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(54) **BIN FOR STORING AND DISCHARGING FREE FLOWING GRANULAR MATERIAL.**

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Description

The invention relates to bulk storage bins with fluid pressure assisted gravity discharge for material in the bin after it assumes its angle of repose.

Free flowing granular material, e.g. sugar, sand, rice, etc. is often stored or contained in silos or bins having rigid walls and bottoms made of metal or some other rigid material. A discharge port is generally provided in the bottom of such a bin or silo, which, when opened, permits the material in the container to flow out. From the discharge port, the material may be conveyed away by a conveying means such as a screw conveyor. If the bottom of the silo or bin, extending from the discharging port to the walls, is flat or horizontal, not all of the free flowing granular material will be discharged through the discharge port by gravity. It is a characteristic of free flowing granular material contained in a flat bottomed bin or silo to stop flowing out the discharge port when the material remaining in the bin is at an angle of repose. The material remaining in the bin after discharge by gravity, forms an inverted partial cone shape inside the silo. The face of the free flowing granular material, extends from the discharge port in the bottom or wall of the silo upward at an angle to the wall of the silo or bin.

To ensure the discharge of the entire contents of a bin, bins have been provided with hopper bottoms. These hopper bottoms have inclined sides, extending upward from the discharge port at an angle towards the bin walls. The angle at which the hopper bottom projects from the discharge port to the bin wall is sufficient to prevent the material in the bin from resting at an angle of repose and to direct the entire contents of the bin towards the discharge port for removal. The shape of the bottom concentrates the weight of the hopper on a smaller area than a flat bottomed silo or bin of the same size. In addition, a bin with a hopper bottom has a higher center of gravity than the same sized bin with a flat bottom. A hopper shaped bin is expensive and wasteful of space.

The general concept of using pneumatically movable flexible membranes inside a container to move materials in the container is known, for example as disclosed in DE—A—2705689, which describes a bin for free-flowing granular material, having a floor, a structural side wall extending upwardly from the floor and a flexible bag suspended from the bin side wall and anchored in registry with a discharge opening. The bag is inflatable away from the bin side walls and floor for causing the material to move towards the discharge opening.

Further none of such prior art has, to applicants knowledge, suggested using a dual-wall, flexible, cup-shaped inflatable bag as the storage bin with its inner wall moveable by pneumatic pressure to cause stored materials to flow by gravity from their angle of repose toward a discharge opening

in the bag.

According to the invention there is provided a bin for free-flowing granular material having a floor, a structural side wall extending upwardly from the floor and a flexible bag suspended from the bin side wall and anchored in registry with a discharge opening, which bag is inflatable away from the bin side wall and floor for causing the granular material to move towards the discharge opening, characterised in that the bag includes a section adjacent the top thereof to provide slack in the bag which absorbs strain on the bag during loading of the bin.

Some embodiments of the invention are described in detail below with reference to drawings which illustrate those embodiments, and in which:

Fig. 1 is a sectional elevation view partially schematic of one embodiment of the storage and discharge bin of this invention having a center discharge.

Fig. 2 is a fragmentary sectional elevation view of a portion of the bin around the discharge opening shown in Fig. 1.

Fig. 3 is a partial sectional elevation view of a portion around the bottom outside edge of the bin shown in Fig. 1.

Fig. 4 is a detailed sectional elevation view of a portion of the upper side edge of the bin shown in Fig. 1.

Fig. 5 is a partial sectional elevation view, also partially schematic, illustrating another embodiment of this invention.

Fig. 6 is a partial detailed elevation view of a portion of the embodiment shown in Fig. 5.

Fig. 7 is a schematic side elevation view of another embodiment of this invention and its controls;

Fig. 8 is a detail elevation view of a top cover of the bin;

Fig. 9 is a detail sectional view of the means for attachment of the bag to the bin walls;

Fig. 10 is an elevation view looking along line 10—10 of Fig. 7;

Fig. 11 is a detail sectional elevation of the discharge area of the bin;

Fig. 12 is a partial sectional elevation of another embodiment of the invention;

Fig. 13 is a view taken along line 13—13 of Fig. 12;

Fig. 14 is a partial sectional elevation of another embodiment of the invention,

Figs. 15A—15F are a series of schematic views showing the sequence of conditions and actions in unloading the bin.

Fig. 16 is a schematic side elevation of another embodiment of the side unloading bin of this invention.

Figs. 17A—17D are a series of schematic views showing the sequence of conditions and actions in unloading the bin of Fig. 16.

Figs. 18A—18F are a series of schematic views showing the sequence of conditions and actions in deflating the flexible cup shaped bag.

Fig. 19 is a schematic view of a safety pressure

relief system for the bag.

Detailed Description of the Preferred Embodiments

As shown in Fig. 1 a storage bin 10 for storing and discharging free-flowing granular material is provided with an inflatable, double-walled, flexible cup-shaped bag 12 having an inner wall 14 and outer wall 16. The bag 12 provides a bottom 18 and side walls 20 of a flexible bin for storing free-flowing granular materials which may be discharged through a discharge opening 22.

The bin rests on a floor 24 having an opening 26 to accommodate discharge of the materials from the bin. A discharge conduit 30 with any suitable type gate or valve means 32 may be utilized to control the discharge of material from the bin.

To discharge the free flowing granular material from a bin constructed in accordance with this invention the gate 32 of the discharge opening 26 must be opened. The contents of the bin may then flow out the opening to be carried away by a conveying means, such as a screw conveyor (not shown), or to be discharged into a moveable container for transport to a different area. The free flowing granular material will continue to flow out of the bin through the discharge port by gravity until the angle of repose for the particular material in the bin is reached, or nearly reached. At the angle of repose, the inner face R of the free flowing material assumes an inverted cone shape with its apex at the discharge opening and discharge of the material by gravity stops.

To overcome the angle of repose and complete the discharge operation, air under low pressure is forced into the bag 12 between the inner and outer walls. The bag 12 begins to inflate at the top of the bin and bulge inwardly towards the center of the bin. This inflation forces the free flowing granular material nearest the top of the inverted cone to cascade down towards the discharge opening by gravity. The pneumatic pressure within the cup shaped bag needs to be relatively low, e.g. about 1.7 to 6.9 kPa, sufficient to overcome the limited resistance caused by the small quantity of granular free flowing material at the top of the inverted cone.

As air continues to inflate the bag, the inner wall 14 extends further towards the center of the storage area until full inflation is achieved and substantially the entire contents of the bin are discharged through the discharge opening.

The flexible cup-shaped bag 12 is anchored adjacent the discharge opening to a stationary member such as the floor opening 26 or conduit 30. In the embodiment illustrated in Fig. 2 it is anchored to the conduit 30 by means of a flat annulus 34 and a flange 36 forced together by a nut and bolt 38 to sandwich the ends of the inner and outer bag walls 14 and 16 adjacent the discharge opening 22. To assist in the anchoring a rope 40 may be secured to the end of the inner wall 14 by an extra loop of material and a heat seal 42 provided, as illustrated in Fig. 2.

The outer edge of the bottom portion and lower

side wall of the cup-shaped bag 12, and particularly the outer wall 16, are anchored to the floor 24 as shown in detail in Fig. 3. Also, the inner wall 14 may be of such size as to require an additional portion of the inner wall to be cemented or heat-sealed to the bottom portion as shown at heat seal 44. The outer wall 16 is looped around a rope 46 and doubled back and heat-sealed at 48. A stud 50 extending from floor 24 has a nut 51 screwed down against a flange 54 of a corrugated side wall 52 sandwiching the bottom edge of outer wall member 16 between the flange 54 and the floor 24.

The anchoring arrangement shown in Figs. 2 and 3 assists in preventing the flexible wall bag from tilting due to large forces of the stored material if it shifts due to loading or unloading. Additionally, wall 52, which may conveniently be corrugated material such as used for grain bins, farm buildings or the like, provides some lateral load support for the outer flexible wall 16. The wall 52 extends upwardly as shown in Fig. 1 and surrounds the outside of the flexible cup-shaped bag 12.

There is provided an opening 56 into the space between the walls 14 and 16 near the top of the side walls of the bag for inflating the bag 12. There is also an exhaust opening 58 near the bottom of the side walls between the walls of the bag as shown in Fig. 1.

As shown in Fig. 4, the corrugated side wall 52 has a top flange 60. A suitable means for providing slack at the upper portion of the side walls to assist in the discharge includes a slack loop 62 in the upper end of wall 14 which is held up by means of a heat-sealed or cemented loop 64 of fabric material, an O-ring 66 and a coil spring 68 hooked to the O-ring and to a support 70. A hoop 72 is secured to the side wall 52 by a nut and bolt 74 to provide support from the side wall for the outer flexible wall 16. A rope 76 and heat seal arrangement similar to that previously described is also provided as shown in Fig. 4. An extension of the outer flexible wall 16x may extend upwardly over flange 60 and be sandwiched between flange 60 and spring support 70 and secured by nut and bolt 77.

As shown in Fig. 1, material may be placed into the storage bin via an inlet chute 78 which may be supported from building structure, not shown, and connected to tension cables 80 extending to the spring support 70. A fabric roof 82 of a material similar to that from which the flexible walls of the flexible wall bag are made is provided to cover the top of the bin. The roof has a one-way vent 84 which will allow air to escape from the bin when the bin is being filled, but will not allow dust or particulate material from the granular free-flowing material to escape.

The slack provided by slack loop 62 assists in the inflation of the bag to discharge the flexible free-flowing material from its angle of repose R in Fig. 1. After material is discharged down to the angle of repose R, fluid under pressure such as air is blown into inlet 56 which initially inflates the

flexible loop 64 providing a good start for the flexible wall assisted discharge of the material.

Another and alternative embodiment for providing slack in the inner side wall at the top of the material after discharge to the angle of repose and to assist in the discharge is shown in Figs. 5 and 6, wherein the same reference numbers indicate the same parts as previously described. Figs. 5 and 6 show, however, a separate inflatable annulus or tire 86 with a separate inflation opening 88. The tire may be inflated to create a bulge or slack in the inner side wall 14 as shown in Fig. 5. The side wall 14 is secured to the corrugated wall 52 by means of hoop 72 and nut and bolt 74 as shown in Fig. 6.

A center discharge side-unloading bin which does not require a hole in the bottom of the supporting floor can be accomplished by providing a false, or raised, floor to create a discharge well at least in the discharge area of the center of the bin and an elongated, closed casing conveyor extending from this raised discharge well to the side of the bin.

The slack above the angle of repose near the top of the flexible side walls of the cup-shaped bag eliminates undue stress at that point during the initial inflation period. The corrugated wall back-up support allows the use of a lighter-weight fabric material and prevents puncturing of the flexible bags. The anchoring to the floor at the outer corners of the outer wall prevents tipping or tilting and is conveniently accomplished by securing this wall under a flange of the corrugated wall.

Embodiments of the invention in side unloading form are shown in Figs. 7—18. Referring to Fig. 7, a bin 10' of this invention is especially suitable and adapted for bulk storage and handling (discharging) free flowing granular material. The bin is supported on a floor or other support 12' having suitable strength to bear the load of the material in the bin. The bin is constructed with side walls 14' which are preferably light weight corrugated metal of the type commonly used for farm grain bins, buildings and the like. The side walls 14' have formed therethrough a discharge opening 16' in the lower portion thereof.

The bin is optionally provided with a suitable top 18' which may be either metal or cloth and preferably has vent means therein (not shown) to allow venting of air from the bin when it is being filled while preventing loss of dirt size particulate material. A suitable loading chute 20' may be supported from the upper floor 22', for example. However, any suitable known means can be used for putting material to be stored into the bin.

The bin side walls 14' have flanges at both ends including flange 24' around the upper periphery of the side wall and flange 26' at the bottom edge of the side wall. Within the bin there is an inflatable generally cup-shaped bag 28' having an inner wall 30' and an outer wall 32'. A portion of the outer wall 32' may be held beneath the lower flange 26' of the side wall 14' and an upper extension of inner bag wall 30' may be supported over the top of bin side wall flange 24'. The

bottom flange 26' is bolted or otherwise securely attached to the floor by conventional securing means, see Fig. 3.

There is provided through the outer wall 32' of the bag and wall 14' of the bin an inflation opening 34' and a deflation opening 36". Although the inflation opening is shown near the top of the cup shaped bag, it can be at any other suitable location.

The top of the double walled bag 28' is slanted and the top of the two bag walls are clamped together by a clamp 38'. This clamp spirals around the bin from a high portion near the top of the bin opposite the discharge opening 16' to a lower portion above the discharge opening, see Fig. 7.

The clamp 38' is shown in detail in Fig. 9 and includes a pair of metal straps 40' sandwiching the ends of the inner and outer wall 30' and 32' and the end of inner wall extension 42' therebetween. The assembly is clamped together and clamped to the bin side wall 14' in numerous locations by a nut and bolt means 44'. The ends of the flexible material bags may rope 46' around them for securing in the clamp.

The inner and outer bag wall 30' and 32' may in some instances be glued together so that they may not inflate in a generally triangularly shaped area 48' extending above and outwardly from the discharge opening 16', see Fig. 10. This prevents the walls from separating upon inflation of the bag. However, such adherence was not necessary in handling sugar, and its use is optional. Both walls of the bag 28' are sealed around the discharge opening by a plate 50' abutting against a backup plate 51'.

A discharge shroud 52' shown in detail in Fig. 11 extends outwardly from the bin discharge opening a distance sufficient so that the material in the bin can flow into a discharge conveyor by gravity. The discharge shroud 52' includes side walls 54', a top wall 56' and a bottom wall 58'. A transparent hatch 60' having a handle 62' is hinged at 64' for closing the top of the discharge shroud and providing access to material therein. At the bottom of the shroud 52 there is a screen 66' for screening the material and a gate valve 68 which may be operated by handle 70'. Below the discharge shroud and particularly below the gate valve 68' there is a screw type conveyor 72' in a conveyor housing 74 for conveying away material discharged. Because the discharge opening 16' is above the level of the floor 12' a built up floor segment 75' is provided.

For inflation and deflation of the bag there is provided a blower 76', see Fig. 7, having an outlet line 78' with valves 80' and 82' controlling whether the output of the blower is directed to inflating the inflatable bag 28' through line 86' or venting to atmosphere. Alternatively the blower could just be turned on when air pressure is required. Line 86' is provided with a check valve 88' to prevent collapsing of the bag during an emptying cycle or if the blower stops. There is a further line 87' connected to deflation opening 36'

leading back to the inlet of the blower 76' and controlled by valves 90' and 92'. A control box 84' is provided with suitable controls for controlling valves 80', 82', 90' and 92'. The control box can also be used to directly control the switching on and off of the blower thus eliminating some of the automatically controlled valving. Manually controlled valves would then be used to select either inflation or deflation.

In connection with the controls, there is a material indicator 94' of a commercially available type (e.g. Z-tron level switch made by Dexelbrook Engineering) which indicates when there is material flowing over it in the bin. This material indicator is positioned just adjacent the discharge in an area just outside the normal boundary of the material emptied to its angle of repose, and is connected electrically to the control box 84', or to directly control the blower.

A perforated vacuum hose 96' is positioned between the walls of the bag 28' at the outside periphery of the bottom to assure that the bag assumes its original position during deflation.

In operation, the bin 10' of Fig. 7 is initially filled with the bulk material to be stored, e.g. sugar, rice, corn, powders, grains, etc. This material should be free flowing material and of a type which can be handled within the bin. Fig. 15A shows the bin loaded with material. When it is desired to discharge material from the bin, gate 68' is opened by virtue of pulling on handle 70' and the material flows out of the bin and out of the discharge opening until such time as it approximates its angle of repose and uncovers the sensor of bin material indicator 94'. At this time the material is in the condition of Fig. 15B. When it senses no material the bin level indicator 94' gives a signal to the control box 84' to start inflating the bag by relatively low pressure from the blower 76'. The top of the bag 28' starts inflating by the inner wall 30' bulging inwardly as shown in Fig. 15C. The material continues to flow and the bag wall 30' continues to expand as shown in Figs. 15D and 15E. During discharge when the material covers the indicator 94' the inflation stops, the check valve 88' holds the low pressure, and the material discharges by gravity until it again uncovers the indicator. This cycle is repeated during the discharge. Near the end of the emptying cycle the inner wall 30' of the bag 28' has raised off the bottom and lifted the small amount of material remaining into the discharge opening, see Fig. 15F.

For deflating the bag and causing it to assume its original position, vacuum applied through perforated vacuum hose 96' draws the bottom of the inner bag wall into the bottom corners of the bin. Inflated toroidal tube 97' is provided to assure that enough slack exists so that the walls of bag 28' are not unduly strained when the bag is again loaded with bulk materials.

If at any time during the discharge there was a problem it could be inspected through transparent hatch 60' and if access is required at the point of discharge the hatch can be opened. Other

transparent viewing areas can be provided in the bin wall.

As a safety measure and to prevent overpressure on the bag wall and consequent damage to the bag during the discharge cycle a pressure relief means is included in the blower system. Overpressure could occur if there were a malfunction of the probe and/or blower, a blockage of material near the probe causing it to misread material flow, or a malfunction of the shut off switch over the bin is completely emptied. An accurate, simple and inexpensive pressure relief means for the very low pressures involved (1.5 to 7 kPa) is shown in Fig. 19. A manometer 110 is connected to blower outlet 78' via line 112, of the same diameter and having a check valve 114 therein. A vented collection connector 116 surrounds the outer leg of the manometer. The system illustrated provides a pressure relief at 5.5 kPa because at any higher pressure the water will be blown out of the manometer into the canister. The check valve prevents vacuum from sucking the water into line 78'. The manometer can be easily refilled with water after a pressure relief blow out.

Fig. 12, 13 and 14 show alternative embodiments in which, for various reasons, it is desirable to have the discharge opening 16' several feet above the level of the floor. In the Fig. 12 and 13 embodiments a false floor 90' which may be installed on top of a honeycomb support 100' is positioned to raise the level of the bottom of the bin until a point just below the discharge opening 16'.

Fig. 14 represents another approach to the problem in which the floor is a tapered false floor 102' tapering upwardly from a point at the floor opposite the discharge opening to a point above the floor and just below the discharge opening.

The advantage of both the Fig. 12 and Fig. 14 embodiments is in having the discharge opening above the level of the floor but not requiring the bag 28' to lift relatively heavy weight of material being discharged any significant distance.

Fig. 16 shows another and presently preferred embodiment. The parts illustrated in Fig. 16 which are substantially the same as those in Fig. 7 bear the same reference numerals. Fig. 16 for example has the same double walled slanted top cup shaped bag 28' clamped to the walls by annular clamp 38'. Additionally, the embodiment of Fig. 16 shows in more detail the inflatable tube 97' with an inflation opening 99' therefor. This inflatable tube or collar extends around the periphery of the bin below the clamp 38'. By inflating tube 97' slack is provided for the inner wall 30' of bag 28'. Thus, this slack is needed when loading the bag with heavy material which causes the bag to conform to the corrugations of the outer wall 14'. By allowing such strain to be absorbed by the air in the inflatable tube 97' strain is removed to a large extent from the clamp 38' and walls of the bag.

Additionally, inflatable tubes 102' and 104' may be placed at levels above the clamp 38' and

provided with suitable inflation openings 103' and 105' for further assisting in the discharge of the materials if the top end of the inflatable bag does not reach the top side of the bin opposite the discharge opening.

In the Fig. 16 embodiment a screw conveyor 106' extends radially from the bin at an angle to the floor to provide discharge at a suitable level to equipment, further storage, etc. This conveyor is beneath a built up false floor 108' also extending at an angle across the segment of the floor. A discharge opening 16' in the floor above the conveyor is closed by a hand operated slide gate 110'. The indicator probe 94' is positioned above the discharge opening 16' and an access opening 112' is provided to allow inspection of the discharge area and access thereto.

In operation of this embodiment reference is had to Figs. 17A—D consecutively. As shown in Fig. 17A the bulk material M will flow by gravity at the discharge when the gate 110' is removed and the conveyor 106' is operative. To assist in discharge above the line of clamp 38' tube 102' is inflated, see Fig. 17C, and later tube 104' may be inflated as in Fig. 17D.

In all embodiments the inner wall of the inflatable bag is self cleaning. This is believed to be due to its periodic flexing and the fact that the material always flows by gravity without being lifted or forced by the bag under high pressure.

Figs. 18A—F illustrate the use of the perforated vacuum tube or hose 96' and the inflatable bag during the deflation and reloading of the bin. As seen in Fig. 18A deflation is starting and vacuum is applied to perforated vacuum hose 96' and at the same time inflatable tube 97' is inflated to bulge it, see Fig. 18B. Thereafter the bag gradually assumes its original position fitting snugly into the corners of the cylindrical bin as shown in Figs. 18C, D and E. However, the inner wall will be bulged out to provide slack when loading the bin as shown in Fig. 18E. Fig. 18F shows how this slack is provided and such is useful in allowing the inner wall to conform to the corrugations in bin wall 14' and otherwise stretch as needed to fill voids when refilling the inner bag with the bulk material to be stored. The inflatable collar 97' may be inflated by the same power source that provides the vacuum to perforated vacuum hose 96'.

In the center discharge embodiment (e.g. Fig. 1), the sensing probe to control the inflation can be in a separate hopper between the bin discharge and a conveyor. As shown in Fig. 1 the discharge conduit 30 leads to a hopper 130 and is controlled by valve means 32 (which can also be a slide valve positioned at the discharge opening 22). The hopper feeds to a conveyor 132 for carrying the material away. A probe 134 is similar in construction, function and operation to probe 94' in the side unloading embodiment.

As can be seen the invention disclosed provides a unique pneumatically assisted handling and discharge means for granular free flowing material in which the bin for storing the material is simple and inexpensively constructed, it has uniform

weight distribution over a supporting floor and can automatically assist in discharging material beyond the angle of repose by automatically inflating the supporting double walled bag. As compared with conventional bulk storage and hoppers the present invention presents dramatic differences in size of the silos required, shipping weight, erection time equipment and costs, floor loading, maintenance and cost.

Claims

1. A bin for free-flowing granular material having a floor (24), a structural side wall (52) extending upwardly from the floor (24) and a flexible bag (12) suspended from the bin side wall (52) and anchored in registry with a discharge opening (22), which bag (12) is inflatable away from the bin side wall (52) and floor (24) for causing the granular material to move towards the discharge opening (22), characterised in that the bag (12) includes a section (62) adjacent the top thereof to provide slack in the bag (12) which absorbs strain on the bag during loading of the bin.

2. A bin as claimed in Claim 1, wherein the bag (12) is a double-walled bag consisting of an outer wall (16) which is anchored around the periphery of the floor (24), and an inner wall (14) having a folded loop section (62) adjacent the top thereof, which folded loop section (62) is suspended by springs (68) from the side wall (52) of the bin.

3. A bin as claimed in Claim 1, wherein the section of the bag (12) which provides slack in the bag overlies a flexible annulus (86) mounted on the side wall of the bin, with a separate air supply (88) for inflating the flexible annulus (86).

4. A bin as claimed in any one of Claims 1 to 3, including a hopper (130) located below the discharge opening (22), and a material detector (134) mounted in the hopper for detecting the presence of material therein.

5. A bin as claimed in Claim 1, wherein the discharge opening (16') is in the lower portion of the side wall (14') of the bin, which is of cylindrical form, and the bag (28') is suspended by a clamp (38') which spirals around the side wall (14') from a high point opposite the discharge opening (16').

6. A bin as claimed in Claim 5, wherein a material detector (94') is positioned in the bin adjacent the discharge opening (16') and is connected to an air supply for controlling inflation of the bag.

7. A bin as claimed in any one of Claims 1 to 6, wherein the floor (24) has at least a portion (75') which slopes upwardly towards the discharge opening (16') until it reaches the discharge opening.

Patentansprüche

1. Ein Behälter für freifließendes körniges Material, mit einem Boden (24), einer tragenden Seitenwand (52), die sich vom Boden (24) nach oben erstreckt, und mit einem elastischen Beutel

(12), der an der Behälterseitenwand (52) aufgehängt und in Übereinstimmung mit einer Auslauföffnung (22) befestigt ist, wobei der Beutel (12) von der Behälterseitenwand (52) und vom Boden (24) weg aufblasbar ist, um das körnige Material zu veranlassen, sich zur Auslauföffnung (22) hin zu bewegen, dadurch gekennzeichnet, daß der Beutel (12) einen Abschnitt (62) nahe seiner Oberseite besitzt, um für einen Spielraum im Beutel (12) zu sorgen, der während der Füllung des Beutels auf den Behälter wirkende Belastungen aufängt.

2. Behälter nach Anspruch 1, bei dem der Beutel (12) eine doppelwandiger Beutel ist, der aus einer Außenwand (16), die um die Außenfläche des Bodens (24) herum befestigt ist, und aus einer Innenwand (14) mit einem gefalteten Schleifenteil (62) nahe deren Oberseite besteht, wobei der gefaltete Schleifenteil (62) mittels Federn (68) an der Seitenwand (52) des Behälters aufgehängt ist.

3. Behälter nach Anspruch 1, bei dem der für Spielraum sorgende Abschnitt des Beutels (12) einen nachgiebigen Ring (86) überlagert, der an der Seitenwand des Behälters angebracht ist, wobei eine gesonderte Luftzufuhr (88) zum Aufblasen des nachgiebigen Ring (86) vorgesehen ist.

4. Behälter nach einem der vorangehenden Ansprüche 1 bis 3, mit einem Einfülltrichter (130) unterhalb der Auslauföffnung (22) und mit einem im Einfülltrichter angeordneten Materialanzeiger (134) zur Anzeige für dort vorhandenes Material.

5. Behälter nach Anspruch 1, bei dem die Auslauföffnung (16') im unteren Teil der Seitenwand (14') des Behälters angeordnet und zylindrisch geformt ist, und bei dem der Beutel (28') mit einer Klammer (38'), die sich von einem hohen Punkt gegenüber der Auslauföffnung (16') um die Seitenwand (14') spiralförmig herumwindet, aufgehängt ist.

6. Behälter nach Anspruch 5, bei dem ein Materialanzeiger (94') im Behälter nahe der Auslauföffnung (16') angeordnet und mit einer Luftzuführung verbunden ist, um das Aufblasen des Beutels zu überwachen.

7. Behälter nach einem der Ansprüche 1 bis 6, wobei der Boden (24) zumindest einen Teil (75') enthält, der schräg nach oben zur Auslauföffnung (16') hin verläuft, bis er die Auslauföffnung erreicht.

Revendications

1. Silo pour matière granulaire coulant libre-

ment, comportant un plancher (24), une paroi latérale (52) de structure s'élevant du plancher (24) et une poche flexible (12) suspendue à la paroi latérale (52) du silo et ancrée en alignement avec une ouverture (22) de déchargement, laquelle poche (12) peut être éloignée par gonflage de la paroi latérale (52) du silo et du plancher (24) afin de provoquer un déplacement de la matière granulaire vers l'ouverture (22) de déchargement, caractérisé en ce que la poche (12) comprend une partie (62) adjacente à son sommet afin de donner à la poche (12) du mou qui absorbe la contrainte appliquée à la poche pendant le chargement du silo.

2. Silo selon la revendication 1, dans lequel la poche (12) est une poche à double paroi comprenant une paroi extérieure (16) qui est ancrée à la périphérie du plancher (24), et une paroi intérieure (14) comportant une partie repliée en boucle (62) adjacente à son sommet, laquelle partie repliée (62) en boucle est suspendue par des ressorts (68) à la paroi latérale (52) du silo.

3. Silo selon la revendication 1, dans lequel la partie de la poche (12) qui donne du mou à la poche s'étend au-dessus d'un anneau flexible (86) monté sur la paroi latérale du silo, une alimentation en air indépendante (88) étant destinée à gonfler l'anneau flexible (86).

4. Silo selon l'une quelconque des revendications 1 à 3, comprenant une trémie (130) située au-dessous de l'ouverture (22) de déchargement, et un détecteur (134) de matière monté dans la trémie afin d'y détecter la présence de matière.

5. Silo selon la revendication 1, dans lequel l'ouverture (16') de déchargement est située dans la partie inférieure de la paroi latérale (14') du silo, qui est de forme cylindrique, et la poche (28') est suspendue par une bride (38') qui forme une hélice autour de la paroi latérale (14') à partir d'un point haut opposé à l'ouverture (16') de déchargement.

6. Silo selon la revendication 5, dans lequel un détecteur (94') de matière est positionné dans le silo à proximité immédiate de l'ouverture (16') de déchargement et est reccordé à une alimentation en air afin de commander le gonflage de la poche.

7. Silo selon l'une quelconque des revendications 1 à 6, dans lequel le plancher (24) comporte au moins une partie (75') qui est inclinée vers le haut en direction de l'ouverture (16') de déchargement jusqu'à ce qu'elle atteigne l'ouverture de déchargement.

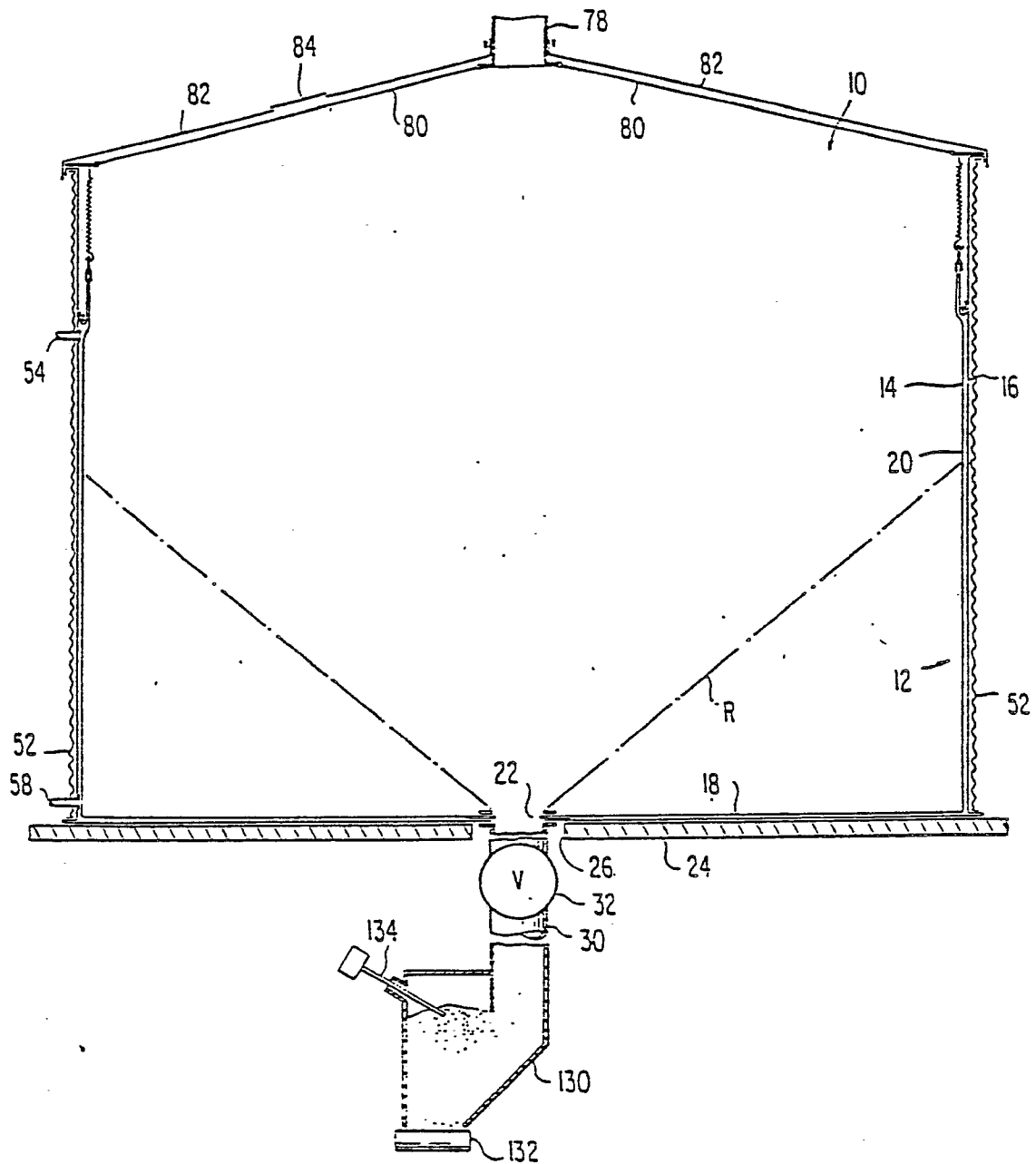
55

60

65

7

FIG. 1



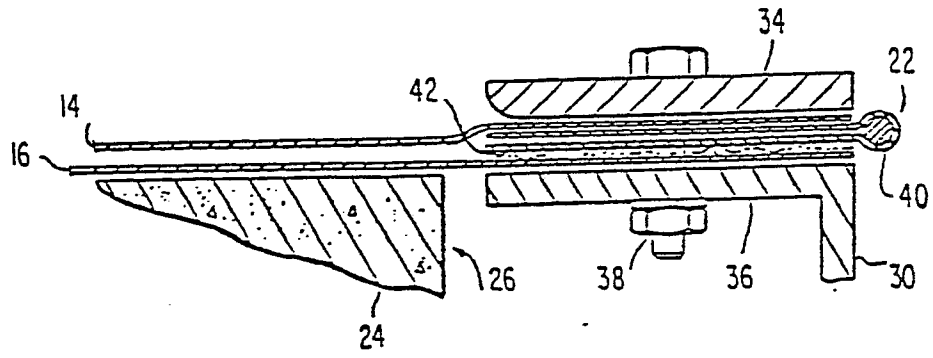
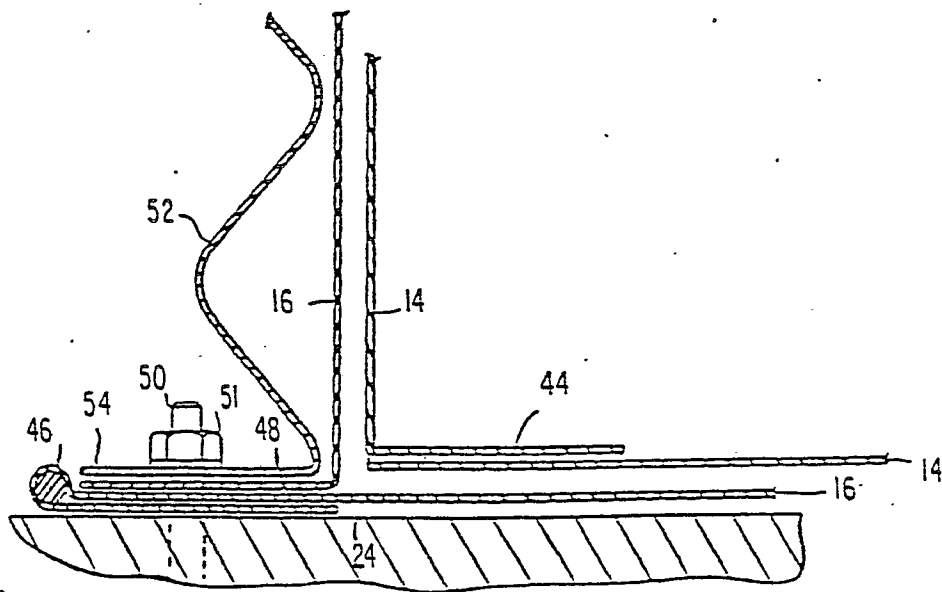
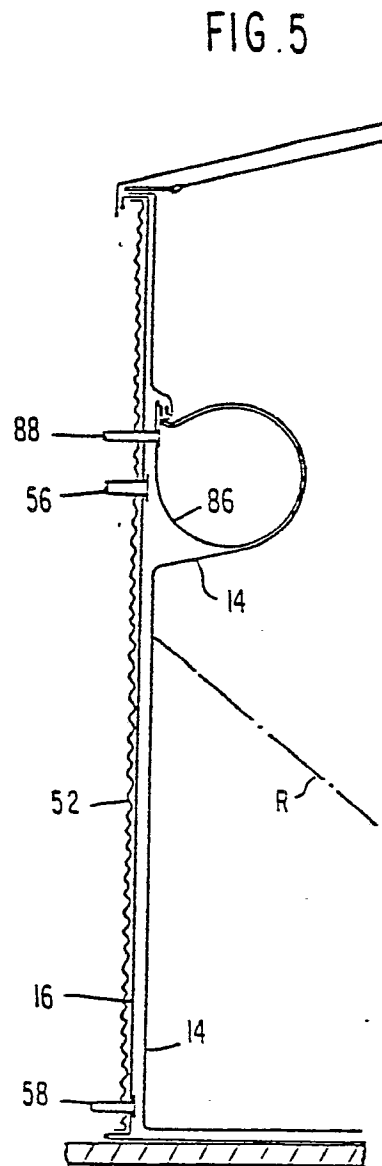
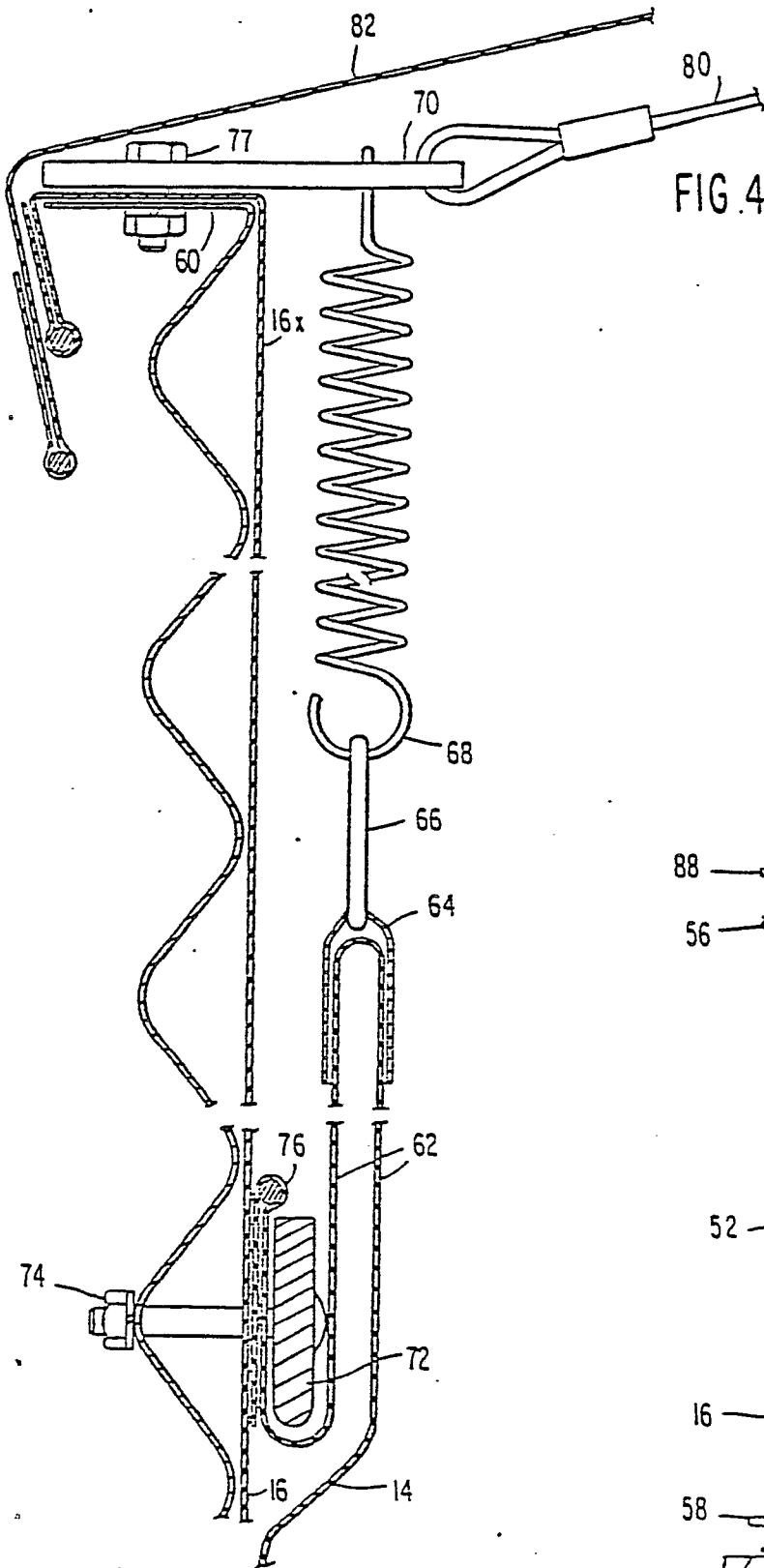


FIG. 2

FIG. 3





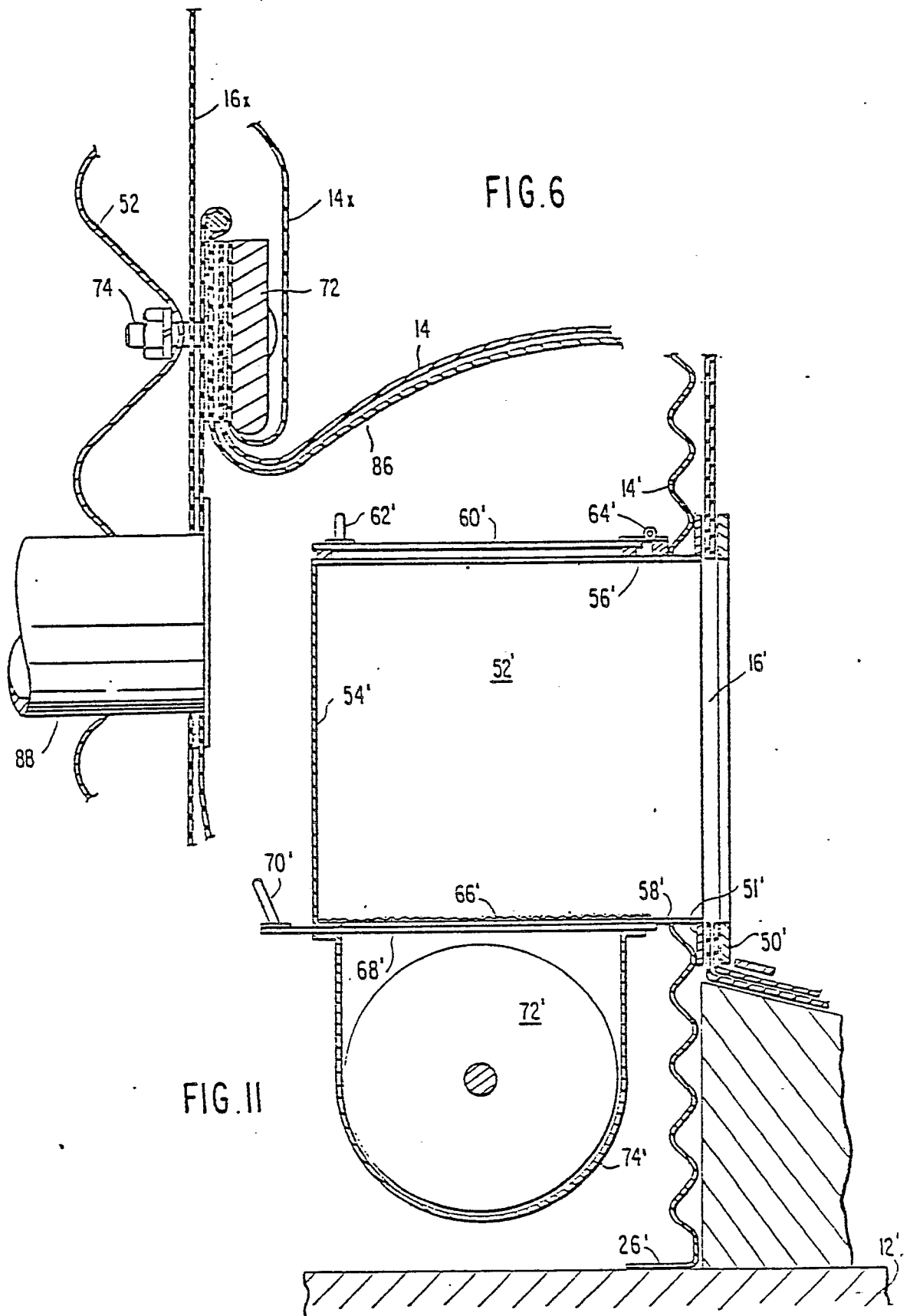


FIG. 7

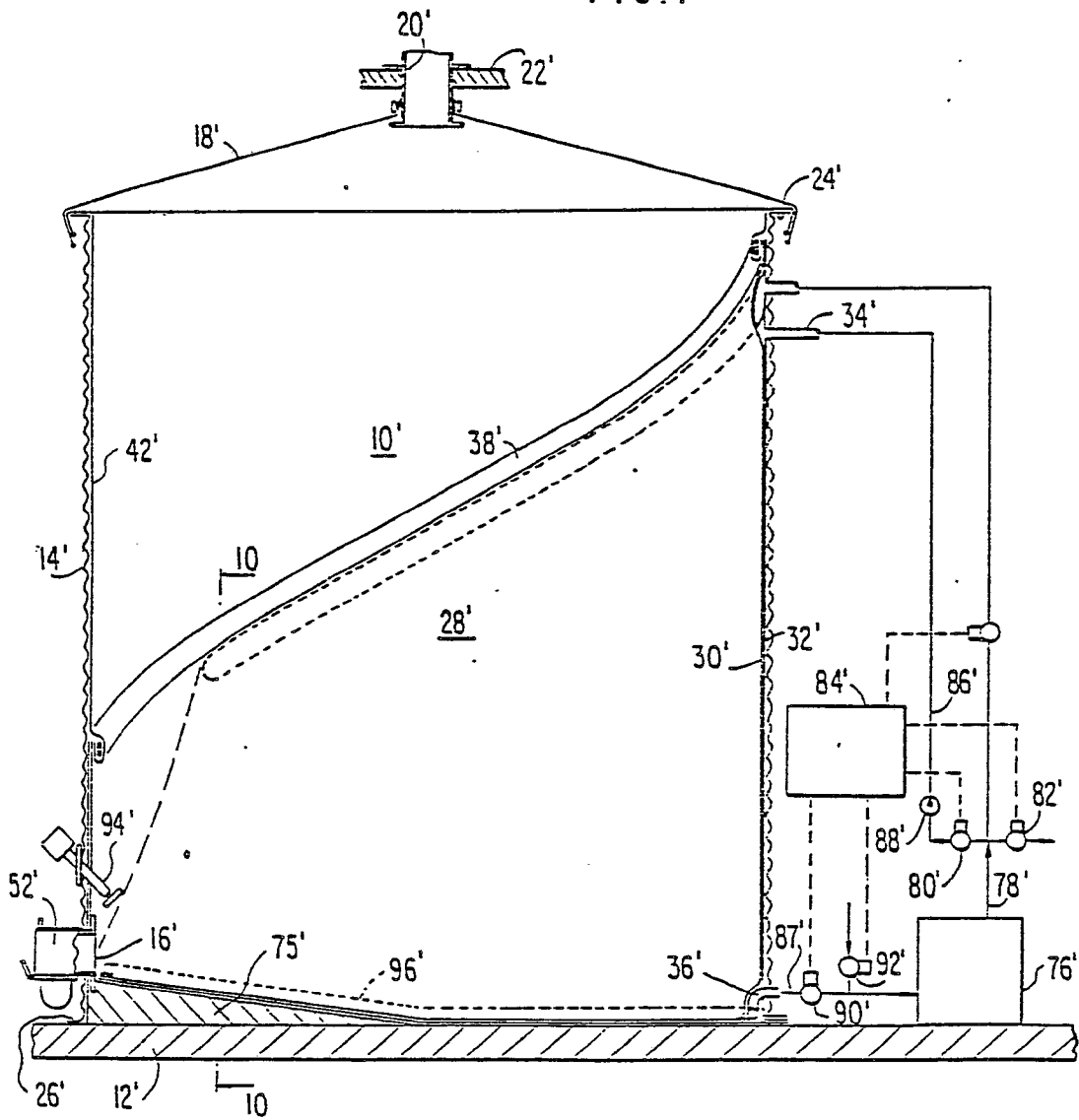


FIG. 19

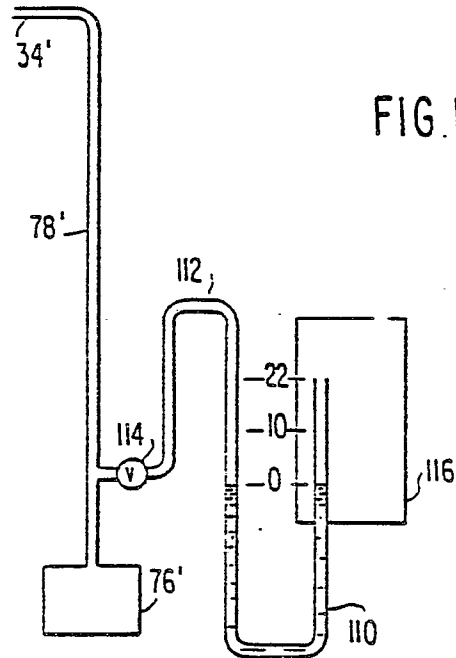


FIG. 8

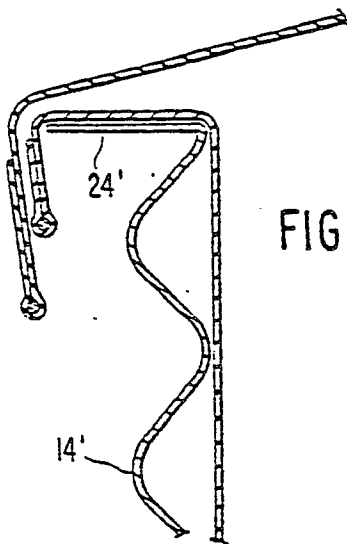


FIG. 9

