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Michaud et al.

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[54] **GROUND EFFECT DOLLY**

[75] Inventors: **Treffle Michaud; Lucien Hubert; Gerard Poulin,** all of Sherbrooke, Quebec, Canada

[73] Assignee: **Universite de Sherbrooke,** Sherbrooke, Quebec, Canada

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[51] **Int. Cl.** **B60v 1/00**

[58] **Field of Search** 180/116, 117, 118, 180/120, 121, 124, 125

[56] **References Cited**

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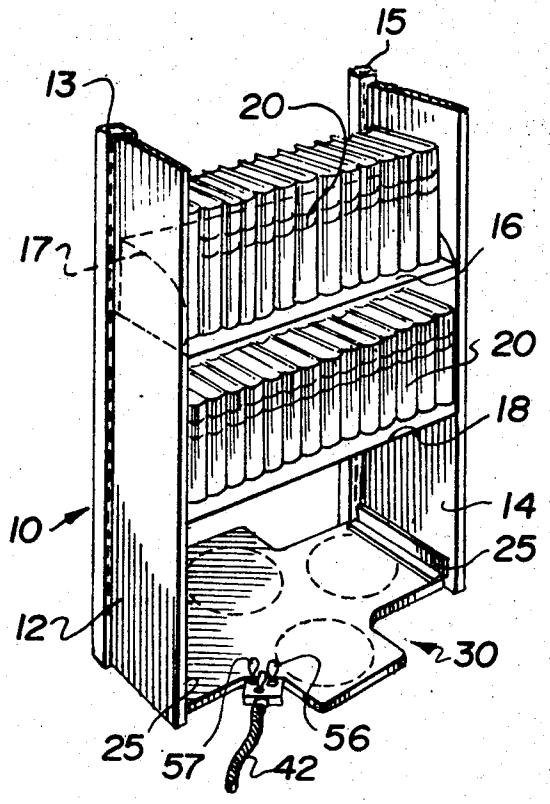
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Primary Examiner—Gerald M. Forlenza
Assistant Examiner—D. W. Keen
Attorney—Larson, Taylor and Hinds

[57] **ABSTRACT**

A ground effect dolly for moving library type bookstacks from one place on the floor to another and which can be operated by only one person if necessary. The dolly is formed of a rigid frame which is adapted to support the lower end portions of the vertical posts of a bookstack, and two sets of gas inflatable pads or cushions mounted to the undersurface of the platform. One set of pads serves to bear the major portion of the load, the other pads are used primarily for maintaining the load in an upright position during displacement. The pads are fed with a convenient gas such as air under pressure, and a distribution system enables control of the pressures in the auxiliary pads relative to the load bearing ones, as well as the relative pressures in the load bearing pads.

10 Claims, 5 Drawing Figures



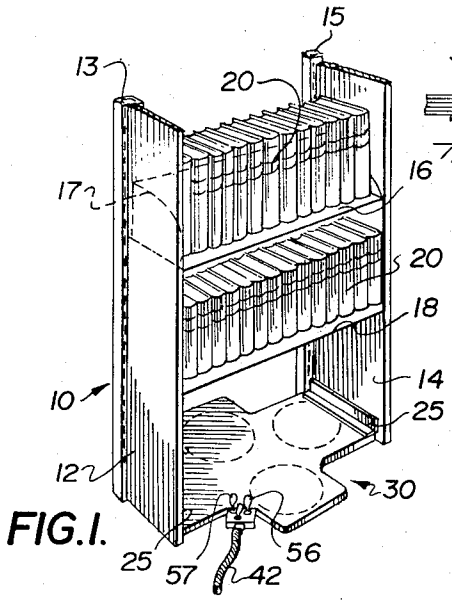


FIG. 1.

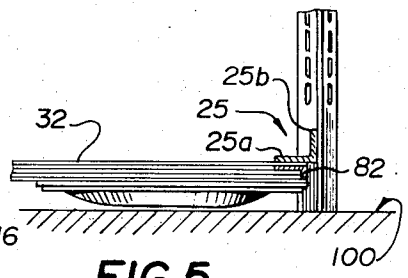


FIG. 5.

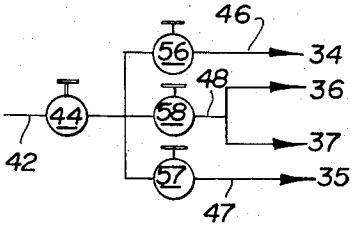


FIG. 4.

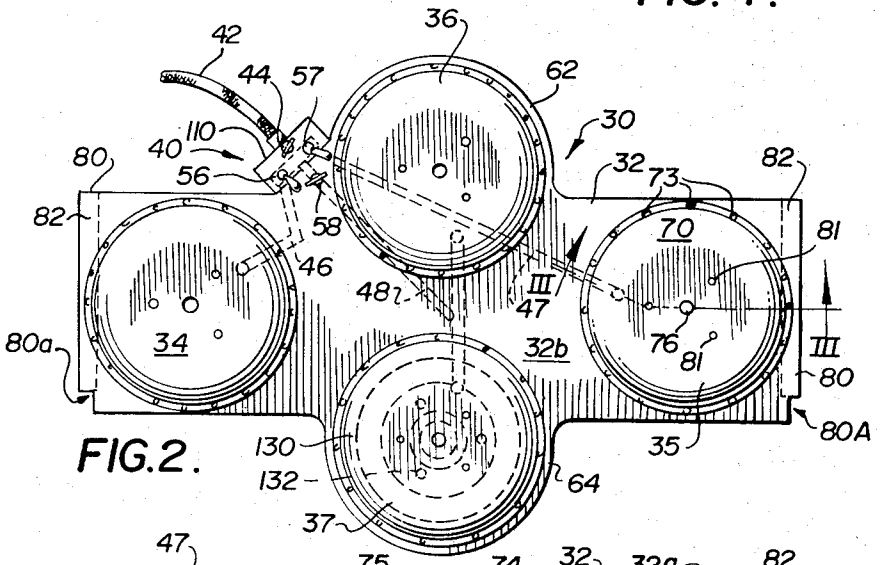


FIG. 2.

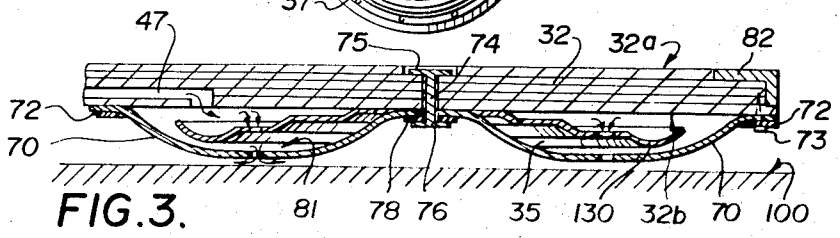


FIG. 3.

GROUND EFFECT DOLLY

This invention relates to dollies which rely on a plurality of gas inflatable cushions or pads for providing a lift force sufficient to overcome the weight of a load. In particular, this invention is concerned with a lift means which enables displacement of tipsy loads such as filled bookstacks along smooth surfaces.

The ground effect dolly which is hereinafter described in detail is designed for handling bookstacks. However, it should be understood that this invention may find other applications when it is desired to lift and move over a smooth surface a fairly heavy load whose base is relatively narrow as compared to the height of the load's center of gravity.

For various reasons bookstacks may be required to be changed location on the floor of a library, be it for relocating a particular sector of references, renovation of the library room, etc. Since most libraries use series of interconnected bookstack units which are constructed strictly for holding books in a static condition, unloading of every individual bookstack must be done before transportation. This function which requires care to preserve the sequential arrangement of the books is normally carried out by hand and therefore constitutes a long tedious task; a normal bookstack can hold as many as 125 books.

On the other hand, because of frequent additions to certain collections of books it is the common practice to leave considerable free space on numerous shelves because of the sequential book numbering system and this is done, of course, in an effort to reduce the number of times any large series of books has to be moved any number of bookstacks down. The result is a considerable loss of valuable space. Still, there comes the time when more room is required for new books, which means that all the books preceeding or following the crowded sector have to be shifted to an adjacent bookstack; this again must be done by hand. In the case of fast growing libraries the cost involved in inserting new books can become very high indeed, especially if the floor space is limited.

The object of the invention, therefore, is to justify the use of independent bookstacks and provide a dolly which can be used to move such independent bookstacks either in a loaded or unloaded condition from one place on a library floor to another location.

The prior art comprises a variety of dollies; some of them utilizing rollers or casters and others gas cushions. Examples of gas cushion or ground effect dollies are described in prior patents, in particular: U.S. Pat. Nos. 3,493,071, dated 2/3/70, granted to A.N. Street et al; 3,247,921, dated 4/26/66, granted to C.H. Latimer-Needham et al; 3,276,530, dated 10/4/66, granted to H.J. Borneman; 3,282,360, dated 11/1/66, granted to C.A. Amann et al; 3,432,645, dated 12/9/69, granted to J.H. Bertin et al; and 3,392,800, dated 7/16/68, granted to V.K. Swamy. Such prior ground effect dollies have one or a plurality of gas cushions fed with a pressurized gas at the same flow rate.

However, a major problem encountered when attempts are made at moving a filled independent bookstack is the high degree of instability of such a load. The base of a bookstack is long enough for side-to-side forces to cancel out; the width being a mere 10 inches or so and the center of gravity being at a height of some 3 feet from the base, a very slight displacement of the

latter in the fore-aft direction will immediately upset the bookstack's precarious state of equilibrium. This is somewhat enhanced by the fact that conventional library bookstacks being made of thin metallic components have a certain degree of resiliency when assembled as individual units. An other limiting factor of course is the lack of space within which to maneuver between adjacent rows. Hence, when attempts are made at moving a bookstack with a dolly having a plurality of gas cushions fed at the same flow rate, one or more of the cushions tend to deflate with the result that one corner of the structure remains in contact with the floor.

We have found that a compact dolly for moving loaded bookstacks can be made using a rigid platform, a first set of gas cushions for lift, a second set of gas cushions for balance and a gas supply system feeding the two sets of gas cushions at different flow rates thereby to minimize the gap between the gas cushions and the ground surface or floor, particularly at the balance gas cushions.

This invention therefore provides a ground effect dolly adapted for moving heavy tipsy loads, comprising a rigid platform, a first and a second pair of gas cushions mounted to the underside of the platform. The straight line joining the centers of pressure of the first pair of gas cushions, intersects the straight line that joins the centers of pressure of the other gas cushions. The dolly also includes supply means connectable with a source of pressurized gas, duct means adapted to feed a flow of pressurized gas to the gas cushions, and flow resistance means for reducing the mean pressure in one pair of gas cushions with respect to the mean pressure in the other pair thereof.

The invention also provides a dolly which includes flow adjusting means for adjusting the relative pressure in the gas cushions that bear the major proportion of the load thereby to correct for any side-to-side load unbalance.

In the accompanying drawings which illustrate a preferred embodiment of our invention:

FIG. 1 is a perspective view of a simplified bookstack with a ground effect dolly in position for lifting same;

FIG. 2 is a plan view of the underside of a dolly in accordance with this invention;

FIG. 3 is a cross-sectional view of a section of the dolly taken along line III—III of FIG. 2;

FIG. 4 is a circuit diagram of one form of gas supply control system for the ground effect dolly of this invention; and

FIG. 5 is a partial elevational view of one post of a bookstack and the adjacent end of a ground effect dolly showing one form of anchoring means.

With reference to FIG. 1, a bookstack (10) is shown which is resting upon two spaced apart vertical posts (12) and (14) strengthened by means of corner members (13), (15), and which has two vertically spaced apart shelves (16) and (18) receiving series of books (20), a third (lower) shelf has been omitted completely. A normal library type bookstack will have five, six or even seven spaced-apart shelves such as at 16 and 18, and the height of such bookstacks is of the order of 7 feet. For simplification purposes, however, bookstack (10) shown in FIG. 1 only has two shelves. Furthermore, details of the structure of conventional bookstacks have been omitted, but it should be understood that the usual construction consists of an assembly of

sheet metal components retained to one another such as to form a generally vertical framework onto which the individual shelves are removably attached. Certain details (17) of the upper shelf (16) are shown in dotted lines in FIG. 1. Such bookstacks are usually disposed in a back-to-back configuration and in rows such that only their front face is accessible, and normally all such bookstacks are interconnected to one another through the use of common side members (12), (14). However, to be transportable by means of a dolly as taught by this invention, the bookstacks must be independent self-supporting units.

FIG. 1 also shows a preferred embodiment of the ground effect dolly in accordance with this invention, referred to generally by reference numeral 30, in position between posts (12) and (14) of bookstack (10). Also visible in FIG. 1 is an anchoring angle iron (25) secured to posts (12) and (14) and adapted to transmit the lifting force created by dolly (30) to the posts (12), (14) of bookstack (10), as will be described hereinafter in detail. Only one angle iron (25) is clearly visible in FIG. 1 although it should be understood that another one is secured to the hidden side of post (12). As will be described hereinafter, inflation of dolly (30) can lift bookstack (10), with the books (20) in place, sufficiently for the posts (12) and (14) to raise a fraction of an inch off the floor. There being nothing except a film of gas (normally air) between the floor and the dolly, the friction is practically nil, and it becomes relatively easy for one person to move the dolly-bookstack assembly along a smooth floor without inducing oscillations as could upset the weak state of upright equilibrium of the assembly. Once at destination, the gas supply to the dolly is cut off and the bookstack gently lowers till the posts (12) and (14) regain contact with the floor. The dolly can then be retrieved.

Referring now to FIGS. 2 and 3 of the drawings, a preferred dolly construction in accordance with this invention is shown. FIG. 2 shows the underside of dolly (30) whereas FIG. 3 is a cross-sectional view taken along line III—III of FIG. 2, of the right hand side portion of dolly (30). Dolly (30) comprises a rigid, cross-shaped platform (32), a first pair of spaced apart gas cushions (34) and (35) mounted to the underside of platform (32) and projecting below surface (32*b*), a second pair of gas cushions (36) and (37) also mounted to platform (32) and likewise projecting below surface (32*b*), and a pressurized gas supply system (40) adapted to feed a pressurized gas, normally compressed air, to cushions (34) to (37). Supply system (40) comprises a supply line (42) connectable with a suitable source of compressed air (not shown), a main valve (44) for controlling the gas flow through the gas cushion assembly, a pair of individual ducts (46) and (47) leading to spaced apart cushions (34) and (35) respectively, a common auxiliary duct (48) leading to cushions (36) and (37) in parallel, and control valves (56), (57) and (58) for controlling the gas flow through ducts (46), (47) and (48) respectively.

Platform (32) is essentially an elongated planar structure which has sufficient rigidity to maintain all four gas cushions (34) to (37) in a substantially planar relationship. FIG. 2 shows the underside of platform (32), a portion of which can be seen in cross-section in FIG. 3 with gas cushion (35) also in cross-section. The cruciform platform (32) essentially comprises an elongated rectangular area at the opposite ends of which gas cushions (34) and (35) are located, and two opposed coplanar, symmetrical wing portions (62) and (64) at equal distances from end portions (80), which provide suitable extensions for receiving gas cushions (36) and (37). It has been found that a two-inch-thick platform (32) made of plywood can provide adequate strength and rigidity. However, care must be taken to locate cushions (34) and (35) as close as possible to edges (80) of platform (32), which edges will in operation support the total weight of the bookstack being moved. Such a disposition of cushions (34) and (35) also enhances the side-to-side stability of dolly (30). Moreover, end portions (80) should conform to the inside faces of posts (12), (14), and therefore in the case of posts using corner members (13), (15) (see FIG. 1), a check or indentation (80a) may be made to allow platform (32) to be properly positioned in the fore-and-aft direction.

With particular reference to FIG. 3, the upper surface of platform (32) is shown at reference numeral (32*a*) and its undersurface (32*b*). The structure of a gas cushion of the type used in this preferred embodiment consists essentially of a flexible membrane (70) held peripherally to the underside (32*b*) of platform (32) by means of a circular ring member (72) suitably secured to platform (32) such as by bolts, screws, rivets, (73) etc., a few of which can be seen in FIG. 2. Ring (72) should be sufficiently rigid to provide a gas-tight fit between membrane (70) and the undersurface (32*b*) of platform (32). In practice, the diameter of ring (72) should correspond generally to the width of the rectangular portion of platform (32) and to the length of wing portions (62), (64). The central portion of membrane (70), which coincides with the center of pressure of the cushion is retained to the lower surface (32*b*) by means of a pin (74) having enlarged head portions (75) and (76) and a lower retaining washer (78). Membrane (70) has three equally spaced apart orifices (81) which are disposed in a circle around the center of membrane (70). Duct (47) opens into the gas cushion which is formed between undersurface (32*b*) of platform (32) and the inside surface of membrane (70). Hence, compressed air within membrane (70) can only escape through orifices (81) and flow outwardly therefrom. The gas cushions also incorporate a dish-shaped element (130) made of rigid material such as steel and also provided with three orifices (132) but disposed between orifices (81) of membrane (70). Disc (130) which is secured to platform (32), serves two purposes. It provides a more uniform distribution of air in the space between it and membrane (70), and also it works as an abutment which limits the possible vertical play of platform (32) thereby reducing the amplitude of any oscillation of the bookstack being carried. In operation, a pressurized gas such as compressed air is fed into cushion (35) by means of duct (47). The air proceeds through orifices (132) to the space between disc (130) and membrane (70), hence causing the membrane (70) to inflate as shown in FIG. 3. The pressure within cushion (35) gradually builds up until, at equilibrium, the flow of air through orifices (81) equals the flow of incoming air. In this condition, the air leaving orifices (81) forms a very thin film of air that completely separates the membrane (70) from ground surface (100).

Referring now to FIG. 5, an inverted angle member (82) is mounted to each edge portion (80) of platform

(32), and is adapted to come into contact with the inwardly projecting flange (25*a*) of angle iron (25), angle members (32) serve to strengthen and protect the ends (80) of the platform (32). Angle iron (25) is secured to post (14) of bookstack (10) by means of its vertical flange (25*b*) which can either project upwardly or downwardly from horizontal flange (25*a*).

It should be apparent that the center of gravity of a bookstack having six or seven loaded shelves, will be located within the base of the bookstack but from 3 to 4 feet above the surface of the ground. Since the base of a normal bookstack is an essentially narrow rectangular area (the opposite edges of which are defined by the posts of the bookstack, and roughly 10 inches by 3 feet), there will be substantial stability in the side-to-side direction. However, very little displacement of the center of gravity in the fore-and-aft direction will suffice to upset the static equilibrium of the assembly. Therefore the gas cushion dolly in accordance with this invention includes two widely spaced apart load bearing gas cushions (34) and (35) which are intended to support the bulk of the load, and two auxiliary gas cushions (36) and (37) which are designed to provide better stability in the fore-and-aft direction. The auxiliary cushions therefore are located such that imaginary straight line joining their centers of pressure will intersect the corresponding line of the load bearing gas cushions (34) and (35). Preferably, these lines bisect one another at right angle and the gas cushions of each pair should be as large as possible and of identical construction. In the illustrated embodiment, all four gas cushions are identical circular structures so that the width of the rectangular area of platform (32) is about equal to the length of wing portions (62), (64).

We have determined that for a ground effect dolly to be usable for transporting tall heavy tipsy loads such as loaded bookstacks, the gap between the gas cushions and the supporting surface, particularly at the auxiliary cushions, should be kept as small as possible, in practice being a few thousandths of an inch, for otherwise there will be a tendency for one of the auxiliary gas cushions to become overloaded, then deflate, thus keeping a corner of platform (32) or portions of posts (12), (14) in contact with the ground. It has also been found that instability develops if the auxiliary gas cushions which are used to balance the load in the fore-and-aft direction, operate at too high a pressure. In fact, for easy operation, the thickness of the air film at the balance gas cushions may be as small as 0.010 of an inch, and the gap at posts (12), (14) should be of the order of 1/8 of an inch. Hence, the lifting force for raising the load off the ground should be created primarily by load bearing cushions (34) and (35). A small contribution on the part of auxiliary cushions (36) and (37) is inevitable as such is necessary for equilibrium purposes. Control valve (58) which is in circuit with auxiliary duct (48) is therefore a flow resistance means which in certain applications will be permanently adjusted for a given set of conditions or type of cushions. The correct pressure ratio of main cushions (34), (35) over auxiliary cushions (36), (37) will depend upon the load, the rigidity of the platform and other characteristics of the dolly, but in general should be of the order of two to one.

It has also been found that maneuvering of a bookstack can be greatly facilitated if means is provided for adjusting the relative pressure in load bearing cushions (34) and (35). In fact the load is not normally equally distributed between posts (12) and (14). Accordingly in a preferred embodiment, control valves (56) and (57) are disposed in circuit with ducts (46) and (47) respectively which enable control of the relative pressures in cushions (34) and (35) therefore enabling adjustment of the difference between the lifting forces created by load bearing cushions (34) and (35). Theoretically, one of the control valves (56) and (57) could be replaced by a fixed pressure reducing device of intermediate value such that only one control valve would be required for varying the relative pressures in ducts (46) and (47) either positively or negatively; but a set of two hand operated valves such as indicated at (56) and (57) have proved to be relatively easy to maneuver.

FIG. 4 illustrates schematically the compressed gas supply system shown in FIG. 2, using the same reference numerals. The source of compressed air is connected to ground effect dolly (30) by means of a main line (42) controlled by means of main valve (44). A suitable fitting can then be connected to the output side of main valve (44) leading to pressure reducing devices (56), (57) and (58) in parallel, which in turn are connected with ducts (46), (47) and (48) respectively. As noted above, auxiliary duct (48) feeds both auxiliary gas cushions (36) and (37) at about the same flow rate. Ducts (46), (47) and (48) can be simple compressed gas lines or as seen in FIG. 3 built-in channels.

The shape of platform (32) is of some importance. As noted above, the two pairs of gas cushions, (34), (35) and (36), (37), must be held in a given fixed configuration, and the shape that best approximates the preferred right angle configuration is that of a cross. Moreover, a cruciform platform (32) leaves more room for the operator to place his feet while moving a bookstack. This is particularly important since the least hesitation on the part of the operator may suffice to cause the assembly to tip over. It is for this reason that the edges of wing portions (62), (64) follow the contour of cushions (36), (37).

For better stability, auxiliary gas cushions (36), (37) should be as far apart from one another as is conveniently possible. Still, surprisingly good results have been obtained with a cruciform platform (32) whose length to width ratio is of the order of three to two. Stability is also enhanced by the use of large gas cushions which have the effect of better distributing the lifting force over the ground surface. However, other platform shapes are conceivable such as diamond-shaped, oblong, etc. provided the opposite edges are sufficiently wide to correspond to the length of anchoring angle irons (25) or of the width of the bookstack posts (12) and (14), and are parallel and spaced apart from one another the desired distance.

Referring again to FIG. 5, the opposite edges of platform (32) are adapted to fit underneath the inwardly projecting flange (25*a*) of angle iron (25) such that upon inflation of the gas cushions (34) to (37) the edges of dolly (30) will contact flange (25*a*) and then as the pressure increases within the gas cushions the lifting force created by the film of air emanating from orifices (81) overcomes the weight of the bookstack and posts (12) and (14) begin to raise a short distance above the supporting surface (100). Vertical flange (25*b*) must be solidly secured to post (14) such as by welding, bolts, rivets, etc. The height of angle iron (25)

will of course depend upon the thickness of dolly (30); in practice once lifted, the posts (12), (14) should stabilize at about 1/8 of an inch above the floor (100). The length of iron angle (25) and of angle member (32) should be about equal to the width of the bookstack once in mounted position on dolly (30). Other types of anchoring means might be considered although the above described angle iron arrangement has been found both simple and efficient and it facilitates location of platform (32) in the forward backward direction along vertical flange (25a).

The operation of the dolly thus far described is substantially as follows: with dolly (30) located between posts (12) and (14) about centrally of the width of the bookstack, shut-off valve (44) is turned to the "open" position whereupon cushions (34) to (37) begin to inflate. The relative pressure in load bearing pads (34), (35) is then adjusted manually by means of control valves (56) and (57) until both load bearing cushions (34), (35) raise off the ground surface (100); the gap at main cushions (34), (35) should then be adjusted to a few thousandths of an inch by means of a valve (44). If the auxiliary cushions (36), (37) tend to raise more than the main ones, their mean pressure should be reduced by means of valve (58). Normally, the dolly will rest upon its nose or back because of a slight unbalance in the fore-and-aft direction. This should be easily counteracted by the operator, gently pulling or pushing one of the upper shelves; such a slight deviation from perfect balancing in this direction can help to control the displacement of the dolly (30) and the bookstack (10) carried thereby. Of course, if the bias is too pronounced, the dolly should be deflated using shut-off valve (44), and the platform moved in or out slightly until the biasing force reduces to a manageable value.

In practice, a cruciform dolly was built according to FIGS. 2 and 3 using four identical circular cushions of a diameter of 10 inches each with three orifices of 3/16 of an inch, 1 ¾ inches from the center of the membrane, and incorporating a rigid dish-shaped element within the membrane. The cushions were mounted to a 1 ½ inch thick plywood platform (32) measuring 35 ¾ inches by 26 inches, the width of the four arms being 11 inches. The gas supply, compressed air at 80 psi, provided a flow rate of 4 to 6 cubic feet per minute; the flow rate should be as stable as possible. This system was found quite adequate for handling bookstacks of the order of 1,500 pounds and measuring 7 ½ feet high on a base of 3 feet by 10 inches.

It was found that certain bookstack constructions assembled as independent units could be adapted for the described gas cushion dolly with the simple addition of angle irons (25) welded to the posts (12), (14) about 2 inches from the ground. However, other constructions required more elaborate modifications, for example, opening of the space between the lowest shelf and the ground for insertion of the dolly, welding of certain structural reinforcements, etc. Such modifications should preferably be made at the point of manufacture.

The control valves (44), (56), (57), (58) which control the flow of air through ducts (46), (47), (48) can be mounted on a control box (110) as shown in FIG. 2. This arrangement requires bending over on the part of the operator for adjustment of valves (56) and (57) once shutoff valve (44) has been switched open. To alleviate this, control box (110) could be installed on an upstanding support (not shown) fixed to platform (32) at a suitable location, and from which would depend extensions of ducts (46), (47) and (48).

Hence, this invention provides a ground effect dolly (30) that comprises a rigid platform (32) whose opposite end portions (30) are adapted to fit between the posts (12), (14) of a bookstack or other similar tall heavy tipsy load, the end portions (80) being connectable with the posts (12), (14) by means of a suitable anchoring means such as angle irons (25). Dolly (30) also includes load bearing cushions (34), (35) at each end portion (80), and a pair of auxiliary gas cushions (36), (37), all being mounted to the underside (32*b*) of platform (32) but projecting slightly therebelow at least when inflated. The lines joining the centers of pressure of one pair of gas cushions intersect that of the other pair preferably at right angle and at their respective mid-points. Dolly (30) further includes supply means (42) connectable to a source of pressurized gas, duct means (46), (47), (48) leading to the gas cushions, valve means (44) for controlling the gas flow through the dolly, and flow resistance means (58) for restricting the flow of gas to the auxiliary cushions or pads (36), (37) relative to main cushions (34), (35). The illustrated dolly (30) also includes flow adjusting means (56) and/or (57) for adjusting the relative pressures in main cushions (34), (35), in order to enable balancing of the load (10) in the side-to-side direction.

Such ground effect dollies (30) have been found to perform best on a smooth horizontal floor surface, but in practice, slight irregularities of the order of 1/8 of an inch or very slight gradual elevations could still be managed although with due care.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A ground effect dolly adapted for moving, along a generally smooth planar and horizontal supporting surface, a tall heavy load whose base portion is relatively narrow, comprising an elongated rigid platform adapted to be disposed under said load in a horizontal position, first and second pairs of gas cushion means mounted to the underside of said platform with the straight line joining the centers of pressure of gas cushion means of said first pair intersecting the straight line joining the centers of pressure of gas cushion means of said second pair; the first pair located one at each end of the platform and adapted to produce a significantly greater lifting force than the cushions of the second pair, and the second pair located adjacent the long sides of the platform and adapted to balance the load in a direction transverse to the direction of elongation, supply means connectable with a source of pressurized gas; duct means adapted to feed a flow of pressurized gas to said gas cushion means; and pressure differential flow resistance means operable while the load is being supported by the cushions for controllably reducing the flow of pressurized gas to said second pair of gas cushion means relative to the flow to said first pair of gas cushion means until each gas cushion means of said first pair when inflated of said gas produces a significantly greater lifting force than the mean lifting force of gas cushion means of said second pair thereof and the cushions of the second pair provide stability in a direction transverse to the direction of elongation.

2. A ground effect dolly adapted for moving along a generally horizontal, smooth, planar surface a tall and heavy load supported in its static upright position by

means of two spaced apart posts defining the small sides of a narrow rectangular base area on said surface, comprising: an elongated rigid platform having two opposite end portions, said platform being adapted to fit between said posts with said end portions connectable therewith for lifting said load; a pair of load bearing gas cushions mounted to said platform for primarily supporting the weight of the load, each one being located adjacent a different one of said end portions, and projecting below the bottom surface of said platform at least when gas inflated; a pair of auxiliary gas cushions mounted to said platform, one on either side of the straight line joining the centers of pressure of said load bearing gas cushions, and projecting below said bottom surface at least when gas inflated for stabilizing the load in a direction transverse to the said direction of elongation; supply means connectable with a source of pressurized gas; duct means leading from said supply means to said gas cushions; valve means for controlling the gas flow through said ground effect dolly; and differential pressure flow control means operable while the load is being supported by the cushion for controllably reducing the lifting force created by said auxiliary gas cushions relative to that created by said load bearing gas cushions until the load is primarily supported by the load bearing cushions and the pressure of the auxiliary cushions is at a level to produce stability in a direction transverse to the said direction of elongation.

3. A ground effect dolly adapted for moving library type bookstacks along an essentially planar, horizontal, smooth surface, comprising an elongated rigid platform having two opposite end portions, adapted to closely fit between the posts of a bookstack and connectable with said posts for lifting said bookstack; a load bearing gas cushion at each one of said opposite end portions, mounted to said platform and projecting slightly therebelow at least when gas inflated for primarily supporting the weight of the load; a pair of auxiliary gas cushions mounted to said platform and projecting slightly therebelow at least when gas inflated for stabilizing the load in a direction transverse to the said direction of elongation, said auxiliary gas cushions being disposed on either sides of the straight line joining the centers of pressure of said load bearing gas cushions; supply means connectable with a source of pressurized gas; duct means leading from said supply means to said gas cushions; valve means in circuit with said duct means for controlling the gas circuit with said duct means and for controlling the gas flow through said ground effect dolly; differential pressure flow control means in circuit with at least part of said duct means and operable while the load is being supported by the cushions for controllably restricting the flow of gas to said auxiliary gas cushions to reduce the lifting force created by said auxiliary gas cushions relative to that of said load bearing gas cushions until the load is primarily supported by the load bearing cushions and the pressure of the auxiliary cushions is at a level to provide stability in a direction transverse to the said direction of elongation; and lift adjusting means in circuit with at least part of said duct means for adjusting the difference in pressure in said load bearing gas cushions, to compensate for load imbalance in the direction of elongation of the load.

4. A ground effect dolly as defined in claim 3, wherein said duct means comprises first and second ducts leading from said supply means to said load bearing cushions respectively, and a third duct leading from said supply means to both said auxiliary gas cushions in parallel, said differential flow control means comprising a valve in circuit with said third duct.

5. A ground effect dolly as defined in claim 4, wherein said lift adjusting means comprises a pressure control valve in each said first and second ducts whereby to enable manual control of the difference in pressures in said load bearing gas cushions.

6. A ground effect dolly as defined in claim 4, wherein said straight line joining the centers of pressure of said load bearing gas cushions, and the straight line joining the centers of pressure of said auxiliary gas cushions intersect one another at right angle and at their respective middle points.

7. A ground effect dolly as defined in claim 6, wherein said platform is cruciform having a wing portion on each side of and coplanar with an elongated rectangular area, said opposite end portions defining the ends of said rectangular area, said wing portions being symmetrical with respect to the longitudinal axis of said rectangular area, and centered upon the middle point thereof, each one of said auxiliary gas cushions being at least partially located in a different one of said wing portions.

8. A ground effect dolly as defined in claim 7, wherein the width of said rectangular area is equal to the length of said wing portions, and wherein all said gas cushions are of the same dimensions.

9. A ground effect dolly as defined in claim 3, wherein each gas cushion is circular and is formed by a flexible membrane secured to the underside of said platform in a gas-tight manner by means of a rigid annular ring whose outside diameter is generally equal to the width of said rectangular area, said ring being secured to said platform, said flexible membrane having a series of small orifices disposed in a circle centered on the center of said ring, a rigid dish-shaped element having a diameter slightly less than the inside diameter of said annular ring and secured to said platform within said membrane and having spaced apart orifices, and means attaching the center of said membrane to the underside of said platform.

10. A ground effect dolly adapted for moving, along a generally smooth, planar and horizontal supporting surface, a tall, heavy load the base portion of which is relatively narrow, comprising an elongated rigid platform adapted to be disposed under said load in a horizontal direction, first and second pairs of gas cushion means mounted to the underside of the platform with the straight line joining the centers of pressure of gas cushion means of said first pair intersecting the straight line joining the centers of pressure of gas cushion means of said second pair; supply means connectable with a source of pressurized gas; duct means adapted to feed a flow of pressurized gas to said cushion means; said duct means comprising first and second ducts leading from said supply means to said first cushions, respectively, and a third duct leading from said supply means to both said auxiliary gas cushions in parallel; and pressure differential flow resistance means including a valve in circuit with said third duct for reducing the flow of pressurized gas to said second pair of gas cushion means whereby each gas cushion means of said first pair when inflated of said gas produces a significantly greater lifting force than the mean lifting force of gas cushion means of said second pair thereof.

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