

May 30, 1950

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2,509,985

APPARATUS FOR DELIVERING PULVERULENT MATERIAL TO A BAG FROM
SOURCES OF SUPPLY THROUGH CONTAINERS UNDER CONSTANT
HEAD, VOLUMETRIC FEEDER MEANS, AND A PACKER

Filed Oct. 17, 1946

3 Sheets-Sheet 1

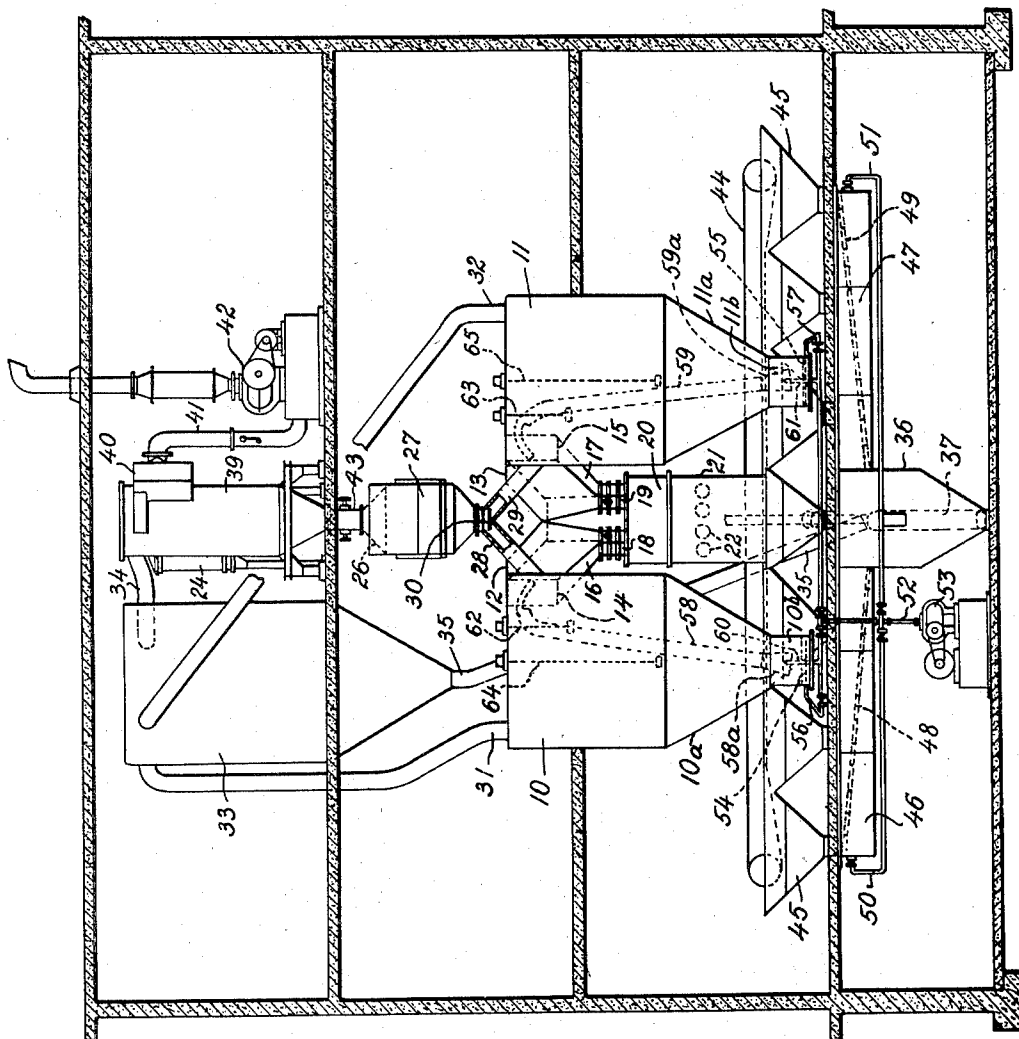


Fig. 1.

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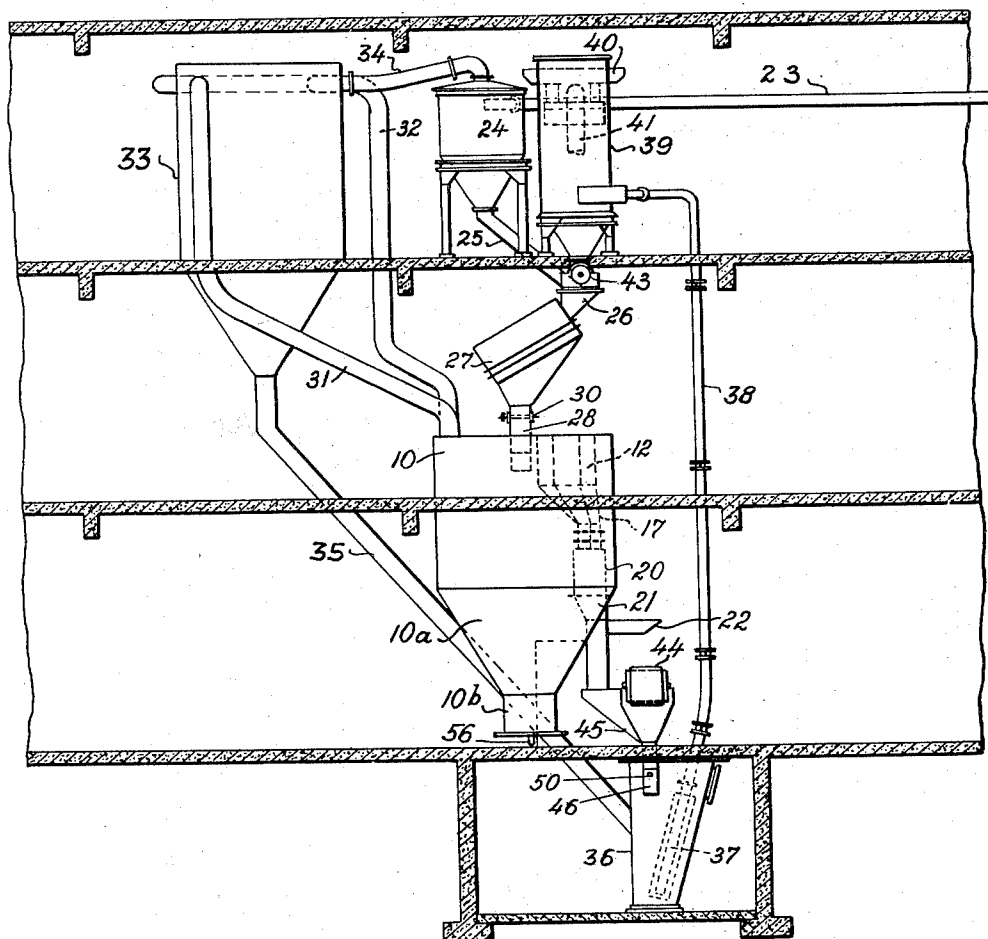
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Fig. 2.



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3 Sheets-Sheet 3

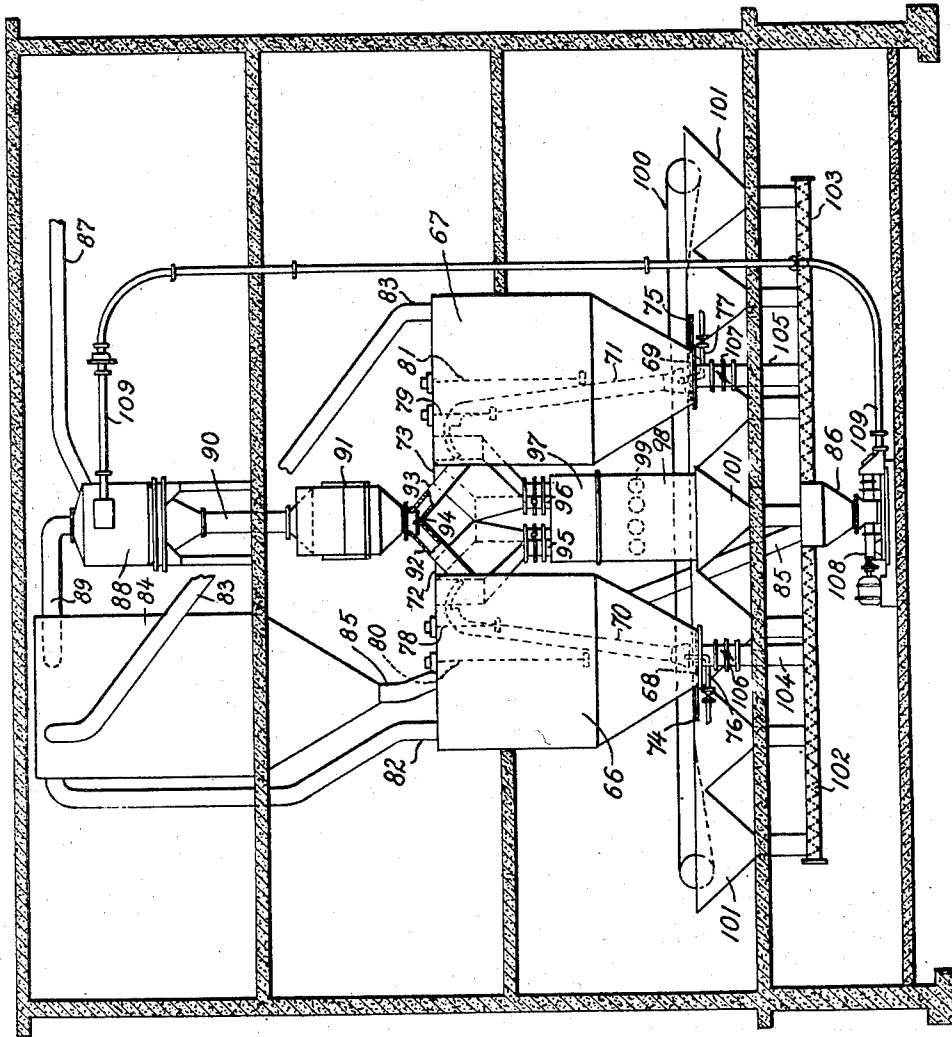


Fig. 3.

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UNITED STATES PATENT OFFICE

2,509,985

APPARATUS FOR DELIVERING PULVERULENT MATERIAL TO A BAG FROM SOURCES OF SUPPLY THROUGH CONTAINERS UNDER CONSTANT HEAD, VOLUMETRIC FEEDER MEANS, AND A PACKER

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Application October 17, 1946, Serial No. 703,861

11 Claims. (Cl. 226-48)

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This invention relates to the packaging of dry pulverulent material, such as cement, lime, soda ash, fertilizers, and other similar materials, which have the characteristic of becoming fluent when admixed with air or other inert gas in proper proportions. More particularly, the invention is concerned with a novel installation for packaging purposes, which includes a packing machine and means for supplying material thereto in such manner that the machine functions to deliver the material at a uniform rate. In addition, the new apparatus includes provision for recovering material lost as a result of spillage or dusting and returning the collected spillage and dust to the main supply of material for proper blending therewith. The new equipment is not only superior in performance to prior similar apparatus, in which the rate of delivery of the material fluctuates for numerous reasons, but also occupies less plant space and is easier to operate.

The equipment of the invention may be employed for the packaging of any of the pulverulent materials having the characteristic above mentioned, but, since it affords special advantages when employed for the packaging of cement, an embodiment of the invention for that use will be illustrated and described in detail for purposes of explanation.

In cement plants, the packaging of the cement at high speeds in bags of uniform weight presents a major problem. At the present time, the bags are intended to be packed to a uniform weight of ninety-four pounds, and, for this purpose, it is common to employ packers having two or more nozzles on which the bags are mounted while they are being filled. In most packers, volumetric feeding devices, such as flutter wheels or high speed horizontal screws, are used to impel the material through the nozzles, and usually the packers include weight responsive means to cut off flow from the nozzles, when the bag has been filled to the desired weight. Although such weight responsive means are carefully regulated and ordinarily adjusted to cut off at slightly less than the bag weight desired, variations of several pounds in the bag weights are frequently encountered, and, since the material is marketed on a weight basis, such variations present a serious problem for the manufacturer.

The fluctuations in the weight of the bags filled

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on present packing apparatus are caused by irregular delivery of the material to the volumetric feeder in the packer. Such irregularities arise from the tendency of pulverulent material in a large feed bin, such as is used to supply present packers, to de-aerate to a greater or less degree and thus pack together and change in density. Another cause of irregular feeding is the tendency of the material to bridge or arch in the bin with the result that the feeder may at one time be starved and then subsequently flooded. Although elaborate expedients have been employed in the construction of feed bins and of devices associated therewith to prevent such irregularities in feeding of the material, the results heretofore attained have been far from satisfactory.

In the packaging of cement by the use of present equipment, further difficulties are encountered in the handling of the fine particles recovered in dust collectors and of the material spilled in the neighborhood of the packer or recovered from broken bags. Such recovered materials are likely to vary in aeration or else they are of fine particle size and thus usually differ chemically from larger particles. Accordingly, a direct return of recovered materials to the packer feed bin would produce segregation in the bin and result in irregularity in the composition of the packed material.

The present invention is directed to the provision of an installation for the packing of pulverulent materials which overcomes the difficulties above pointed out. In the new equipment, a supply of the material in a vessel is initially rendered fluent by aeration and then elevated to a container, in which a body of the material of constant depth is maintained at all times, any excess material supplied to the container preferably being returned to the vessel. The material passes from the container to the volumetric feeder of a packer and, since the material being supplied to the feeder is under a constant head, the feeder delivers the material to the packer nozzles at a uniform rate. The vessel and the container are connected to a dust recovery system and the recovered dust and spillage collected about the nozzles of the packer are returned to the container. Because of the mixing of the material resulting from its aeration and elevation to the container in the manner described, such direct

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return of the dust and spillage to the main supply does not produce segregation in the vessel or variation in the composition of the contents of the bags. In the preferred form of the new installation, a pair of vessels, each having a container connected to the packer, are used, and the packer may be supplied from the containers selectively, so that materials of different composition may be contained in the two vessels and the packer rapidly changed over from one feed to the other.

For a better understanding of the invention, reference may be had to the accompanying drawings, in which

Fig. 1 is a diagrammatic front elevational view showing one form of installation embodying the invention;

Fig. 2 is a diagrammatic side elevational view of the apparatus shown in Fig. 1; and

Fig. 3 is a diagrammatic front elevational view of a modified form of installation.

The installation illustrated in Fig. 1 includes a pair of vessels 10, 11 for holding supplies of cement, ordinarily of different composition, and the vessels have conical lower sections 10a, 11a, terminating, respectively, in bottom cylindrical sections 10b, 11b of relatively small diameter. Containers 12, 13 are associated with the respective vessels, and, in the construction illustrated, the containers are mounted near the tops of their respective vessels and are in communication with the interior thereof through openings 14, 15. The containers have inclined walls 16, 17 leading from the lower edges of the openings 14, 15 and have outlets connected through valves 18, 19 to volumetric feeding means 20 in a packer 21 of standard construction provided with horizontal nozzles 22.

The material to be packaged is pneumatically conveyed from a source of supply through a transport line 23 to a device 24 in which the material is separated from the large excess of air used for conveying purposes. From the separator 24, the material passes through a pipe 25 to a chute 26 leading to a screen 27. From the lower end of the screen, a pair of lines 28, 29 lead to the respective vessels, and a valve 30 controls the flow through the lines 28, 29, so that the material may be supplied to one or the other of the vessels, as desired.

The vessels 10, 11 have vents through their tops connected by lines 31, 32, respectively, to a dust collector 33, which is also connected by a line 34 to the separator 24. The dust recovered in the collector 33 is delivered through a line 35 to a container 36 disposed below the level of the packer and material collected in the container 36 is raised by pneumatic conveying means 37 through a line 38 to a tank 39 provided with an air purifying filter 40 connected through a line 41 to an exhauster 42. The material collected in the tank 39 is discharged through a feeder 43, as required, into the chute 26 leading to screen 27, and is thence conducted to vessels 10, 11 with fresh material being supplied.

A conveying belt 44 is mounted to extend along the front of the packer beneath the nozzles and the filled bags are carried away from the packer on the belt. A plurality of hoppers 45 are mounted beneath the belt and the hopper immediately below the packer discharges into container 36. The hoppers on either side of the packer discharge into chambers 46, 47 lying on opposite sides of the container 36 and containing inclined false bottoms 48, 49 made of porous material,

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known as aeration blocks. The false bottoms in the chambers lead downwardly from the outer ends of the chambers to container 36 and air is supplied to the chambers beneath the false bottoms through air lines 50, 51 connected to an air line 52 supplied by a blower 53. The material discharged from the hoppers upon the upper surfaces of the false bottoms 48, 49 is aerated by air diffusing through the porous blocks and flows down the inclined surfaces to enter container 36 through openings in its opposite side walls.

The supply of material within each vessel 10, 11 is aerated by air or other inert gas diffusing means 54, 55 in the cylindrical bottom end section 10b, 11b of each vessel. Such diffusing means may take the form of a false bottom of aeration blocks to the under surface of which air is supplied through lines 56, 57 connected to the air line 52. The aerated material is elevated from the vessels to be discharged into their associated containers through elevator pipes 58, 59 within the vessels. The pipes have enlarged intake sections 58a, 59a at their lower ends and air is introduced into the intake sections of the pipe through air nozzles 60, 61 connected to the air line 52 and extending upward through the lower ends of the vessels and into the intake sections a short distance. The pipes 58, 59 have curved upper ends extending into the containers 12, 13 and, upon introduction of air through the nozzles into the lower ends of the pipes, the fluent material and air rise through the pipes to be discharged into the containers. The containers are thus filled to a specific level, after which excess material discharged into the containers overflows the bottom edges of openings 14, 15 and returns to the vessels.

The vessels 10, 11 are, respectively, provided with high level signal devices 62, 63 and low level signal devices 64, 65. Such devices may merely give indications or may be used for controlling the supply of material delivered through the transport line 23, as desired.

In the operation of the installation shown in Figs. 1 and 2, the vessels 10, 11 are supplied with the material to be packaged, and both vessels may contain the same material and be employed at the same time, or materials of different compositions may be supplied to the vessels and the vessels used in alternation. When both vessels are to be used for the same material, the material is supplied through the transport line 23 and passes through the separator 24 to screen 27 and is directed into the vessels in alternation. The contents of the vessels are then aerated and elevated to fill the containers 12, 13 to the desired level. From the containers, the material passes to the volumetric feeder of the packer and the feeder discharges the material at a uniform rate through the packer nozzles, since the supply to the feeder is under a constant head at all times.

Dust from the separator 24 and from the vessels and the containers in communication therewith is recovered in separator 33 and delivered to the container 36. Container 36 also receives spillage from the packer and the contents of bags that are broken during the packing operation. The material collected in container 36 is then raised to the container 39 and discharged, as required, into the chute 26, through which the fresh material delivered through the transport line passes to screen 27 and thence through lines 28, 29 to the respective vessels 10, 11. Such direct return of the collected dust and spillage to the main supply vessels is permissible in the new

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equipment, because the material within the vessels is thoroughly mixed as a result of the aeration and elevation of the material from the vessels to their containers with the excess material discharged from the containers returning to the vessels. The new equipment thus insures not only uniform filling of the bags by the packer, but also provides for the return of the dust and spillage in such a way as to prevent variations in the contents of the bags.

In the modified form of apparatus illustrated in Fig. 3, the vessels 66, 67 are provided with aerating means 68, 69 and with elevator pipes 70, 71 discharging through openings in the walls of the respective vessels into containers 72, 73. Air or other inert gas for aeration is supplied to the aerating means in the vessels through lines 74, 75 and air used for elevating is discharged into the intake sections at the lower ends of the elevating pipes through nozzles 73, 77. The vessels are provided with high level signal devices 78, 79 and low level signal devices 80, 81. The vessels have vents in their upper ends connected through lines 82, 83 to a dust collector 84 and the collected dust is conducted through a line 85 to a container 86. The material to be packaged is pneumatically conveyed through a transport line 87 to an air separator 88, which is connected by a line 89 to the dust collector 84. The material passes from the separator 88 through a line 90 to the screen 91 from which lines 92, 93 lead to the respective vessels 66, 67. A valve 94 controls flow through the lines 92, 93, so that material from the screen may be delivered into either vessel 10, 11, as desired.

The containers 72, 73 are connected through valves 95, 96 to a volumetric feeder 97 in a packer 98 provided with nozzles 99. A conveyor belt 100 runs beneath the nozzles and over the top of a plurality of hoppers 101. The central hopper in the group leads directly into container 86 and the hoppers on either side thereof discharge into the casings of screw conveyors 102, 103, which deliver material into container 86. Lines 104, 105 containing valves 106, 107 lead from the bottoms of the respective vessels 66, 67 to conveyors 102, 103. Container 86 discharges into intake of a transport pump 108 connected by a line 109 to the separator 88.

The operation of the apparatus shown in Fig. 3 is as follows: The material to be packaged is delivered through the transport line to the separator 88 and flows therefrom through screen 91 and alternately through lines 92, 93 to the interior of vessels 66, 67. The supplies of material in the vessels are aerated and then elevated through pipes 70, 71 to containers 72, 73, in which a body of material of constant depth is maintained at all times. From the containers, the material passes to the volumetric feeder 97 in packer 98. Dust recovered in the dust collector 84 from the vessels 66, 67 and their containers and also from the separator 88 passes to the container 86, as does also spillage collected in the chutes 101. The material from vessel 86 is returned to the separator 88 and flows with the fresh supply of material to vessels 66, 67. The connections 104, 105 from the bottoms of the vessels 66, 67 provide a convenient means for emptying the vessels, whenever a change in the kind of material to be packaged is to be made.

In the different forms of apparatus illustrated, the vessels in which the material is aerated have been shown as having conical lower ends, and aeration blocks are employed as the means for

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diffusing air through the material. It is to be understood that the vessels need not have the specific form illustrated, and other aerating means, such as air rings or perforated plates, may be used in place of the blocks. In the event that the vessels are of cylindrical form, the aerating means may have an area substantially less than the cross-sectional area of the vessel in which it is used.

The apparatus for elevating the pulverulent material from the supply vessels forms the subject matter of my application, Serial No. 703,859, filed October 17, 1946, and the apparatus for supplying the material under constant head to the packer forms the subject matter of my application, Serial No. 703,860, filed October 17, 1946.

I claim:

1. Apparatus for filling bags with uniform weights of a pulverulent material, which comprises a vessel for holding a body of the material, means for maintaining the interior of the vessel at substantially atmospheric pressure, a container having a part above the level of material in the vessel, means for introducing inert gas into the material in the vessel to render the material fluent, an elevator pipe having an intake near the bottom of the vessel and an outlet for directing material into the container, means for introducing inert gas into the pipe through the intake to cause the gas and material to rise through the pipe and issue through the outlet into the container, an outlet orifice from the container, the container having a wall for confining a body of material of constant depth above said outlet orifice and also having an opening through which material overflowing said wall may escape from the container, the outlet of the elevator pipe being positioned to direct material into the container above said wall, volumetric feeding means at a level lower than the container outlet orifice, a connection between the volumetric feeding means and the container outlet orifice, and a packer for receiving pulverulent material from the volumetric feeding means for filling a bag with the pulverulent material.

2. Apparatus for filling bags with uniform weights of a pulverulent material, which comprises a vessel for holding a body of the material, means for maintaining the interior of the vessel at substantially atmospheric pressure, a container having a part above the level of material in the vessel, means for introducing inert gas into the material in the vessel to render the material fluent, an elevator pipe having an intake near the bottom of the vessel and an outlet for directing material into the container, means for introducing inert gas into the pipe through the intake to cause the gas and material to rise through the pipe and issue through the outlet into the container, an outlet orifice from the container, the container having a wall for confining a body of material of constant depth above said outlet orifice and also having an opening through which material overflowing said wall may escape from the container, the outlet of the elevator pipe being positioned to direct material into the container above said wall, means for collecting dust from the vessel and the container, means for returning collected dust to the interior of the vessel, volumetric feeding means at a level lower than the container outlet orifice, a connection between the container outlet orifice and the volumetric feeding means, and a packer for receiving pulverulent material from the volumetric

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feeding means for filling a bag with the pulverulent material.

3. Apparatus for filling bags with uniform weights of a pulverulent material, which comprises a vessel for holding a body of the material, means for maintaining the interior of the vessel at substantially atmospheric pressure, a container having a part above the level of material in the vessel, means for introducing inert gas into the material in the vessel to render the material fluent, an elevator pipe having an intake near the bottom of the vessel and an outlet for directing material into the container, means for introducing inert gas into the pipe through the intake to cause the gas and material to rise through the pipe and issue through the outlet into the container, an outlet orifice from the container, the container having a wall for confining a body of material of constant depth above said container outlet orifice and also having an opening through which material overflowing said wall may escape from the container, the outlet of the elevator pipe being positioned to direct material into the container above said wall, volumetric feeding means at a level lower than the container outlet orifice, a connection between the container outlet orifice and the volumetric feeding means, a packer for receiving material from the volumetric feeding means for filling a bag with the pulverulent material, and means for collecting spillage at the packer and returning it to the interior of the vessel.

4. Apparatus for filling bags with uniform weights of a pulverulent material, which comprises a vessel for holding a body of the material, means for maintaining the interior of the vessel at substantially atmospheric pressure, a container having a part above the level of material in the vessel, means for introducing inert gas into the material in the vessel to render the material fluent, an elevator pipe having an intake near the bottom of the vessel and an outlet for directing material into the container, means for introducing inert gas into the pipe through the intake to cause the gas and material to rise through the pipe and issue through the outlet into the container, an outlet orifice from the container, the container having a wall for confining a body of material of constant depth above said outlet orifice and also having an opening through which material overflowing said wall may escape from the container, the outlet of the elevator pipe being positioned to direct material into the container above said wall, volumetric feeding means at a level lower than the container outlet orifice, a connection between the container outlet orifice and the volumetric feeding means, a packer for receiving pulverulent material from the volumetric feeding means for filling a bag with the pulverulent material, dust collecting means for recovering dust from the vessel and container, means for collecting spillage at the packer, and means for returning the spillage and collected dust to the interior of the vessel.

5. Apparatus for filling bags with uniform weights of a pulverulent material, which comprises a vessel for holding a body of the material, means for maintaining the interior of the vessel at substantially atmospheric pressure, a container having a part above the level of material in the vessel, means for introducing inert gas into the material in the vessel to render the material fluent, an elevator pipe having an intake near the bottom of the vessel and an outlet for directing material into the container, means for introduc-

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ing inert gas into the pipe through the intake to cause the gas and material to rise through the pipe and issue through the outlet into the container, an outlet orifice from the container, the container having a wall for confining a body of material of constant depth above said container outlet orifice and also having an opening through which material overflowing said wall may escape from the container, the outlet of the elevator pipe being positioned to direct material into the container above said wall, a pneumatic transport line through which the material is conveyed in suspension in air, a tank to which the line leads and in which the material is separated from the conveying air, means for conducting material from the tank to the interior of the vessel, means for collecting dust from the tank, vessel, and container, means for delivering the dust into the interior of the vessel, volumetric feeding means below the level of the container outlet orifice, a connection between the container outlet orifice and the volumetric feeding means, and a packer for receiving pulverulent material from the volumetric feeding means for filling a bag with the pulverulent material.

6. Apparatus for filling bags with uniform weights of a pulverulent material, which comprises a vessel for holding a body of the material, means for maintaining the interior of the vessel at substantially atmospheric pressure, a container having a part above the level of material in the vessel, means for introducing inert gas into the material in the vessel to render the material fluent, an elevator pipe having an intake near the bottom of the vessel and an outlet for directing material into the container, means for introducing inert gas into the pipe through the intake to cause the gas and material to rise through the pipe and issue through the outlet into the container, an outlet orifice from the container, the container having a wall for confining a body of material of constant depth above said container outlet orifice and also having an opening through which material overflowing said wall may escape from the container, the outlet of the elevator pipe being positioned to direct material into the container above said wall, a pneumatic transport line through which the material is conveyed in suspension in air, a tank to which the line leads and in which the material is separated from the conveying air, means for conducting material from the tank to the interior of the vessel, means for collecting dust from the tank, vessel, and container, volumetric feeding means below the level of the container outlet orifice, a connection between the container outlet orifice and the volumetric feeding means, a packer for receiving pulverulent material from the volumetric feeding means for filling a bag with the pulverulent material, means for collecting spillage at the container, and means returning the spillage and collected dust to the interior of the container.

7. Apparatus for filling bags with uniform weights of a pulverulent material, which comprises a vessel for holding a body of the material, means for maintaining the interior of the vessel at substantially atmospheric pressure, a container having a part above the level of material in the vessel, means for introducing inert gas into the material in the vessel to render the material fluent, an elevator pipe having an intake near the bottom of the vessel and an outlet for directing material into the container, means for introducing inert gas into the pipe through the intake

to cause the gas and material to rise through the pipe and issue through the outlet into the container, an outlet orifice from the container, the container having a wall for confining a body of material of constant depth above said container outlet orifice and also having an opening through which material overflowing said wall may escape from the container, the outlet of the elevator pipe being positioned to direct material into the container above said wall, means for collecting dust from the vessel and the container, means for purifying the collected dust, means for delivering the purified dust into the interior of the vessel, volumetric feeding means below the level of the container outlet orifice, a connection between the container outlet orifice and the volumetric feeding means, and a packer for receiving pulverulent material from the volumetric feeding means for filling a bag with the pulverulent material.

8. Apparatus for filling bags with uniform weights of a pulverulent material, which comprises a pair of vessels each for holding a body of the material, means associated with each vessel for maintaining the interior thereof at substantially atmospheric pressure, a pair of containers each associated with a vessel and having a part above the level of material in its related vessel, means for introducing an inert gas into the material in each vessel to render the material fluent, an elevator pipe for each vessel, each pipe having an intake near the bottom of its related vessel and an outlet for directing material into the container associated with its vessel, means for introducing inert gas into each pipe through the intake thereof to cause material and gas to rise through the pipe and issue through the outlet into the container related to the pipe, an outlet orifice from each container, each container having a wall for confining a body of material of constant depth above its outlet orifice and also having an opening through which material overflowing said wall may escape from the container, the outlets of the elevator pipes being positioned to direct material into the respective associated containers above their said walls, volumetric feeding means at a level lower than either container outlet orifice, valved connections between the respective containers and the volumetric feeding means, and a packer for receiving pulverulent material from the volumetric feeder means for filling a bag with the pulverulent material.

9. Apparatus for filling bags with uniform weights of a pulverulent material, which comprises a pair of vessels each for holding a body of the material, means associated with each vessel for maintaining the interior thereof at substantially atmospheric pressure, a pair of containers each associated with a vessel and having a part above the level of material in its related vessel, means for introducing an inert gas into the material in each vessel to render the material fluent, an elevator pipe for each vessel, each pipe having an intake near the bottom of its related vessel and an outlet for directing material into the container associated with its vessel, means for introducing inert gas into each pipe through the intake thereof to cause the gas and material to rise through the pipe and issue through the outlet into the container related to the pipe, an outlet orifice from each container, each container having a wall for confining a body of material of constant depth above its outlet orifice and also having an opening through which material over-

flowing said wall may escape from the container, the outlets of the elevator pipes being positioned to direct material into the respective associated containers above their said walls, volumetric feeding means at a level lower than either container outlet orifice, valved connections between the respective containers and the volumetric feeding means, a packer for receiving pulverulent material from the volumetric feeding means for filling a bag with the pulverulent material, means for collecting dust from the vessels and containers, and means for returning the collected dust to the vessels.

10. Apparatus for filling bags with uniform weights of a pulverulent material, which comprises a pair of vessels each for holding a body of the material, means associated with each vessel for maintaining the interior thereof at substantially atmospheric pressure, a pair of containers each associated with a vessel and having a part above the level of material in its related vessel, means for introducing an inert gas into the material in each vessel to render the material fluent, an elevator pipe for each vessel, each pipe having an intake near the bottom of its related vessel and an outlet for directing material into the container associated with its vessel, means for introducing inert gas into each pipe through the intake thereof to cause the gas and material to rise through the pipe and issue through the outlet into the container related to the pipe, an outlet orifice from each container, each container having a wall for confining a body of material of constant depth above its outlet orifice and also having an opening through which material overflowing said wall may escape from the container, the outlets of the elevator pipes being positioned to direct material into the respective associated containers above their said walls, volumetric feeding means at a level lower than either container outlet orifice, valved connections between the respective containers and the volumetric feeder means, a packer for receiving pulverulent material from the volumetric feeding means for filling a bag with the pulverulent material, and means for introducing material into the containers to maintain the supply therein.

11. Apparatus for filling bags with uniform weights of a pulverulent material, which comprises a pair of vessels each for holding a body of the material, means associated with each vessel for maintaining the interior thereof at substantially atmospheric pressure, a pair of containers each associated with a vessel and having a part above the level of material in its related vessel, means for introducing an inert gas into the material in each vessel to render the material fluent, an elevator pipe for each vessel, each pipe having an intake near the bottom of the vessel and an outlet for directing material into the container associated with its vessel, means for introducing inert gas into each pipe through the intake thereof to cause the gas and material to rise through the pipe and issue through the outlet into the container related to the pipe, an outlet orifice from each container, each container having a wall for confining a body of material of constant depth above its outlet orifice and also having an opening through which material overflowing said wall may escape from the container, the outlets of the elevator pipes being positioned to direct material into the respective associated containers above their said walls, volumetric feeding means at a level lower than either container

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outlet orifice, valved connections between the respective containers and the volumetric feeder means, a packer for receiving pulverulent material from the volumetric feeding means for filling a bag with the pulverulent material, means for collecting dust from the vessels and containers, means for collecting spillage at the packer, and means for returning the collected dust and spillage to the vessels.

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