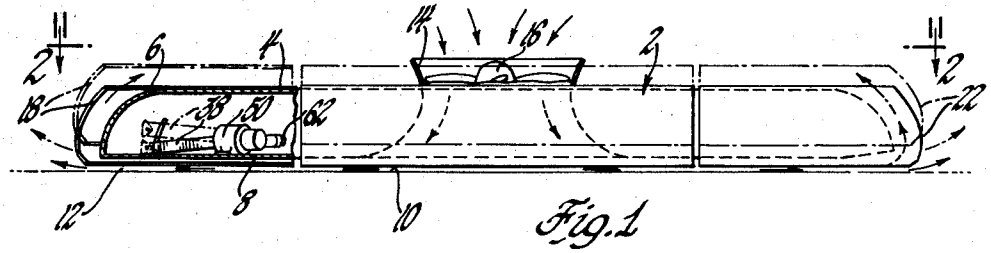


Fig. 1

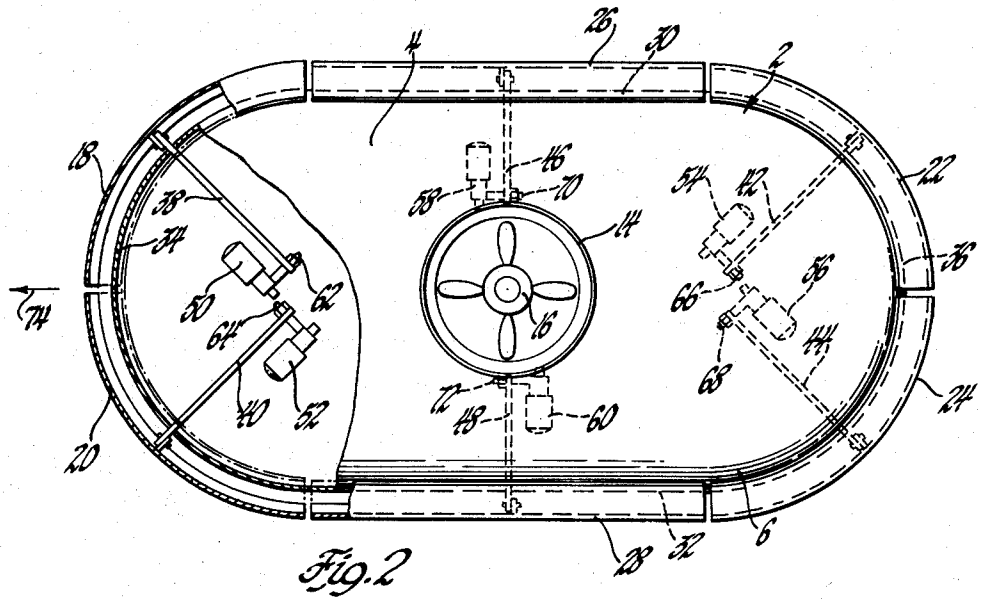


Fig. 2

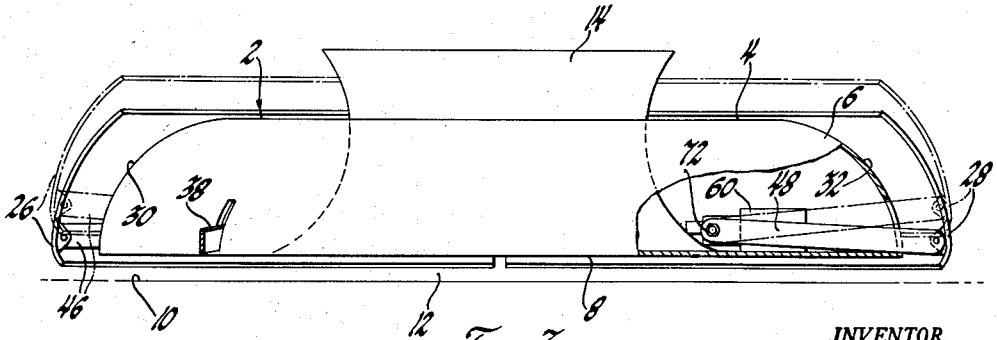


Fig. 3

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GROUND EFFECT VEHICLE

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This invention relates to ground effect vehicles and more particularly to vehicles which are supported above the ground by means of low pressure free air cushion generated by a shrouded fan mounted in the vehicle on an axis perpendicular to the ground.

The present invention is concerned primarily with ground effect vehicles in which a power driven single stage axial fan disposed concentrically within a cylindrical shroud mounted in the vehicle directs air downwardly therethrough to form a cushion or pad beneath the vehicle which supports the latter in frictionless spaced relation with the ground. Although the elimination of friction is singularly advantageous in terms of the power required to propel the vehicle, as with all known types of ground effect machines, the absence of frictional contact with the ground introduces serious difficulties in terms of directional control of the vehicle and rate of response of such control.

An object of the present invention is to provide an improved ground effect vehicle.

Another object is to provide a ground effect vehicle incorporating improved means for accomplishing directional control and maneuverability.

A further object is to provide a vehicle of the general character described in which directional control is obtained by mechanism acting directly on the air discharged radially from the peripheral gap between the vehicle and the ground.

A still further object is to provide a device of the stated character in which the entire periphery of the vehicle is surrounded by a segmented fence, which segments may be lowered selectively into the path of radially discharged air.

A yet further object is to provide an arrangement of the stated character wherein the fence segments are curved in cross section so that when lowered into the path of radial discharge, the inner surface of the segments act to deflect and reverse the direction of radial discharge.

Still a further object is to provide a ground effect vehicle having an elongated hull formed with parallel depending side walls joined to generally semi-circular depending end walls, wherein the fence is divided into six segments, each of which is mounted on a separate elevator arm pivotally mounted on the hull substantially inboard of the periphery thereof.

A yet further object is to provide a device of the stated character in which the fence segments are individually operable by remotely controlled reversible motor means.

These and other objects, advantages and features of the invention will become more fully apparent as reference is had to the accompanying specification and drawing wherein:

FIG. 1 is a schematic side elevational view of a plenum chamber type air cushion vehicle incorporating the invention;

FIG. 2 is a plan view, partly in section and with parts broken away, looking in the direction of arrows 2—2 of FIG. 1; and

FIG. 3 is a partially sectioned end elevational view of the vehicle shown in FIGS. 1 and 2.

Referring now to the drawings and particularly FIGS. 1 and 2, there is shown an air cushion type ground effect

vehicle in which the reference numeral 2 designates the hull or superstructure thereof. Hull 2 includes a horizontal top wall portion 4 which is bounded by a continuous curvilinear perimeter in the form of a downwardly curved side wall 6 having a terminal edge 8. When vehicle 2 is in operation, the gap between the terminal edge 8 and the ground 10 defines a clearance 12 which functions in a manner shortly to be described. Mounted centrally of hull 2 is a vertically directed flared shroud 14 in which is concentrically disposed a single stage axial fan 16. Fan 16 is driven in any suitable manner by an engine or motor, not shown, to provide a continuous stream of low pressure air which is directed downwardly through shroud 14 to establish low pressure air cushion between the hull 2 and ground 10 which supports the vehicle in frictionless spaced relation above the latter. Since the cushion of air so generated elevates the entire vehicle some distance above the ground, depending upon the air horsepower expended, it will be evident that the clearance 12, previously referred to, acts as a peripheral restriction which allows a continuous radial discharge of air. However, with the proper power setting for fan 16, air input may be adjusted to exactly balance the air loss by radial discharge and the vehicle will thereafter remain at a fixed elevation supported solely by the volume of air confined beneath the vehicle within the boundary defined by the lower edge 8 of hull side wall 6.

In order to accomplish directional control and horizontal propulsion of the vehicle in accordance with the present invention, hull 2 is surrounded by a curvilinear fence composed of four quarter circular segments 18, 20, 22, 24 and straight segments 26 and 28. As seen best in FIG. 2, hull 2 in plan form has parallel side walls 30, 32 and semi-circular fore and aft ends 34 and 36. Accordingly, fence segments 26 and 28 lie outboard of and parallel with the side wall portions of the hull, while fence segments 18, 20 and 22, 24 bound semi-circular end walls 34 and 36, respectively. Each segment 18, 20, 22, 24, 26 and 28 is rigidly attached to the outer end of an inwardly extending normally horizontal elevator arm 38, 40, 42, 44, 46 and 48, respectively. At their inboard ends, each elevator arm 38, 40, 42, 44, 46 and 48 is attached to identical electric motor drive mechanisms 50, 52, 54, 56, 58 and 60, respectively, which are individually controlled in a known manner from any desired remote location, on the vehicle hull or otherwise. Mechanisms 50, 52, 54, 56, 58 and 60 include drive shafts 62, 64, 66, 68, 70 and 72 which elevate and lower arms 38, 40, 42, 44, 46 and 48 in vertical planes through a range which causes the lower edge of each segment to travel from a position vertically level with the lower edge 8 of the hull to a position substantially below the lower edge 8. Therefore, when the vehicle hull is in any given elevated position, any single fence segment or combination of segments may be lowered so that a portion thereof intercepts the radial air discharge through gap 12. Since radial air discharge is normally equal in all directions, it will be evident that interception accomplished by lowered fence segments will disturb the radial thrust balance normally existing and cause the vehicle to move in the direction from which thrust has been reduced. Thus, for example, if it is desired to move the vehicle in the direction of the arrow 74 in FIG. 2, fence segments 18 and 20 are lowered as shown in solid lines in FIG. 1, while the fence segments 22 and 24 as well as 26 and 28 remain in the elevated position vertically parallel with the hull side wall 6. Forward movement of the vehicle then occurs owing to the thrust differential between the front and rear of the vehicle. In addition, because of the curvature of each of the fence segments, the radial air flow intercepted thereby is caused to be discharged in virtually the opposite direction and thereby

augments to some extent the thrust exerted at the opposite end of the vehicle.

It is to be particularly noted that because of the semi-circular end configurations of the hull and the associated quarter circular fence segments, the vehicle may not only be propelled forwardly, backwardly, and laterally in either direction, but may also be used to "crab," turn, or rotate by selective lowering of one or more of the fence segments. By way of example, if it is desired to cause the vehicle to rotate clockwise about its central vertical axis, the fences **18** and **24** are lowered an equal amount. Lowering of only one of the quarter circular fences will, of course, induce turning, or in the case of operation in a crosswind, cause the vehicle to assume a "crab" angle which allows the vehicle to travel along a selected straight path.

While but one embodiment of the invention has been shown and described, it will be apparent that other changes and modifications may be made therein. It is, therefore, to be understood that it is not intended to limit the invention to the embodiment shown, but only by the scope of the claims which follow.

I claim:

1. A ground effect vehicle comprising, a hull having a peripheral depending side wall, air flow generating means mounted on said hull, means for directing said air flow vertically downward through said hull to form an air cushion supporting said hull in spaced relation to the ground, a segmented fence spaced outwardly of and surrounding said periphery, and means for selectively adjusting the vertical level of each segment of said fence relative to the adjacent portion of said hull periphery.

2. A ground effect vehicle comprising, a hull having a curvilinear periphery bounded by a continuous depending side wall, air flow generating means mounted on said hull, means for directing said air flow vertically downward through said hull to form an air cushion supporting said hull in spaced relation to the ground, a segmented fence spaced outwardly of and surrounding said periphery, and means for selectively adjusting the vertical level of each segment of said fence relative to the adjacent portion of said hull periphery.

3. In a ground effect vehicle of the type wherein air flow is continuously directed downwardly therethrough so as to establish an air cushion between the vehicle and the ground, a hull having a curvilinear perimeter in the form of a continuous depending wall the lower edge of which normally defines a perimetrical clearance with the ground restricting radial air flow from the area bounded by the depending wall, a segmented fence spaced outwardly from and surrounding said perimeter, means hinging each segment to said hull, and means for raising and lowering each segment independently relative to the adjacent portion of the hull perimeter.

4. The structure set forth in claim 3 wherein the hull is formed with straight parallel side wall portions and semi-circular forward and rearward end wall portions, and said fence comprises a pair of quarter circular segments bounding each semi-circular wall portion, and a pair of straight segments extending parallel with said parallel side wall portions.

5. The structure set forth in claim 4 wherein said fence hinging means comprises a generally horizontally extending arm for each segment rigidly connected at its outer end to said segment, the inner end of each arm being operatively connected to a rotatable shaft reversibly driven by a remotely operated electric motor.

6. The structure set forth in claim 5 wherein the motor and driven shaft form a unit assembly mounted on said hull so that the shaft forms the hinge axis for the associated arm.

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