Sept. 7, 1965 E. F. NEEDHAM 3,204,932

INFLATABLE JACK STRUCTURES

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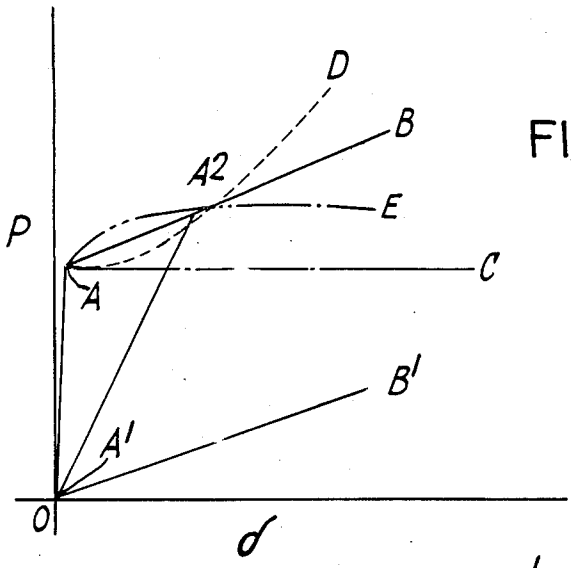
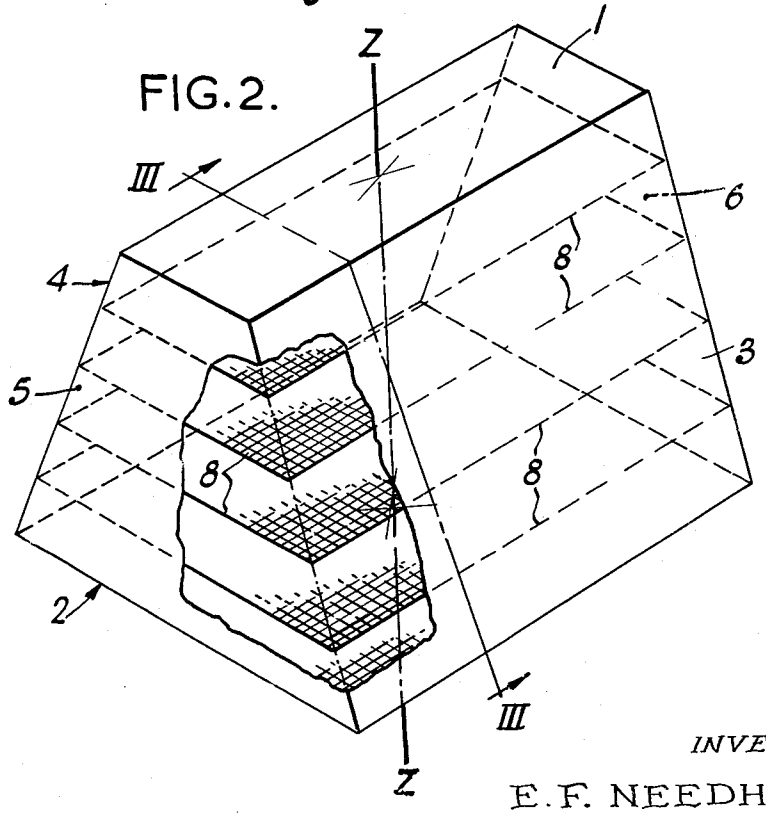


FIG.1.

FIG.2.



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FIG. 3.

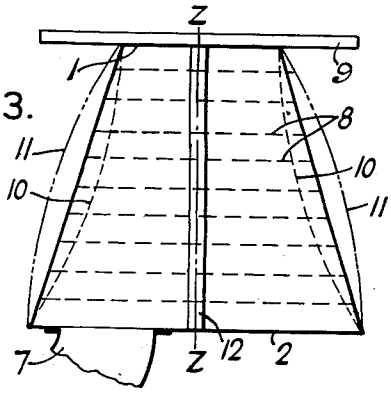


FIG. 4.

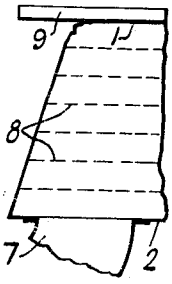


FIG. 8.

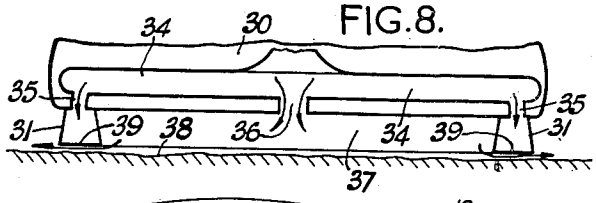


FIG. 9.

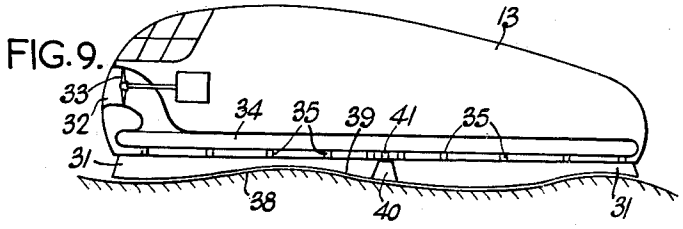
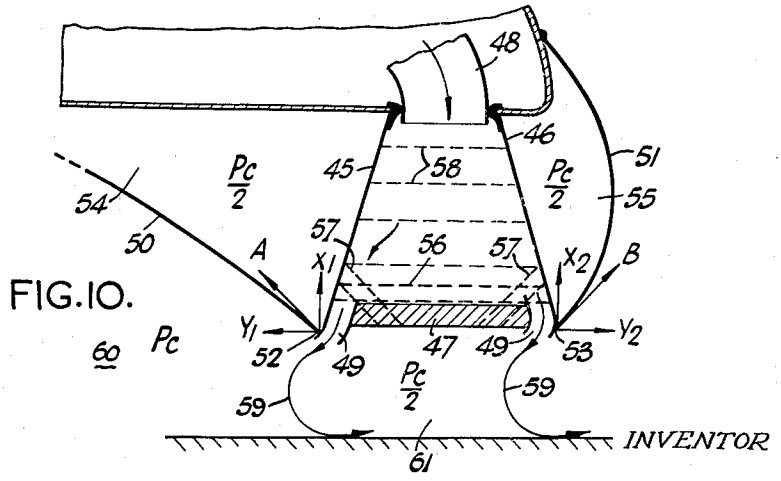


FIG. 10.



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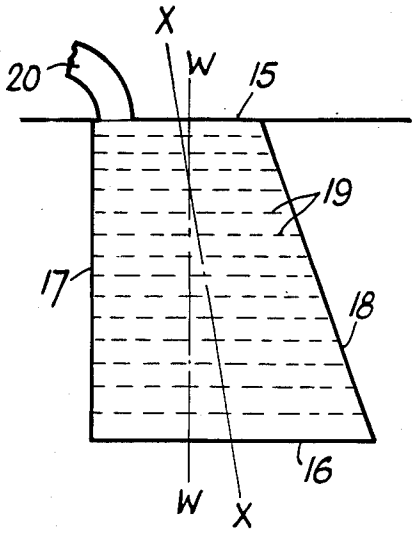
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FIG.5.



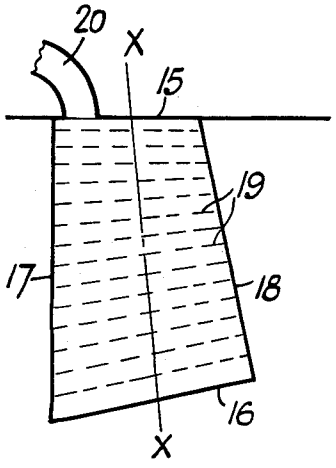


FIG.6.

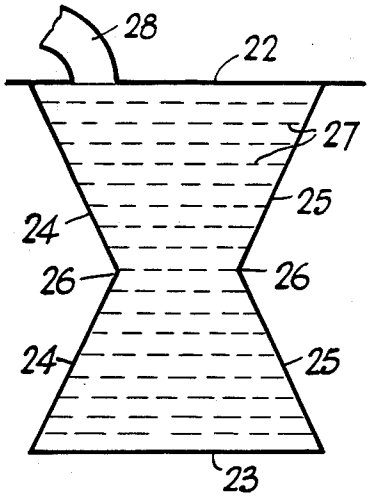


FIG.7.

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United States Patent Office

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INFLATABLE JACK STRUCTURES

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Claims priority, application Great Britain, Mar. 15, 1962, 10,042/62
6 Claims. (Cl. 254—93)

This invention relates to inflatable deformable structures, that is to say structures which attain a normal shape when inflated but which can be deformed from that shape, the structures recovering their normal shape when the circumstances causing the deformation cease.

Such structures can be used for many purposes taking various forms. Some typical examples are inflated bags for lifting heavy weights on soft ground, inflated fenders on ships and dock quays, shock absorbers, and suspension systems.

A more particular use of such structures is in vehicles of the kind adapted to be supported over a surface on at least one cushion of pressurised gas contained beneath the vehicle by means of one or more downwardly extending walls, the walls on their own containing the cushion or acting in combination with curtains of moving fluid. The walls may extend for the whole periphery of the vehicle, or may extend only along the sides, other means being provided for containing the cushion at the front and rear of the vehicle.

The present invention is concerned with providing an inflatable structure which can be deformed or collapsed in a predetermined manner, the space within the structure when it is inflated being connected to a recuperation region such that any changes in inflation pressure due to deformation or collapse are small. According to the invention there is provided an inflatable deformable structure having two load bearing surfaces connected by flexible surfaces, the flexible surfaces being constrained to assume, with the load bearing surfaces, an inflated shape which differs from the shape they would otherwise assume, the inflated shape having a cross-sectional area which varies from a maximum to a minimum along an axis joining the load bearing surfaces, the variation, subject to such changes in inflation pressure as may occur and are taken into account, corresponding to a desired relationship between the load applied to the load bearing surfaces and the deformation or collapse of the structure due to the load.

In a particular example the structure has a cross-section which is trapezoidal, the parallel sides being the load bearing surfaces and the taper of the cross-section providing the predetermined ratio of deformation to load. This ratio can be further varied by making the non-parallel sides other than straight. The cross-section can be other than symmetrical about an axis normal to the parallel sides.

Structures of trapezoidal or similar cross-section are a particularly convenient form for the downwardly extending walls for vehicles supported by one or more cushions of pressurised gas, and according to a feature of the invention there is provided a vehicle which is supported above a surface by at least one cushion of pressurised gas formed and contained beneath the vehicle, the cushion being contained at least in part by an inflatable wall structure formed as a structure constrained to assume when inflated a configuration which, in a cross-section normal to the length of the wall, tapers from a narrow surface to a wider surface substantially parallel to the narrow surface, one of said surfaces being attached to the vehicle and the other surface co-operating with the surface over which the vehicle is travelling, the space

within said wall structure being in free communication with a recuperation region, the arrangement being such that changes in inflation pressure in the space due to deformation of the wall structure by external forces applied to the said wider surface are small. In alternative arrangements the structure may taper from a narrow surface to a dimension which is larger than that of the narrow surface and then to a narrow surface again, or from a wide surface to a narrower dimension and then to a wider surface again.

In a further alternative arrangement, subsidiary cushions of pressurised gas can be formed beneath the surface of the wall structure which co-operates with the surface over which the vehicle is travelling, and according to another feature of the invention means are provided in this surface of the wall structure for forming at least two curtains of moving fluid, the curtains extending in the direction of the length of the wall, so that, when in operation at least one cushion of pressurised gas is formed beneath the said surface.

The effect of keeping changes in inflation pressure small may be achieved, for example, by allowing the inflated structure to comunicate with a substantially fixed volume recuperation region which may be an enclosed chamber of rigid construction, or it may be in communication with a pressurising source at constant pressure. In either event the communication should be through low impedance ducts or apertures so as to reduce to an acceptable degree temporary increases of pressure within the structure which might arise due to impulsive deformations.

Structures according to the invention may be maintained inflated by continuous exposure to a source of inflation pressure, and in the case of the suggested application to gaseous-cushion-supported vehicles above referred to the source may be the same source as that which supplies the gas to the vehicle-supporting cushion. In particular, in the example referred to above in which curtains of moving gas are formed beneath a wall structure according to the invention, the source may be the source of gas for the curtains. In such cases the further advantage may be achieved that the stiffness of the inflated structure, which is of course related to the pressure of the inflating gas, is variable in conformity with the pressure of the gas in the vehicle-supporting cushion and/or the pressure of the gas supply for the gaseous curtains.

The invention will be readily understood from the following description of some embodiments with reference to the accompanying drawings in which:

FIGURE 1 illustrates the various load/deflection curves for various forms of structure,

FIGURE 2 is a perspective view of a structure according to the invention,

FIGURE 3 is a cross-section on the line III—III of FIGURE 2,

FIGURE 4 is a fragmentary cross-section of one side of the structure illustrated in FIGURES 2 and 3 illustrating the partial collapse or deformation thereof,

FIGURE 5 is a cross-section, similar to that of FIGURE 3, illustrating a further structure according to the invention,

FIGURE 6 is another cross-section, similar to that of FIGURE 3, illustrating another structure according to the invention,

FIGURE 7 is a further cross-section, similar to that of FIGURE 3, illustrating yet a further structure according to the invention,

FIGURE 8 is a vertical cross-section through the bottom of a vehicle embodying the invention,

FIGURE 9 is a side view of a typical vehicle illustrated in FIGURE 8, and

FIGURE 10 is a diagrammatic cross-section through a wall as shown in FIGURE 8, to an enlarged scale illustrating a modification thereof.

The structure illustrated in FIGURES 2 and 3 is of trapezoidal cross-section, the parallel sides **1** and **2** being the loading bearing surfaces and being connected by flexible surfaces or sides **3** and **4** and having ends **5** and **6** to form a closed shape. Air is fed to the interior of the structure by means of a duct **7** in the load bearing surface **2**. The structure is constrained to retain its shape by means of a series of cords **8** extending between the flexible surfaces **3** and **4** and arranged in planes parallel to the load bearing surfaces **1** and **2**. When a load is applied to the load bearing surfaces **1** and **2** the structure eventually collapses or deforms along the axis Z—Z.

The actual operation can be understood by reference to FIGURE 1 in conjunction with FIGURE 3. Assuming that the structure, as shown, is inflated from a constant pressure source to a pre-determined pressure X lbs. per square inch, and that the area of the narrower load bearing surface **1** is Y square inches, then, as the structure is constrained to retain its preset cross-section, as a load up to the value XY lbs. is applied and assuming that the load is applied so as to act through the centre of gravity of the cross-section, i.e. in the axis Z—Z, then there is substantially no collapse or deformation of the structure along the Z—Z axis. The curve of load/deflection is represented in FIGURE 1 by the straight line O–A. The slight deformation is due to slight stretching etc. of the materials used in the construction of the sides and cords. As soon as the load reaches the value XY lbs., there is no tension in the connecting surfaces **3** and **4** at the positions where they are attached to the narrow load bearing surface **1**. This condition is at point A in FIGURE 1. If the load is further increased, the structure will collapse from the narrow bearing surface **1**, until the minimum area at that end has increased sufficiently so that the new area times the pressure equals the new load. This load/deformation is indicated in FIGURE 1 by the curve AB. The actual slope of this curve is dependent upon the taper of the structure. Thus, for example, taking the extreme case in which the connecting surfaces **3** and **4** are parallel, that is the cross-section is a rectangle, then once the initial load XY lbs. is exceeded, the structure will collapse entirely, this being represented in FIGURE 1 by the curve AC.

FIGURE 4 illustrates the form of the structure where a load has been applied which is sufficient to collapse the structure by a distance equal to that of four planes or layers of cords **8** plus some small additional distance. The structure collapses completely for the part equal to the four planes or layers of cords and the surfaces of the structure between the fourth and fifth layers of cords has bulged slightly and has collapsed slightly so that the new minimum area is sufficient, at the inflation pressure, to support the load.

In order to ensure that the structure deforms or collapses progressively in the desired manner the load may be applied to the narrow load bearing surface by a rigid member which is at least as wide as the largest dimension of the cross-section to which the structure is to deform or collapse. Thus, in FIGURE 3, the load bearing surface **1** bears against a rigid member **9**. If the structure is intended to be capable of collapsing completely then the width of the member **9** should be at least equal to the width of the wider bearing surface **2**. If such a rigid member is not used the narrow load bearing surface will pass down into the interior of the structure as far as the first plane of cords **8**. The structure will continue to collapse in this manner, successive planes of cords being pushed down into the interior of the structure as each plane encounters the next succeeding plane. This form of collapse or deformation modifies the curve very slightly. The load on the wider load bearing surface **2** is preferably applied by a substantially rigid surface which is at least as wide as the bearing surface **2**.

The curve AB is a straight line if the connecting flexible surfaces **3** and **4** are also straight. If these surfaces are constrained to assume concave curves, as indicated by dotted lines **10** in FIGURE 3, then the load/deformation curve is as AD in FIGURE 1. If the connecting flexible surfaces **3** and **4** are constrained to assume convex curves, as indicated by dotted lines **11**, then the load/deformation curve is as AE in FIGURE 1.

Theoretically, the shape of the load/deformation curve from point A in FIGURE 1 corresponds to the actual curvature of the flexible surfaces **3** and **4**. Actually the load/deformation curve will be modified slightly by the distance between the parallel planes of cords **8**, the closer these planes are the more nearly correct will be the curve. The curve will also be affected by any pressure variation which occurs within the structure and also by any stretching and/or the stiffness of the material of which the structure is made.

The position of point A in FIGURE 1 is dependent upon the area of the narrow load bearing surface **1** and the pressure within the structure. By reducing the area, point A will be lower down, and by making the area negligible, that is, by making the cross-section a triangle, point A will be at O. An alternative method of affecting the position of point A is to pre-load the structure, for example, by a tie **12** as in FIGURE 3. Depending upon the initial tension of the tie **12**, so will the position of point A vary. Thus, if the initial tension of the tie is such that the load it applies to the load bearing surfaces exactly balances the load on the narrow load bearing surface **1** due to the inflation pressure, then point A will be at O. With any other lower initial tension then point A will be at some other position on the curve OA of FIGURE 1. The effect of the tie once the structure starts to collapse will depend on the "rate" of the tie. For example, if the tie is effectively "rateless" i.e. it maintains a constant load on the bearing surfaces at all times irrespective of the collapse of the structure, then once the structure starts to collapse the tie does not affect the load/deformation curve. If the tie is not "rateless" then the load/deformation curve of the structure is modified until, if so arranged, the deformation or collapse of the structure reaches a position in which the tie no longer applies a load to the load bearing surfaces. After this position the load/deformation curve reverts to its original slope which it would have without a tie.

The effect of the tie can be appreciated by reference to FIGURE 1. If the tie **12** has an initial tension which applies a load which exactly offsets the inflation load, as contained above, that part of the curve represented by OA disappears and the point A will be at A^1 which is at O. If the tie is considered as being rateless then the load/deformation curve will be A^1–B^1. The curve A^1–B^1 will be of the same slope as the curve AB.

If the tie **12** has a "rate" then the load applied by the tie will decrease as the structure deforms, as stated above, and the load/deformation curve is modified. In FIGURE 1, assuming again an initial tension which exactly offsets inflation load, the load/deformation curve will again start at A^1 but the slope will be intermediate between that of OA and A^1–B^1. The actual slope will depend upon the "rate" but a typical example is a curve which commences at A^1 at a slope which intersects the AB curve at A^2. At this point the structure has deformed or collapsed to the extent that the tie no longer applies any load to the load bearing surfaces, the structure therefore continues to deform with a load/deformation curve of the structure without the tie, i.e. the curve is A^2–B. Thus for this example the load/deformation curve is A^1–A^2–B.

As so far described, it has been assumed that the structure has been inflated from a constant pressure source, that is that there is no increase in pressure within the structure with deformation. This can readily be done by connecting the interior of the structure to a constant pres-

sure source, such as a pump. However, it may not be convenient to connect the structure to a pump or the like and the recuperation region may be a constant volume chamber. If the volume of this chamber is very large compared with the volume of the structure, then there will only be a slight pressure rise within the structure when it is deformed and this will have little effect. Obviously as the volume of the recuperation region in a constant volume system is decreased relative to that of the structure, then the pressure rise or deformation of the structure gradually becomes a factor which affects the load/deformation curve of the structure, but, if desired, it is possible to at least partly offset this effect by suitably designing the cross-section of the structure.

Structures as described above can be used in many ways. For example, it has been proposed to lift aircraft which have run off a runway, or have had their undercarriages collapse, by putting flexible bags under their wings and inflating them. Structures according to the present invention can readily be used for this purpose and provide a controlled lift. At the same time the load on the aircraft wing is not concentrated and further damage can be avoided.

A structure similar to FIGURES 2 and 3 could also be used as a fender for ships etc. The cross-section of the structure could be so dimensioned that a predetermined increase in load occurred as the fender was deformed. The fender could conveniently be mounted along the face of a quay and either be inflated from a pressure supply or be connected to a constant volume recuperation region. The ratio of the recuperation region to that of the structure will affect the load/deformation curve, but this can be allowed for in the design.

The structure can also be non-symmetrical about an axis normal to the load bearing surfaces, as illustrated in FIGURE 5. The load bearing surfaces **15** and **16** are parallel but the flexible surfaces or sides **17** and **18** are not symmetrically positioned about an axis W—W which is normal to the load bearing surfaces **15** and **16**. The structure is constrained by perforated diaphragms **19** and inflated through a duct **20**. If a load is applied so as to act at all times through the centre of gravity of the structure, i.e. along the axis X—X, then the structure will collapse along that axis. If however, the load is not so applied, there will be some tilting of one load bearing surface relative to the other.

The load bearing surfaces need not be parallel but may be inclined to one another as in FIGURE 6. This example is a modification of that illustrated in FIGURE 5 and the same references have been applied. The load bearing surfaces **15** and **16** are inclined to one another, and the inclination of the constraining diaphragms **19** varies from load bearing surface **15** to load bearing surface **16**. Again, as in the example illustrated in FIGURE 5, if a load is applied so as to act at all times through the centre of gravity of the structure, i.e. along the axis X—X, then the structure will collapse along that axis. If the load is not so applied then some tilting of one load bearing surface relative to the other will occur.

Tilting of one load bearing surface relative to the other will also occur in the example illustrated in FIGURES 2 and 3 if the load is not applied so as to act at all times through the centre of gravity of the structure, i.e. along the axis Z—Z.

In the arrangements described and illustrated, the structure starts to collapse or deform at one load bearing surface, the deformation progressing towards the other load bearing surface. By making the structure of a shape which is the equivalent of two structures as illustrated in FIGURE 3 joined together, then other forms of deformation can be achieved. Such an example is illustrated in FIGURE 7. The load bearing surfaces **22** and **23** are shown parallel while the connecting flexible surfaces **24** and **25** first become closer together as they progress from one of the load bearing surfaces, reaching a minimum distance at **26**, and then becoming further apart as they approach the other load bearing surface. The surfaces **24** and **25** are constrained to this shape, when inflated, by perforated diaphragms or the like **27**. The structure is inflated through a duct **28**. By joining two structures of trapezoidal cross-section together at their narrow load bearing surfaces, the structure will start to deform at the centre and progress outwards in each direction towards the wider load bearing surfaces. Conversely, joining two such structures together at their wide load bearing surfaces, the structure will start to deform at the two extremities at the narrow load bearing surfaces and progress inwards to the centre. Other arrangements can readily be provided.

As stated above, an example of the application of the invention is in vehicles of the kind which are supported over a surface by one or more cushions of pressurised gas contained beneath the vehicle at least in part by one or more downwardly extending walls.

The closer the bottom surfaces of the walls are to the surface over which the vehicle is travelling, the smaller will be the mass flow requirements to maintain the cushion. However, the closer to the surface, the more likely are the walls to suffer impact with obstacles, resulting in damage and also the imposition of undesirable movements on the vehicle. It has been proposed to make such walls flexible and readily deformable, but difficulties arise in obtaining a construction which is sufficiently rigid to retain the desired shape and position under normal operating conditions and yet will readily deform when necessary. It may also be desirable that movement of the wall as a result of such deformation should be as far as possible vertical. If the movement is not substantially vertical, the peripheral boundary of the gaseous cushion can be arranged to move inwards or outwards relative to the centre of the vehicle and this will result in a movement of the centre of pressure of the gaseous cushion.

FIGURES 8 and 9 illustrate the application of the invention to a vehicle of the so-called "plenum-chamber" type, in which the vehicle **30** has a downwardly depending deformable wall **31** extending round the periphery of the bottom surface of the vehicle. The wall **31** is an inflated structure, as described above with reference to FIGURES 2 and 3. Air is drawn in through an intake **32** by a propeller **33** and is fed to a chamber **34** extending over the bottom surface of the vehicle. Air is fed from the chamber **34** via ducts **35** to the wall **31** and also via a duct **36** to the space **37** contained by the wall **31** beneath the bottom of the vehicle. In operation air is fed via the duct **36** into the space **37**, a cushion of pressurised air being formed. Continued supply of air to the space eventually builds up a pressure which supports the vehicle above the surface **38** with a small clearance between the bottom surface **39** of the wall **31** and the surface **38**. Excess air escapes to the atmosphere beneath the bottom of the wall **31**. Chamber **34** acts as a constant pressure source for the inflation of the wall **31**.

If for any reason the height of the bottom of the vehicle above the surface **38** decreases locally, as when passing over obstacles such as rocks, sand dunes, waves and the like, the wall is readily deflected upward at that locality.

To improve the stability of the vehicle the space **37** can be divided to form separate air cushions by a structure **40**. This structure is similar to that of FIGURES 2 and 3 and is fed with air from the chamber **34** via ducts **41**.

In another form of vehicle, not illustrated, walls may be provided only along the sides of the vehicle, extending in a fore and aft direction, the gaps between the ends of the walls at the front and rear of the vehicle being closed by other means such as hinged flaps and the like or by curtains of moving fluid which issue from the bottom of the vehicle.

Structures according to the invention may also be used in vehicles as described above with reference to FIGURES 8 and 9 with curtains of moving fluid formed between the bottom surfaces of the wall and the surface over which the vehicle is operating. FIGURE 10 illustrates diagrammatically the modification of the structure as illustrated in FIGURES 2 and 3 and described above.

The wall is of trapezoidal vertical cross-section, having flexible sides **45** and **46** and a semi-rigid bottom surface **47**. The sides **45** and **46** are attached to the bottom surface of the vehicle in an air-tight manner. Air is supplied to the interior of the wall via a duct **48**. Formed in the bottom surface **47** of the wall are two supply ports **49** which communicate with the interior of the wall. Two flexible air-tight diaphragms **50** and **51** are attached to the bottom surface of the wall, one, **50**, at the inner corner **52** and the other, **51**, to the outer corner **53**. The inner diaphragm **50** is attached also to the bottom surface of the vehicle inside the wall to form an air-tight chamber **54**. The outer diaphragm **51** is attached also to a part of the outer skin of the vehicle to form an air-tight chamber **55**. The chambers **54** and **55** are interconnected in order to ensure that the pressures on each are the same, by a number of ducts **56**. Also a series of small tubes **57** or the like are positioned in the side wall to connect the chambers **54** and **55** with the space **61** beneath the bottom surface **47** of the side wall. The side wall is constrained to the required configuration when inflated by a series of cords **58** arranged at suitable intervals in planes substantially parallel to the bottom surface **47**.

In operation air is supplied via the duct **48** to the interior of the wall inflating it to the desired shape, as shown. The air issues from the supply ports **49** to form two air curtains **59**, the curtains assisting in forming and maintaining one or more cushions of pressurised air in the space **60**. A further cushion of pressurised air is also formed in the space **61** beneath the wall.

The pressure of the air at **61** will be intermediate that of the cushion pressure in space **60** and the surrounding atmosphere. For convenience the pressures in the present example are considered as being Pc in space **60** and Pc/2 at **61**. As the chambers **54** and **55** are connected to the cushion at **61** by the tubes **57**, the pressure in these chambers is also Pc/2. The pressure within the wall will depend upon the pressure of the supply via the duct **48**.

The action of the diaphragms **50** and **51**, when the wall is inflated, is to produce loads on the bottom corners **52** and **53** of the wall in the directions of the arrows A and B. The load represented by arrow A can be resolved into an upward vertical component X_1 and a horizontal component Y_1 acting inwards toward the center of the vehicle, Similarly the load represented by arrow B can be resolved into an upward vertical component X_2 and an outward horizontal component Y_2. The geometry of the diaphragms **50** and **51** is arranged such that at all times the components Y_1 and Y_2 are equal thus maintaining the bottom of the wall in its correct position horizontally, and the vertical components combined are equal to the load due to the inflation pressure of the air inside the wall times the horizontal area of the wall at the top of the wall. This results in the stresses in the sides **45** and **46**, at their points of attachment to the bottom surface of the vehicle, being reduced to zero when the wall is fully inflated, the stresses in the sides increasing from zero to a maximum at the lower corners **52** and **53**. The geometry of the diaphragms **50** and **51** can be varied, for example, to produce a combined vertical component which is less than the load due to the inflation pressure.

In operation, if the clearance between the bottom surface **47** of the wall and the surface over which the vehicle is travelling decreases, then the pressure of the cushion at **61** will increase due to the air curtains **59** becoming effectively stronger as they have a small clearance to close. This increase in cushion pressure increases the load on the bottom surface **47** and the wall progressively collapses upwards, from the top, until the pressure of the gas inside the wall multiplied by the now increased area at the top of the wall equals the increased load acting on the bottom surface **47**. As the wall collapses the clearance between the bottom surface **47** and the surface over which the vehicle is operating increases, decreasing the pressure of the cushion **61**. Thus in fact, an intermediate position is reached, where a slightly increased pressure is balanced by a slight collapse of the wall. As described above, the tapered construction gives the effect of a "rate" and this "rate" can be varied by varying the degree of taper of the side-wall. The reduction in clearance between the bottom surface **47** and the surface over which the vehicle is operating may arise in various ways such as by the vehicle taking up a different attitude, or by the vehicle traversing obstacles such as waves. The pressure in the chambers **54** and **55** varies with variation of the pressure of the cushion at **61**, and the diaphragms insure vertical collapse. However, the diaphragms will allow the wall to deflect sideways if contact with an obstacle should occur.

Thus, as illustrated in FIGURE 9, if the vehicle is operating over waves, the side-wall may be deformed in several places, and the positions of deformation will travel along the side-walls as the vehicle passes over the waves. As the clearance beneath the bottom surface **47** increases again, so the side-walls will return to their normal configuration.

The cushion space **60** can be subdivided to improve the stability of the vehicle by various means. The space may be subdivided, for example, by curtains of moving air issuing from the bottom of the vehicle or by flexible or part flexible keels. Alternatively, structures according to the invention may be used, as illustrated in FIGURE 9, with or without the provision of means for forming air curtains beneath their bottom surfaces.

A structure such as is described above will also deflect side-ways if a load is applied in a sideways manner. The deflection will be similar in nature to that of the structures described in the co-pending application of Ernest Frederick Needham and Reginald Bannerman Page, Serial No. 249,081, filed January 2, 1963. As a load is applied to one side of the structure the tension in the surface forming the other side of the structure will gradually be reduced as the load increases. As soon as the tension is reduced to zero the side will collapse and the structure deflect with no substantial further increase in the load. The provision of a tie or ties as in FIGURE 3, or other pre-loading devices, will also affect the sideways deflection of the structure.

I claim:

1. An inflatable deformable structure comprising a base platform, a load bearing platform spaced from said base platform in a direction normal thereto and extending substantially parallel to said base platform, means including at least two flexible side members connecting said platforms to form an inflatable enclosure, the cross-section of said enclosure continuously varying from one platform towards the other platform, a plurality of constraining members of inextensible material connecting said side members, the lengths of said constraining members varying between a minimum and a maximum to define the variation in cross-section of the enclosure, each of said platforms being of a size and shape at least equal to the largest cross-section of the enclosure, and means for supplying inflation gas at a predetermined pressure to the interior of said enclosure and for releasing gas from the enclosure on deformation of the structure to maintain the inflation pressure in said enclosure substantially constant.

2. A structure as claimed in claim 1 in which the distance between the flexible side members varies progressively from a maximum at one of said platforms to a minimum at the other platform.

3. A structure as claimed in claim 1 wherein the flex-

ible side members are spaced apart symmetrically from an axis normal to the platforms.

4. A structure as claimed in claim 1 in which the platforms are rigid.

5. A structure as claimed in claim 2 including a rigid member attached to the platform at which the distance between the said flexible side members is a minimum, the rigid member being at least as wide as the maximum distance between the said flexible side members.

6. A structure as claimed in claim 1 including means for causing a fluid to issue from the base platform and form a curtain of moving fluid between said base platform and a subjacent surface above which the structure is positioned.

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Disclaimer

3,204,932.—*Ernest Frederick Needham*, Highcliffe, England. INFLATABLE JACK STRUCTURES. Patent dated Sept. 7, 1965. Disclaimer filed Oct. 5, 1965, by the assignee, *Hovercraft Development Limited.*

Hereby enters this disclaimer to claim 5 of said patent.

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