Oct. 29, 1968 G. J. OEHLER 3,407,971

BULK CONTAINER

Filed Aug. 15, 1966 3 Sheets-Sheet 1

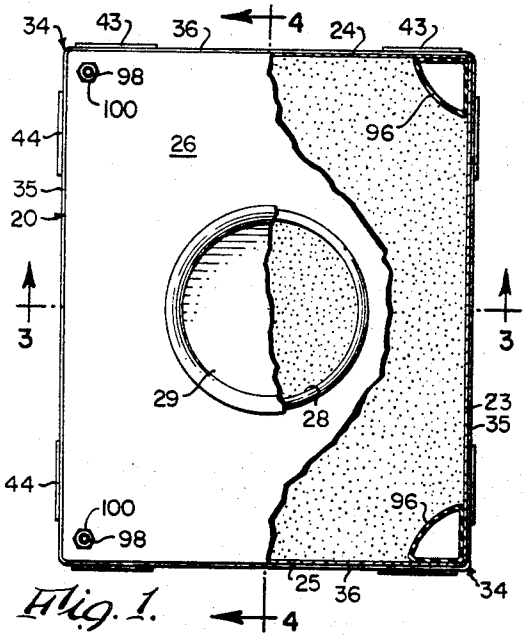


Fig. 1.

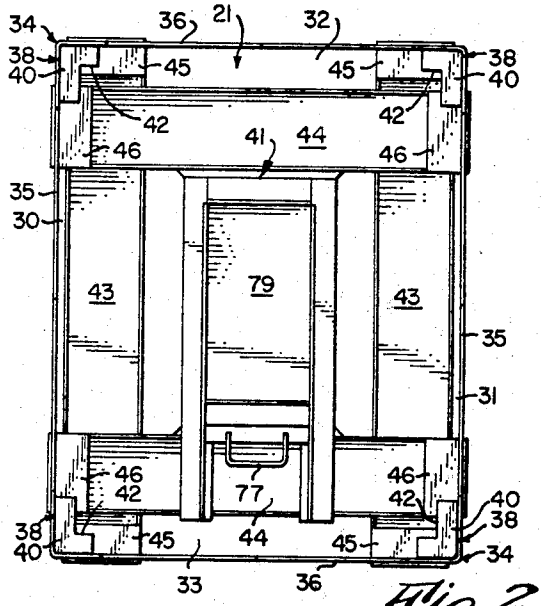


Fig. 2.

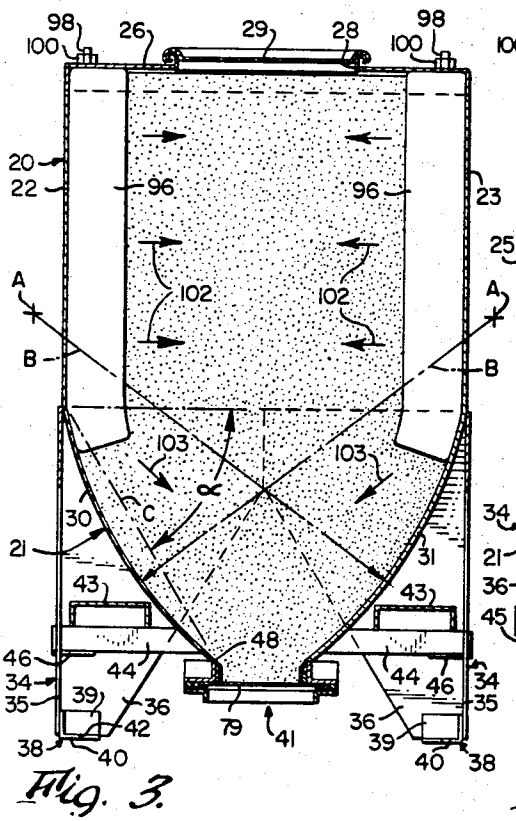


Fig. 3.

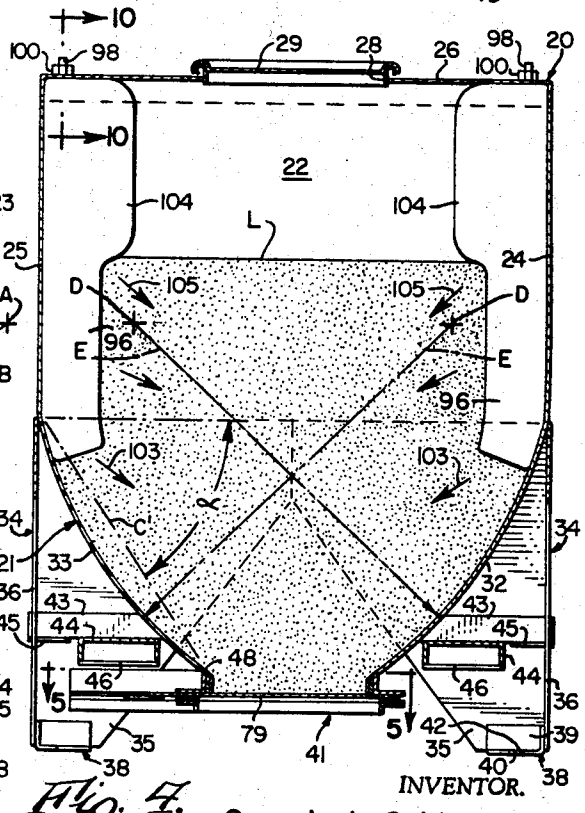


Fig. 4.

INVENTOR.
Gerard J. Oehler
BY
Popp and Sommer
ATTORNEYS

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BULK CONTAINER

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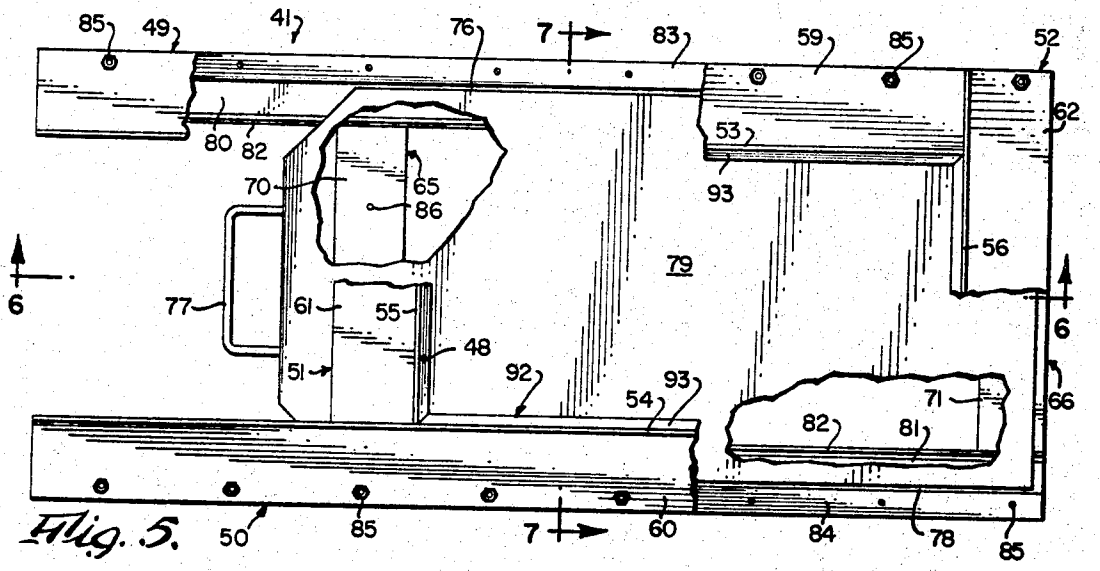


Fig. 5.

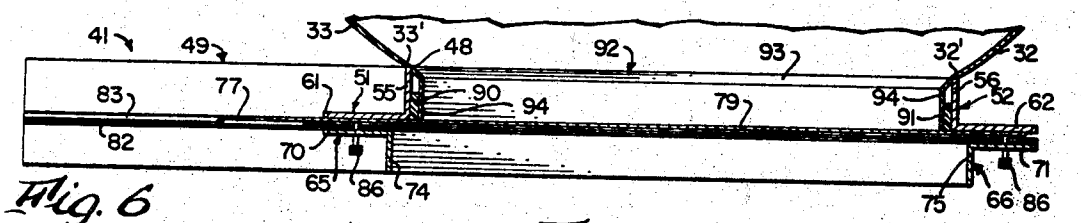


Fig. 6

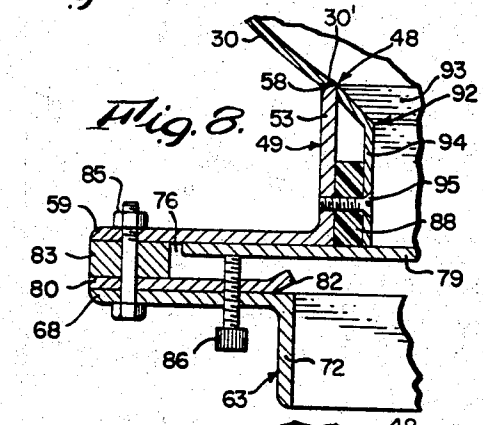


Fig. 8.

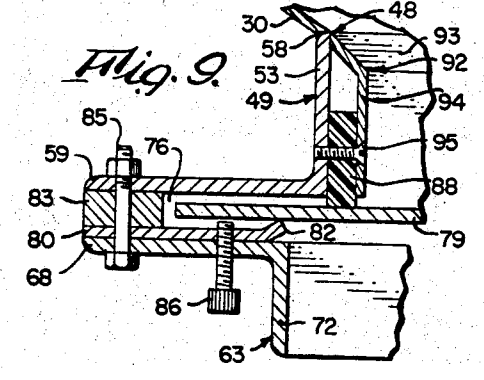


Fig. 9.

Fig. 7.

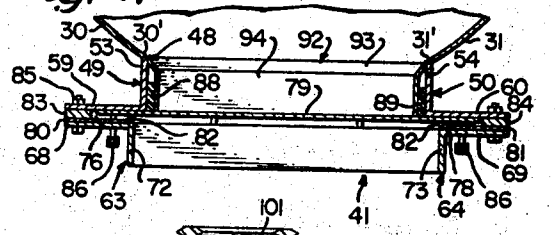
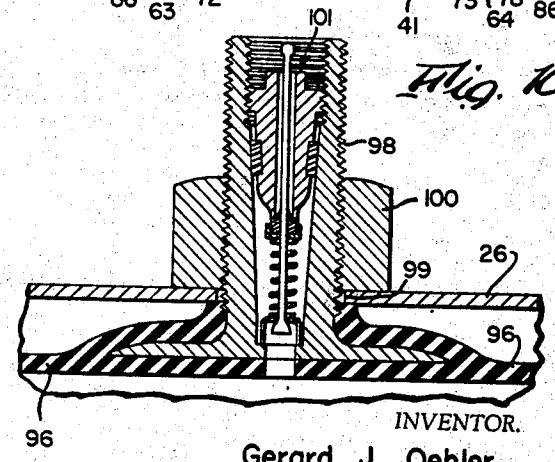


Fig. 10.



INVENTOR.

Gerard J. Oehler

BY

Popp and Sommer

ATTORNEYS

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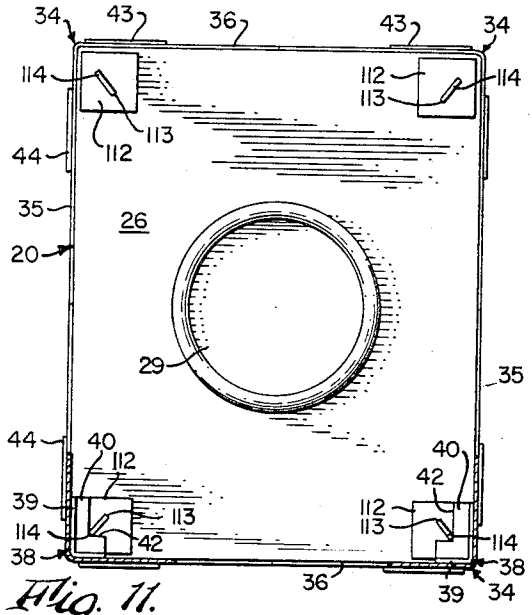


Fig. 11.

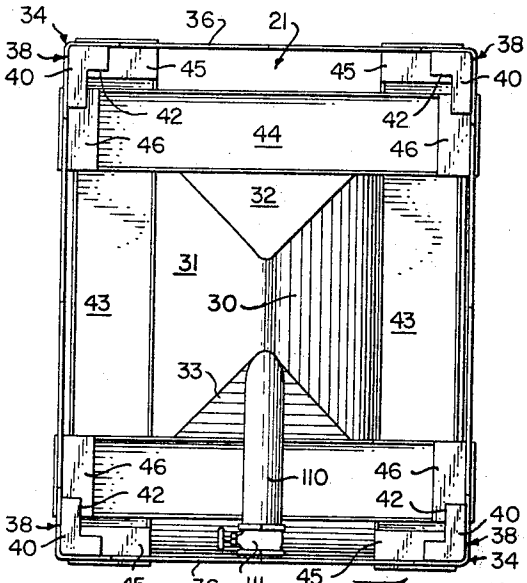


Fig. 12.

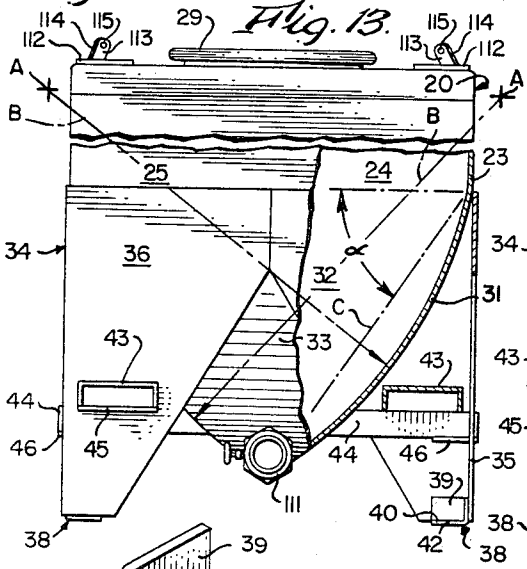


Fig. 13.

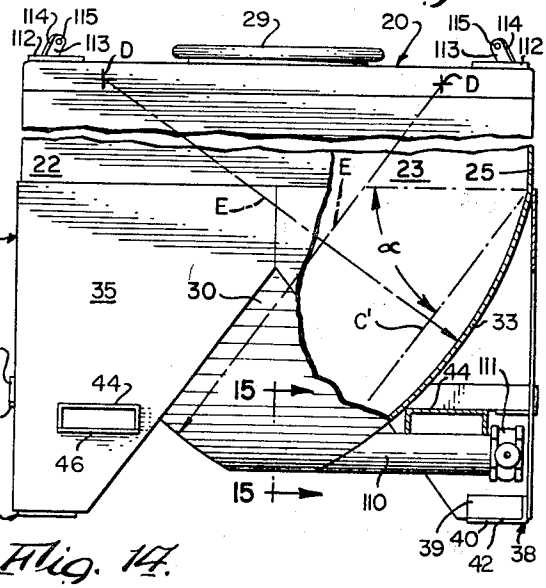


Fig. 14.

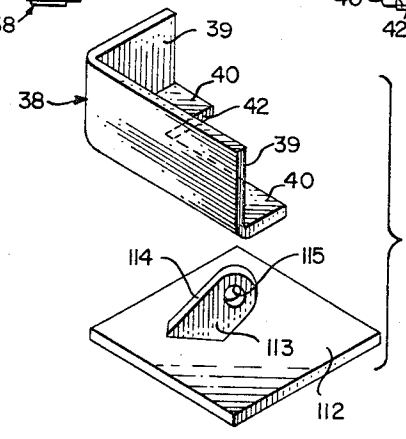


Fig. 16.

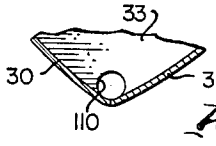


Fig. 15.

INVENTOR.
Gerard J. Oehler
BY
Popp and Sommer
ATTORNEYS

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Patented Oct. 29, 1968

3,407,971

BULK CONTAINER

Gerard J. Oehler, Williamsville, N.Y., assignor to Oehler's Welding and Fabrication Corp., Buffalo, N.Y., a corporation of New York

Filed Aug. 15, 1966, Ser. No. 572,455
6 Claims. (Cl. 222—185)

ABSTRACT OF THE DISCLOSURE

A bulk container for powdered or liquid material, but especially adapted for shipping titanium dioxide so that it will not agglomerate in transit, and having the features of bottom discharge and vertical stacking of similar containers one upon another.

This invention relates to a container for shipping or storing bulk material.

Bulk containers broadly are old but those of the prior art were deficient in one or more respects which are overcome by the present invention.

A primary object of the present invention is to provide a bulk container which will have a maximum cubic capacity for the bulk material but yet which is constructed so that removal of such material, particularly if powdered or pulverulent, will be assured.

The problem of removal of powdered or pulverulent material is particularly acute when the shipment of titanium dioxide is considered. This material when in transit tends to agglomerate in marble-sized balls which are unacceptable commercially, necessitating repulverizing the material if to be used.

Accordingly, another important object of the present invention is to provide a container for shipping titanium dioxide in bulk so that it will not agglomerate in transit. As well, the container of the present invention is suitable for confining other dry powdered or pulverulent bulk material. Further, the bulk container of the present invention is adapted to confine liquid materials.

Another object of the present invention is to provide such a bulk container for dry materials which has an improved selectively operable outlet means for removing the bulk material, such means being simple in construction and easy to operate.

Still another object of the present invention is to provide a bulk container having a construction such that similar containers can be readily stacked one upon another and in the process of stacking them the upper container will be automatically centered on the lower container.

Other objects and advantages of the present invention will be apparent from the ensuing description of embodiments thereof illustrated in the accompanying drawings wherein:

FIG. 1 is a top plan view of a bulk container embodying one form of the present invention and showing portions of such container broken away to reveal hidden structure, this container being especially adapted to confine dry powdered titanium dioxide.

FIG. 2 is a bottom elevational view of the container shown in FIG. 1.

FIG. 3 is a vertical central transverse sectional view thereof taken on line 3—3 of FIG. 1.

FIG. 4 is a similar vertical transverse sectional view thereof but taken along a perpendicular plane, being taken on line 4—4 of FIG. 1.

FIG. 5 is a horizontal sectional view thereof, on an enlarged scale, taken on line 5—5 of FIG. 4 and showing details of the slide gate assembly at the bottom of the

container, certain portions of the assembly illustrated in FIG. 5 being broken away to reveal hidden structure.

FIG. 6 is a vertical longitudinal sectional view of the slide gate assembly taken on line 6—6 of FIG. 5.

FIG. 7 is a vertical transverse sectional view thereof taken on line 7—7 of FIG. 5, the slide gate being illustrated in this figure in a clamped closed condition.

FIG. 8 is a fragmentary enlarged view of the left portion of the structure shown in FIG. 7 and illustrating more clearly the clamped closed condition of the slide gate.

FIG. 9 is a view similar to FIG. 8 but showing the slide gate in a condition released for sliding movement to open it.

FIG. 10 is a fragmentary enlarged sectional view taken on line 10—10 of FIG. 4 and showing the details of mounting an inflatable bag at one corner of the container.

FIG. 11 is a top plan view of another form of bulk container constructed in accordance with the principles of the present invention, the container here illustrated being adapted for the confinement of liquid bulk material.

FIG. 12 is a bottom elevational view of the container shown in FIG. 11.

FIG. 13 is an end elevational view of the container shown in FIG. 11, this view being taken from the bottom of FIG. 11, with portions being broken away to reveal hidden structure.

FIG. 14 is a side elevational view of the container shown in FIG. 11, this view being taken from the left of FIG. 11, and also having portions broken away.

FIG. 15 is a fragmentary vertical sectional view thereof taken on line 15—15 of FIG. 14.

FIG. 16 is an exploded perspective view of the foot element of an imaginary upper container arranged above a lug element on an imaginary lower container of similar construction to depict the cooperation between such elements when the containers are stacked.

FIGS. 1–10

The bulk container shown in FIGS. 1–10 is intended primarily for the containment of powdered and pulverulent materials, particularly titanium dioxide. The container is shown as including an upper elongated rectangular section represented generally by the numeral **20** and a likewise elongated lower hopper section represented generally by the numeral **21** in order to provide an unstable environment tending to prevent undesirable arching of the pulverulent material above the bottom of the container. Upper section **20** comprises longer opposite or opposing side plates or walls **22, 23** and shorter opposite or opposing and or side plates or walls **24, 25**, each of these plates being rectangular in outline and arranged in a vertical plane and adjacent plates are connected together along their vertical meeting edges in any suitable manner as by being welded. Upper section **20** is also shown as including a top wall **26** which covers the entire rectangular horizontal cross sectional areas of the container as viewed in plan and this top wall is connected along its outer edges to the upper edges of the side and end walls **22–25** in any suitable manner as by being welded thereto.

A filling opening **28** of circular shape in plan is shown as arranged centrally in top wall **26**. This opening is closed by a removable cover **29** of any suitable construction.

An important feature of the present invention is the construction of the lower hopper section **21**. In general, this section **21** may be described as having an inverted outwardly curved pyramidal shape including four outwardly curved walls which, as compared to flat walls, tend to eliminate arching of the powdered material as it is being withdrawn from the discharge opening at the bottom of the container. More specifically, hopper section **21** includes an outwardly curved longer side wall **30** which along its upper edge is coterminous with and an extension

of the lower edge of corresponding upper side wall **22**; a similar but oppositely arranged or opposing outwardly curved longer side wall **31** is similarly associated with respect to upper side wall **23**; an outwardly curved shorter end or side wall **32** has its upper edge coterminous with and forming an extension of the lower edge of the corresponding upper end wall **24**; and a similar but oppositely arranged or opposing outwardly curved shorter end or side wall **33** is similarly associated with the opposite upper side wall **25**. The curved walls **30–33** are suitably joined together along their meeting edges as by being welded together. If curved walls **30–33** are formed from plates separate from upper side walls **22–25**, they are suitably joined along their corresponding meeting edges as by being welded together.

Another important feature of the present invention is that each of the curved walls **30–33** is partially cylindrical as viewed from the edge and generated about a center having a radius of curvature such that the chordal distance between the opposite ends of the curved wall is at an angle α to the horizontal falling in the range from **55** to **65** degrees when the container is in an upright position as illustrated in FIGS. 3 and 4. Such a chordal line is indicated at C in FIG. 3 and at C' in FIG. 4. This angle α is critical in that if it is greater too much volume of the container is sacrificed for the floor area occupied by the container, and if the angle is smaller the powdered or pulverulent material will not freely and completely discharge through an outlet opening provided in the bottom of the hopper section.

The curved walls **30** and **31** are shown severally in FIG. 3 as generated about a center A with a radius B, center A being located above the lower edge of upper section **20** and away from its corresponding curved wall **30** or **31** more than half the distance between the opposing side walls **22** and **23** of the upper section. Likewise, the other curved walls **32** and **33** are shown severally in FIG. 4 as generated about a center D with a radius E, center D being located above the lower edge of upper section **20** and away from its corresponding curved wall **32** or **33** more than half the distance between the opposing side walls **24** and **25** of the upper section.

More specifically, in the preferred embodiment shown, the radii of curvature of curved walls **30–33** are substantially equal; the centers D for radii E are located inside the container between shorter upper side walls **24**, **25** and above the lower edge of upper section **20**, and the centers for radii A are located outside the container beyond longer upper side walls **22**, **23** and above the lower edge of upper section **20**, but slightly below centers D. This construction produces an angle α in FIG. 3 of about 59° and an angle α in FIG. 4 of about 56°, resulting in not only optimum container volume for occupied floor area, but also free and complete discharge of the powdered or pulverulent material through the outlet opening.

Before describing this outlet and the slide gate assembly associated therewith, the means for supporting the container in an upright condition will be first described.

At each corner a leg **34** is provided. Each such leg comprises two vertically arranged corner plates **35** and **36** which have their upper edges suitably connected to the lower part of the upper container section as by being welded thereto. These corner plates are shown as meeting and being joined together along their intersecting vertical edges and as having downwardly tapering remote edges. Their lower ends have suitably connected thereto a foot member **38** which is in the form of an L-shaped angle, as best shown in FIG. 16, including a vertical flange **39** and a horizontal flange **40**. The lower surfaces of the four feet **38** are coplanar and arranged below the selectively operable outlet means represented generally by the numeral **41** at the bottom of hopper section **21**. The foot members **38** are connected to their respective legs in any suitable manner as by welding the upstanding flanges **39** to the inner surfaces of the corner plates **35** and **36**. The lower flange or base of the edge of the feet **38** has a cutout indicated at **42** leaving a crotch for a purpose later to be described.

In order to enable the container to be readily lifted and moved, the legs **34** are shown as supporting inverted cross channels **43**, **43** and **44**, **44**, the pair of channels **43** extending between the pairs of opposite corner plates **36** and passing over the other pair of channels **44** which extend between the pairs of opposite corner plates **35**. These corner plates are suitably cut out with rectangularly shaped openings through which the end portions of the channels **33** and **34** extend. Preferably the open end portion of each U-shaped channel **43** is closed on its fourth and lower side by a plate **45**. A similar plate **46** is similarly arranged with respect to each of the channels **44**. The rectangular open ends of these channel assemblies are adapted to receive the arms or tines of a fork lift truck (not shown), whereby when received in either the pair of channels **43** or **44** the container can be lifted and transported to another location by the truck.

Another important feature of the present invention is the construction of the slide gate assembly **41** which is best shown in FIGS. 5–9 and will now be described. The lower edges of the curved walls **30–33** do not meet but are spaced so as to provide a rectangular opening as viewed in plan and as indicated at **48** in FIGS. 5 and 6, these lower edges being represented in FIGS. 6 and 7 by the numerals **30'**, **31'**, **32'** and **33'**, respectively. A throat structure depends from these lower edges and is provided by the vertical flanges of two longitudinal upper angle members **49** and **50** and of two transverse upper angle members **51** and **52**. These flanges are designated **53–56** for the respective angles **49–52**. The upper edges of these flanges are suitably connected to the lower edges of the curved walls as by being welded thereto as shown at **58** in FIGS. 8 and 9, for example. Extending laterally outwardly from the lower edges of vertical flanges **53–55** are horizontal flanges **59–62**, respectively. The lower surfaces of horizontal flanges or plates **59–62** are coplanar.

Arranged below the upper angle members **49–52** are corresponding but inverted lower angle members **63–66**. These lower angle members **63–66** have horizontal flanges or plates **68–71**, respectively, and also downturned or vertically extending flanges **72–75**, respectively. These vertical flanges **72–75** define a rectangular area slightly larger than that defined by the upstanding flanges **53–56**.

Opposing longitudinal horizontal plates **59** and **68** on one side, and the similar opposing longitudinal horizontal plates **60** and **69**, are vertically spaced apart to provide ways indicated at **76** and **78** severally adapted to receive the marginal longitudinal edge portions of a slide gate plate **79**. At one end this slide gate **79** has a handle **77** secured thereto for moving the gate longitudinally along the ways **76** and **78**.

The floor of each way supports another plate, designated **80** in the case of plate **68** and **81** in the case of plate **69**, having at its inner end which is adjacent the longitudinal lower vertical flange **72** or **73** an upturned lip **82** to provide a rail. The two rails so provided are adapted to support and permit the sliding therealong of slide gate **79**. Interposed between plates **59** and **80** is a spacer bar **83** and on the other side a similar spacer bar **84** is interposed between plates **60** and **81**. The assembly of plates and spacers are clamped together by a series of longitudinally spaced nut and bolt assemblies indicated typically at **85** which extend through registered holes provided in these members.

Slide gate **79** is vertically movable in its ways **76** and **78** between an upper position shown in FIG. 8 and a lower position illustrated in FIG. 9. To lift the slide gate **79** from its lower to its upper position, a series of jack screws **86** are provided at intervals along each of the ways **76** and **78**. As shown, the threaded shanks of these jack screws **86** extend through threaded holes provided in the lower wall members of the corresponding way.

Perimetral yieldable sealing means are provided about the interior of the throat of the slide gate assembly. As shown, such means include two longitudinal strips **88** and **89** and two transverse strips **90** and **91**. These may be made of any suitable elastomeric material such as rubber. Arranged inwardly of these strips is a rectangular funnel-shaped member **92** having an outwardly flaring upper rim portion **93** and a rectangular vertical side wall **94**. Screws, such as the one designated **95** in FIGS. 8 and 9, secure the funnel member **92** and the sealing strips **88–91** to the outer throat wall of the assembly. The lower edge of the continuous rectangularly-shaped sealing member constituted by strips **88–91** constantly engages the upper surface of slide gate **79** whether in its upper position shown in FIG. 8 or its lower position shown in FIG. 9. In this connection, the lower edge of the funnel-shaped member **92** is substantially coplanar with the lower surfaces of upper horizontal plates **59–62**.

Referring to FIGS. 2 and 4–6, it will be seen that the longitudinal members defining ways **76** and **78** extend beyond superposed cross angle members **51** and **65** so that when the gate is pulled to its fully opened position it will be adequately supported.

When the slide gate **79** is closed and not intended to be opened, it is normally lifted into clamping engagement with upper plates **59–62** by turning jack screws **86** as illustrated in FIG. 8. However, when it is desired to open the slide gate, these jack screws **86** are backed off or lowered so as to lower the slide gate onto the rails formed by upturned lips **82**. The area of contact now between these rails and the slide gate is very limited and the gate can be readily slid back and forth along these rails by clasping handle **77**. It is preferred to lower jack screws **86** sufficiently so that their upper ends are completely out of contact with slide gate **79**, as depicted in FIG. 9.

Another important feature of the present invention which has particular pertinency when a pulverulent material such as titanium dioxide is confined within the container, is the provision of pneumatic means for immobilizing the pulverulent material within the container. It is my contention that the reason why titanium dioxide tends to agglomerate or ballup when shipped and subjected to the vibrations inevitable therewith is due to allowing the titanium dioxide to move within the container. I prevent this by providing at each corner of the container essentially within the upper section thereof a vertically elongated inflatable bag which is represented by the numeral **96**. Each of these bags **96** is made of an elastic material such as rubber or the like and enclosed so as to confine air under pressure.

As best shown in FIG. 10, the upper end of each bag **96** is provided with an externally threaded valve stem **98** extending through a hole **99** provided in top wall **26** and secured in position by a nut **100** screwed onto the valve stem and bearing against the upper surface of top wall **26**. This valve stem **98** is adapted to house a conventional filling valve indicated at **101** of the type employed in the valve stems of vehicle tires sold under such trademarks as Bridgeport, Dill or Schrader.

In using the bags **96**, before filling the container through opening **28** with a pulverulent material such as titanium dioxide these bags are deflated or collapsed. The container is then filled with the bulk material until all apparent air voids are eliminated, following which cover **29** is mounted to close opening **28**. Thereafter each of bags **96** is inflated by connecting its valve stem **98** to a source of compressed air. As the bags are inflated they enlarge in volume and exert a pressure generally horizontally inwardly upon the confined bulk material as represented by the arrows typically indicated at **102**. The lower ends of these bags which may extend slightly into the lower hopper section **21** exert an inwardly and downwardly directed pressure on bulk material as represented typically by arrows **103**. While the bags **96** may be inflated with any suitable pressure, I have used a pressure of ten pounds per square inch gauge.

I have been successful in shipping titanium dioxide in a container having the construction shown in FIGS. 1–10 and at its destination have been able to open the slide gate assembly **41** and fully remove the titanium dioxide still in a pulverulent condition and without having been balled up, contrary to the experience of others when attempting to ship this product in other bulk containers.

Referring to FIG. 4, as pulverulent material is withdrawn through the outlet provided by opening slide gate **79**, the portions of the bags **96** above the level represented at L in FIG. 4 of pulverulent material appear to bulge inwardly to overlap the bulk material, as indicated at **104** in this figure. This inward bulging of the upper portion over the lower portion seems to exert an inward and downward force represented typically by the arrows **105** upon the bulk material, urging the same to move toward the slide gate assembly **41**. Therefore the inflatable bags **96** not only immobilize the pulverulent material in transit which in the case of titanium dioxide is prevented from balling up, but also facilitate the removal of this material through the discharge opening in the bottom of the hopper by exerting a downward force upon the material thereby tending to extrude it through the outlet opening.

FIGS. 11–16

The form of container shown in FIGS. 11–16 is intended principally for the containment of liquid bulb material. It has a generally similar construction to that shown in FIGS. 1–10 and hence similar reference indicia have been applied to indicate like parts. The exception is the omission of the slide gate assembly **41** and the substitution therefor of an outlet conduit or pipe **110** extending laterally outwardly from one of the outwardly curved side walls of the lower hopper section. This conduit or pipe **110** is shown as having a selectively operable valve **111** of any suitable construction. By keeping this valve closed the liquid material can be confined within the container and by opening this valve the desired amount thereof can be withdrawn.

The form of bulk container illustrated in FIGS. 11–16 is shown as provided with an additional feature which might also be applied to the bulk container shown in FIGS. 1–10. This feature will now be described. On the top of the container adjacent each corner thereof is suitably secured as by welding a base plate **112** from which an upstanding lug **113** extends upwardly and inwardly, generally diagonally of the rectangular container shape. This lug is suitably secured to base plate **112** as by being welded thereto. The laterally outermost edge **114** of each of the lugs **113** at its junction with base plate **112** is generally in lines with the crook or inside corner of the crotch or cutout **42** of the corresponding foot **38** of the container. This arrangement is provided so that when one container as described is stacked on another container of similar construction the four inwardly sloping lugs **113** will engage the crotches **42** of the feet on the higher container and tend to center the latter as it is lowered on the lower container so that ultimately the crooks of these feet will be positioned adjacent the outer lower edges **114** of these lugs and the lower surfaces of the foot members **38** will rest upon the upper surfaces of the base plates **112**.

Each lug **113** is shown as provided adjacent its outer end with an opening or hole **115** adapted to receive a cable, hook or similar element (not shown) of a lifting crane, whereby the container having such lugs can be lifted from above.

From the foregoing it will be seen that the embodiments illustrated and described achieve the various objects stated. Inasmuch as other changes and modifications may occur to those skilled in the art without departing from the spirit of the present invention, the same is intended to be limited only by the scope of the appended claims.

What is claimed is:

1. A bulk container, comprising an upper rectangular

section, and a lower hopper section in general having an ineverted outwardly curved pyramidal shape and including an outwardly curved partially cylindrical wall on each of its four sides, said walls being joined together along their meeting edges and to said upper section, the radius of curvature of each of said walls being such that a chord extending between its opposite ends inclines to the horizontal at an angle falling in the range of from 55 to 65 degrees when the container is in an upright position, and the center for said radius being located no lower than the lower edge of said upper section and also located away from its curved wall more than half the distance between the opposing side walls of said upper section to one of which side walls is joined such curved wall.

2. A bulk container according to claim 1 wherein said upper section is of elongated rectangular shape to provide two longer and two shorter opposing upper rectangular side walls, and said lower section is likewise elongated to provide two longer and two shorter partially cylindrical lower side walls severally extending downwardly from said longer and shorter upper side walls respectively.

3. A bulk container according to claim 2 wherein the centers for said radii of said shorter lower side walls are located inside the container above the lower edge of said upper section and between said two shorter upper side walls, and the centers for said radii of said longer lower side walls are located outside the container above the lower edge of said upper section and beyond said two longer upper side walls.

4. A bulk container according to claim 3 wherein the radii of curvature of said lower side walls are substantially equal, the chord extending between the opposite ends of each of said longer lower side walls inclines to the horizontal at an angle slightly greater than that of the chord extending between the opposite ends of each of said shorter lower side walls, and the centers for said radii of said longer lower side walls are located slightly below the centers for said radii of said shorter lower side walls.

5. A bulk container, comprising an upper rectangular section, a lower hopper section in general having an inverted outwardly curved pyramidal shape and including an outwardly curved partially cylindrical wall on each of its four sides, said walls being joined together along their meeting edges and to said upper section, and an elongated inflatable bag in each corner of said container, such bags when inflated being adapted to pressurize the bulk material confined within said container, especially when filled.

6. A bulk container, comprising an upper rectangular section including a top wall, a lower hopper section in general having an inverted outwardly curved pyramidal shape and including an outwardly curved partially cylindrical wall on each of its four sides, said walls being joined together along their meeting edges and to said upper section, and an elongated inflatable bag in each corner of said upper section and pendant from said top wall and is inflated from the exterior thereof, such bags when inflated being adapted to pressurize the bulk material confined within said container, especially when filled.

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SAMUEL F. COLEMAN, *Primary Examiner.*