United States Patent

[11] **3,578,100**

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Paris, France
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[33] **France**
[31] **133598**

[54] **DEVICE FOR CONFINING PRESSURE-FLUID CUSHIONS, MORE PARTICULARLY FOR WATERBORNE GROUND-EFFECT MACHINES**
11 Claims, 5 Drawing Figs.

[52] **U.S. Cl.** **180/126,** 180/121, 114/67.1
[51] **Int. Cl.** **B60v 1/04**
[50] **Field of Search** 180/126, 120; 114/67.1; 115/11

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Attorney—Stevens, Davis, Miller & Mosher

ABSTRACT: A pressure-fluid cushion device for a ground-effect machine movable opposite a surface, which device comprises two sidewall structures extending substantially parallel to and on each side of the longitudinal medial plane of the machine and having a front end portion and a rear end portion, the sidewall structures having sufficient rigidity to resist deformation as a result of variable external forces acting on them during displacement of the machine and laterally defining a space between the machine and the said surface, chambers obstructing the space at the front and rear and extending between the sidewall structures, these chambers being bounded by flexible skirts deformable by such external forces, and means for supplying pressure fluid to the chambers and space.

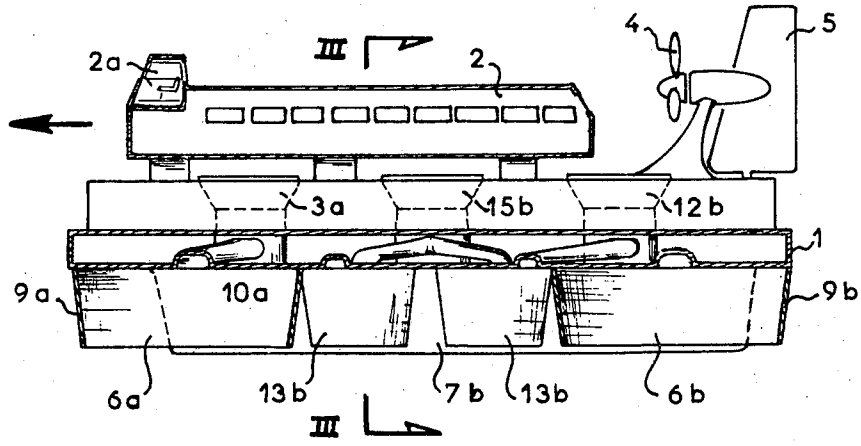


Fig. 2

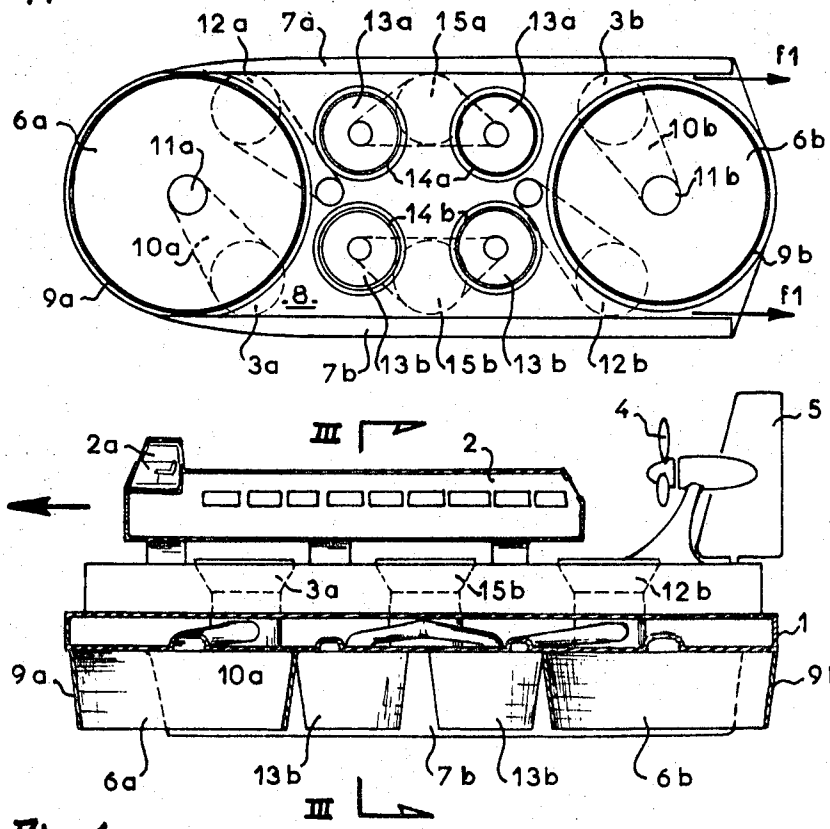


Fig. 1

Fig. 3

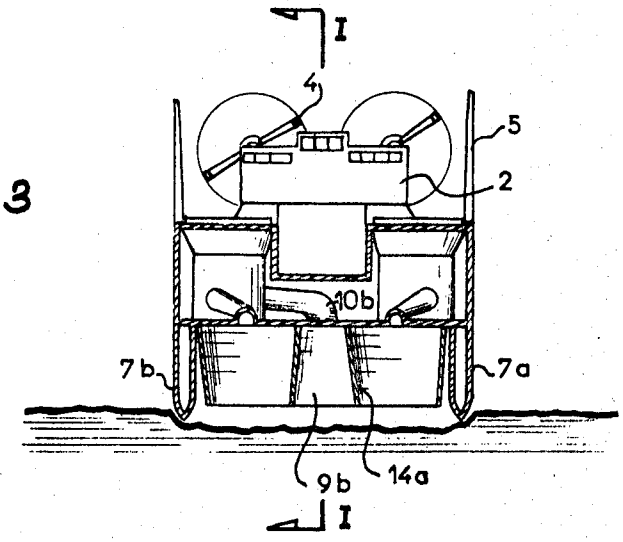


Fig. 4

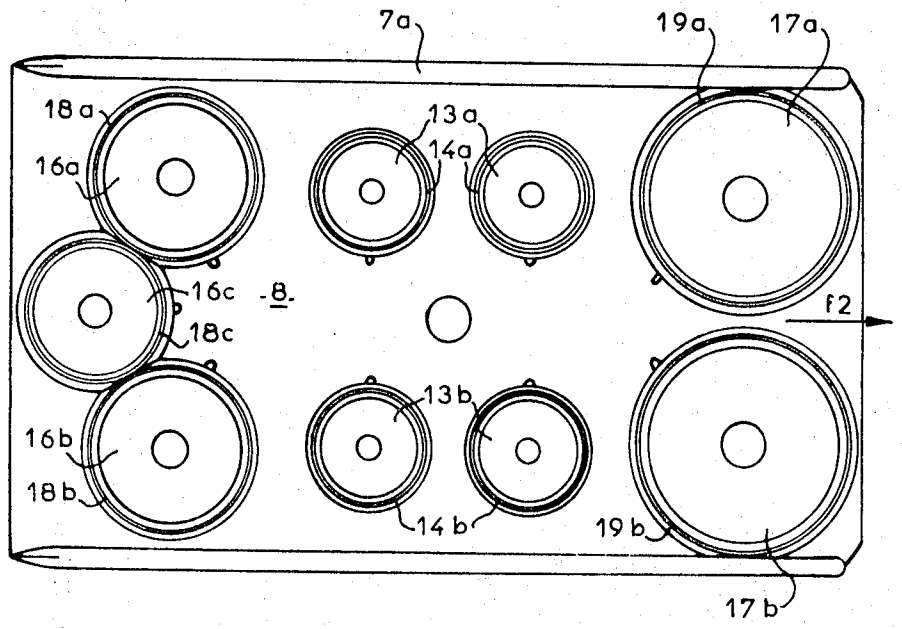
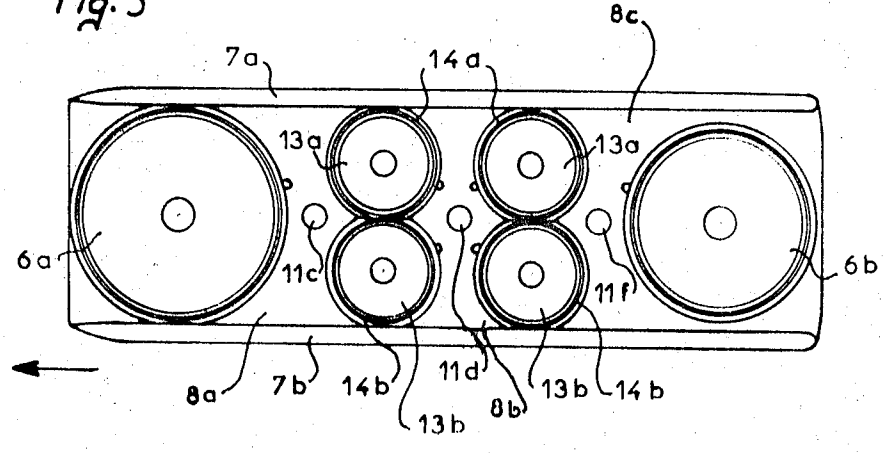

7a
19a
17a
18a
16a
13a
14a
16c
8
18c
f2
13b
16b
18b
14b
19b
17b

Fig. 5


8c
7a
14a
13a
13a
6a
11c
11f
6b
8a
7b
14b
11d
13b
14b
13b
8b

DEVICE FOR CONFINING PRESSURE-FLUID CUSHIONS, MORE PARTICULARLY FOR WATERBORNE GROUND-EFFECT MACHINES

Waterborne ground-effect machines already exist with longitudinal sidewalls cooperating with front and rear transverse walls to confine a pressure-fluid cushion adapted to support the machine over the water. The transverse walls of such craft have considerable resistance to displacement. If there is only one cushion, such a craft has practically no roll and pitch stability.

Attempts to overcome this disadvantage by dividing the single chamber by means of partitions, arranged in various ways, have resulted either in an unsatisfactory stability or in an increase in the drag of the machine, or both.

The invention relates to a device for confining the pressure-fluid cushions serving to support the ground-effect machines on the surface over which they are displaced. The device is a combination which gives better stability than existing ground-effect machines and less resistance to displacement.

This combination has sidewall structures extending substantially in the longitudinal direction of the machine and at least two plenum-type chambers, one to the front and one to the rear of these structures and between them, these chambers being preferably circular in plan and situated in the immediate vicinity of the sidewalls, possibly even in contact with the sidewalls. The chambers and sidewalls define a space in which a pressure-fluid cushion can be established and maintained and in which other chambers, possibly arranged like the chambers already mentioned, may be provided.

The sidewall structures may be connected to the platform or principal structure of the machine or, preferably, form an integral part of it, extending it towards the surface. They may comprise tanks, preferably in the vicinity of their free ends, and these tanks may house fuel or various elements required for operation of the machine.

When the sidewall structures are an integral part of the machine, they increase the rigidity of the machine. When the fuel and elements are housed in the wall tanks as just described, the center of gravity of the machine is brought nearer the supporting surface, without increasing its weight or reducing its perpendicular distance to the surface.

Clearly, the features listed above greatly facilitate the construction of ground-effect machines, especially large waterborne ground-effect machines.

In the accompanying drawings:

FIG. 1 represents an elevation, in section along a line I–I in FIG. 3, through a ground-effect machine having the improvements embodying the invention;

FIG. 2 shows the machine illustrated in FIG. 1, from below:

FIG. 3 is a cross section along a line III–III in FIG. 1;

FIG. 4 shows a second embodiment of the invention from below;

FIG. 5 shows a third embodiment of the invention from below.

FIGS. 1 to 3 show a ground-effect machine embodying the invention, with a structure comprising a platform 1 having a cabin 2, a pilot's compartment 2*a*, means for supplying pressure fluid to the lifting cushions, such as compressors, and driving means, for example air screws 4, associated with rudders 5.

In accordance with the invention, the device for confining the pressure-fluid cushions consists of a set of chambers 6*a*, 6*b* associated with two sidewall structures 7*a*, 7*b* which are arranged substantially in the longitudinal direction of the machine, so that at least one supplementary pressure-fluid cushion is formed in a space 8 between the chambers and the sidewalls.

In accordance with the invention, also, chambers 13*a*, 13*b* defined by skirts 14*a*, 14*b* are arranged symmetrically, at least relative to the longitudinal central axis of the machine, within the space 8. They are circular in plan.

The sidewall structures are adjacent to skirts 9*a*, 9*b* situated respectively at the front and rear of the machine. One or more

sources of pressure fluid such as 3*a*, 3*b*, 12*a*, 12*b*, 15*a*, 15*b*, adapted to supply the various chambers 6*a*, 6*b*, 13*a*, 13*b* and the space 8 independently, are connected to these by ducts such as 10*a*, 10*b* connected to orifices such as 11*a*, 11*b*.

The independent supply to the chambers 6*a*, 6*b* and to two groups of chambers 13*a*, 13*b* give the machine practically complete pitch stability and roll stability respectively.

In this embodiment, the skirt 9*a* closing the space at the front of the vehicle is in contact with the sidewall structures 7*a*, 7*b*, whereas the skirt 9*b* closing the space at the rear of the vehicle is near the sidewalls but does not touch them. This arrangement is convenient when the ramming pressure due to displacement of the machine is not enough to contribute to supplying pressure fluid to the space 8 and when some of the fluid within this space is to be used for propulsion of the machine (arrows f_1).

A plurality of variants are possible within the scope of the invention.

In the embodiment illustrated in FIGS. 4 and 5, the various chambers and the space 8 are supplied in a manner similar to that described with reference to FIGS. 1 to 3. The propulsion means are also similar to those already indicated, and the arrangement of the platform is not shown.

Three separate but adjacent chambers 16*a*, 16*b*, 16*c* respectively defined by skirts 18*a*, 18*b*, 18*c* are situated at the front of the vehicle between the sidewall structures 7*a*, 7*b*. The skirts 18*a*, 18*b* of the chambers 16*a*, 16*b* are near to, but do not touch, the sidewalls 7*a*, 7*b*, so that the ramming pressure due to displacement of the machine contributes to the supply of pressure fluid to the space 8. These skirts also make it easier for waves to flow between the sidewalls. The chamber 16*c* extends in front of the chambers 16*a*, 16*b*, so that the drag is further reduced.

The skirts 19*a*, 19*b* of chambers 17*a*, 17*b* are in substantially fluidtight contact with the sidewalls 7*a*, 7*b* and at a distance from one another, so that the fluid contained in the space 8 can be used for propulsion of the machine (arrow f_2).

If the skirts of the chambers near or in contact with the sidewalls are deformable, the pressure exerted by the cushion on the skirt defining a cushion is partly compensated by the pressure of the cushion confined by the adjacent skirt or by the rigidity of a sidewall structure.

As the embodiment in FIG. 5 illustrates, the space 8 may be subdivided. To this end, the chambers 13*a*, 13*b* are adapted to form barriers which cooperate with other chambers or with the sidewall structures 7*a*, 7*b* to define spaces 8*a*, 8*b*, 8*c*. The skirts 14*a*, 14*b* of the chambers 13*a*, 13*b* are preferably in substantially fluidtight contact with at least one of the walls 7*a*, 7*b* or—if they are adjacent—with one another.

Advantageously, some or all of the spaces 8*a*, 8*b*, 8*c* may be supplied independently with pressure fluid by way of orifices 11*c*, 11*d*, 11*f*.

We claim:

1. A pressure-fluid cushion device for a surface effect vehicle movable in spaced relationship along a bearing surface, comprising two transversely spaced and longitudinally extending, port and starboard, rigid sidewall structures confining sidewise a primary cushion space formed against said bearing surface, two longitudinally spaced and transversely extending, prow and stern, flexible closure systems confining endwise said primary cushion space, said prow closure system comprising at least one continuous close contour prow skirt projecting towards said bearing surface and bounding a secondary cushion space formed against said bearing surface, said prow skirt having a general shape of revolution with a front, forwardly convex curved portion directly exposed to ambient air and with its generatrices directed towards said bearing surface, and said stern closure system likewise comprising at least one continuous close contour stern skirt projecting towards said bearing surface and bounding a further secondary cushion space formed against said bearing surface, said stern skirt having a general shape of revolution with a rear, rearwardly convex curved portion directly exposed to ambient air

and with its generatrices directed towards said bearing surface, and a substantially unobstructed passage connecting said primary cushion space with said ambient air and defined sidewise at least partly by one of said skirts and endwise by said bearing surface.

2. A device as claimed in claim 1, wherein said passage is formed towards the rear of the cushion space for discharge of the pressure fluid from the space, this passage acting as a propulsion nozzle defined at least partly by a stern skirt.

3. A device as claimed in claim 2, in which the nozzle is also defined by the rear end portion of a sidewall structure.

4. A device as claimed in claim 3, in which two similar nozzles substantially symmetrical relative to the longitudinal medial plane of the vehicle are respectively defined by the two rear end portions of the sidewall structures.

5. A device as claimed in claim 4, in which the nozzles are defined by a same single stern skirt.

6. A device as claimed in claim 2, in which the nozzle is defined by two stern skirts laterally spaced from one another.

7. A device as claimed in claim 6, in which the nozzle is situated substantially in the longitudinal medial plane of the vehicle.

8. A device as claimed in claim 7, in which the stern skirts are in contact with the respective rear end portions of sidewall structures.

9. A device as claimed in claim 1 wherein said passage is formed near the front of the cushion space for the admission of air into the space and acts as an intake duct defined at least partly by a prow skirt.

10. A device as claimed in claim 9, in which the duct is also defined by the front end portion of a sidewall structure.

11. A device as claimed in claim 10, in which two similar ducts substantially symmetrical relative to the longitudinal medial plane defined respectively by the two front end portions of the sidewall structures.