United States Patent

[11] 3,552,519

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[31] No. 40292/67

[54] **AIR-CUSHION VEHICLES**
1 Claim, 8 Drawing Figs.

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[51] Int. Cl. B60v 1/00, B60v 1/16
[50] Field of Search 180/124, 125, 119

[56] **References Cited**

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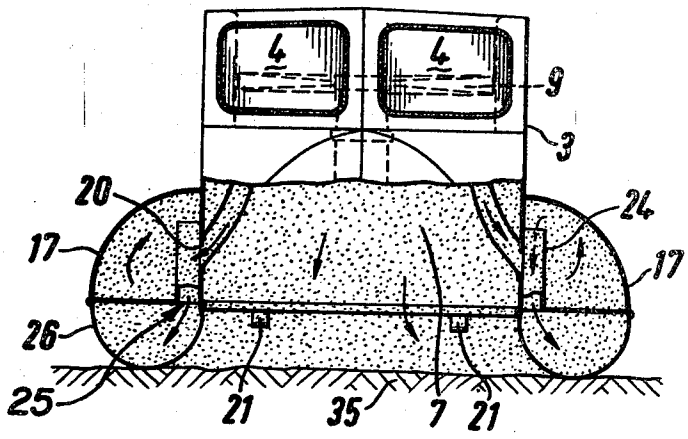
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Primary Examiner—Harry A. Levy
Attorney—Woodard, Weikart, Emhardt & Naughton

ABSTRACT: An air-cushion vehicle has inflatable means confining the cushion, preferably in the form of a skirt, acting between the ground and the vehicle undersurface.



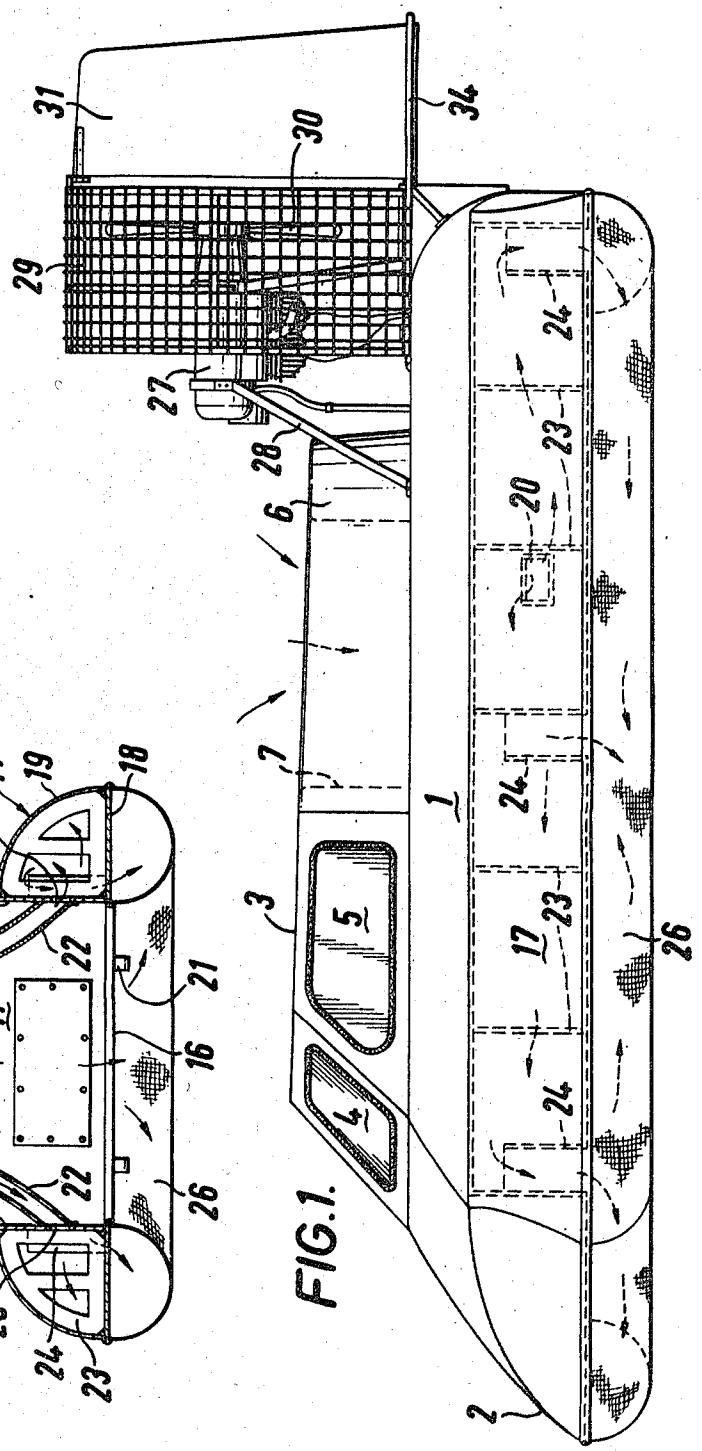

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FIG. 1.

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FIG. 4.

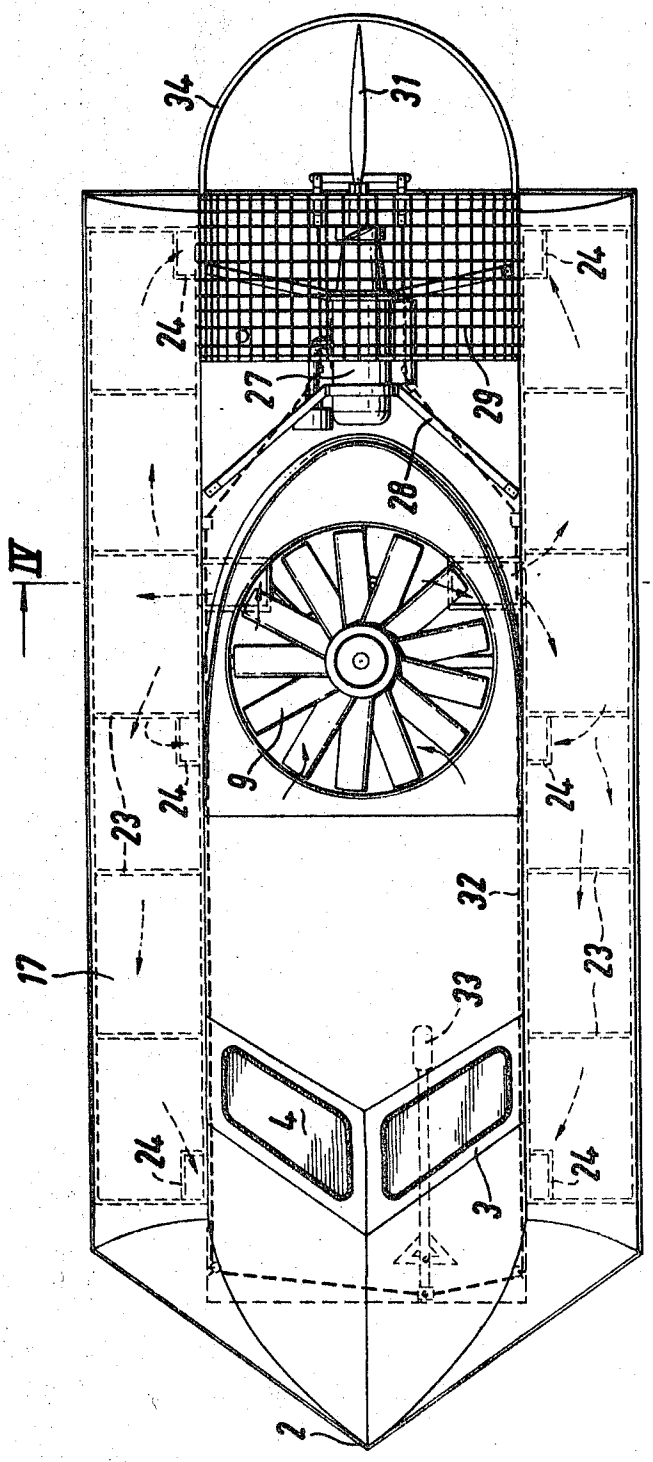


FIG. 2.

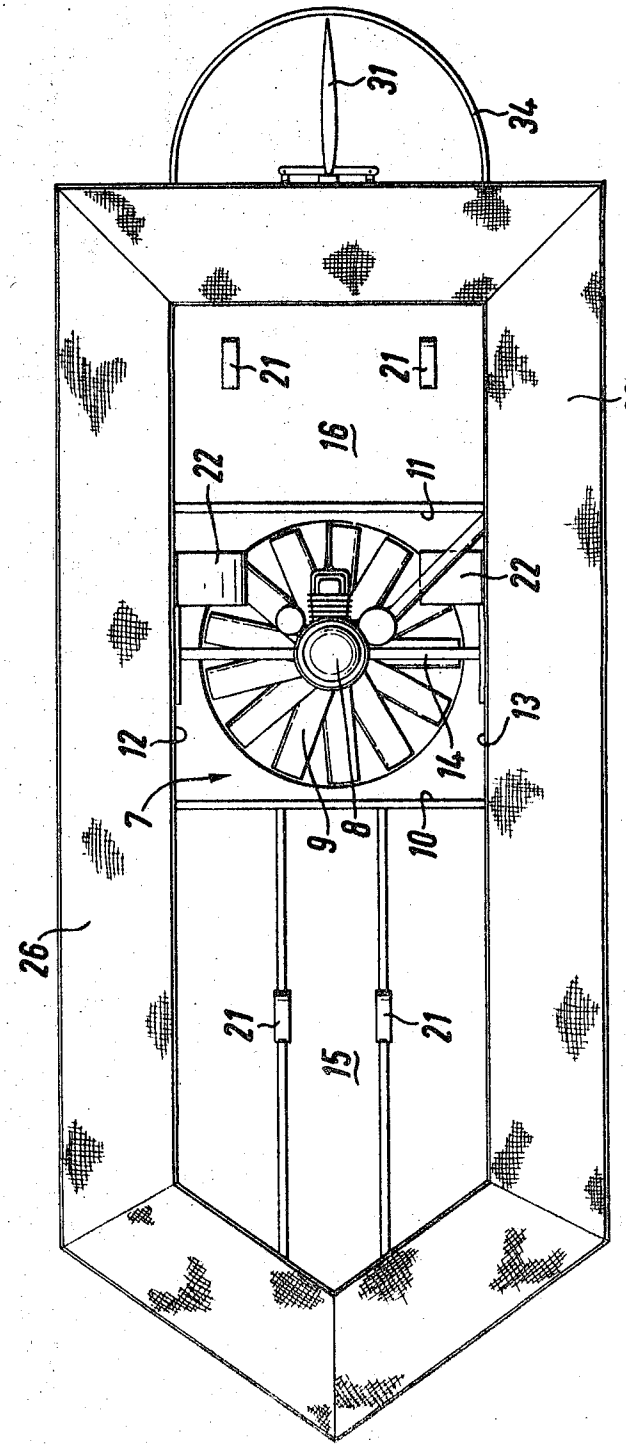


FIG. 3.

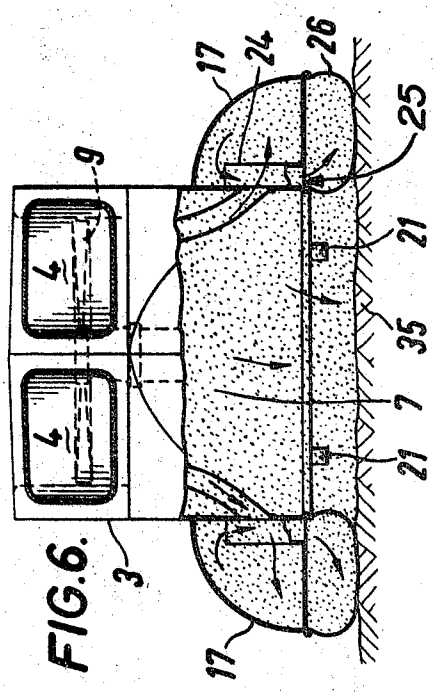


FIG.6.

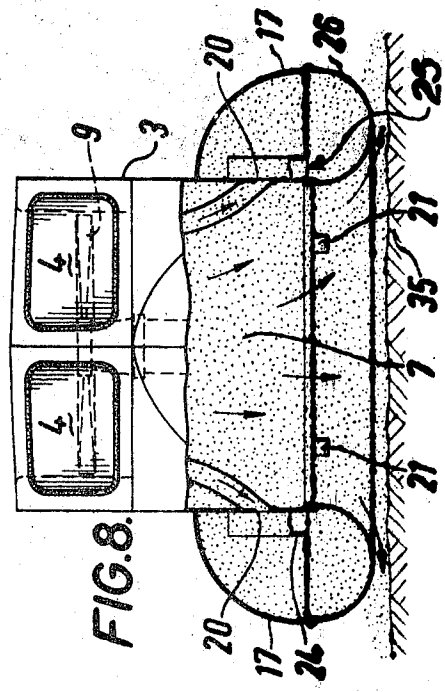


FIG.8.

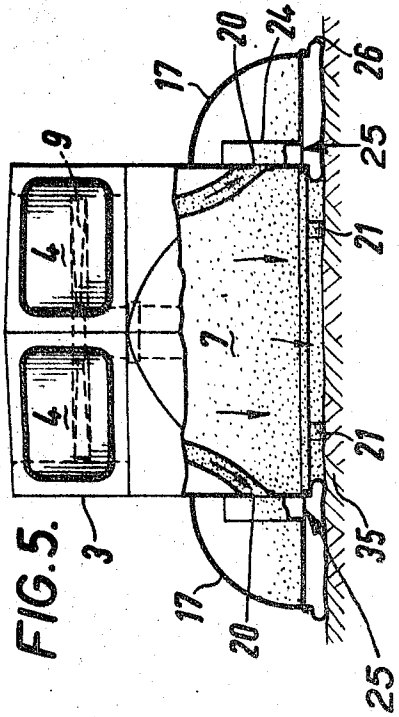


FIG.5.

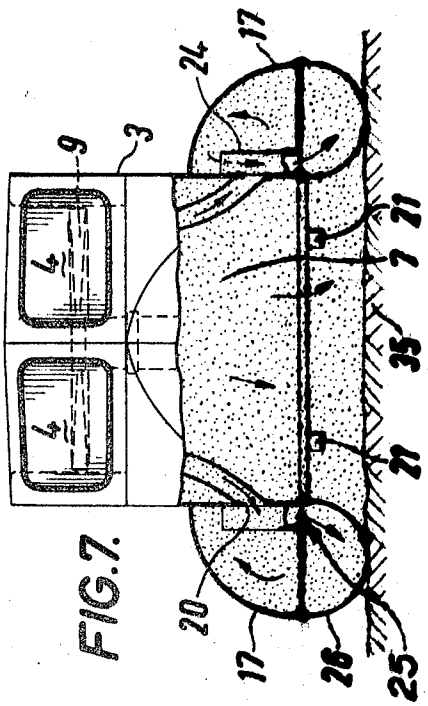


FIG.7.

AIR-CUSHION VEHICLES

This invention relates to Air-Cushion Vehicles (A.C.Vs.), sometimes referred to as Ground Effect Vehicles.

In known Air-Cushion Vehicles a flow of fluid, usually air, is directed against a surface to produce a fluid cushion which supports a vehicle in vertically spaced relationship above the said surface. Although fluids other than air can be used, reference hereinafter will be made solely to the use of air. A vehicle so supported on an air cushion can then be caused to move transversely over the surface by means of a propeller, jet stream or other suitable propulsion means. When the vehicle is at rest the vehicle is supported on the base thereof, which is in contact with the surface above which it is to be supported by an air cushion. When the flow of air is commenced the vehicle is lifted by reaction between the air flow and the surface, and/or by pressure at the underside of the vehicle until an equilibrium is reached and the vehicle is supported on an air cushion. This mode of lifting is inefficient in that it requires the use of more powerful means for producing the air flow initially to raise the vehicle than are required to maintain the air cushion and to propel the vehicle.

According to the present invention an Air-Cushion Vehicle comprises means for forming and maintaining an air cushion capable of supporting the vehicle at an operating level above a surface, means for driving the vehicle at the operating level over the surface and inflatable means adapted to act between the vehicle and the said surface, the arrangement being such that with the vehicle at rest, inflation of the inflatable means raises the vehicle so that the vertical distance that the vehicle has to be raised to the operating level by the means for producing and maintaining the air cushion is reduced.

Preferably the inflation means are adapted to be inflated by means for producing a flow of air to produce and maintain the air cushion.

The air cushion may be at least partially surrounded by a dependent rim or skirt which is flexible or movable to enable the vehicle to move over uneven terrain. In accordance with an important feature of the present invention the dependent rim or skirt is constituted by the inflatable means. Thus an annular closed inflatable skirt may surround the undersurface of the vehicle.

Further features of the invention will become apparent from the description of a particular embodiment thereof made with reference to the accompanying drawings wherein:

FIG. 1 is a side view of an Air-Cushion Vehicle in accordance with the particular embodiment;

FIG. 2 is a plan view of the Vehicle;

FIG. 3 is an underneath plan view of the Vehicle;

FIG. 4 is a section on the line IV–IV of FIG. 2; and

FIGS. 5, 6, 7 and 8 are front views, partly in section, showing the vehicle raising itself onto its air cushion.

Referring now particularly to FIGS. 1, 2 and 3 of the drawings, the Air-Cushion Vehicle shown therein comprises a body or hull 1 which is generally rectangular viewed in plan having pointed bows 2. A compartment 3 in which the driver of the vehicle and one passenger can sit side-by-side has a divided windscreen 4 and side windows 5. A sliding roof over the compartment 3 provides access for the driver and passenger. Immediately behind the compartment 3 is the upper casing or funnel 6 of a vertically extending shaft 7 through which air is impelled downwardly to form an air cushion which supports the vehicle. As can be seen in FIG. 2 of the drawings the funnel is hemielliptical viewed in plan, the curved end of the funnel being rearwardly directed. The part of the shaft 7 within the funnel is of circular cross section. A two-stroke twin cylinder air cooled petrol engine 8 driving a 13 bladed impeller fan 9 is positioned in the upper part of the shaft 7 adjacent the base of the funnel 6. The fan 9 is positioned above the motor and is of the axial type adapted to draw air vertically downwards into the shaft. As can be seen in FIG. 3 of the drawings the shaft 7 below the funnel 6 is of square cross section and is defined between front, rear and sidewalls 10, 11, 12 and 13. Transversely extending struts 14 secure the engine 8 to the sidewalls 12 and 13. Watertight flat bottom elements 15 and 16 close the underside of the vehicle in front of and behind the shaft 7. Dependent elements 21 on which the vehicle can skid, in the event that the skirt deflates, are provided on the undersurface of the elements 15 and 16. The Air-Cushion for supporting the vehicle is formed in the lower end part of shaft 7.

A pair of elongate chambers 17 extend, one on either side of the vehicle, from the stern thereof to positions immediately behind the bow (see FIG. 1). As can well be seen in FIG. 4 of the drawings, each chamber 17 has an inner vertically extending sidewall formed by a sidewall 12 or 13 of the shaft 7, a horizontal bottom wall 18 level with bottom elements 15 and 16 and an outer convex sidewall 19 of semicircular cross section. A bore 20 is formed through each shaft sidewall to allow air drawn into the shaft by the fan 9 to flow into the chambers 17. An elongate duct 22 of rectangular cross section extends from each bore 20 to a position immediately below the fan 9. The ducts 22 may include unidirectional valves which allow the passage of air from the shaft 7 to the chambers 17 but prevent the passage of air from the chambers 17 to the shaft 7. These valves delay deflation of an inflated skirt in the event of the fan 9 becoming inoperative. Stiffening frames 23 extend across the chamber 17 at spaced positions therealong. In each chamber 17 three upstanding pipes 24 of rectangular cross section extend upwardly from bores 25 through the lower chamber wall 18 to positions high in the chamber. One pipe 24 is positioned adjacent each end wall of the chamber and one pipe 24 is positioned centrally of the length of chamber. The pipes 24 allow air in the chambers 17 to pass into the inflatable skirt to be described hereinafter.

A dependent flexible skirting strip 26 of air retaining material, for example canvas, of greater width than the bottom wall 18 of the chamber 17, links the radially inner and outer margins of the chamber 17. The strip also depends from positions at the front and rear of the vehicle which are spaced apart by the width of the wall 18 so that a continuous annular inflatable skirt of closed tubular form surrounds the undersurface of the vehicle (see FIG. 3). When inflated (see for example FIG. 4), the skirt 26 is of semicircular cross section. The cross-sectional area of the chamber 17 is greater than that of the inflated skirt 26.

A two-stroke twin cylinder air cooled petrol engine 27 similar to the engine 8 is mounted on upstanding stays 28 at the rear of the vehicle behind the funnel 6 and is surrounded by a protective cowl 29 of wire mesh. The engine 27 drives a two blade axial fan 30 which directs a stream of air rearwardly with respect to the vehicle. A rudder in the form of a tail fin 31 pivotal about a vertical axis, is positioned behind the fan 30 and is controlled by cables 32 generally indicated in dotted lines which are connected to a steering rod 33 in the compartment 3 (see FIG. 2). A hoop 34 which protects the fin 31 extends rearwardly from the stern of the vehicle.

The operation of the vehicle will now be described with reference to FIGS. 5 to 8 of the drawings. The arrows indicate the direction of air flow. The vehicle is shown resting on a supporting surface 35 in FIG. 5 of the drawings. It will be noted that the undersurface of the skids 21 abut the surface 35. The fan 9 driven by the engine 8 commences to draw air into the shaft 7 and air pressure in the shaft rises as the lower end thereof is closed by the supporting surface and the skirt 26. Air enters the chambers 17 through ducts 22 and bores 20, and the skirt 26 from the chambers 17 through pipes 24. Inflation of the skirt proceeds as is shown in FIGS. 6 and 7 of the drawings and the vehicle is lifted by the air in the skirt expanding the skirt to the inflated semicircular form. In the fully inflated condition of the skirt 26 shown in FIG. 7 the vehicle is raised to a vertical level immediately below the operating level. Formation of the supporting air cushion then raises the vehicle to the operating level shown in FIG. 8. The vehicle supported on its air cushion hovers above the supporting surface 35 in vertically spaced relationship thereto and may be driven by the impelling motor 27 and controlled by movement

of the tail fin **31**. In use the rigid chambers **17** serve as plenums for the skirt **26** and the skirt even if perforated or torn to a substantial amount, is maintained in inflation by the reservoir of air under pressure in the chambers **17**. The vehicle described is capable of moving over land, water or a mixed terrain.

I claim:

1. An air-cushion vehicle comprising a vertically extending shaft, means for impelling air down said shaft to produce an air-cushion capable of supporting the vehicle at an operating level above a surface, means for driving the vehicle at said level over said surface, a rigid chamber extending along each side of the vehicle, means for communicating the interiors of the chambers with the interior of the shaft, an annular inflatable skirt having a cross section of a closed loop surrounding the marginal part of the undersurface of the vehicle, and means communicating the interior of the skirt with the interiors of the chambers, said skirt and said undersurface of said

vehicle forming a cavity over said surface for receiving air directly from said shaft for production of said air-cushion, said skirt being inflated by the means for producing the flow of air to form and maintain the air-cushion, the arrangement being such that with the vehicle at rest, inflation of said skirt raises the vehicle so that the vertical distance that the vehicle has to be raised to said level by the means for forming and maintaining the air-cushion is reduced, each chamber has a horizontal floor, wherein the undersurface of said floor forms the upper wall of the inflated skirt and wherein said means communicating the interior of the skirt with the interiors of the chambers comprises, for each chamber a pipe extending upwardly from a through bore in said floor, the upper end of said pipe being disposed above the position at which the means communicating the interior of said chamber with the interior of said shaft enters said chamber.