United States Patent [19]

Bertin

[11] **3,779,333**

[45] **Dec. 18, 1973**

[54] **MULTI-CUSHION AND MULTI-FAN SYSTEM FOR SURFACE EFFECT MACHINES**

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[73] Assignee: **Bertin & Cie,** Plaisir, France

[22] Filed: **Apr. 6, 1971**

[21] Appl. No.: **131,607**

[30] **Foreign Application Priority Data**

Jan. 17, 1961 France 849,877

June 30, 1961 France 866,604

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 741,991, July 2, 1968, Pat. No. 3,586,118, which is a continuation-in-part of Ser. No. 502,934, Oct. 23, 1965, Pat. No. 3,478,835, which is a continuation-in-part of Ser. No. 165,634, Jan. 11, 1962, Pat. No. 3,263,746.

[52] **U.S. Cl.** **180/121**

[51] **Int. Cl.** **B60v 1/04**

[58] **Field of Search** ..... 180/116, 121, 119, 180/117, 118, 120, 125, 128, 129; 244/138 R; 104/23 FS

[56] **References Cited**

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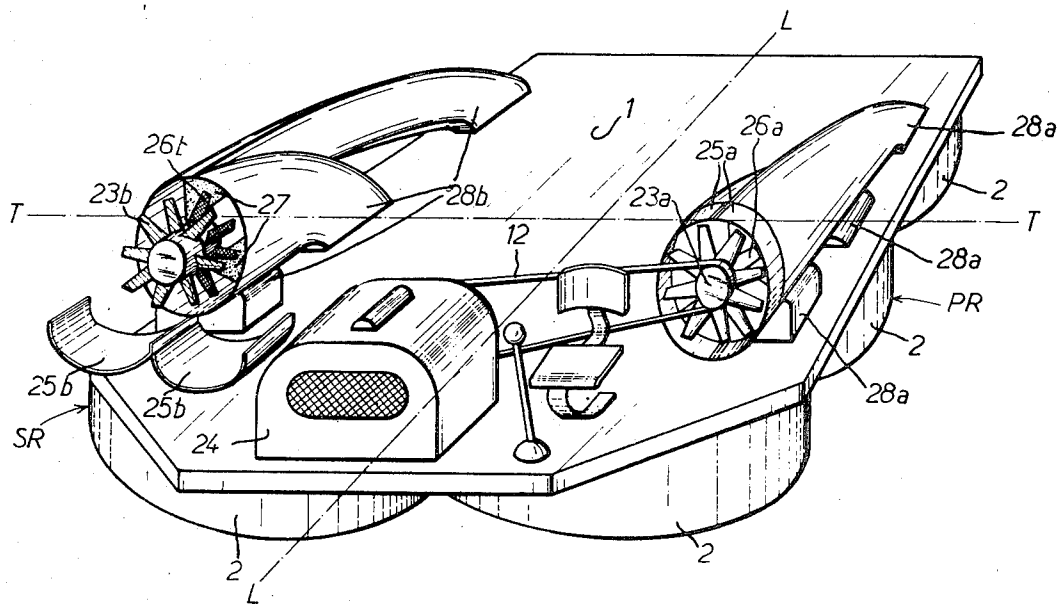
Primary Examiner—Kenneth H. Betts

Attorney—Stevens, Davis, Miller & Mosher

[57] **ABSTRACT**

From the elongated platform of an air-cushion vehicle depend a plurality of cushion containing skirts alined behind each other in two parallel rows on opposite sides of the longitudinal axis, with each skirt of one row being paired with a corresponding skirt of the other row at a same longitudinal level along said rows. Two lift fans are fitted on the platform at a same longitudinal level and on both sides of the longitudinal axis. The discharge of each fan is fractionated and connected via a ramified ducting to the individual skirt contained cushions of the row on the same side as said fan.

5 Claims, 7 Drawing Figures



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SHEET 1 OF 3

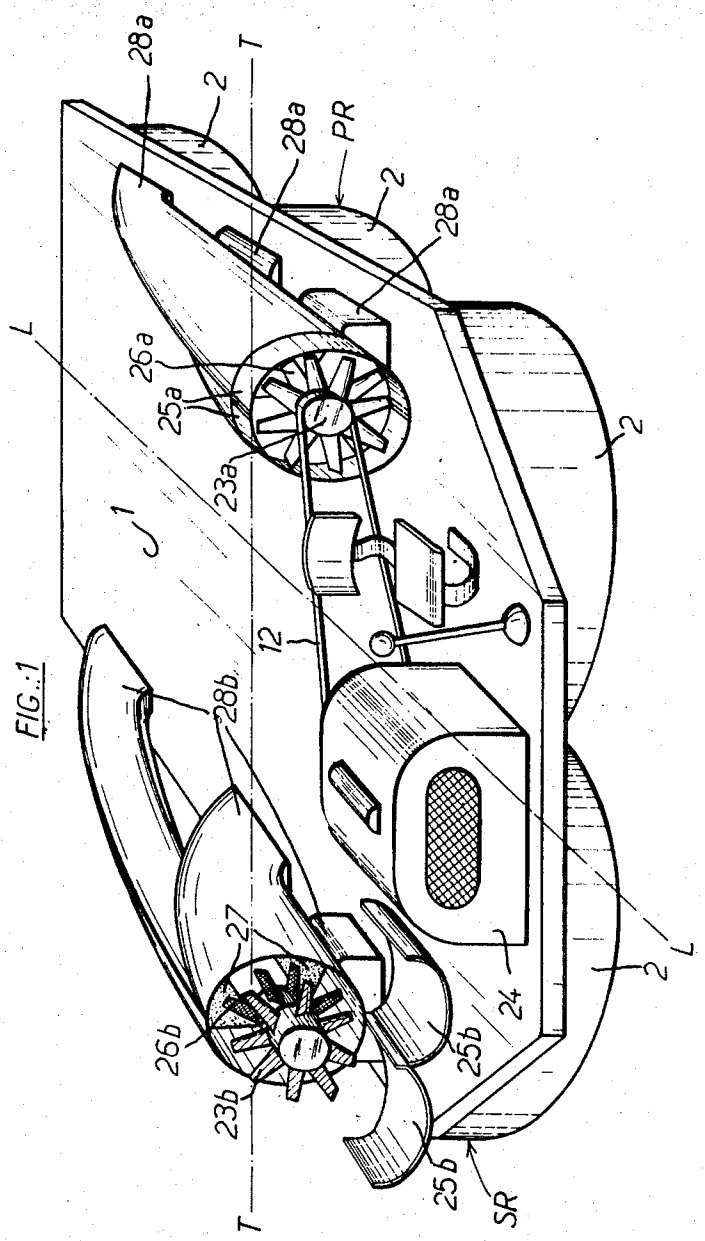


FIG. 1

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ATTORNEYS

FIG.:2

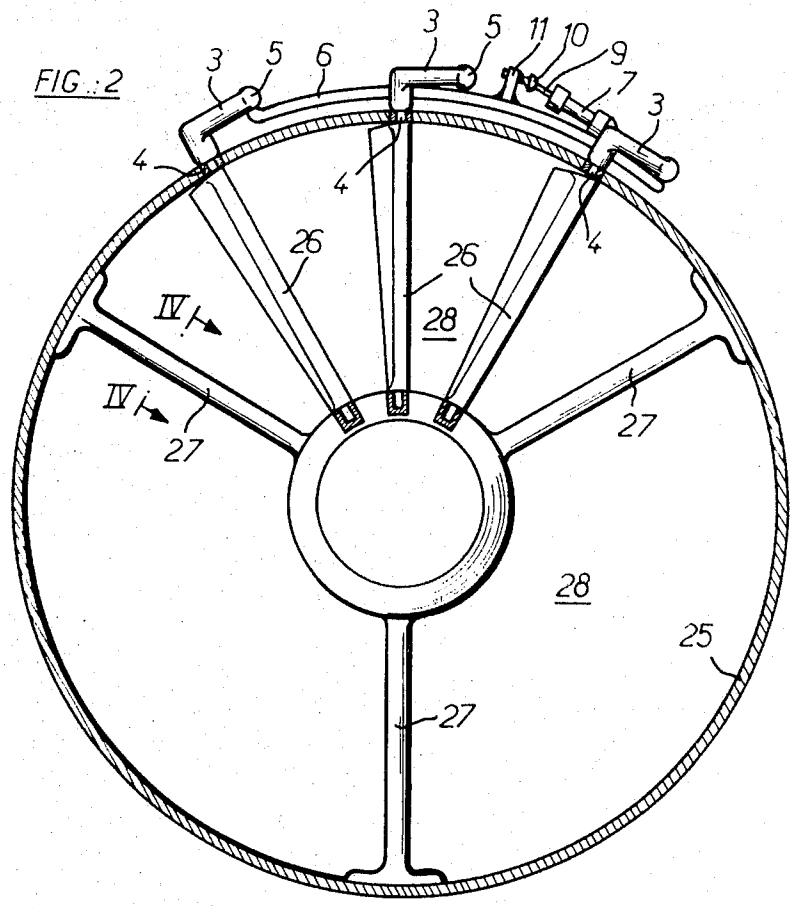


FIG.:4

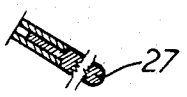
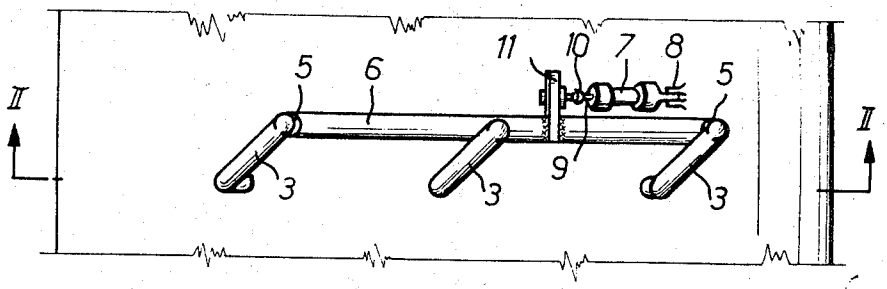


FIG.:3



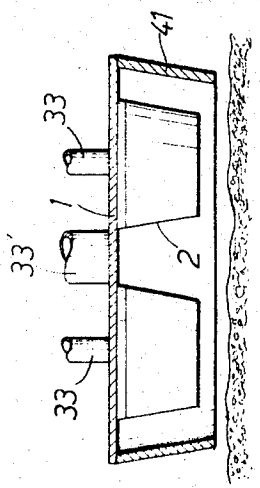


FIG. 5

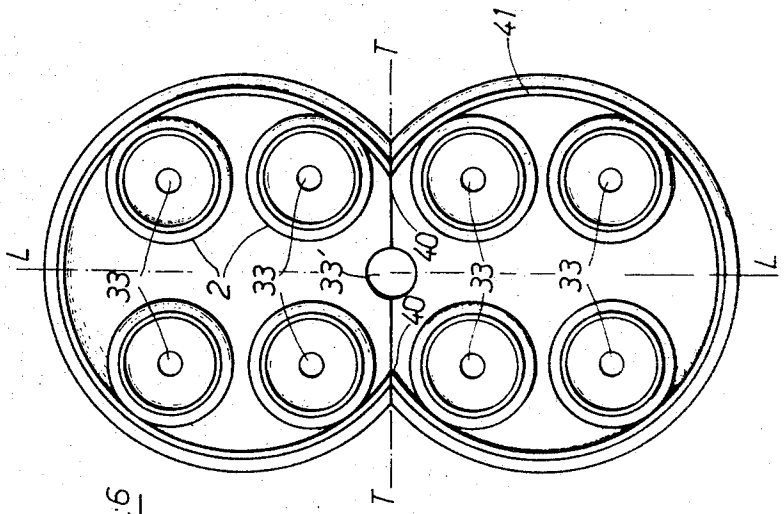


FIG. 6

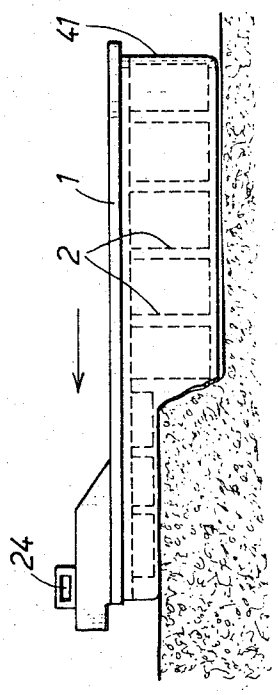


FIG. 7

MULTI-CUSHION AND MULTI-FAN SYSTEM FOR SURFACE EFFECT MACHINES

This is a continuation-in-part of my copending application Ser. No. 741,991 filed July 2, 1968, now U.S. Pat. No. 3,586,118 which is itself a continuation-in-part of my application Ser. No. 502,934 filed Oct. 23, 1965, now U.S. Pat. No. 3 478 835, which was itself a continuation-in-part of my application Ser. No. 165 634 filed Jan. 11, 1962, now U.S. Pat. No. 3 263 764.

This invention relates to ground-effect vehicles or the like which are sustained at a small height above a ground, sea or other surface, by compressed fluid cushions, and is more particularly concerned with the stability of such craft.

Flight testing has shown that such vehicles are usually unstable and that they tend to oscillate in a combined pitching and rolling motion when traveling over rough ground. It has additionally been found that even directional stability cannot be ensured in an absolutely satisfactory fashion by the use of fins, as ground irregularities will in certain cases set up instantaneous transverse components in the sustaining force or lift.

The main object of the invention is to improve the natural stability of ground-effect vehicles sustained basically on gaseous cushions, without increasing the rate of gas flow required for sustentation. This object is attained according to the invention by a sort of catamaran distribution of a plurality of discrete gaseous cushions in one row of one side of the longitudinal axis of the vehicle and of an equal number of like cushions in another row on the opposite side of said axis with corresponding cushions in one row and the other being located at a same longitudinal level, this catamaran distribution of cushions being combined with a discrete pressure fluid supply system wherein two lift fans at a same longitudinal level and on opposite sides of said axis have their fractionated discharge connected via a ramified ducting to the individual cushions of the respective rows.

In a prefered embodiment of the present invention, both fans are driven from a same motor located on said axis by means of radiating mechanical transmissions extending transversely.

Other advantages and objects of the invention will appear in the following description with reference to the accompanying drawings in which:

FIG. 1 is a perspective view of a vehicle according to the invention;

FIG. 2 is a cross section of a compressor, taken along line II—II of FIG. 3, just to the rear of the rotor;

FIG. 3 is a plan view from the top of FIG. 2, showing a control linkage;

FIG. 4 is a fragmentary section of a partition, taken along line IV—IV of FIG. 2;

FIGS. 5 and 6 are respectively a side elevation and a plan view of a preferred embodiment;

FIG. 7 is a diagrammatic side elevation of an alternative embodiment.

Referring to FIG. 1, the vehicle comprises a platform 1 of elongated shape with a major longitudinal or roll axis LL and a minor transverse or pitch axis TT. From the underface of platform 1 depend six skirts 2 grouped in two rows of three: a port row PR and a starboard row SR symmetrical about the longitudinal axis LL, each skirt of one row being at the same longitudinal level as a corresponding skirt of the other row.

The skirts 2 define plenum chambers which, when supplied with compressed air, laterally bound as many elemental air cushions which sustain the vehicle above the ground or sea surface in a known manner.

This compressed air supply is delivered by two fans 23*a* and 23*b* of the axial-flow type, which are mechanically driven by a common motor 24 by means of belts such as 12. The fans are provided with shrouds 25*a* and 25*b* so that the assembly of each fan with the respective shroud constitutes a ducted fan. The port fan 23*a* is shown with its shroud 25*a* and its belt 12 in position whereas the starboard fan 23*b* is shown with its shroud 25*b* open and its driving belt removed. It is seen that the two fans are symmetrically located about the longitudinal axis LL and that the common motor 24 is centrally located, being on said axis. Also, the transmission means 12 radiate from said central motor 24 and extend in a transverse plane parallel to the transverse axis TT.

The port fan 23a discharges into the cushions of the port row PR through a port ramified ducting 28a and likewise the starboard row SR is supplied through a starboard ramified ducting 28b with air discharged by the starboard fan 23*b*. These fans each have a fractionated discharge section provided with a row of pivotable stator guide vanes 26*a*, 26*b* designed for controlling the discharge pressure of the fans in a known manner, as described for instance in Jendrassik U.S. Pat. No. 2,305,311.

FIGS. 2 to 4 illustrate constructive details common to both ducted fans and therefore the reference indices a and b supplementing the reference numerals used in FIG. 1 have been omitted in FIGS. 2 to 4, the same reference numerals being used however to designate the same members in every FIG.

Radial partitions 27, numbering three per fan, extend just to the rear of the rotor and as clearly shown on FIG. 2, subdivide the discharge side of the ducted fan into three arcuately adjacent portions extending over about 120° of the circle formed by the cross section of shroud 25. At these three portions of the discharge side of each ducted fan respectively originate three discrete feed passages 28 which lead to respective air cushions bounded by the skirts 2. It is to be understood that the arcuately adjacent portions 28 need not be shaped as sectors of a circle as in the embodiment of FIG. 2, they being susceptible to various configurations and the essential feature being that they provide separate and discrete discharge openings for the fan.

The pivotable vanes 26 are grouped into said sectors (three in the present example) which correspond to the feed passages 28 bounded by the partitions 27. The vanes 26 of each sector are interconnected through a control linkage comprising (see also FIG. 3): a crank 3 fast with the pivot 4 of each vane and actuated, through a ball-and-socket joint 5, by a transmission arm 6 under the control of a jack 7 which is pivotally mounted on the casing at 8 and whose operating rod 9 is coupled, by mean of a ball-and-socket joint 10, to a slide 11 integral with the arm 6.

Therefore in the given example, there will be three similar vane control linkages for each fan with three separate operating jacks.

It will be appreciated that a simultaneous actuation of the jacks 7 to tilt all the vanes 26 associated to either fan will thus enable the discharge air flow of either fan to be varied with respect to that of the other and the

platform to be thereby tilted about its roll axis LL, whereas a tilting of the vanes **26** of one sector only, while not appreciably affecting the flow through the other sectors, will enable the platform to be tilted about its pitch axis TT.

While only three skirts **2** are shown in each row in FIG. **1**, this number will conveniently be greater, e.g. four in the preferred embodiment of FIGS. **5–6** and even eight as shown on FIG. **7**. In any case, the overall distribution of the skirts **2** — fans **23** — motor **24** is symmetrical about the longitudinal axis LL, the skirt distribution being itself preferably symmetrical about the transverse axis TT too. Moreover, in the examples of FIGS. **6** and **7**, there are two or more skirts **2** in each of the four quadrants defined by said axes LL and TT.

Of course, the provision of such large number of skirts in two rows, while increasing platform stability, causes a substantial leakage through the respective day-light clearances, since the greater the number of skirts, the larger the total perimeter thereof.

In the preferred embodiment of FIGS. **5** and **6** with eight skirts **2** distributed by couples in each quadrant LL-TT, such skirts are surrounded by an outer skirt **41** which extends all along the periphery of the oblong platform **1** and which is lobated, having its cuspidal edges **40** paired in the transverse plane TT and positioned intermediate two successive skirts **2** in each row, whereas the peripheral skirt **41** is smoothly curved and outwardly convex at the prow and the stern, that is at its intersection zone with the longitudinal plane LL.

In the eight-skirts per row embodiment of FIG. **7**, there is also provided a peripheral skirt **41**.

I claim:

1. A surface effect machine having a platform of elongated shape with a major longitudinal axis and a minor transverse axis, said platform extending on both the portside and the starboardside of said longitudinal axis as well as on both the prowside and the sternside of said transverse axis, comprising:

a port row formed of a multiplicity of continuous cushion seals confining as many individual mutually segregated cushion spaces is generally longitudinal alignment under said portside of said platform,

a starboard row formed of a further multiplicity of continuous cushion seals confining as many individual mutually segregated cushion spaces in generally longitudinal alignment under said starboardside of said platform, respective individual cushion spaces of said port row and starboard row being paired in generally transverse alignment,

a port ducted supply having a fractionated discharge, located at said platform portside,

a starboard ducted supply having a fractionated discharge, located at said platform starboardside in generally transverse spacing with said port supply,

a port ramified ducting connecting said fractionated discharge of said port supply to plural individual cushion spaces of said port row, and

a starboard ramified ducting connecting said fractionated discharge of said starboard supply to plural individual cushion spaces of said starboard row.

2. A machine as claimed in claim **1**, further comprising a central motor unit fitted to said platform substantially on said longitudinal axis thereof, and two transmission means radiating from said central motor unit and extending respectively to said port supply and to said starboard supply to activate the same simultaneously.

3. A machine as claimed in claim **2**, wherein said two transmission systems extend substantially in a same transverse plane parallel to said transverse axis.

4. A machine as claimed in claim **1**, wherein each of said port row and starboard row comprises individual cushion spaces both under said prowside and under said sternside of said platform, the overall distribution of said cushion spaces being generally symmetrical both about said longitudinal axis and about said transverse axis.

5. A machine as claimed in claim **4**, wherein said overall cushion space distribution is such that a cushion space is wholly located in every one of the four quadrants defined by said axes.

* * * * *

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,779,333 Dated December 18, 1973

Inventor(s) Jean Henri BERTIN

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

The name of the patentee contains a printing error. The patentee's correct name is:

-- JEAN HENRI BERTIN --.

Signed and sealed this 12th day of November 1974.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

USCOMM-DC 60376-P69
* U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334.