United States Patent

[11] 3,582,027

[72] Inventors **Herbert F. Hackbarth**
Worthington;
Arthur E. Reams, Columbus, both of, Ohio

[21] Appl. No. **805,675**
[22] Filed **Mar. 10, 1969**
[45] Patented **June 1, 1971**

[73] Assignee **Consolidated Kinetics Corporation**
Columbus, Ohio

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[54] **APPARATUS FOR ISOLATING VIBRATIONS**
10 Claims, 5 Drawing Figs.

[52] **U.S. Cl.** **248/20,** 248/350, 267/124
[51] **Int. Cl.** **F16f 15/04,** F16f 11/00
[50] **Field of Search** ..... 248/20, 188.2, 188.3, 346, 350, 358, (F.D.); 267/124, 126

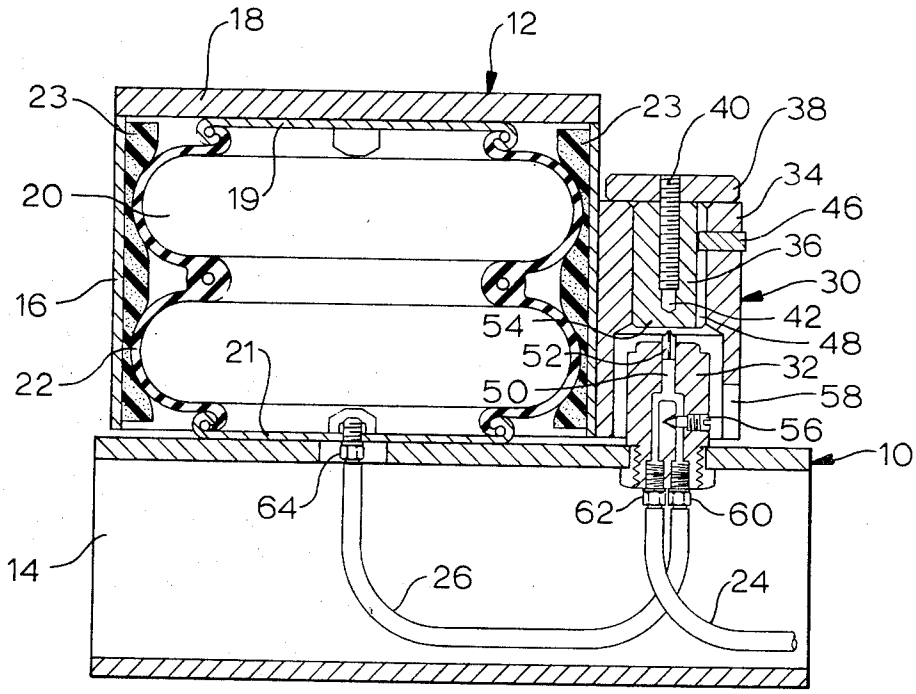
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Primary Examiner—Edward C. Allen
Assistant Examiner—William H. Schultz
Attorney—Schmieding and Fultz

ABSTRACT: A vibration isolation mount comprising a load-supporting means mounted on an inflatable air chamber and means for controlling the pressure automatically within the chamber to maintain the load-supporting means at a constant level. Limit means is provided to prevent excessive movement of the load-supporting means and consequent damage to the assembly upon deflation of the air chamber.



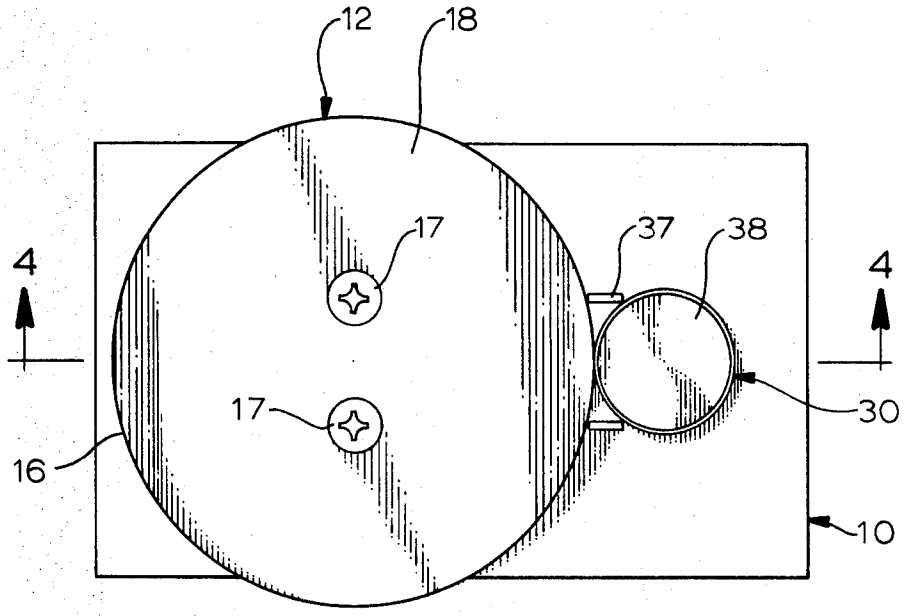


FIG. 1

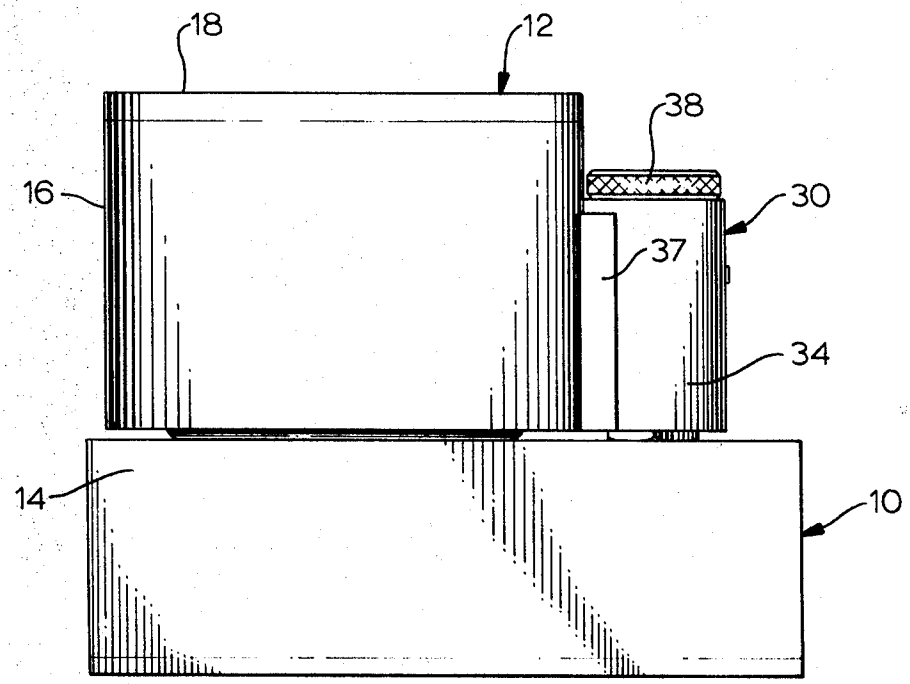


FIG. 2

INVENTOR.
HERBERT F. HACKBARTH
BY ARTHUR E. REAMS
Schmieding & Jultz
ATTORNEYS

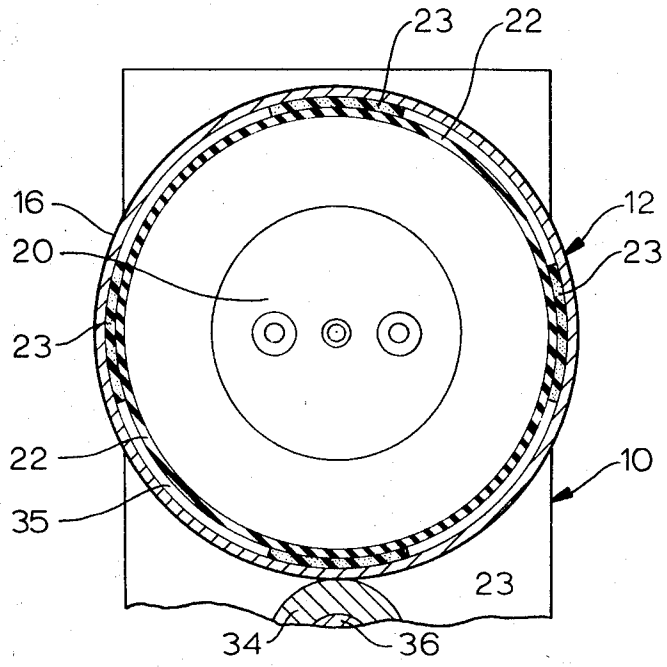


FIG. 5

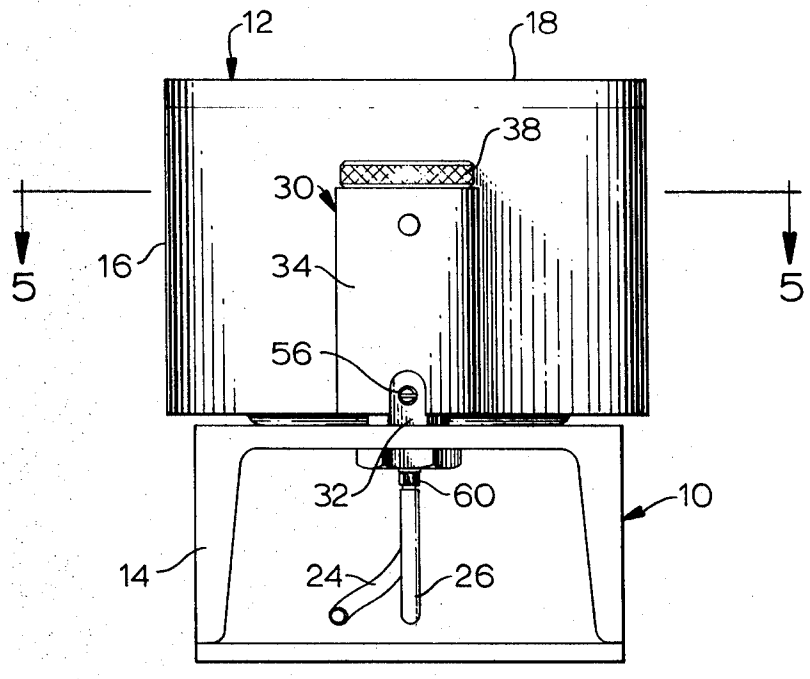


FIG. 3

INVENTOR.
HERBERT F. HACKBARTH
BY ARTHUR E. REAMS
Schmieding & Tultz
ATTORNEYS

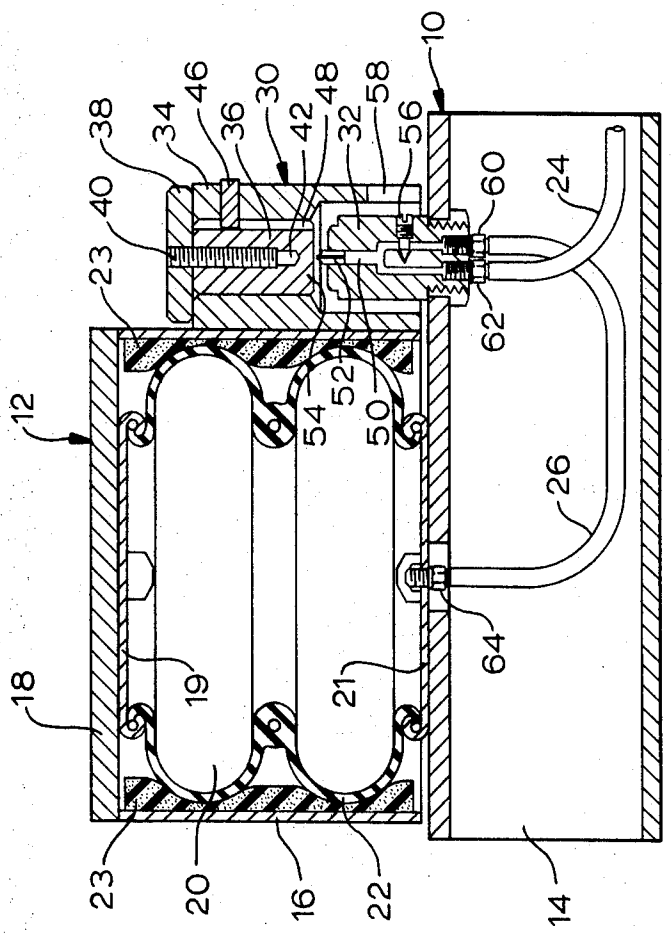


FIG. 4

INVENTOR.
HERBERT F. HACKBARTH
BY ARTHUR E. REMMS
Schmieding & Tulte
ATTORNEYS

APPARATUS FOR ISOLATING VIBRATIONS

This invention relates to vibration isolators for supporting highly sensitive equipment or vibration inducing equipment and more particularly to an improved isolator mount and system adapted for automatic level control.

In general the present invention comprises a vibration isolation mount that includes a base means and a load-supporting means isolated from one another by a resilient air chamber.

The apparatus further comprises an air control means for automatically admitting and releasing pressurized air to and from said air chamber so as to precisely maintain a constant height dimension between said base means and said load-supporting means. Hence the air control means functions to accurately maintain the level of the supported load with respect to the supporting environment.

In accordance with the present invention the isolation mount comprises a novel arrangement of the previously mentioned air chamber and load-supporting means whereby the sidewalls of the latter extend downwardly along the outer wall of the air chamber in spaced protective relationship therewith and with the load-supporting sidewalls including a lower edge normally spaced from said base means when said chamber is normally inflated, and supportedly engaged by said base means upon deflation of said air chamber. This permits the load-supporting means to safely bottom thereby preventing damage to the mount or sensitive equipment supported thereon. As another aspect of the present invention the vibration isolation mount is provided with novel damping means for controlling horizontal vibrations, said damping means being operative between the air chamber sidewall and the load-supporting sidewall. Such damping means preferably comprises vertically extending elastomeric strips disposed between said sidewalls in frictional engagement therewith.

It is another aspect of the present invention to provide an air mount of the type described that includes an air chamber and a load-supporting means provided with a sidewall surrounding said chamber such that the horizontal spring rate of the device can be controlled by controlling the space in between the resilient sidewall of the air chamber and the surrounding sidewall of the load-supporting means.

As another aspect of the present invention the vibration isolation mount is provided with an integral air control means, a first portion of which is mounted on the above-mentioned base means and a second portion of which is mounted on the above-mentioned sidewall of the load-supporting means. Hence, the sidewall of the load-supporting means provides the dual function of preventing excessive vertical compression of the air chamber in the event of loss of air therefrom and also functions as a mounting means for a portion of the air control means.

As still another aspect of the present invention, the vibration isolation mount is provided with integrally fabricated air control means that cooperates with a specifically designed base means such that the conduits for the flow of air between the control means and the air chamber are mounted within and protected by said base means.

It is therefore an object of the present invention to provide a vibration isolation mount that includes a load-supporting means provided with an exterior sidewall that functions to prevent excessive vertical displacement of supported equipment in the case of accidental loss of air.

It is another object of the present invention to provide an improved vibration isolation mount wherein the horizontal spring rate can be accurately controlled so as to provide the maximum in horizontal stability.

It is another object of the present invention to provide an improved vibration isolation mount wherein frictional damping is provided between a controlled resilient air chamber and a surrounding load-supporting means.

It is still another object of the present invention to provide a vibration isolation mount that includes a resilient air chamber and a load-supporting means that also forms an exterior cylindrical wall that functions to prevent damage to the air chamber from moving equipment, hot metal chips, acids and the like.

It is another object of the present invention to provide an improved vibration isolation mount and system that is adapted to safely bottom in the event of leakage or overload without subjecting the sensitive control portion of the apparatus to damaging stresses.

It is another object of the present invention to provide an improved vibration isolation mount and system that includes a novel housing portion that functions as a guide for movable components of the apparatus as well as a protective movable cover for the main body portion of the apparatus.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein preferred forms of embodiments of the invention are clearly shown.

IN THE DRAWINGS

FIG. 1 is a top elevational view of a vibration isolation mount constructed in accordance with the present invention;

FIG. 2 is a side elevational view of a vibration isolation mount constructed in accordance with the present invention;

FIG. 3 is an end elevational view of a vibration isolation mount constructed in accordance with the present invention;

FIG. 4 is a side sectional view of the vibration isolation mount of the present invention, with the section being taken along the line 4–4 of FIG. 1; and

FIG. 5 is a top sectional view of the vibration isolation mount of the present invention, with the section being taken along the line 5–5 of FIG. 3.

Referring in detail to the drawings, FIG. 1—5 illustrate an isolation mount constructed in accordance with the present invention that includes a base means indicated generally at **10** and a load-supporting means indicated generally at **12**, the latter including a load-supporting sidewall **16** and a load-supporting top wall **18**.

A flexible air chamber **20**, FIG. 4, resiliently movably supports load-supporting means **12** on base means **10** and includes a flexible chamber wall **22** formed of synthetic rubber, or the like, top wall **19**, and a bottom wall **21** including a threaded fitting forming a chamber port **64**.

Top wall **18** of load-supporting means **12** is secured to top wall **19** of the air chamber by a plurality of screws **17**. The bottom wall **21** of air chamber **20** is secured to the top wall of base means **10** in the same manner.

As seen in FIGS. **4** and **5**, a clearance space **35** is provided between sidewall **22** of the air chamber **20** and sidewall **16** of load-supporting means **12**. In accordance with one aspect of the present invention such clearance space **35** can be established so as to control the horizontal spring rate between the exterior load-supporting wall **16** and the chamber wall **22**, under horizontally imposed forces or vibrations.

As another aspect of the present invention, a plurality of resilient strips **3** are positioned in compressed relationship between the sidewalls **16** and **22** so as to provide frictional damping between load-supporting means **12** and air chamber **20**.

Strips **23** are preferably formed of cellular or solid elastomeric material such as neoprene or the like.

With reference to FIG. **4**, an air controller indicated generally at **30** includes a body member **32** rigidly mounted on base means **10** that includes a passage or conduit **50** provided with an air discharge port or orifice **52** for controlling the release of pressurized air from the system when load-supporting means **12** tends to depart from a predetermined level in a manner later to be described.

With continued reference to FIG. **4** passage **50** includes inlet port **60** that communicates with a source of pressurized air, not illustrated, via a line **24**, and a third port **60** that communicates with air chamber **20** via a line **26**. An adjustable flow restrictor means **56**, preferably in the form of a threaded needle valve and seat, is provided in passage **50** for controlling the flow rate in line **26** connecting air chamber **26** with air discharge orifice **52** and the above-mentioned source of pressurized fluid.

Referring again to FIG. 4, air controller 30 further includes a housing means 34 including an upper portion provided with a base forming a guide for a vertically slidable air control member 36, the latter being keyed against rotation in said bore by a key element 46 extended into a vertical slot 48.

Air control member 36 is free to move vertically upwardly and is vertically adjusted in its bore by a threaded element 40 disposed in threaded hole 42 and provided with a manual adjusting knob 38, said knob serving as an adjustable stop that limits the downward movement of said air control member.

As seen in FIG. 4, air control member 36 includes a lower surface 54 that abuts the previously mentioned air discharge port 52 in the top of body member 32 and serves to control the volumetric flow rate of air discharged from said port.

The housing means 34, FIG. 4, further includes a lower skirt portion that forms a protective cover for body member 32 and air discharge port 52, with a slot 58 being provided in said skirt portion to permit access to flow restrictor 56.

In operation of the basic mount structure the resilient wall 22 of the air chamber is used in cooperation with the rigid sidewall 16 of the load-supporting means 12 and the spacing or compressed contact between the walls 16 and 22 to control the horizontal spring rate of the isolation mount to most effectively control the horizontal stability of the system.

Also, the use of the partially compressed elastomeric strips 23 is used to provide controlled frictional damping for the isolation of vertically imposed vibrations.

Moreover, both these concepts can be used and established to most effectively provide both the above-described novel results.

In operation of the air controller, the height of the air control mount of FIGS. 1—4 is adjusted by rotating adjusting knob 38 and thereby raise or lower air control member 36 and the lower surface 54 thereof relative to the stationary body member 32. Such adjustment will in effect raise or lower the vertical position of load-supporting means 12 with respect to base means 10 since the upwardly exerted force from air chamber 20 will reach an equilibrium with the airflow bleed at air discharge port 52 thereby causing the surface 54 on air control member 36 to always ride at a threshold position in abutting relationship with air discharge port 52.

In the event that an air leak should occur in the wall of air chamber 20, and the load being supported would cause load-supporting means 12 to bottom then housing 34 of the relatively sensitive air controller can move freely downwardly and bottom without imposing any damaging stresses on the structural elements of the air controller.

We claim:

1. A vibration isolation mount comprising, in combination, a base means; an inflatable air chamber supported on said base means; load-supporting means supported by said air chamber and including a load-supporting sidewall extended downwardly in protective relation with said air chamber and an air controller including an upper member mounted on said load-supporting sidewall and a lower member mounted on said base means and provided with first and second ports, said first port being connected to a source of air pressure and said second port being connected to said air chamber, said ports communicating within said air controller; and means within said air controller responsive to the vertical position of the load-supporting means to bleed air continuously from the system to vary the admission and release of air to the air chamber to maintain a constant level of the load-supporting means with respect to the base means.

2. The apparatus defined in claim 1 wherein said load-supporting sidewall includes a lower edge normally spaced from said base means when said chamber is normally inflated and supportedly engaged by said base means upon deflation of said air chamber.

3. A vibration isolation mount comprising, in combination, a base means; an inflatable air chamber supported on said base means; load-supporting means supported by said air chamber and including a load-supporting sidewall extended downwardly in protective relation with said air chamber, said load-supporting sidewall including a lower edge normally spaced from said base means when said chamber is normally inflated and supportedly engaged by said base means upon deflation of said air chamber; an air controller including an upper member mounted on said load-supporting sidewall and a lower member mounted on said base top wall and provided with first and second ports, said first port being connected to said air chamber, said ports connecting within said air controller; and means within said air controller responsive to the vertical position of the load-supporting means to bleed air continuously from the system to vary the admission and release of air to the air chamber to maintain a constant level of the load-supporting means with respect to the base means.

4. A vibration isolation mount comprising, in combination, a base means; an inflatable air chamber supported on said base means; load-supporting means supported by said air chamber and including a load-supporting sidewall extended downwardly in protective relation with said air chamber, and an air controller including an upper member mounted on said load-supporting sidewall and a lower member mounted on said base means and provided with first and second ports, said first port being connected to said air chamber, said ports connecting within said air controller; and means within said air controller responsive to the vertical position of the load-supporting means to bleed air continuously from the system to vary the admission and release of air to the air chamber to maintain a constant level of the load-supporting means with respect to the base means and damping means operative between said chamber sidewall and said load-supporting sidewall.

5. The apparatus defined in claim 4, wherein said load-supporting sidewall includes a lower edge normally spaced from said base means when said chamber is normally inflated and supportedly engaged by said base means upon deflation of said air chamber.

6. The apparatus defined in claim 4, wherein said damping means comprises a vertically extending guide disposed between said sidewalls.

7. A vibration isolation mount comprising, in combination, a base means; an inflatable air chamber supported on said base means; load-supporting means supported by said air chamber and including a load-supporting sidewall extended downwardly in protective relation with said air chamber, said load-supporting sidewall including a lower edge normally spaced from said base means when said chamber is normally inflated and supportedly engaged by said base means upon deflation of said air chamber; an air controller including an upper member mounted on said load-supporting sidewall and a lower member mounted on said base means and provided with first and second ports, said first port being connected to a source of air pressure and said second port being connected to said air chamber, said ports communicating within said air controller and means within said air controller responsive to the vertical position of the load-supporting means to bleed air continuously from the system to vary the admission and release of air to the air chamber to maintain a constant level of the load-supporting means with respect to the base means; and damping means operative between said chamber sidewall and said load-supporting sidewall.

8. The apparatus defined in claim 7 wherein said damping means comprises a vertically extending guide disposed between said sidewalls.

9. A vibration isolation mount comprising, in combination, base means; an inflatable air chamber supported on said base means; load-supporting means supported by said air chamber and including a load-supporting sidewall extended downwardly in protective relationship with said air chamber and engageable with said base means upon deflation of said air chamber; an air controller communicating with said air chamber and mounted on one of said means and operatively associated with the other of said means; means for supplying air continuously to the air controller; and means including an

air control member within the air controller to bleed air continuously from the system at a variable rate responsive to the vertical position of the load-supporting means, said air control member being movably mounted whereby upon leakage-imposed engagement of the sidewall with said base means said air control member will move to a fail-safe position.

10. A vibration isolation mount comprising, in combination, base means; an inflatable air chamber supported on said base means; load-supporting means supported by said air chamber; an air controller communicating with said air chamber and mounted on one of said means and operatively associated with the other of said means; means for continuously supplying air to the air controller and means within said air controller to bleed air continuously from the system at a variable rate responsive to the vertical position of the load-supporting means including confronting air releasing members which are normally biased away from physical contact by the flow of air bleeding from the system.