United States Patent

[11] 3,578,768

[72] Inventor **Francois L. Giraud**
Plaisir, France

[21] Appl. No. **740,498**
[22] Filed **June 27, 1968**
[45] Patented **May 18, 1971**

[73] Assignee **Societe De L'Aerotrain**
Paris, France

[32] Priority **Oct. 4, 1967, June 19, 1968**
[33] **France**
[31] **123,278 and 155,691**

---

[54] **PARTITIONING SYSTEM FOR FLUID CUSHIONS IN GROUND EFFECT MACHINES**
15 Claims, 7 Drawing Figs.

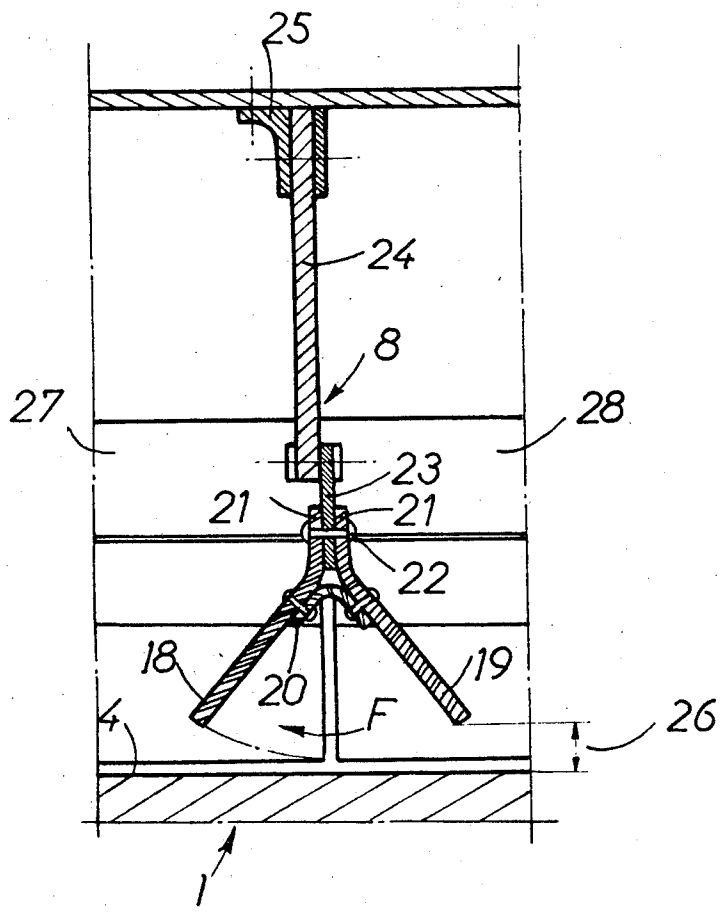
[52] **U.S. Cl.** **104/23,** 180/127
[51] **Int. Cl.** **B61b 13/08**
[50] **Field of Search** ..... 104/23 (F.S.); 180/118, 127

[56] **References Cited**
UNITED STATES PATENTS

3,237,708	3/1966	Strasser et al.	180/127X
3,486,577	12/1969	Jackes	180/127X

Primary Examiner—Joseph R. Leclair
Assistant Examiner—James R. Garrett
Attorney—Stevens, Davis, Miller & Mosher

ABSTRACT: An arrangement for partitioning the compressed fluid cushion of ground effect vehicles and the like machines, said arrangement including dihedral-shaped partitions extending across the cushions and facing one of the walls along which the machine is guided and sustained, said dihedral defining a compartment on either side of same; the outer edges of the elementary partitions facing said wall and normally oblique with reference thereto are separated by a clearance from said wall and by reason of the pivotal securing of the dihedral to the machine along the ridge of said dihedral, any leak of fluid in one of the compartments produces a shifting of the elementary partition bounding the opposite compartment so as to throttle the corresponding clearance and to cut off the leaking compartment.



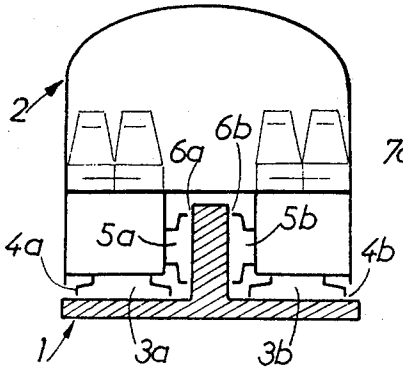


FIG.: 1

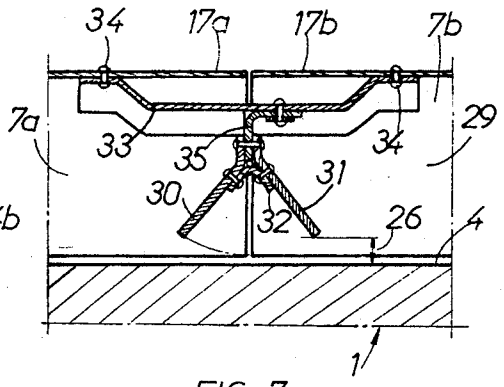


FIG.: 7

FIG.: 4

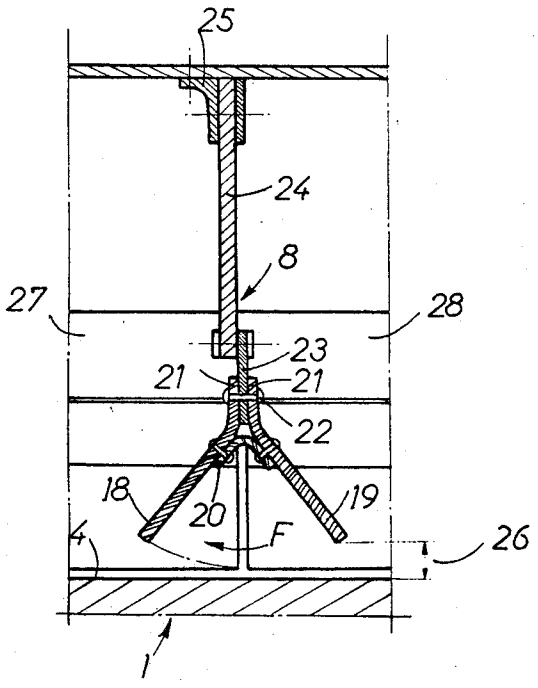


FIG. 2

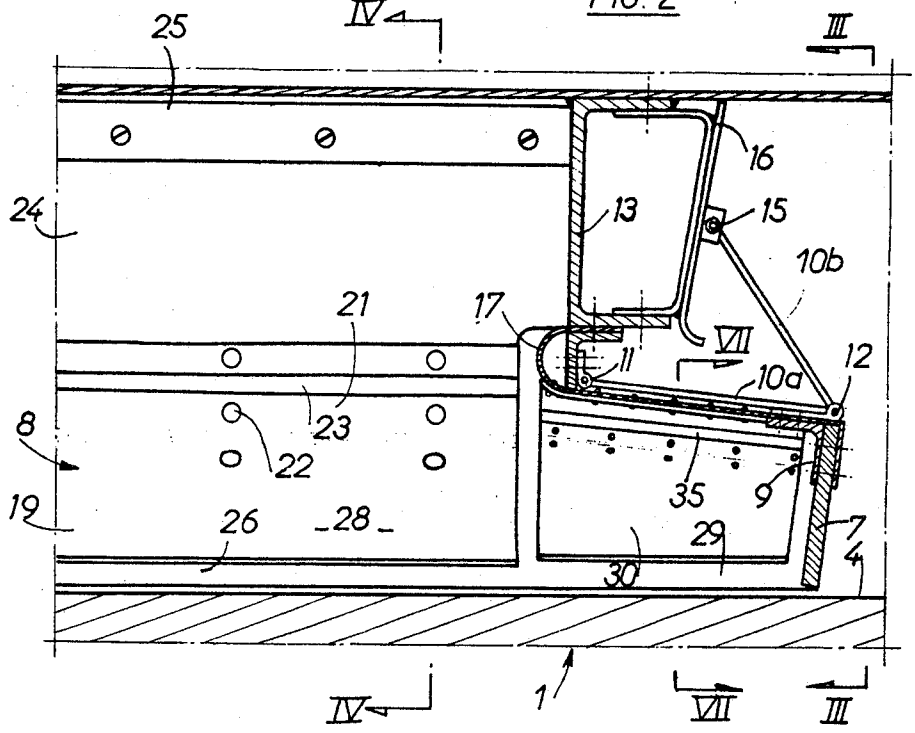

IV
III
25
16
13
15
24
10b
21
17
VII
11
12
10a
8
23
22
35
9
19
26
28
29
7
4
30
IV
1
VII
III

FIG. 3

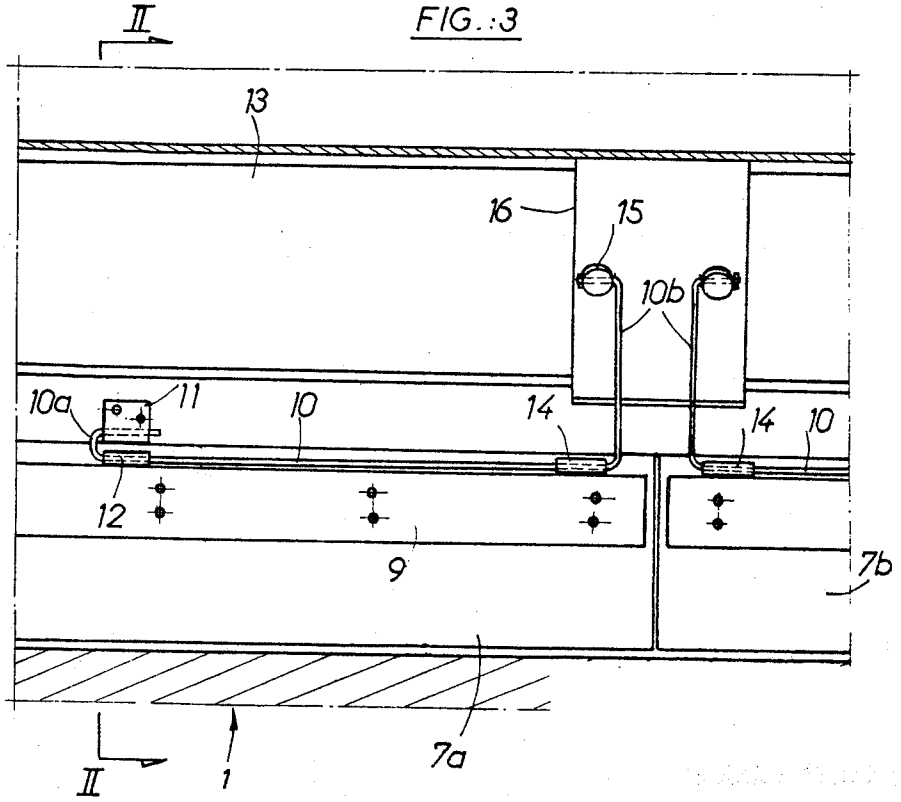

II
13
16
15
10b
10a
11
10
14
14
10
12
9
7b
7a
II
1

FIG.:5

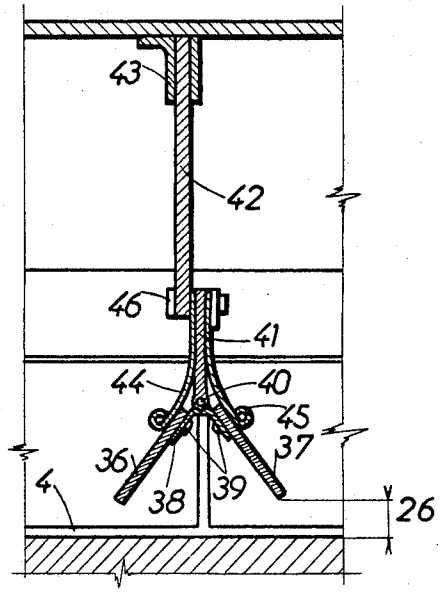
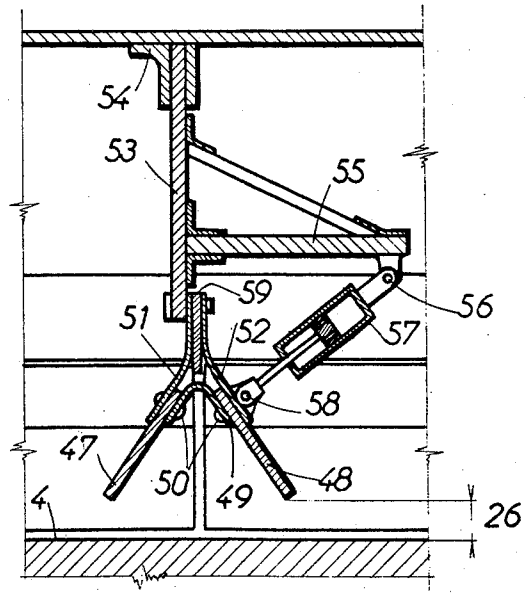

43
42
46
41
44
40
45
37
36
39
38
4
26

FIG.:6


54
53
55
59
56
51
52
57
58
47
50
49
48
4
26

PARTITIONING SYSTEM FOR FLUID CUSHIONS IN GROUND EFFECT MACHINES

SUMMARY AND OBJECT OF THE INVENTION

The present invention has for its object an improved partitioning system for the fluid cushions provided for sustaining and/or guiding a ground effect machine.

According to said invention, such a partitioning system includes two elementary partitions forming an angle transversely between them and extending thus in two planes sloping with reference to a line normal to the surface against which the cushion bears, said elementary angularly set partitions being adapted to pivot in unison under the action of a difference in pressure to either side of said partitioning system, thereby to produce in cooperation with said bearing surface a clearance which varies in accordance with the pivotal angle assumed by said elementary partitions. According to an advantageous feature of the invention, the compressed fluid cushions are confined within bell-shaped areas of which the sidewalls are movable with reference to the machine frame.

Preferably, elastic means are provided for holding the elementary angularly set partitions in a predetermined position cooperating with the bearing surface. Preferably also, the relative movements of the elementary partitions with reference to the machine frame are braked in any suitable manner by friction-operated damping means for instance.

DESCRIPTION OF THE DRAWINGS

The following description and accompanying drawings are given by way of a mere exemplification so as to allow a ready understanding of the invention. In said drawings:

FIG. 1 is a diagrammatic transverse cross section of a movable ground effect machine associated with a guiding track.

FIG. 2 is a partial cross-sectional view showing a cushion-forming space defined by movable sidewalls, said cross section passing through line II–II of FIG. 3.

FIG. 3 is a cross section through line III–III of FIG. 2.

FIG. 4 is a cross section taken along line IV–IV of FIG. 2 and illustrating a first embodiment of partitioning system according to the invention.

FIG. 5 is a similar view of an alternative, preferred embodiment of such system.

FIG. 6 is a further similar view of another alternative embodiment of such system.

FIG. 7 is a cross section of an intermediate partitioning system through line VII–VII of FIG. 2.

DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

As illustrated in FIG. 1, a track 1 is shown which is in the shape of an inverted T and includes an axial rail provided with vertical surfaces facing opposite directions at 6*a*, 6*b* and two projecting carrier flanges the upper surfaces of which 4*a*, 4*b* are substantially horizontal. A movable part or machine 2 constituted by a vehicle in the case considered cooperates with said track. It is carried above said track by cushions 3*a*, 3*b* bearing on the substantially horizontal surfaces 4*a*, 4*b* of the track rail, while it is guided by cushions 5*a*, 5*b* extending along the substantially vertical surfaces 6*a*, 6*b* of the track. The different cushions associated with the vehicle are fed with compressed fluid produced by generators which are not illustrated.

Turning to FIGS. 2 and 3, there is shown a cushion confined laterally by movable sidewalls 7 and subdivided transversely by partitions 8 designed in accordance with the invention. Said cushion is assumed to be a sustaining cushion, but it may as well form a guiding cushion.

The sidewalls made of an advantageously deformable material are secured to an angle bar 9. The arrangement including the sidewall 7 and angle bar 9 is secured pivotally to a rod 10 of which the end 10*a* extends through the folded lugs 11 and 12 rigid respectively with the actual frame 13 of the vehicle and with the sidewall and angle bar arrangement. Said rod 10 extends beyond the lug 12 in a direction substantially parallel with the sidewall 7 so as to pass through another lug carried by said sidewall and angle bar arrangement.

The rod 10 forms also an elastic member urging the sidewall 7 towards the bearing surface 4 provided by the track. As a matter of fact, end 10*b* of said rod engages, through the agency of a friction pad 15, the plate 16 rigid with the vehicle frame. It should be remarked that the ends 10*a* and 10*b* of the rod 10 are thus held in two clearly distinct geometrical planes. Consequently, the rod 10 forms a spring operating against twisting the frictional pad 15 and plate 16 forming a friction-operated damping means.

A yielding wall 17 secured on the one and to the frame 13 of the vehicle and on the other hand to the angle bar 9 provides for complete transverse fluidtightness.

In the example illustrated, each cushion may be confined by a succession of independent lateral walls such as 7*a*, 7*b*, each wall being held by and pivotally secured to the rods 10 forming springs and inserted in opposite head and tail relationship.

Turning now to FIG. 4, the latter shows a partitioning system according to the invention. It should be remarked that the application of such partitions is by no means limited to a transverse subdivision and that, generally speaking, such partitions may be used for longitudinally and/or transversely subdividing the cushion.

The improved partition 8 provided in accordance with the invention includes two elementary partitions 18 and 19 which are preferably deformable and held in planes which slope with reference to a line perpendicular to the bearing surface 4 of the track, as provided by the angle bar 20 rigidly interconnecting the elementary partitions. The adjacent edge portions 21 of any two cooperating partitions 18, 19 are rigidly secured together by rivets 22 to a deformable diaphragm 23 which is carried in its turn by a rigid wall 24 secured in the vehicle frame, for instance by means of an angle bar 25.

The clearance 26 defined between the elementary partitions 18 and 19 on the one hand and the bearing surface 4 on the other hand is reduced when said partitions execute simultaneously a rotation as allowed by the deformable diaphragm 23, so that one of said elementary partitions assumes a position nearer a position perpendicular to the bearing surface 4.

In the arrangement illustrated, the complex partition 8 subdivides the space formed between the sidewalls 7 into two compartments 27 and 28.

The operation of this system is as follows:

If when feeding under identical conditions the compartments 27 and 28 the leak flows are substantially equal, the pressures prevailing to either side of the complex partition 8 executed in accordance with the invention are also substantially equal, the clearance 26 may in such a case be comparatively large without this resulting in any detrimental action on the stability of the vehicle.

In contradistinction if as a consequence of an increase in the leak output out of one compartment for instance out of the compartment 27 the pressure inside the latter decreases, it is then necessary to cut off said compartment, so that the pressure inside the adjacent compartment 28 may not also drop and a certain guiding and/or sustaining force may be maintained.

Such a cutting off is obtained automatically by the improved partitions 8. As a matter of fact, the pressure inside the compartment 27 being lower than the pressure prevailing inside the compartment 28, fluid under pressure flows consequently underneath the elementary partitions 18 and 19 by reason of the clearance 26 extant between the latter and the bearing surface 4 of the track. Said flow of fluid and also said difference in pressure prevailing between the compartments 27 and 28 produce a rotation in the direction of the arrow F of said partitions 18 and 19 round their common pivotal connection provided by the diaphragm 23.

The partition 19 assumes thus a position nearer a normal to the surface 4 of the track and consequently the clearance 26 between said partition and the track is reduced, which leads to a constriction of the passageway afforded for the flow of fluid

from the compartment **28** towards the compartment **27** and thus the two compartments are cut off to a substantial extent with reference to each other.

In order to prevent the partition systems **18** and **19** from rotating beyond an optimum position, it is advantageous to provide stops rigid for instance with the stationary wall **24** in order to limit said rotation.

The rocking movement of the partition system **18**, **19** round the hinge formed by the deformable diaphragm **23** may also be damped.

As illustrated in FIG. **5**, the partitioning system includes two elementary partitions **36**, **37** which are advantageously deformable and held in planes sloping with reference to a line normal to the bearing surface **4** for the cushions sustaining the machine, said elementary partitions being carried by means of an angle bar or stay **38** to which said partitions are secured for instance by bolts or rivets **38**. The angle bar **38** is pivotally secured at **40** to a plate **41** which is carried in its turn by a rigid wall **42** secured to the machine frame, for instance by means of a further angle bar **43**.

To either side of the plate **41** are secured two spring blades **44** and **45** which in the example illustrated are held by a nut-and-bolt system **46** serving also for securing the plate **41** to the rigid stationary wall **42**. Obviously, said manner of securing the springs **44** and **45** is not essential and may be modified as required.

The spring blades **44** and **45** are constituted by elastic blades the free ends of which engage the elementary partitions **36** and **37**.

The clearance **26** defined between the partitions **36** or **37** and the bearing surface **4** is reduced whenever said partitions execute together a rotation round the pivotal connection **40**. The rocking movement of said partitions is braked by the springs **44** and **45** on the one hand by means of their elasticity and on the other hand by reason of the fact that during their rotation the partitions **36** and **37** move with reference to said springs, the friction between the partitions **36** or **37** and the corresponding springs **44** or **46** cooperating in the damping of the rotary movement.

As illustrated in FIG. **6**, the partitioning system includes two elementary partitions **47** and **48** which are advantageously deformable and held in planes sloping with reference to a line normal to the bearing surface **4** for the cushion sustaining the machine, said partitions being secured to an angle bar or stay **49** by rivets **50**.

The whole system is connected with the machine frame by two yielding strips **51** and **52** secured to a rigid wall **53** which is itself carried by the machine frame, for instance through the agency of an angle bar **54**.

To a bracket **55** rigid with the stationary wall **53** there is pivotally secured at **56** the cylinder of a shock absorber **57** of which the piston rod is pivotally connected at **58** with the angle bar **49** connecting the elementary partitions.

A rigid plate **59** is inserted between the two yielding strips **51** and **52** in the area where the latter are to join the wall **53**.

The clearance **26** defined between the partitions **47** and **48** and the bearing surface **4** is reduced when said partitions execute simultaneously a pivotal movement allowed by the yielding strips **51** and **52**. The pivotal movement of said partitions is limited by the stationary plate **59** and is thus damped by the shock absorber **57**.

Turning now to FIG. **7**, the free space **29** limited by the sidewall **7**, its supporting means and the bearing surface **4** of the track is closed by two interdependent intermediate partitions **30** and **31** rigidly secured to a common angle bar **32**. Said partitions **30** and **31** lie substantially in alignment with the cooperating elementary partitions **18** and **19**.

It should be remarked with reference to FIGS. **3** and **7** that the sidewall **7** is subdivided into two aligned portions **7***a* and **7***b* and the same is the case for the fluidtight yielding wall **17** which is subdivided into two portions **17***a* and **17***b*; the connection between the parts **17***a* and **17***b* is performed substantially in registry with the partitions **30** and **31**. A covering sheet **33** which is advantageously elastic is secured by rivets **34** to the parts **17***a* and **17***b* of the fluidtight wall **17** and the system of partitions **30**, **31** is connected with the partition-covering sheet **33** by a yielding hinge **35**.

Said partitions **30**, **31** operate in a manner similar to the above-mentioned partitions **18** and **19** located substantially in alignment therewith in the example illustrated.

The walls **7** and **!7** may also be subdivided into several sections of which the length is advantageously a submultiple of the distance separating two adjacent partitions.

Obviously, the embodiment described have been given only by way of examples and many modifications may be brought thereto, chiefly by replacing certain parts by technically equivalent parts without unduly widening thereby the scope of the invention as defined in the accompanying claims.

I claim:

1. In a surface effect machine movable along a surface with the interposition of pressure fluid cushions formed against said surface, a cushion-confining system comprising a partition wall of generally Y-shaped cross section having two angularly spaced branch portions in generally dihedral assembly of substantial constant angle, extending obliquely on opposite sides of an included plane perpendicular to said surface, to end with free edges which are adjacent and substantially parallel to said surface and which define therewith respective daylight clearances, and connecting means for mounting said dihedral assembly to pivot about an axis substantially parallel to said surface whereby angular displacement of said dihedral assembly causes one branch portion thereof to pivot towards said perpendicular plane thus narrowing the corresponding daylight clearance while the other branch portion pivots away from said plane thus widening the corresponding daylight clearance.

2. Cushion-confining system as claimed in claim **1**, wherein said pivotable dihedral assembly has a mean position of rest at which said free edges are at substantially the same distance from said surface and define substantially equal daylight clearances.

3. Cushion-confining system as claimed in claim **2**, wherein said pivotable dihedral assembly, when in said mean position thereof, is generally symmetrical about said perpendicular plane.

4. Cushion-confining system as claimed in claim **2**, wherein said partition wall of generally Y-shaped cross section further comprises a stationary, rigid stem portion to which said dihedral assembly is pivotally connected by said mounting means.

5. Cushion-confining system as claimed in claim **4**, wherein said mounting means comprises a deformable diaphragm secured at spaced locations thereof respectively to said rigid stem portion and to said dihedral assembly.

6. Cushion-confining system as claimed in claim **4**, further comprising resilient return means extending between said rigid stem portion and said dihedral assembly to urge the latter into said mean position thereof.

7. Cushion-confining system as claimed in claim **4**, further comprising vibration damping means extending between said rigid stem portion and said dihedral assembly.

8. Cushion-confining system as claimed in claim **2**, further comprising spacer means extending between said branch portions to keep the same at a substantially constant angular spacing with respect to each other.

9. Cushion-confining system as claimed in claim **8**, wherein said spacer means comprises a substantially rigid angle bar secured to said branch portions.

10. Cushion-confining system as claimed in claim **2**, wherein said partition wall constitutes an internal dividing wall between two contiguous pressure fluid cushions whereby said wall is subjected on one side thereof to the pressure of one of said cushions and on the other side thereof to the pressure of the other of said cushions, and said pivotal dihedral assembly is responsive to the difference between said cushion pressures whereby said daylight clearances vary as a function of said

pressure difference, said pivotal dihedral assembly being in said mean position thereof with said daylight clearances being substantially equal when said cushion pressures are substantially equal.

11. Cushion-confining system as claimed in claim **10**, further comprising sidewalls separating outmost pressure fluid cushions from the ambient medium and having free edges which are adjacent and substantially parallel to said surface and which define therewith a peripheral daylight clearance, said peripheral daylight clearance being smaller than said formerly mentioned daylight clearances when substantially equal with said pivotal dihedral assembly being in said mean position thereof.

12. Cushion-confining system as claimed in claim **11**, further comprising suspension means for movably supporting said sidewalls on said machine relatively to said surface, and for resiliently urging said sidewalls towards said surface.

13. Cushion-confining system as claimed in claim **12**, wherein said suspension means comprises a bent spring rod hinged to said machine and bearing said sidewalls.

14. Cushion-confining system as claimed in claim **12**, wherein said suspension means comprises friction means for damping relative movement of said sidewalls.

15. Cushion-confining system as claimed in claim **12**, further comprising a flexible diaphragm fluid-tightly interconnecting said sidewalls and said machine.