United States Patent [19]

Dumbaugh

[11] **3,744,676**

[45] **July 10, 1973**

[54] **MEANS FOR SUSPENDING AND VIBRATION ISOLATING FLOW PROMOTING APPARATUS FROM A FLOWABLE MATERIAL CONTAINER**

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[52] **U.S. Cl.** **222/161**

[51] **Int. Cl.** **B65g 3/12**

[58] **Field of Search** 222/161, 196, 197–201; 248/5, 7, 15

[56] **References Cited**

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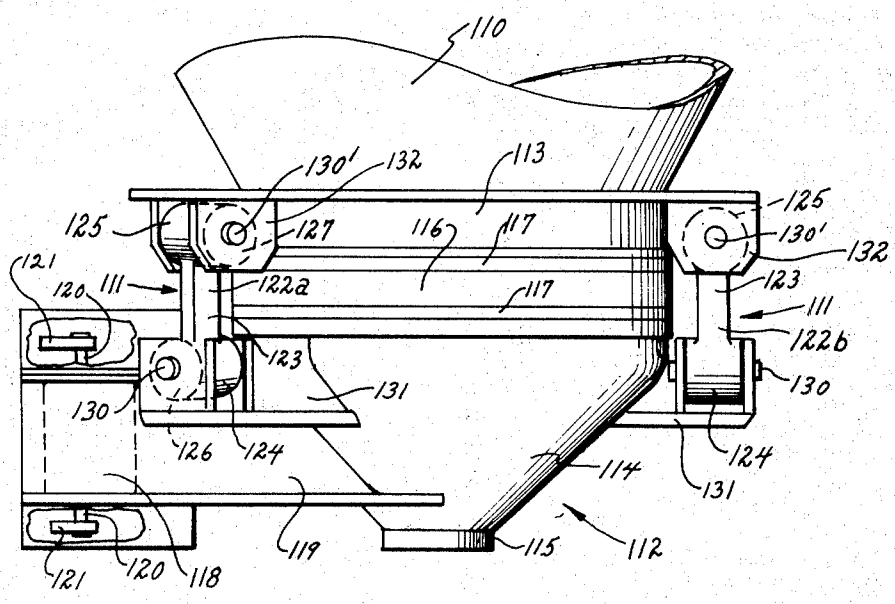
Primary Examiner—Robert B. Reeves
Assistant Examiner—Thomas E. Kocovsky
Attorney—Harry B. O'Donnell, III et al.

[57] **ABSTRACT**

This invention provides improved means for suspending and vibration isolating material flow promoting apparatus from a flowable material container. Basically, the improved means provided by the present invention comprises a member including a central portion, which can be arranged to extend generally vertically between the apparatus and the container, and first and second hollow end portions, located at the opposite ends of the central portion, which can be respectively interconnected to the apparatus and the container. Each of the hollow end portions contains a vibration isolator, and each of the isolators has a bore, which will be arranged generally horizontally when the central portion of the member is arranged generally vertically, for respectively receiving fastener means for securing the first end portion of the member to the apparatus and the second end portion of the member to the container. In particular accordance with the present invention, the isolator bores have their central axes offset from one another by an angle.

8 Claims, 12 Drawing Figures



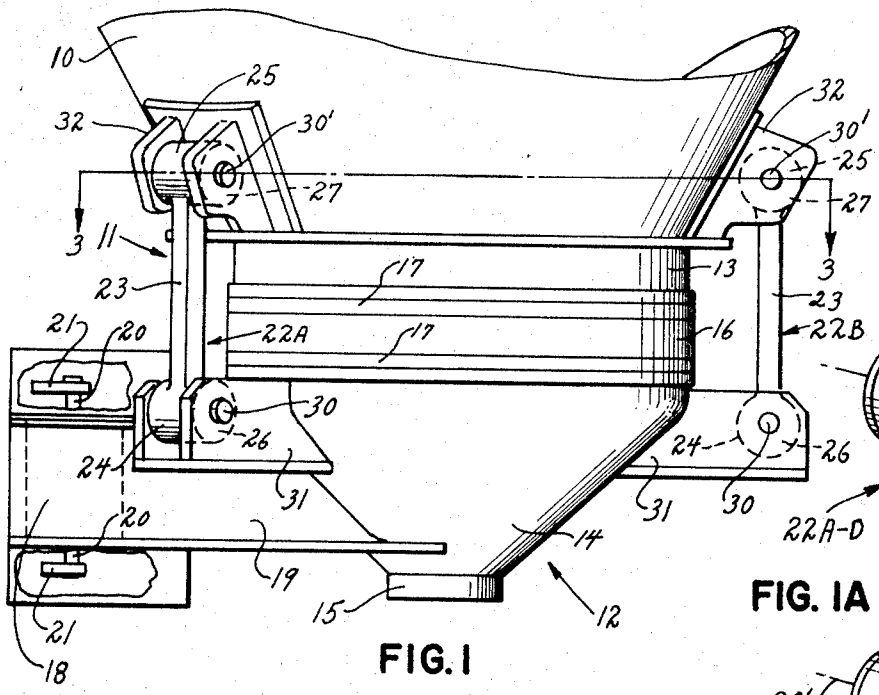


FIG. 1

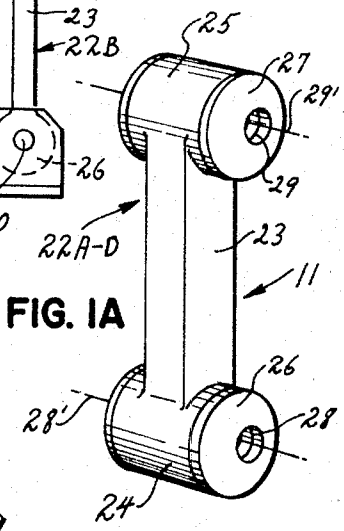


FIG. 1A

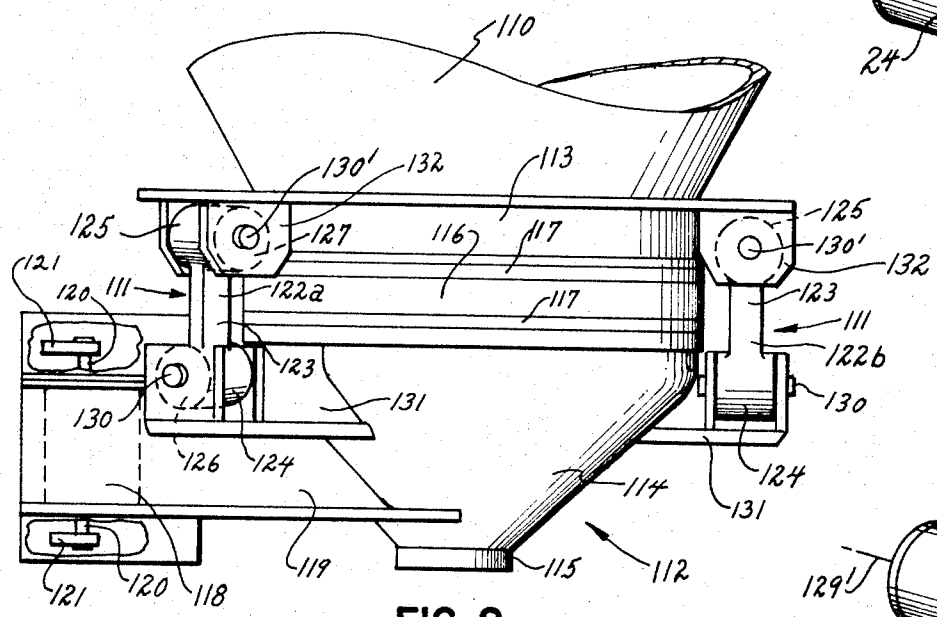


FIG. 2

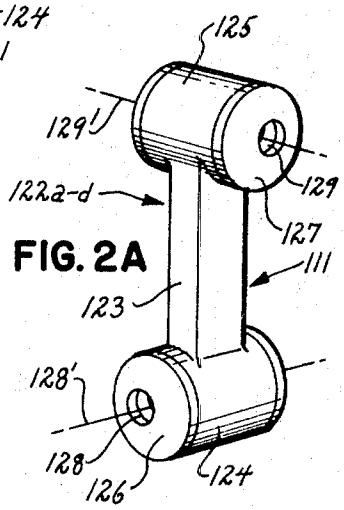


FIG. 2A

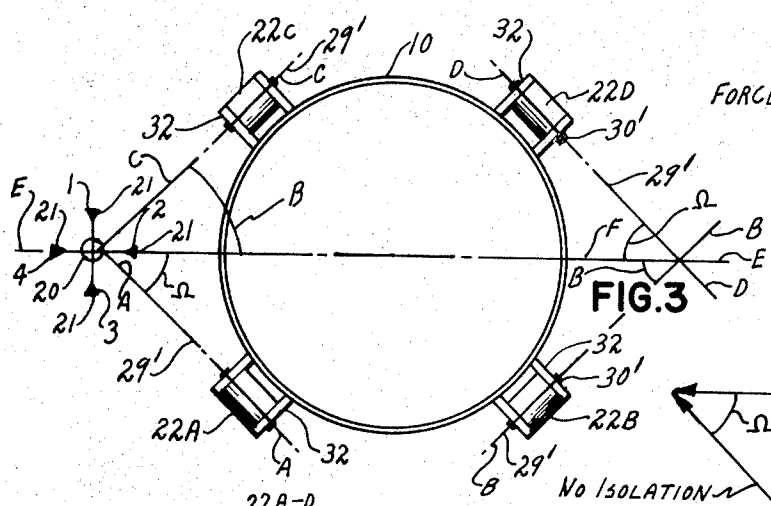


FIG. 3

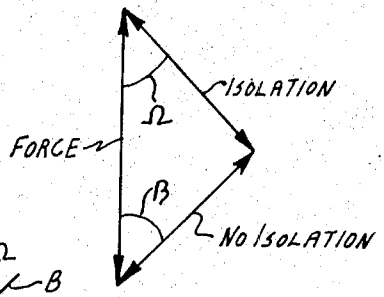


FIG. 4

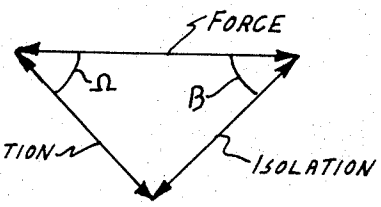


FIG. 5

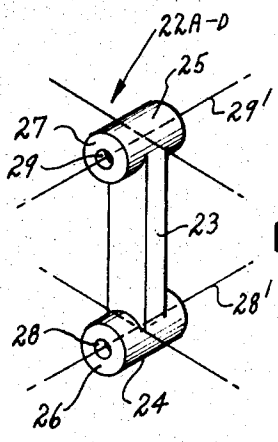


FIG. 6

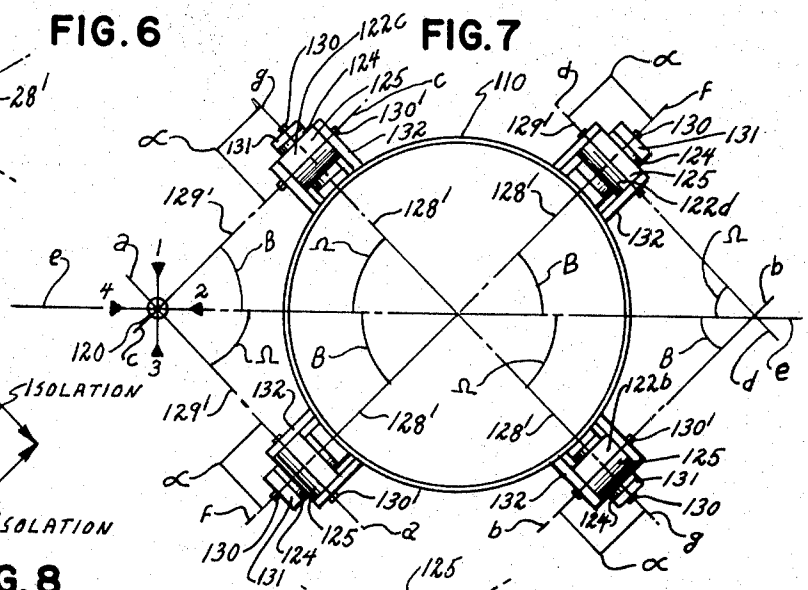


FIG. 7

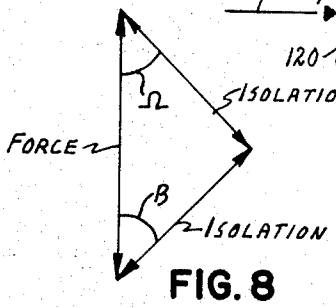


FIG. 8

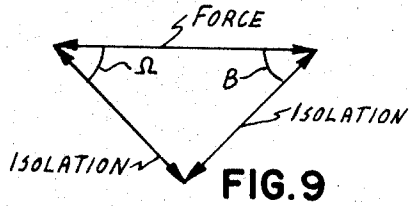


FIG. 9

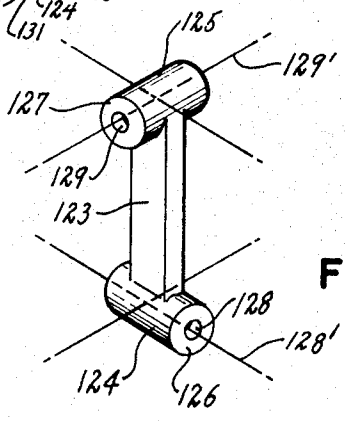


FIG. 10

MEANS FOR SUSPENDING AND VIBRATION ISOLATING FLOW PROMOTING APPARATUS FROM A FLOWABLE MATERIAL CONTAINER

BACKGROUND OF THE INVENTION

This invention relates to material storage means and, more particularly, to improved means for suspending and vibration isolating flow promoting apparatus from a generally vertically arranged flowable material container.

In the past, flowable means have been provided for promoting flow of stored f'owable materials within and from a storage container. Frequently these flow promoting means are not integrally formed with the container and, instead, comprise separately manufactured apparatus which is subsequently connected with the container. Typically, such flow promoting means are suspended from the container adjacent a discharge opening that is usually provided in the bottom of the container.

Heretofore, various means have been provided for suspending the flow promoting apparatus from the container. These old flow promoting apparatus suspension means have also incorporated means for vibration isolating the apparatus from the container. One typical form of such prior-art suspending and vibration isolating means is described in U.S. Pat. No. 3,173,583, while yet another old form is illustrated in FIGS. **1**, **1A** and **3–6** of the present drawings.

These aforenoted prior-art suspending and vibration isolating means have all left quite a bit to be desired in the degree of vibration isolation they have provided between the container and the material flow promoting apparatus.

SUMMARY OF THE INVENTION

This invention provides improved means for suspending and vibration isolating material flow promoting apparatus from a flowable material container. Basically, the improved means provided by the present invention comprises a member including a central portion, which can be arranged to extend generally vertically between the apparatus and the container, and first and second hollow end portions, located at the opposite ends of the central portion, which can be respectively interconnected to the apparatus and the container. Each of the hollow end portions contains a vibration isolator, and each of the isolators has a bore, which will be arranged generally horizontally when the central portion of the member is arranged generally vertically, for respectively receiving fastener means for securing the first end portion of the member to the apparatus and the second end portion of the member to the container. In particular accordance with the present invention, the isolator bores have their central axes offset from one another by an angle.

Preferably, this offsetting angle is substantially a right angle (a 90° angle) and the isolator bores are each lined with a sleeve and have their central axes arranged substantially at a right angle (a 90° angle) with respect to the major axis of the central portion of the member, which is rigid and integrally formed with the two hollow end portions.

The improved means of the present invention provide vastly improved connection and vibration isolation between the container and the flow promoting apparatus since the angular offsetting between the central

axes of the two isolator bores allows torsional movement of the apparatus with respect to the container in two different directions about the generally vertical axis of the member.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention is illustrated in the accompanying drawings, wherein:

FIG. **1** is a somewhat schematic partly broken elevational perspective view of a generally vertically arranged flowable material storage container utilizing one well-known prior-art form of means for suspending and vibration isolating flow promoting means from it;

FIG. **1A** is an enlarged elevational perspective view showing details of construction of the prior-art suspending and vibration isolating means shown in FIG. **1**;

FIGS. **2** and **2A** are views respectively generally simIlar to FIGS. **1** and **1A**, but instead illustrating a presently preferred form of improved suspending and vibration isolator means provided in accordance with the present invention;

FIGS. **3–6** are diagrammatic views respectively showing the operation, force vectorial relationships and constructon of the prior-art means illustrated in FIGS. **1** and **1A**, with FIG. **3** being a sectional view taken along line **3—3** of FIG. **1**, with FIG. **4** being a force vector diagram of two operational conditions while FIG. **5** illustrates the force vector relationships of two other operational conditions, and with FIG. **6** being a smaller and diagrammatic elevational view of the device shown in FIG. **1A** as seen from a different angle; and

FIGS. **7–10** are views respectively similar to FIGS. **3–6** of improved means of the present invntion shown in FIGS. **2** and **2A**.

DETAILED DESCRIPTION

Referring now to the drawings, and more particularly to FIGS. **1** and **1A** thereof, there is illustrated a generaly vertically arranged flowable material storage container **10** utilizing a well-known prior-art form of means **11** for suspending and vibration isolating flow promoting apparaus **12** from it.

The container **10** comprises a generally vertically arranged hollow frusto-conical storage hopper or bin having a bottom opening surrounded by a downwardly extending skirt **13** through which material can be discharged from the container **10.**

The flow promoting apparatus **12** is of a well-known type that is manufactured separately from the container **10** and includes another generally vertically arranged hollow frusto-conical discharge section **14** which has a bottom discharge opening that is surrounded by another skirt **15** and an open upper end that is interonnected tothe container skirt **13** by seal means, such as a flexible sleeve **16** which is tightly banded about it and the container skirt **13** by fastener means such as bands **17.** The flow promoting apparatus **12** further includes a rotar motor **18** that is connected to the apparatus discharge section **14** by a bracket **19,** with the motor **18** having its rotary output shaft **20** generally vertically arranged. The motor output shaft **20** has generally horizontally arranged weights **21** eccentrically mounted on its opposite upper and lower ends.

As further illustrated in FIGS. **1, 1A** and **3–6,** the apparatus **12** is suspended and vibration isolated from the container **10** by a well-known prior-art means **11.** As illustrated, these prior-art suspending and viration iso-

lating means **11** include four suspension and vibraton isolating members **22A-D**, each of which is of substantially identical construction, and which are arranged with their generally vertical or major axes spaced apart from one another by approximately 90° angles around the lower outer circumference of the container **10** (FIG. 3).

As shown in detail in FIGS. 1A and **6**, each of the conventional members **22A-D** includes a central portion **23**, which can be arranged to extend generally vertically between the apparatus **12** and the container **10**, and first and second hollow end portions **25** and **25** located at the opposite ends of the central portion **23** which can be respectively interconnected to the apparatus **12** and the container **10**. Each of the hollow end portions **24** and **25** respectively contains a vibration isolator **26** and **27**, and each of the isolators **26** and **27** respectively has a lined bore **28** and **29** which will be arranged generally horizontally when the central portion **23** of the member **22** is arranged generally vertically. These bores **28** and **29** respectively receive fastener means, such as lower through bolts **30**, for securing the first or lower end portion **24** of the member **23** to the apparatus **12**, as by connecting it to one of four right-angularly spaced apart brackets **31** which extend radially outwardly from the upper outer periphery of the apparatus discharge section **14** and upper through bolts **30'** for securing the second end portion **25** to the container **10**, as by connecting it to one of four other right-angularly spaced apart brackets **32** which extend radially outwardly from the lower outer periphery of the container **10**.

As shown in FIGS. **1**, 1A and **3–6**, each of these prior-art suspending and vibration isolating members **22A-D** has the central axes **28'** and **29'** of both of its isolator bores **28** and **29** arranged parallel to one another.

As best shown in FIG. **3**, two of these prior-art members **22A** and **22D** are arranged with the central axes **28'** and **29'** of both isolator bores **28** and **29** of each member respectively aligned in two generally vertical planes A—A and D—D, both of which planes A—A and D—D intersect at a first angle Ω of approximately 45° another generally vertical plane E—E which passes through the radial centers of both the container **10** and the motor output shaft **20**. And, the other two of these prior-art members **22B** and **22C** are arranged with the central axes **28'** and **29'** of both isolator bores **28** and **29** of each member respectively aligned in two other generally vertical planes B—B and C—C, both of which planes intersect at a second angle β of approximately 45° the aforenoted plane E—E which passes through the radial centers of both the container **10** and the motor output shaft **20**.

In operation of the prior-art mechanism shown in FIGS. **1–1A** and **3–6**, the motor **18** of the flow-promoting apparatus **12** is energized to cause rotation of its output shaft **20** and the weights **21** eccentrically mounted thereon (in a clockwise direction as viewed in FIG. **3**). This, in turn, causes generally horizontal movement of the apparatus **12** with respect to the container **10**. As best shown in FIG. **3**, the weights **21** are rotated through four major points of the compass, which are respectively indicated as points **1,2,3** and **4**, and each of which is disposed at a 45°angle with respect to both of the bore central axes **28'** and **29'** of all four of the old prior-art type suspending and vibration isolating members **22A-D**.

When the motor shaft-carried eccentric weights **21** are rotated into either positions **1** or **3** (FIG. **3**), the force vectors will be as shown in FIG. **4** and vibration isolation will be provided between the apparatus **12** and the container **10** only in a generally horizontal direction that is disposed generally parallel to the planes A—A and D—D, while substantially no such isolation will be provided in the direction parallel to the planes B—B and C—C, whereas, when the weights **21** are in either positions **2** or **4** (FIG. **3**), the force vectors will be as shown in FIG. **5** and vibration isolation will be provided between the apparatus **12** and container **10** only in a generally horizontal direction that is disposed generally parallel to the planes B—B and C—C, while substantially no such isolation will be provided in the direction parallel to the other planes A—A and D—D.

Turning now to FIGS. **2**, 2A and **7–10**, there is illustrated in detail a presently preferred form of improved means **111** provided in accordance with the present invention for suspending and vibration isolating flow-promoting apparatus **112** from generally vertically arranged flowable material storage container **110**, which provide vastly improved connection and vibration isolation between the container **110** and the flow promoting apparatus **112**.

As best shown in FIGS. **2** and 2A, the container **110** comprises a generally vertically arranged hollow frusto-conical storage hopper or bin having a bottom opening surrounded by a downwardly extending skirt **13** through which material can be discharged from the container **110**.

The flow promoting apparatus **112** is of a well-known type that is manufactured separately from the container **110** and includes another generally vertically arranged hollow fusto-conical discharge section **114** which has a bottom discharge opening that is surrounded by another skirt **115** and an open upper end that is interconnected to the container skirt **113** by seal means, such as a flexible sleeve **116** which is tightly banded about it and the container skirt **113** by fastener means such as bands **117**. The flow promoting apparatus **112** further includes a rotary motor **118** that is connected to the apparatus discharge section **114** by a bracket **119**, with the motor **118** having its rotary output shaft **120** generally vertically arranged. The motor output shaft **120** has generally horizontally arranged weights **121** eccentrically mounted on its opposite upper and lower ends.

However, as further illustrated in FIGS. **2**, 2A and **7–10**, the apparatus **112** is suspended and vibration isolated from the container **110** by the improved means **111** of the present invention. As ilustrated, these improved suspending and vibration isolation means **111** include four suspension and vibration isolation members **122*a–d***, each of which is of substantially identical construction, and which are arranged with their major axes generally vertical and spaced apart from one another by approximately 90° angles around the lower outer circumference of the container **110** (FIG. **7**).

As shown in detail in FIGS. 2A and **10**, each of the improved members **122*a–d*** provided in accordance with the present invention includes a central portion **123** which can be arranged to extend generally vertically between the apparatus **112** and the container **110**, and first and second hollow end portions **124** and **125**

located at the opposite ends of the central portion **123** which can be respectively interconnected to the apparatus **112** and the container **110.** Each of the hollow end portions **124** and **125** respectively contains a vibration isolator **126** and **127,** typically formed of an elastomeric compound, and each of the isolators **126** and **127** respectively has a metallic sleeve-lined bore **128** and **129** which will be arranged generally horizontally when the central portion **123** of the member **122** is arranged generally vertically. These bores **128** and **129** respectively receive fastener means, such as lower through bolts **130,** for securing the first or lower end portion **124** of the member **123** to the apparatus **112,** as by connecting it to one of four right-angularly spaced apart brackets **131** whIch extend radially outwardly rrom the upper outer periphery of the apparatus discharge section **114** and upper through bolts **130'** for securing the second end portion **125** to the container **110,** as by connecting it to one of four other right-angularly spaced apart brackets **132** which extend radially outwardly from the lower outer periphery of the container **110.**

However, in particular accordance with the present invention, and as shown in FIGS. **2, 2A** and **7–10,** each of these improved suspending and viration isolating members **122***a–d* has its two isolator bores **128** and **129** constructed with their central axes **128'** and **129'** offset from one another by an angle α. Preferably, this offsetting angle α is substantially a right angle (a 90° angle) and the bore central axes **128'** and **129'** are arranged substantially at a right angle (a 90° angle) with respect to the generally vertically arranged major axis of the central portion **123** of the member **122***a–d*, which is rigid and integrally formed with the two hollow end portions **124** and **125.**

As best shown in FIG. **7,** two of the improved members **122***a* and **122***d* are arranged with the central axes **129'** of their upper isolator bores **129** each respectively arranged in two generally vertically arranged planes $a-a$ and $d-d$, both of which planes $a-a$ and $d-d$ intersect at the first angle Ω of approximately 45° another generally vertically arranged plane $e-e$, which passes through the radial centers of both the container **110** and the motor output shaft **120.** And, the other two of these improved members **122***b* and **122***c* are arranged with the central axes **129'** of their upper isolator bores **129** each respectively arranged in two generally verically arranged planes *b*—*b* and *c*—*c*, both of which planes *b*—*b* and *c*—*c* intersect at the second angle β of approximately 45° the aforenoted plane *e*—*e*, which passes through the radial centers of both the container **110** and the motor output shaft **120.** However, in particular accordance with the present invention, two of the improved members **122***a* and **122***d* also have their lower end portions **124** interconnected by lower through bolts **130** to the apparatus with angularly offset central axes **128'** of their lower isolator bores **128** arranged in a generally vertical plane *f–f* that is also disposed at the second angle β with respect to the plane *e*—*e*, while the other two of the improved members **122***b* and **122***c* have their lower end portions **124** interconnected to the apparatus **112** with the angularly offset central axes **128'** of their lower isolator bores **128** arranged in a generally vertical plane *g*—*g* that is disposed at the first angle Ω with respect to the plane *e*—*e*, which passes through the radial centers of both the container **110** and the motor output shaft **120.**

In operation of the improved mechanism in FIGS. **2, 2A** and **7–10,** the motor **118** of the flow-promoting apparatus **112** is energized to cause rotation of its output shaft **120** and the weights **121** eccentrically mounted thereon (in a clockwise direction, as viewed in FIG. **7**). This, in turn, causes generally horizontal movement of the apparatus **112** with respect to the container **110.** As best shown in FIG. **7,** the weights **121** are rotated through four major points of the compass, which are respectively indicated as points **1,2,3** and **4** and each of which is disposed at a 45° angle with respect to all eight of the bore central axes **128'** and **129'** of the four improved suspending and vibration isolating members **122***a–d* of the present invention. When the motor shaft-carried eccentric weights **121** are rotated into either positions **1** or **3** (FIG. **7**), the force vectors will be as shown in FIG. **8,** and, because the central axes **128'** and **129'** of each of the improved members **122***a* and **122***d* are angularly offset from one another by the angle α of approximately 90° (FIGS. **7** and **10**), vibration isolation will be provided between the apparatus **112** and the container **110** in generally horizontal directions that are disposed generally parallel to all six of the planes *a*—*a*, *b*—*b*, *c*—*c*, *d*—*d*, *f*—*f* and *g*—*g*. Similarly, when the motor shaft-carried eccentric weights **121** are rotated into either positions **2** or **4** (FIG. **7**), the force vectors will be as shown in FIG. **9,** and, because th central axes **128'** and **129'** of each of the improved members **122***a* and **122***d* are angularly offset from one another by the angle α of approximately 90° (FIGS. **7** and **10**), vibration isolation will be provided between the apparatus **112** and the container **110** in generally horizontal directions that are disposed generally parallel to all six of the planes *a*—*a*, *b*—*b*, *c*—*c*, *d*—*d*, *f*—*f*, and *g*—*g*.

Thus, the improved means of the present invention provide vastly improved connection and vibration isolation between the container **110** and the flow-promoting apparatus **112** when weights **121** are in positions **1,2,3** or **4,** since the angular offsetting (angle α) between the central axes **128'** and **129'** of the two isolator bores **128** and **129** of each of the improved members **122***a–d* allows torsional movement of the apparatus **112** with respect to the container **110** in two different directions about the generally vertical axis **123** of each member **122***a–d*.

It should be apparent that while there have been described what are presently considered to be a presently preferred embodiment of the present invention in accorance with the Patent Statutes, changes may be made in the disclosed apparatus without departing from the true spirit and scope of this invention. It is, therefore, intended that the appended claims shall cover such modifications and applicatons that may not depart from the true spirit and scope of the present invention.

What is claimed is:

1. Improved means for suspending and vibration isolating material flow promoting apparatus from a generally vertically arranged flowable material container, said improved means comprising:

a. a member including a rigid central portion, which can be arranged to extend generally vertically between said apparatus and said container, and first and second hollow end portions, located at the opposite ends of said central portion, which can be respectively interconnected to said apparatus and said container,

b. each of said hollow end portions containing a vibration isolator,

c. each of said isolators having a bore, which will be arranged generally horizontally when said central portion is arranged generally vertically, for respectively receiving fastener means for eecuring said first end portion to said apparatus and said second end portion to said container, and

d. said bores having their central axes offset from one another by an angle.

2. The invention of claim **1,** wherein said central axes of said bores are arranged substantially at a right angle to the major axis of said central portion.

3. The invention of claim **1,** wherein said hollow end portions and said central portion are formed integrally with one another

4. The invention of claim **1,** wherein each of said bores is lined with a sleeve.

5. The invention of claim **1,** wherein said angle is substantially a right angle.

6. The invention of claim **5,** wherein said central axes of said bores are arranged substantially at a right angle to the major axis of said central portion.

7. The invention of claim **6,** wherein said hollow end portions and said central portion are formed integrally with one another.

8. The invention of claim **7,** wherein each of said bores is lined with a sleeve.

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