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Coleman

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(54) **MASS FLOW BULK MATERIAL BIN**

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(58) **Field of Search** 222/185.1, 564, 222/561, 153.14, 462; 137/872

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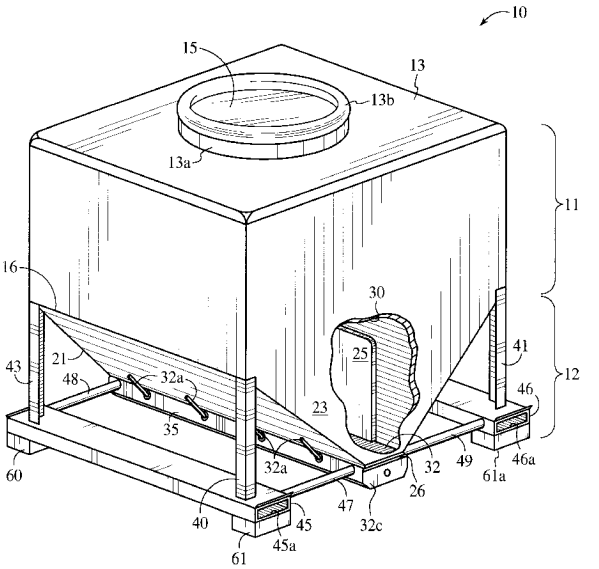
(57) **ABSTRACT**

A bin for storing dry powder bulk material or granules. Bulk material is deposited in an upper section of the bin and is discharged from the bottom of the lower section of the bin. The lower section of the bin is formed with oppositely directed, downwardly sloping walls joined by opposing vertical walls. The downwardly sloping walls, respectively, slope downwardly at an angle greater than the angle of repose of the material or granules in the bin. Disposed in the lower section of the bin is a planar vertical divider wall that is supported by the vertical walls of the lower section. The vertical divider wall has flat surfaces that face, respectively, the oppositely directed, downwardly sloping walls of the lower section for reducing bridging of the dry powder bulk material or granules in the bulk material bin during mass flow of the dry powder bulk material or granules from the upper section through the lower section of the bin.

12 Claims, 4 Drawing Sheets



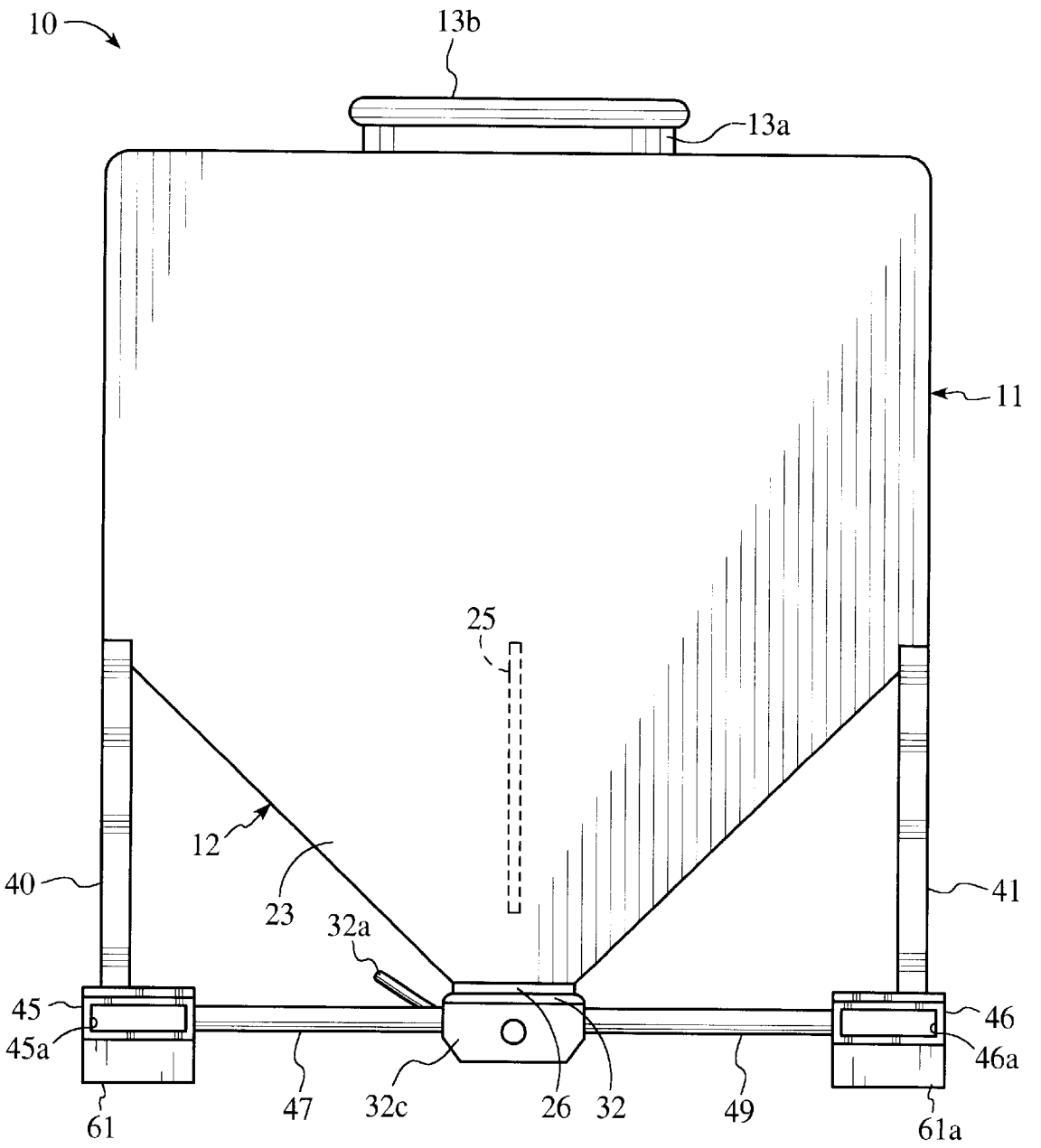


FIG. 1

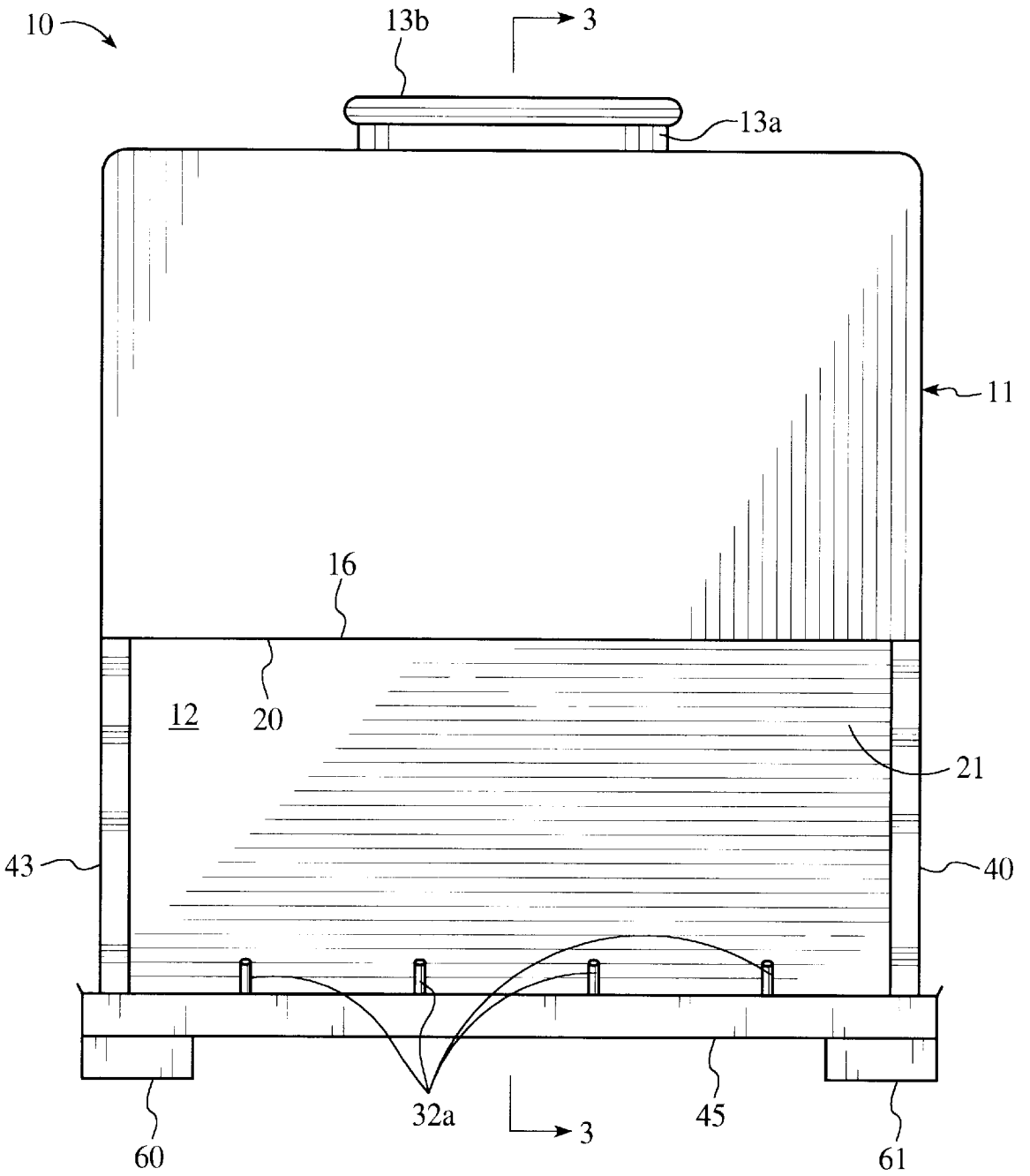


FIG. 2

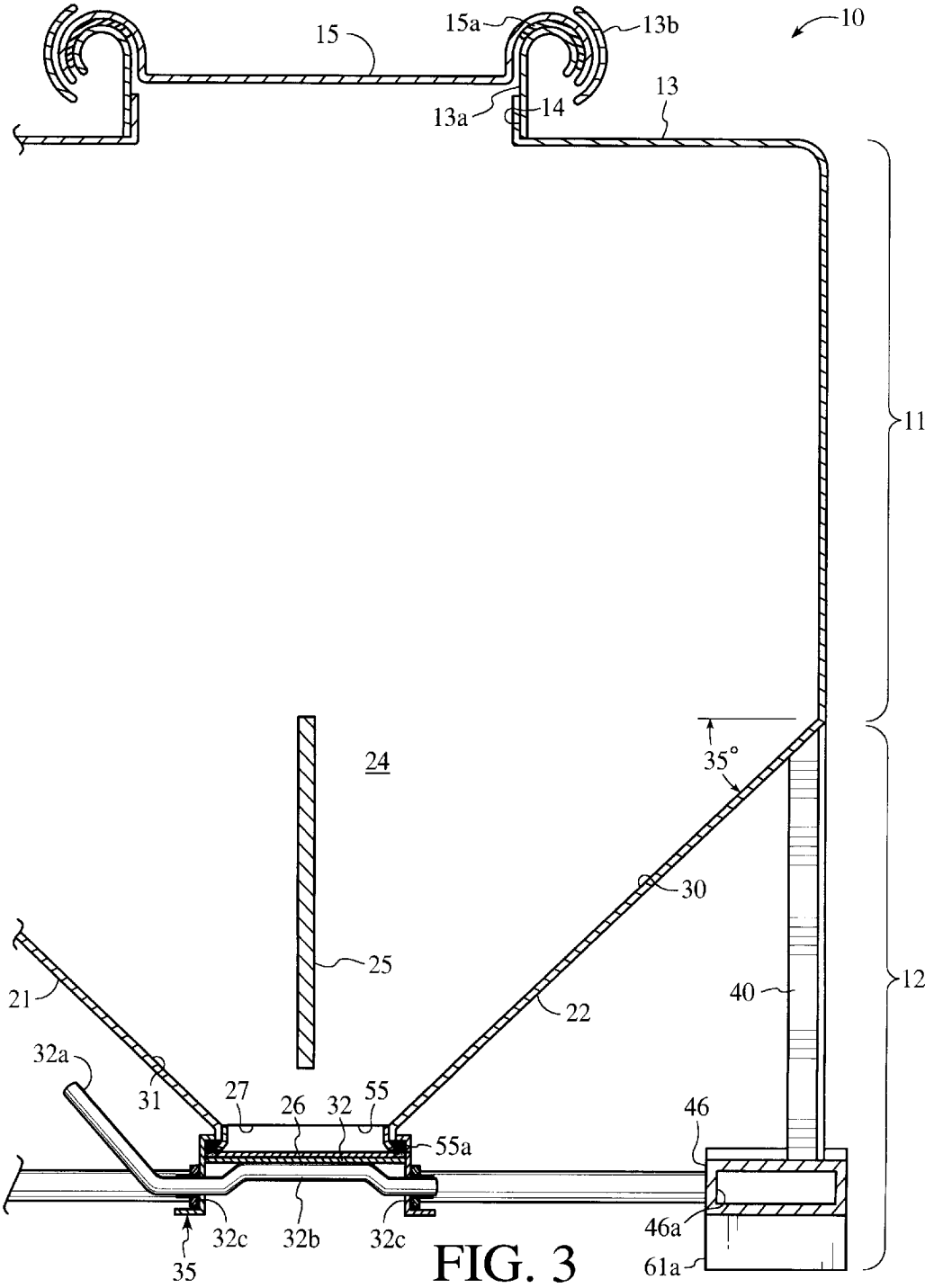

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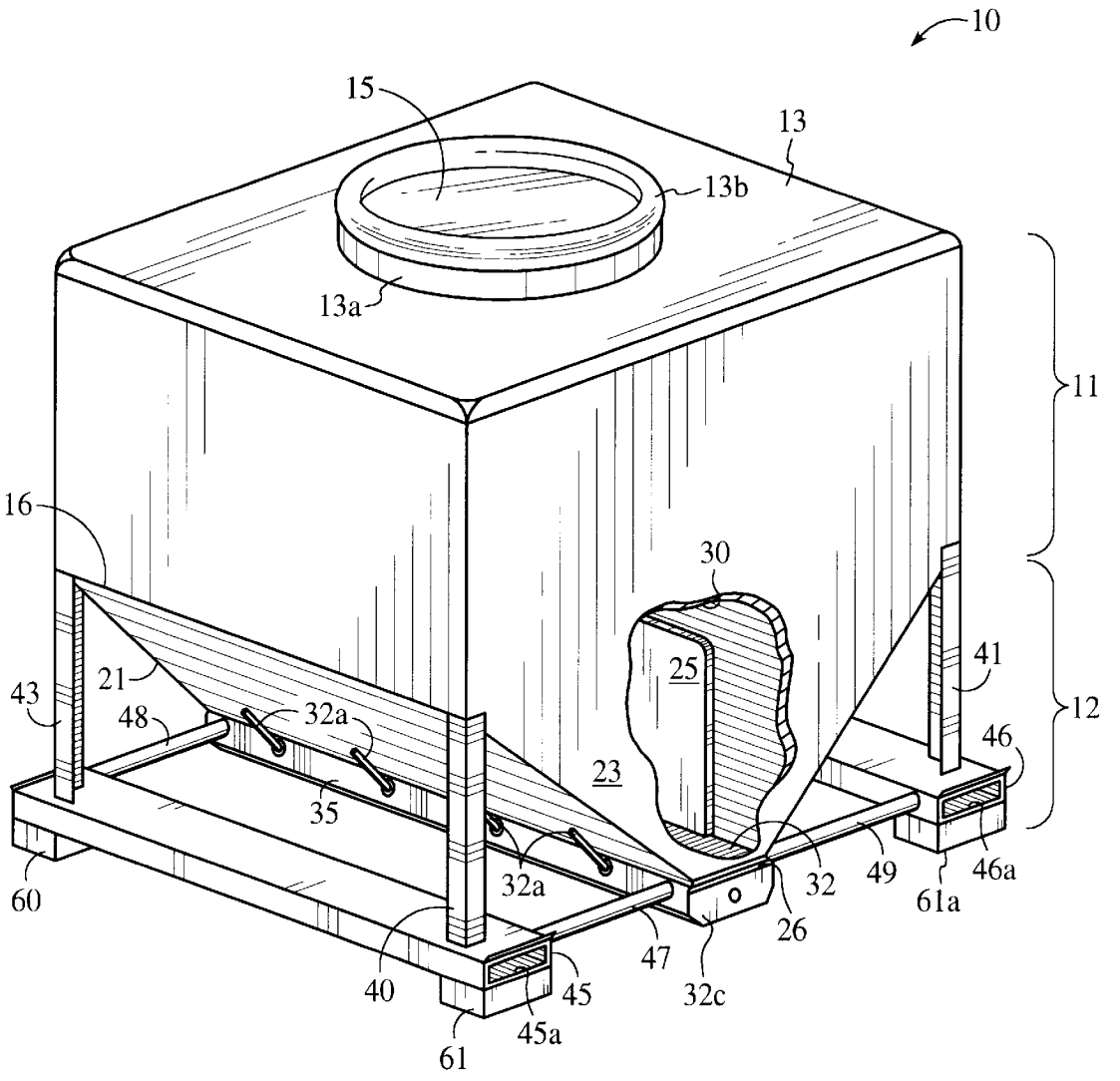
FIG. 3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46a
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61a
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32c
45a
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FIG. 4

MASS FLOW BULK MATERIAL BIN

BACKGROUND OF THE INVENTION

The present invention relates in general to bulk material bins and, more particularly, to a mass flow bulk material bin.

Heretofore, bulk material bins for storing, handling and discharging dry powder and granules failed to unload completely without bridging. Vibrators were used in the bulk material bins for dry powder and granules to reduce bridging of the stored dry powder materials and granules during the discharge thereof from the bin.

In the U.S. patent to Johanson et al., U.S. Pat. No. 5,617,975, granted on Apr. 8, 1997, for Chip Feed System, there is disclosed a chip bin for uniformly discharging wood chips therefrom without a vibrator. The apparatus disclosed in the patent to Johanson et al., U.S. Pat. No. 5,617,975, employed a cylindrical bin and a conical transition section disposed below the cylindrical bin. In one embodiment, a baffle having triangular cross-sectional areas is disposed within the conical transition section. In another embodiment, the transition section is formed with triangular-shaped, flat side outer panels. The bins disclosed in the patent to Johanson, U.S. Pat. No. 5,617,975, are intended to address the problem of reliability and maintenance of conventional vibratory discharges and the problems of chip bin pluggage, bridging and channeling.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a bin or container for storing bulk material, such as dry powder material and granules, and to unload the dry powder material and granules from the bin without a vibrator.

Another object of the present invention is to provide a bin or container for storing bulk material, such as dry powder material and granules, and to unload the dry powder material and granules from the bin without the dry powder material or the granules bridging within the bin.

A feature of the present invention is to provide a bulk material bin or container having an upper section and a lower section. The lower section is formed with a discharge compartment having a plurality of vertical walls joined with a downwardly declining sloping wall for discharging bulk material from the bin to reduce bridging of the bulk material within the bin.

A bulk material bin comprising an upper section and a lower section. Bulk material is deposited in the upper section of the bin and is discharged from the bottom of the lower section. The upper section of the bin is formed with rectangular cross-sectional areas. Bulk material passes freely from the upper section into the lower section. The lower section of the bin is formed with oppositely directed, downwardly, declining sloping walls joined by opposing vertical walls. Disposed in the lower section of the bin is a vertical, flat wall that engages the opposing vertical walls of the lower section and has the opposing vertical, flat surfaces thereof facing, respectively, the oppositely directed, downwardly declining sloping walls of the lower section for reducing bridging of the bulk material in the bulk material bin.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a front elevation view of the bulk material bin embodying the present invention.

FIG. **2** is a side elevation view of the bulk material bin shown in FIG. **1**.

FIG. **3** is an enlarged vertical section view of the bulk material bin shown in FIGS. **1** and **2** taken along line **3**—**3** of FIG. **2**.

FIG. **4** is a perspective view of the bulk material bin shown in FIGS. **1**–**3** and broken away to illustrate compartments of the lower section of the bulk material bin having downwardly declining sloping walls joined by opposing vertical walls and a vertical divider having opposing flat vertical surfaces facing, respectively, the opposing downwardly declining sloping walls for reducing bridging of bulk material in the bulk material bin.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Illustrated in FIGS. **1**–**4** is a bulk material bin or container **10** embodying the present invention. In the exemplary embodiment, the bulk material is a dry powder material or granules. The bin **10** has an upper hollow section or shell **11** and a lower hollow section or hopper **12**. The upper section **11** is made of suitable material, such as stainless steel. An upper horizontal wall **13** of the upper section **11** is formed with a circular opening **14** (FIG. **3**) through which bulk material is deposited into the upper section **11**. A suitable cylindrically-shaped cover **15** (FIGS. **3** and **4**) is removably secured to a cylindrically-shaped neck **13***a* of the upper horizontal wall **13** for the opening and closing of the opening **14**. In the examplary embodiment, the cover **15**, during closure of the opening **14**, forms a seal with the neck **13***a* of the upper horizontal wall **13**. Toward this end, the neck **13***a* is welded to the upper horizontal wall **13** of the upper section **11**. The perimeter of the neck **13***a* has an arcuate cross-sectional area. Similarly, the perimeter of the cover **15** has an arcuate cross-sectional area that seats in sealing engagement with the perimeter of the neck **13***a*. A suitable lock ring **13***b* (FIGS. **1**, **2** and **4**) secures the cover **15** to the neck **13***a* of the upper section **11**. A suitable seal **15***a* fixed to the underside of the perimeter of the cover **15** is disposed in sealing engagement with the perimeter of the neck **13***a* when the cover **15** closes the circular opening **14** of the upper horizontal wall **13** of the upper section **11**.

In the preferred embodiment, the upper section **11** has four upright walls (FIGS. **1**–**4**) joining at right angles. The horizontal cross-sectional areas of the upper section **11** are rectangular. The lower edge **16** of the upper section **11** has a rectangular configuration.

The lower section **12** is made of suitable material, such as stainless steel. The lower section **12** comprises oppositely directed, downwardly declining sloping walls **21** and **22** (FIGS. **2**, **3** and **4**) joining opposing vertical walls **23** and **24** (FIGS. **1**, **3** and **4**). The sloping of the walls **21** and **22** is of a nature that the lower section **12** gradually reduces its horizontal rectangular cross-sectional area in the direction of discharge of bulk material from the lower section **12**. By virtue of the configuration of the bin **10** and, particularly, the rectangular horizontal cross-sectional areas thereof, there is no pinch angle between the upper section **11** and the lower section **12** of the bin **10**.

In the exemplary embodiment, the sloping walls **21** and **22**, respectively, slope generally at an angle of thirty-five degrees with respect to the uppermost horizontal, rectangular cross-sectional area **20** of the lower section **12**. The sloping angle of the sloping walls **21** and **22** may vary dependent on the bulk material in the bin **10**. In the preferred embodiment, the angle of the slope of sloping walls **21** and **22**, respectively, measured from the vertical, provides no landing or support for the bulk material therebetween,

because the inner surfaces thereof are smooth and the angle of the sloping walls **21** and **22**, respectively, is steeper than the angle on which the dry powder material or granules can rest on a sloping surface. An angle steeper than an angle of a sloping surfaces on which the bulk material can rest is known as the angle of repose.

In the exemplary embodiment, the opposing vertical walls **23** and **24** of the lower section **12** are continuations of the respective coextensive vertical walls of the upper vertical walls of the upper section **11**. The lower edges **16** of the upper section **11** seat on the upper edges **20** of the lower section **12** and are secured thereto in a suitable manner, such as welding, so as to provide a smooth change of direction for the bulk material stored in the bin **10**.

Disposed in the lower section **12** of the bin **10** is a vertical bulk material deflecting wall or hopper divider **25** (FIGS. **1**, **3** and **4**) that is secured to vertical walls **23** and **24** of the lower section **12** by suitable means, such as welding. The vertical deflecting wall **25** extends from the uppermost horizontal, rectangular cross-sectional area of the lower section **12** and terminates in spaced relation to a lower wall **26** of the lower section **12** (FIGS. **1**, **3** and **4**). The lower wall **26** surrounds a reactangular discharge opening **27** (FIG. **3**). In the preferred embodiment, the vertical deflecting wall **25** has a planar configuration and has flat, vertical surfaces confronting, respectively, the sloping walls **21** and **22**.

The vertical bulk material deflecting wall **25**, the sloping walls **21** and **22**, and the vertical walls **23** and **24** form bulk material discharge compartments **30** and **31** (FIGS. **3** and **4**). Hence, each discharge compartment is configured by three vertical walls and one sloping wall. By virtue of the configuration of each compartment, the mass flow of the bulk material in the bin **10** is discharged through the bin **10** with reduced bridging and without the employment of a vibrator. With the sloping angle of the sloping walls **23** and **24**, respectively, greater than the angle of repose of dry powder material or granules in the bin **10**, the dry powder bulk material or granules flows freely through the discharge opening **27** of the lower section **12** and reduces the compressive forces between the inner walls of the discharge compartments **30** and **31** without the employment of a vibrator for unloading the bulk material through the discharge opening **27**.

In the examplary embodiment, a manually movable cam lock slide door or gate **32** (FIGS. **1**, **3** and **4**) is disposed below the discharge opening **27** of the lower section **12** for controlling the flow of bulk material through the discharge opening **27**. Secured to the bottom wall **26** of the lower section **12** and surrounding the discharge opening **27** is a door support structure **35**. The door support structure **35** is secured to the bottom of the sloping walls **21** and **22** of the lower bin **12** in a suitable manner, such as by welding. Additionally, rods **47** and **48** are welded to the door support structure **35** and a skid **45** for supporting the door support structure **35**. In a like manner, rods **49** and **50** are welded to the door support structure **35** and a skid **46**.

A suitable horizontal channel **55** (FIG. **3**) is formed in the door support structure **35** to accommodate the rectilinear movement of the door **32**. There is a close fit sealing engagement through a suitable seal **55***a* between the sliding door **32** and the door support structure **35** to control the flow of bulk material through the discharge opening **27**. Extending through the channel **55** transversely thereof and extending outwardly from the support structure **35** are cam levers **32***a*. The cam levers **32***a* are spaced apart between the vertical walls **22** and **23** of the lower section **12**. Each cam lever **32***a* includes a cam **32***b* (FIG. **3**) disposed transversely of the channel **55**. Each cam lever **32***a* is journalled for rotation relative to the sliding door support structure **35** by suitable bearings, such as the bearings **32***c* shown in FIG. **3**. By rotating the cam levers **32***a* in one direction, after the door **32** is moved over a rectilinear path below the discharge opening **27**, the cams **32***b* lift the sliding door upwardly to prevent the flow of powder bulk material from the discharge opening **27**. By rotating the cam levers **32***a* in an opposite direction enables the door **32** to be lowered and moved over a rectilinear path in a longitudinal direction removed from the discharge opening **27** to permit powder bulk material or granules to be discharged from the lower section **12**. At one end of the sliding door **32** is a flange **32***c* that enables the sliding door **32** to be gripped for imparting rectilinear movement to the sliding door **32**. When the flange **32***c* engages the door support structure **35**, the sliding door **32** is completely below the discharge opening **27** to enable the sliding door to prevent the flow of bulk material from the lower section **12**.

Depending from the upper section **11** of the sloping walls **21** and **22** of the lower section **12** are four legs, only legs **40**, **41** and **43** are shown (FIGS. **1**–**4**), made of suitable material such as stainless steel. The legs, at the top thereof, are secured to the upper section of the sloping walls **21** and **22** in a suitable manner, such as by welding. Skid **45** is secured to the lower ends of legs **40** and **43**. A skid is secured to the lower ends of the remaining legs. Shoe **61** is secured to the underside of the skid in a suitable manner, such as by welding. Shoe **61***a* is secured to the skid in a suitable manner, such as by welding. The skids **45** and **46** have rectangular cross-sectional areas and are configured to receive the tines, not shown, of a conventional fork lift truck. It is apparent that conventional casters or wheels may be mounted on the skids **45** and **46** in lieu of the blocks **61** and **61***a*.

What is claimed is:

1. A bulk material bin comprising:

(a) an upper section for storing bulk material;

(b) a lower section disposed below and in communication with said upper section for receiving bulk material from said upper section and for discharging bulk material from said bin,

(c) said lower section being formed with oppositely directed, downwardly sloping walls joined by opposing vertical walls; and

(d) a planar vertical divider disposed in said lower bin connected to said opposing vertical walls, said vertical planar divider including flat, vertical opposing surfaces confronting, respectively, said oppositely directed, downwardly sloping walls for reducing bridging of bulk material in said bin during the mass flow of the bulk material within said bin.

2. A bulk material bin as claimed in claim **1** wherein said upper section is configured to form rectangular horizontal cross-sectional areas and said lower section is configured to form rectangular horizontal cross-sectional areas decreasing in dimension in the direction of flow of bulk material through said lower section.

3. A bulk material bin as claimed in claim **2** wherein said lower section is formed with a bulk material discharge opening, said bulk material bin further comprising:

(a) a slide door disposed below said bulk material discharge opening; and

(b) slide door support means attached to said oppositely directed, downwardly sloping walls, said slide door

support means supported by said lower section and supporting said slide door for movement over a rectilinear path, said slide door support means being formed with a horizontal channel to receive said slide door for movement over a rectilinear path to control the flow of bulk material through said discharge opening.

4. A bulk material bin as claimed in claim **1** wherein said lower bin includes a horizontal, rectangular uppermost cross-sectional area and each of said oppositely directed, downwardly sloping walls slopes at an angle generally of 35° relative to said horizontal, rectangular uppermost cross-sectional area.

5. A bulk material bin comprising:

(a) an upper section for storing bulk material;

(b) a lower section comprising a compartment, said compartment being disposed below and in communication with said upper section for receiving bulk material from said upper section and for discharging bulk material from said bin,

(c) said compartment being formed with a downwardly sloping wall joined by opposing vertical walls, and

(d) a planar vertical bulk material deflecting wall connected at its ends to said opposing vertical walls and having a flat, vertical deflection surface confronting said downwardly sloping wall for reducing bridging of said bulk material in said bin during the mass flow of bulk material within said bin.

6. A bulk material bin as claimed in claim **5** wherein said upper section is configured to form rectangular horizontal cross-sectional areas and said compartment is configured to form rectangular horizontal cross-sectional areas decreasing in dimension in the direction of flow of bulk material through said compartment.

7. A bulk material discharge bin as claimed in claim **5** wherein said compartment communicates with a discharge opening, said bulk material bin further comprising a slide door disposed below said discharge opening; and slide door support means supported by said lower section, said slide door support means supporting said slide door for movement over a rectilinear path and being formed with a horizontal channel to receive said slide door for movement over the rectilinear path to control the flow of bulk material through said discharge opening.

8. A bulk material bin as claimed in claim **5** wherein said lower bin includes a horizontal, rectangular uppermost cross-sectional area, and said downwardly sloping wall declines generally at an angle of 35° relative to said horizontal, rectangular uppermost cross-sectional area.

9. A bulk material bin as claimed in claim **3** wherein said slide door support means comprises camming means for cam locking said sliding door when said slide door is disposed below said discharge opening.

10. A bulk material discharge bin as claimed in claim **7** wherein said slide door support means comprises camming means for cam locking said slide door when said slide door is disposed below said discharge opening.

11. A bulk material bin as claimed in claim **1** wherein each of said oppositely directed, downwardly sloping walls slope at an angle greater than the angle of repose of the material in said bin.

12. A bulk material bin as claimed in claim **5** wherein said downwardly sloping wall slopes at an angle greater than the angle of repose of the material in said bin.

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