

Jan. 23, 1968

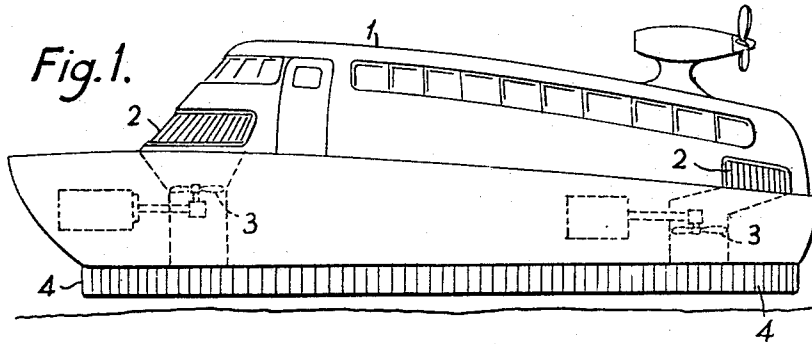
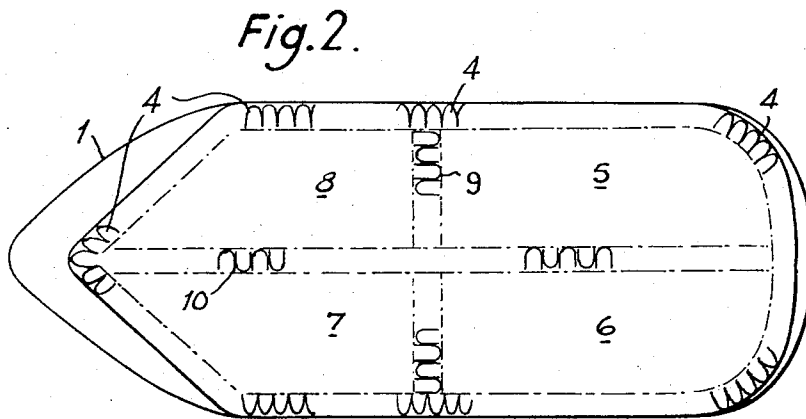
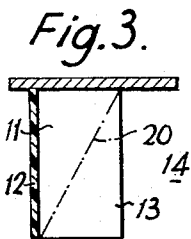
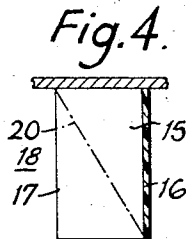
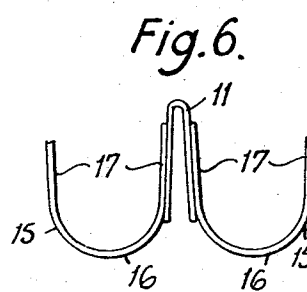
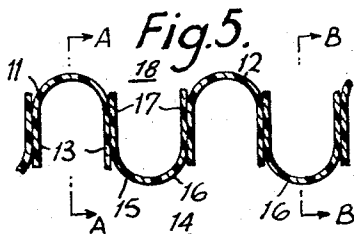
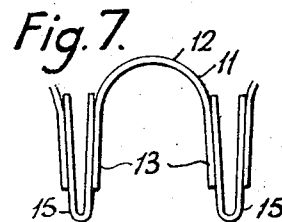
D. S. BLISS

3,365,018

SKIRT CONSTRUCTION FOR SURFACE EFFECT DEVICE

Filed Feb. 19, 1965

2 Sheets-Sheet 1



INVENTOR
DENYS STANLEY BLISS
BY
Cameron, Kerkam & Sutton
ATTORNEYS

1

2

3,365,018

SKIRT CONSTRUCTION FOR SURFACE EFFECT DEVICE

Denys Stanley Bliss, Southampton, England, assignor to
Hovercraft Development Limited, London, England, a
British company

Filed Feb. 19, 1965, Ser. No. 434,003

Claims priority, application Great Britain, Feb. 20, 1964,
7,183/64

6 Claims. (Cl. 189—121)

ABSTRACT OF THE DISCLOSURE

An air-cushion vehicle is given stability by dividing up the cushion space by means of flexible walls. The cushion-dividing walls each comprise two co-operating series of independently deflectable wall members of U-like lateral cross-section and disposed side by side in a row with adjacent side portions of neighbouring wall members overlapping each other and disposed alternately so that the hollow of one wall member faces in a direction opposite to that of its immediate neighbour. The middle portions of each wall member are inclined downwardly towards the cushion compartment into which the associated side portions of that member extend so that the wall member is subjected to wholly tensile loads.

This invention relates to vehicles for travelling over a surface and which are supported above that surface by at least one cushion of pressurised gas, formed and contained beneath the vehicle.

The cushion of pressurised gas may be contained beneath the vehicle by one or more downwardly projecting structures, by curtains of moving fluid issuing from the bottom of the vehicle or by a combination of downwardly projecting structures and fluid curtains.

When the cushion of pressurised gas is contained by downwardly projecting structures, these are preferably flexible. Where flexible structures are used in combination with fluid curtains to contain the cushion of pressurised gas, the flexible structures may be used to contain the upper part of the cushion of pressurized gas, the lower part being contained by curtains of fluid issuing from the bottom edges of the flexible structures. Further, such structures can be used to subdivide or compartment a cushion.

Co-pending applications Ser. No. 267,695, filed Mar. 25, 1963, now abandoned, and Ser. No. 566,948, filed July 21, 1966, describe and illustrate cushion-containing structures comprising a plurality of separate downwardly projecting flexible members attached to the underside of the vehicle, each member comprising an outer portion, the inner surface of which faces towards the cushion space, and two side portions extending inwardly from the outer portion into the cushion space bounded by the structure. It is a feature of such members that the pressure sustained by them maintains the material of which they are formed in tension enabling a very light and flexible construction to be used. However, when used to divide or compartment a cushion the pressures on either side of the members may be substantially equal. Furthermore, during operation, the pressures in the various compartments of a cushion are liable to fluctuate, the members experiencing a higher pressure first on one side and then on the other. Whilst the members function efficiently with a higher pressure acting on the inner surface of the outer portion, they do not function as efficiently when the higher pressure acts on the outer surface of the outer portion.

According to the invention there is provided a gaseous-cushion supported vehicle wherein the cushion space is

divided, or compartmented, into a plurality of cushion-containing spaces or compartments by a wall structure comprising two series of separate or independently deflectable downwardly projecting flexible members attached to the lower part of the vehicle, one series comprising members having an outer or boundary portion, the inner surface of which faces towards one cushion-containing space or compartment, and two side portions extending inwardly from the outer portion into said one cushion-containing space or compartment, bounded by and on one side of the wall, the other series comprising members having an outer or boundary portion, the inner surface of which faces towards another cushion-containing space or compartment, and two side portions extending inwardly from the outer portion into the other cushion-containing space or compartment, bounded by and on the other side of the wall, the members of the two series alternating in a predetermined arrangement.

In one embodiment of the invention the compartmenting wall structure may comprise two series of separate downwardly projecting members arranged so that for at least part of the length of the wall each member of one series contiguously separates two successive members of the other series.

The compartmenting wall structure may further comprise two series of separate downwardly projecting members which are arranged so that for at least part of the length of the wall structure two contiguous members of one series separate two successive members of the other series. Other arrangements of downwardly projecting members can be provided, and these arrangements may be symmetrical, i.e. equal numbers of members facing in each direction, or may be unsymmetrical, more members facing in one direction than in the other.

The flexible members comprising the compartmenting wall structure may be used with or without a fluid curtain issuing downwardly therefrom. Where the flexible members comprising the compartmenting wall are used in combination with a fluid curtain issuing from the bottom edges of the members, the curtain-forming fluid supplied to the members may be supplied either by a source common to all the members comprising the wall structure, or by at least two sources, one source common to the alternate flexible members constrained to bound the cushion-containing compartment on one side of the wall, another source common to the remaining alternate flexible members constrained to bound the cushion-containing compartment on the other side of the wall.

The invention will be understood from the following description of certain embodiments in conjunction with the accompanying drawings in which:

FIGURE 1 is a side elevation of one particular form of vehicle embodying the invention,

FIGURE 2 is an inverted plan of the vehicle illustrated in FIGURE 1,

FIGURE 3 is a vertical cross-section on the line A—A of FIGURE 5,

FIGURE 4 is a vertical cross-section on the line B—B of FIGURE 5,

FIGURE 5 is an enlarged horizontal sectional view of a compartmenting wall structure as illustrated in FIGURE 2,

FIGURES 6 and 7 illustrate diagrammatically arrangements of a compartmenting wall structure as shown in FIGURE 5, under differing operating conditions,

FIGURE 8 is a vertical cross-section similar to that of FIGURE 3 illustrating a modification thereof,

FIGURE 9 is a vertical cross-section similar to that of FIGURE 4 illustrating a modification thereof,

FIGURE 10 is a vertical cross-section similar to that of FIGURE 8 illustrating a modification thereof,

3

FIGURE 11 is a plan view of the arrangement illustrated in FIGURE 10,

FIGURE 12 is a plan view similar to that of FIGURE 11 illustrating an embodiment thereof, and

FIGURE 13 is a similar view to that of FIGURE 5, illustrating a modification thereof.

FIGURES 1 and 2 illustrate a vehicle 1, of the so-called plenum chamber type, in which a cushion of pressurized gas, usually air, is formed and contained beneath the vehicle, air being drawn in through intakes 2 by propellers 3 and fed to a space beneath the vehicle for the formation of the pressurized cushion; the cushion is contained at its periphery by a flexible wall structure 4.

As seen in FIGURE 2, which is an inverted plan, the space contained beneath the vehicle is sub-divided into separate cushion-containing spaces 5, 6, 7 and 8, by a series of further wall structures 9 and 10 extending in a direction normal to the fore and aft axis of the vehicle and parallel to the fore and aft axis respectively.

FIGURE 3 is a vertical cross-section through a member 11, on the line A—A of FIGURE 5, an alternate series of which form part of the walls 9 and 10 of FIGURE 2. The member 11 is formed of a single sheet of flexible material, curved to form a channel-shaped cross-section when viewed from above. The member 11 thus has an outer portion 12 and two side portions 13, the inner surface of the outer portion 12 facing towards the space 14, and the side portions extending inwards into the space 14, in which space is formed a cushion of pressurized air which assists in supporting the vehicle. The member normally has a rectangular or channel-shaped cross-section with substantially square corners at the top where it is attached to the vehicle but assumes a rounded cross-section further down as seen in FIGURE 5. The cross-section of the member may, however, be rounded for the entire height of the member.

FIGURE 4 is a vertical cross-section through a member 15, on the line B—B of FIGURE 5, an alternate series of which form the remaining part of the wall 10 of FIGURE 2. The member 15 is formed of a single sheet of flexible material, curved to form a channel-shaped cross-section when viewed from above. The member thus has an outer portion 16 and two side portions 17, the inner surface of the outer portion 16 facing towards the space 18, and the side portions extending inwards into the space 18, in which space is formed a cushion of pressurized air which also assists in supporting the vehicle. The member normally has a rectangular or channel-shaped cross-section with substantially square corners at the top where it is attached to the vehicle but assumes a rounded cross-section further down as seen in FIGURE 5. The cross-section of the member may, however, be rounded for the entire height of the member.

In the examples illustrated in FIGURES 3 and 4 the side portions 13 and 17 of the members 11 and 15 have been shown as extending for their full width from top to bottom. The side portions can be tapered to reduce their width gradually from top to bottom, as is indicated by the dotted lines 20.

FIGURE 5 illustrates diagrammatically a horizontal cross-section of the alternate facing members 11 and 15. The series of flexible members 15 for example, have outer portions 16 and two side portions 17 extending in one direction whilst the other series of flexible members 11 have outer portions 12 and two side portions 13 extending in the other direction. The condition illustrated in FIGURE 5 is purely diagrammatical and is not normally attained.

If the cushion pressure is higher on the upper side of the wall structures, as considered in FIGURE 5, i.e., in space 18, then the flexible members 16 will expand and the adjacent members 11 will collapse, the members 16 remaining efficient in retaining the cushion pressure on that side of the compartmenting wall. An indication of what may happen in such a circumstance is shown dia-

4

grammatically in FIGURE 6. In the event that the cushion pressure on the other side of the wall i.e., in space 14, increases above that of the first mentioned cushion a reverse effect will occur; that is, flexible members 11 facing the cushion of increased pressure will extend or expand and continue to contain the cushion, whereas adjacent flexible members 15 will distort and collapse, as is indicated diagrammatically in FIGURE 7.

FIGURES 8 and 9 are vertical cross-sections through alternate forms of members which could form the wall structures 9 and 10 of FIGURE 2. As shown in FIGURE 8 member 21 is formed of a single sheet of flexible material curved to form a channel-shaped cross-section when viewed from above. The member 21 has an outer portion 22 depending from the bottom surface 29 of the vehicle at an inclination to the vertical. Two side portions 23 extend inwards into the space 24 in which is formed a cushion of pressurized air which assists in supporting the vehicle. The member may have a rectangular or channel-shaped cross-section with substantially square corners at the top where it is attached to the vehicle and assume a rounded cross-section further down as seen in FIGURE 11, or the cross-section of the member may be rounded for the entire height of the member.

In FIGURE 9 the member 25 is formed of a single sheet of flexible material curved to form a channel-shaped cross-section when viewed from above. The member thus has an outer portion 26 depending downwardly from the bottom surface of the vehicle 29 and at an inclination to the vertical. The side portions 27 extend inwards into the space 30 in which is formed a cushion of pressurized air which also assists in supporting the vehicle.

Members formed as illustrated in FIGURES 8 and 9 can be of thinner material in that the stresses can be purely tensile if the angle 28 subtended by the outer surfaces 22 or 26 and the bottom edges of the side portions 23 or 27 is substantially a right angle. In the examples illustrated in FIGURES 3 and 4 there will be some compressive stresses in the material and either the material will need to be thicker and stronger to resist these stresses or some buckling must be accepted.

FIGURE 10 shows a cross-section through a member 30 attached to the bottom surface 31 of a vehicle where, in accordance with another embodiment of the invention, fluid enters the members 30 through ports 32 in surface 31, flows down in contact with the inner surfaces of the outer portions 33 and issues from the bottom edges 34 to form a moving fluid curtain.

FIGURES 11 and 12 illustrate diagrammatically two alternative methods for supplying air to the members when curtains of air are to be formed from the lower parts of the members, as for example in FIGURE 10. FIGURES 11 and 12 show a compartmenting wall structure comprising one series of flexible cushion bounding members 35, constrained to bound cushion space 37, the remaining series of members 36 constrained to bound cushion space 38. The flexible members 35 and 36 when used in combination with a fluid curtain to separate cushion spaces 37 and 38, may, as in FIGURE 11, be provided with a common duct 39 for supply of fluid to the wall structure via ports 40, or alternatively as in FIGURE 12, the flexible members 35 and 36 may be provided with a fluid supply to the wall structure by ducts 41 and 42 feeding via ports 43 and 44 respectively.

It will be appreciated that the arrangements for ducting the fluid supply to the flexible members 35 and 36 as shown in FIGURES 11 and 12 may be used with the alternate facing segmented compartmenting wall 10 as shown in FIGURES 2 and 3, and may also be used with all such forms of a compartmenting wall as hereinbefore illustrated whether the members are projecting vertically downwards from the bottom surface of a vehicle or whether the compartmenting wall members are projecting downwards at an inclination to the vertical.

As the members open and close under the action of

5

the pressure variations, the distortion will result in a variation of the vertical height of the members. By overlapping opposing members, as in FIGURE 13, the amount of distortion is decreased with a corresponding decrease in the variation of the vertical height of the members. As illustrated in FIGURE 13, a wall structure is formed of alternate members 50 and 51. The outer portions 52 and 53 overlap, and with equal pressures on either side of the wall structure the members assume cross-sections as shown. If the pressure increases on the upper side of the wall structure, as considered in FIGURE 13, the members 51 open as indicated by the dotted lines 54 assuming a condition very similar to that illustrated in FIGURE 6. It will be appreciated that the movement of the side portions 56 is less than in the embodiment illustrated in FIGURE 5. A similar extension of the members 50 occurs when the pressure on the lower side of the wall structure, as considered in FIGURE 13, increases above the pressure on the upper side. The members then assume a condition very similar to that illustrated in FIGURE 7.

Although compartmenting wall structures have been described and illustrated as extending across the bottom of the vehicle, wall structures in accordance with the invention can also extend parallel to and spaced a short distance from the wall structure at the periphery of the vehicle.

I claim:

1. A gaseous-cushion supported vehicle wherein the cushion space is divided into at least two cushion compartments by a wall structure comprising two cooperating series of independently deflectable, downwardly projecting flexible wall members attached to the undersurface of the vehicle body, one of said series comprising wall members each having a boundary portion and two side portions extending therefrom into one of said cushion

6

compartments, the other of said series comprising wall members each having a boundary portion and two side portions extending therefrom into the other of said cushion compartments, the wall members of the two series being disposed side by side in a row in a contiguous, alternating relationship with adjacent side portions of neighbouring wall members overlapping each other, the boundary portion of each wall member being inclined downwardly towards the cushion compartment into which the associated side portions of that wall member extend.

2. A vehicle as claimed in claim 1 wherein the boundary portion of a flexible member defines the periphery of the cushion compartment at the position of that member.

3. A vehicle as claimed in claim 1 wherein the angle subtended by the boundary surface of a member and the lower edge of the side portions is substantially a right angle.

4. A vehicle as claimed in claim 1 including means for supplying a fluid to a wall structure so as to flow down the inner surface of the boundary portion of each member and issue from the bottom of each member and form a curtain of moving fluid.

5. A vehicle as claimed in claim 4 including separate means for supplying fluid to each series of flexible members.

6. A vehicle as claimed in claim 1 wherein each member of one series alternates with a member of the other series.

References Cited

UNITED STATES PATENTS

3,166,137	1/1965	Cooper	180—7
3,211,246	10/1965	Lewis	180—7
3,249,166	5/1966	Cockerell et al.	180—7

A. HARRY LEVY, *Primary Examiner*.