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WALL DEVICE FOR BOUNDING AN AIR CUSHION

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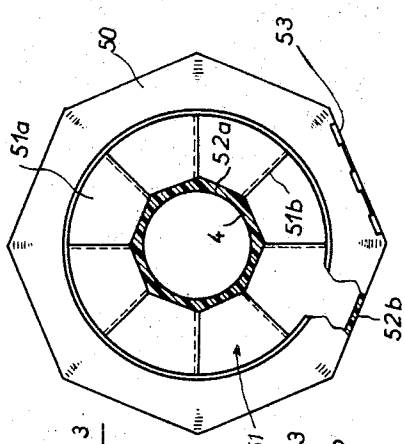

Fig.: 3

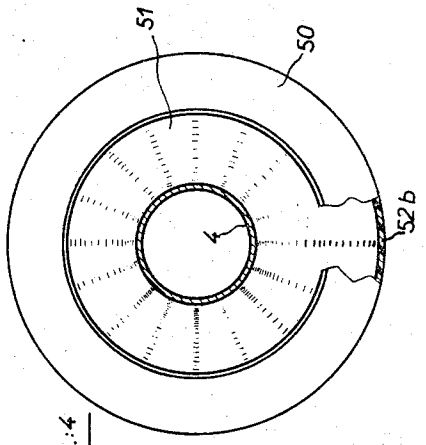

Fig.: 4

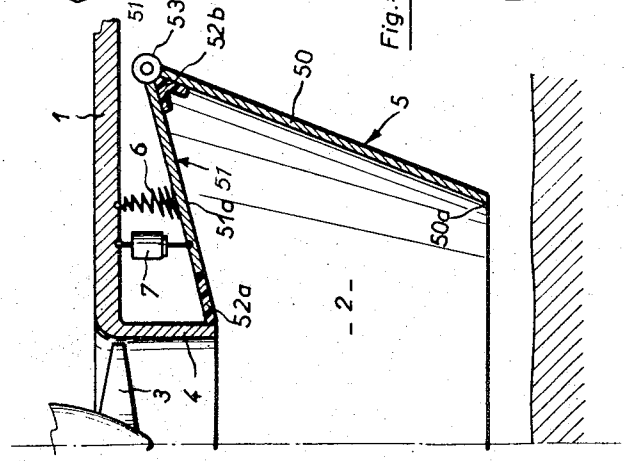

Fig.: 2

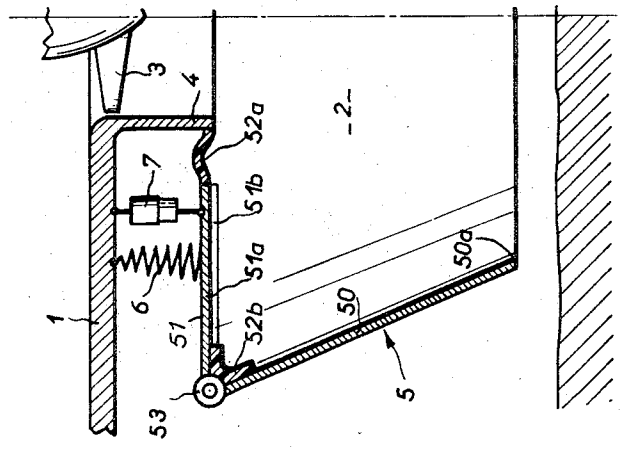

Fig.: 1

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WALL DEVICE FOR BOUNDING AN AIR CUSHION

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9 Claims. (Cl. 180—7)

This invention relates to vehicles supported by at least one pressure-fluid cushion, more particularly vehicles supported by several air cushions each of which is surrounded by a deformable wall made of solid material.

The invention relates generally to the obtaining of characteristic stability of a cushion during its dynamic operation, i.e., the elimination of instability resulting in the spontaneous vertical oscillation of the part of the vehicle disposed above the cushion and resting on it, and the entry into resonance of the cushion when the latter is subjected to periodic influences of the sort that occur during the movement of the vehicle at normal speed over undulating ground, land or water.

Theoretical studies carried out by the applicants show that the volume of the cushion and the law of the variation of that volume under the influence of the variations of the pressure of the cushion are essential parameters of the dynamic stability of the vehicle borne by the cushion.

It was found to be very desirable to have an air cushion bounded by means defining by the cushion an internal volume which was variable in inverse proportion to the pressure of the gas contained in that volume, and this invention relates particularly to such an arrangement.

According to the invention, a vehicle with an air cushion has at least one composite envelope comprising two parts, a side wall advantageously sloping outwards towards the top and an annular support plate which is at least substantially flat and horizontal in the normal position, the side wall being articulated in a sealing-tight manner by its top edge to the outer circumference of the annular support plate and the latter likewise being articulated in a sealing-tight manner on the vehicle proper at its inner circumference and returned to the normal position by any resilient elements known in the field of suspension. The resilient elements are preferably provided with shock absorbers.

The side wall and the support plate are advantageously made of materials that are inextensible under the action of the internal pressure of the supporting fluid cushion, so that variations in their external diameter and their local bending in elevation correspond to variations in the volume provided for the cushion which, if they are present at all, are at least negligible compared with the variations in the volume resulting from the movements of the support plate.

The invention will now be described with reference to the accompanying drawings, in which:

FIGURE 1 shows a half cross-section of an envelope defining an air cushion according to the invention in the normal operating position;

FIGURE 2 shows the envelope in the temporarily raised position, and

FIGURES 3 and 4 are two views from below illustrating two modifications, respectively polygonal and circular, of the envelope in FIGURES 1 and 2.

In the drawings **1** is a platform or the bottom of a vehicle supported by at least one pressure-fluid cushion **2**. The latter is fed in any appropriate known manner and preferably independently of the other cushions, for example by means of a blower **3** and a supply conduit **4** for the pressure fluid.

The cushion is contained by a composite envelope, the structure of which forms the essential part of the invention. This envelope, generally designated **5**, comprises mainly a side wall **50** and an annular plate **51** supporting this wall, which, seen in plan, has any closed form, for example a circular, rectangular or polygonal one. This wall preferably slopes outwards towards the top, as shown in the drawings. It is made of a material which is inextensible but advantageously deformable, such as fabric coated to make it impermeable.

The annular plate **51** is also practically inextensible under the influence of the variations in the pressure of the cushion **2** defined by the composite envelope, but it can be deformed vertically so as to vary the volume of the cushion appropriately. In the ordinary case in which the perimeter of the connecting line of the wall **50** and the plate **51** does not vary, the latter may comprise several rigid, flat elements **51***a*, trapezoidal in plan, the radial edges of which have overlapping joints **51***b*. Articulations or hinges are provided at **53** while the inner circumference of the elements **51***a* is connected to the platform **1**, or more exactly to the base of the feed conduit **4**, by a diaphragm **52***a* made of a deformable and advantageously elastic material such as rubber. A band seal **52***b*, also made of rubber, can be associated with the hinges **53** (FIGURES 1 to 3).

In a modification shown in FIGURE 4, the annular plate **51** comprises a simple diaphragm made of radially ribbed metal sheet and advantageously plastics-lined so as to make it stronger and diminish any vertical vibrations of the composite envelope **50**, **51**.

If desired, this plate can be secured to the conduit **4** so that it can be deformed vertically, and it may have yieldable connections akin to articulations **52***b* on its outer circumference. In this case, if it is flat in the normal position (FIGURE 1), the change of the plate to the position shown in FIGURE 2 (which corresponds to the highest accelerations applied to the platform **1** by its movement over uneven country) may cause its outer perimeter and also that of the wall **50** to be reduced, and this, coupled with its vertical deformation, will reduce the volume of the cushion **2** and temporarily increase the desired damping effect, in spite of the inevitable increase in volume in this case in which the skirt is relatively extensible.

Resilient elements **6** and shock absorbers **7** are advantageously disposed between the platform **1** and the plate **51** to keep the latter in a normally approximately horizontal position and prevent resonance due to the characteristic elasticity of the composite envelope made in this way.

The plan area defined by the bottom edge **50***a* of the wall **50** is greater than the one defined by the articulations at **52***a* of the plate **51** on the platform. In these conditions, the operation of a composite envelope as described, compared with that of conventional inextensible skirts the top edges of which are directly secured to a platform, has the feature that any chance increase in the internal pressure of the fluid cushion **2** tends to act on the difference in the areas mentioned above and to raise the plate **51**. As this is articulated to the platform along its inner circumference at **52***a*, it will be raised on the outer side, becoming deformed slightly as shown on FIGURE 2. As a result, the volume of the cushion **2** is immediately reduced and the periodic movement of the platform that this pressure increase might cause is quickly diminished. Conversely, a chance reduction in pressure causes a relative lowering of the outer circumference of the plate **51** and the bottom edge **50***a* of the wall **50**.

The embodiment which has just been described can, of course, be modified, for example by the substitution of equivalent technical means. For example, the plate **51**,

the springs 6 and even the shock absorbers 7 can be replaced by light inflatable structures.

What is claimed is:

1. A ground effect machine movable along a bearing surface and comprising a rigid structure having a side facing said bearing surface and including a rigid portion protruding from said structure toward said bearing surface and fixedly secured to said rigid structure with a projected section spaced from said side, and wall means for confining laterally a pressure fluid cushion formed against said bearing surface, wherein the improvement comprises a system for supporting said cushion confining wall means relatively to said protruding portion, comprising:

a pressure responsive, deformable plate device in the general shape of an annulus with an inner periphery adjacent said projected section of said protruding portion and an outer periphery adjacent said cushion confining wall means, said plate device extending to form a substantially fluidtight, cushion bounding physical wall on the side of said pressure fluid cushion opposite to said bearing surface whereby said pressure fluid cushion is bounded endwise by said plate device and said bearing surface and sidewise by said confining wall means, said plate device being deflectable conical-wise upon exertion of pressure thereon with said outer periphery thereof moving bodily toward and away from said rigid structure while said inner periphery thereof remains in proximity to said projected section of said protruding portion, whereby said outer periphery of said plate device extends entirely on a same side of said inner periphery thereof,

first means for hingedly connecting said inner periphery of said plate device to said projected section of said protruding portion in spaced relationship with said rigid structure whereby said plate device is deflectable conical-wise to adopt generally V-shaped cross sections of varying angular extents, and

second means for hingedly connecting said outer periphery of said plate device to said cushion confining wall means, whereby said wall means move bodily with respect to said inner periphery upon conical-wise deflection of said deformable plate device.

2. Movable body as claimed in claim 1, further comprising resilient return means extending between said rigid structure and said deformable plate device for urging the same to deflect conical-wise about said first hinge means toward said bearing surface.

3. Movable body as claimed in claim 2, further comprising damping means extending between said rigid structure and said deformable plate device and forming, in cooperation with said resilient return means, a suspension system for said cushion confining wall means and plate device hinged assembly on said rigid structure about said first hinge means.

4. Movable body as claimed in claim 1, wherein at least one of said first and second hinged connecting means comprises a flexible strip of fluidtight material extending peripherally of said plate device to ensure fluidtight hinged connection thereof.

5. Movable body as claimed in claim 1, wherein said plate device comprises a plurality of rigid elements in edgewise overlapping relation.

6. Movable body as claimed in claim 1, wherein said rigid protruding portion comprises a pressure fluid supply duct opening into the space bounded laterally by said cushion confining wall means and endwise by said plate device and said bearing surface, said duct being integral with said rigid structure and being hingedly connected to said plate device through said first means.

7. Movable body as claimed in claim 1, wherein said cushion confining wall means comprises a skirt made of flaccid, fluidtight material and has a longitudinal outline which tapers toward said bearing surface.

8. Movable body as claimed in claim 1, wherein said plate device extends, in a normal position thereof, in a plane generally containing both said inner periphery and said outer periphery thereof and is deflectable conical-wise bodily on one side or bodily on the other side of said plane from said normal position thereof.

9. Movable body as claimed in claim 8, wherein said plate device, when in said normal position thereof, extends substantially parallel to said bearing surface.

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