METHOD AND EQUIPMENT FOR FILLING OPEN MOUTH RECEPTACLES WITH PULVERULENT MATERIAL

Clarence W. Vogt, Weston, Conn.

Filed July 21, 1958, Ser. No. 749,866
22 Claims. (Cl. 141—5)

This invention relates to the art of packaging and more particularly to the filling of open mouth receptacles or containers with pulverulent material.

As conducive to an understanding of the invention it is noted that where pulverulent material such as flour, powdery cake, coffee and other ground materials are charged into open mouth containers or vials, such as bags or bottles by siftling or discharging it through a tube, the operation is extremely time-consuming, especially where large numbers of containers are to be filled. In addition, due to the large amounts of air entrained with the material, the latter is not firmly packed or compacted into the container with the result that a given volume of the material has relatively little weight and in addition, due to indeterminate quantities of air that remain in the container, the weight of a given volume varies from container to container.

In an attempt to speed up the filling operation, gas under pressure is applied to the material to cause it to discharge more rapidly into the container, due to the large quantities of gas entrained with the material, it tends to spout or dust from the container as the latter is being filled, resulting in waste of the material in addition to the health hazards to the workmen caused by reason of the large number of particles entrained into the atmosphere. In addition, due to such spouting or dusting, the inside of the container adjacent its mouth becomes coated with the particles, which interfere with effective sealing of such mouth.

It is accordingly among the objects of the invention to provide a relatively simple method and equipment for expeditiously filling open mouth containers with pulverulent material at a relatively high rate of speed without spouting or dusting, hence without waste of the material as it is discharged into the containers and with the desired degree of compaction so that a given volume of material in the container is relatively heavy in weight.

According to the invention in its broadest aspect, pulverulent material is forced through an outlet port or orifice of a nozzle into an open mouth cavity or container in communication with the nozzle, by the application of gas under pressure to a charge of material and a large percentage of the gas content therein is vented therefrom prior to its entrance into the cavity or container.

In the accompanying drawings in which is shown one or more of various possible embodiments of the several features of the invention,

Fig. 1 is a longitudinal sectional view of filling equipment according to one embodiment of the invention, and Fig. 2 is a longitudinal sectional view of a filling nozzle according to another embodiment of the invention.

Referring now to the drawings the equipment desirably comprises a cylindrical casing 11 having an annular flange at its upper end which extends laterally inward and outward toward the casing 11 as at 12 and 13. Associated with the casing 11 is a gas chamber which desirably comprises a casing 14 having opposed walls 15 and 16 and an enlarged portion 17 defining a gas reservoir. The walls 15 and 16 have vertically aligned openings 18 and 19, and the wall 15 has an upstanding rim 21 coaxial with opening 18 and of inner diameter greater than that of opening 18 to define an annular shoulder 22.

The rim 21 and the casing 11 are secured together as by screws 23; the inner surface of rim 21; the opposed wall 11' of casing 11; the undersurface of flange portion 13 and the shoulder 22 defining an annular chamber 24.

Extended through the opening 19 in wall 16 is an elongated sleeve 28 of inner diameter slightly less than that of casing 11. The sleeve 28 extends its lower end which has a beveled annular flange 29, has an annular flange 31 which is secured to the undersurface of wall 16 as by screws 32. The length of the sleeve 28 is such that when so mounted, its upper end 33, which is beveled as at 34 on its inner surface, will extend slightly into opening 18 being viewed from the lower end 35 of casing 11 to define an annular port 34, the outer diameter of sleeve 28 being less than the inner diameter of opening 18 to define a gas inlet port 37.

As the diameter of opening 18 is greater than the outer diameter of the cylindrical portion 11' of casing 11, an annular passageway is provided, to accommodate the annular skirt 39 of an annular piston 41 slidably mounted in chamber 24, the portion of chamber 24 beneath the piston being vented as at 41. The lower end of skirt 39 has an inwardly extending annular flange 42 which is movable in port 36, between the opposed ends 33 and 35 of the sleeve 28 and the casing 11 respectively and defines a valve member.

To provide an effective seal for the piston 41, annular seals 43, 44 are provided in its inner and outer peripheries and the skirt 39 is provided with an external annular seal 45 which engages the wall surface of opening 18. In addition, the upper end 33 of sleeve 28 has an annular seal 46 against which the valve member or flange 42 may abut.

Desirably, the dimensions of the piston 41, the flange 42 and the port 36 are such that when the flange is in its uppermost position against the end 35 of casing 11, the top surface of the piston 41 will be spaced from the undersurface of flange portion 13 of casing 11.

Secured as by screws 51 to the flange portion 13 is a cover plate 52 which has a beveled central port 53 aligned with the casing 11. The cover plate 52 has an elongated recess 54 in its undersurface which in conjunction with the flange of casing 11 defines a channel in which a plate 55 having a beveled end 56 is slidably mounted to open and close the port 53 as desired. An annular gasket 57 is provided in the flange portion of the casing 11 coaxial with the port 53 to provide a seal with respect to plate 55 and port 53. A hoper 58 is mounted on the top surface of the cover plate 52.

Positioned in the casing 11 and sleeve 28 and extending coaxially therewith is a cylindrical filter liner or sleeve 61 which is laterally spaced from the casing 11 and the sleeve 28 to define an annular chamber 62. To this end, the inner flange portion 12 has a reduced diameter portion 63 on its undersurface which encompasses the upper portion of liner 61. The lower end of the liner has an outwardly extending annular flange 64 which seats in an annular recess 65 in the lower end of the casing 11.

The liner 61 is preferably of porous material such as sintered metal and desirably differs in permeability from its upper to its lower portion, the upper portion being of substantially greater permeability.

The liner 61 is releasably held in position as by a cup-shaped retainer 66 which has an annular top surface 67 with an upstanding peripheral rim 68 that encompasses the lower end 29 of sleeve 28, the bevel portion of end 29 being engaged by inclined screws 69 through rim 68.
3 releasably to mount the retainer 66, the top surface 67 having an annular gasket 71 to provide a seal.

The inner surface 72 of the retainer tapers inwardly to a point at 73 in the lower end thereof, said port being axially aligned with the liner 61.

The retainer 66 in its undersurface, coaxial with the port 73 has an annular recess 74 in which is positioned the flange end 75 of a sleeve or nozzle 76, the inner end of the nozzle 76 desirably being beveled as at 77 to form substantially a continuation of the inclined surface 72 of the retainer 66.

The outer end of the nozzle 76 has a plate 78 of larger diameter secured thereto as by welding, the plate 78 having an outlet port or orifice 79 axially aligned with the nozzle 76.

The nozzle 76 serves as a filter to vent gas that may pass therethrough and to restrain passage of the material being packaged and for this purpose is preferably of porous material such as sintered metal. Desirably, the plate 78 is of non-porous material and serves as a spreader for the material passing through orifice 79.

To prevent the material from sticking to plate 78 it may be of "Teflon" or coated with a release agent such as silicone.

The nozzle 76 is releasably secured to the retainer 66 as by a split ring 81 of inner diameter less than the outer diameter of flange 75 and which encompasses nozzle 76, the ring being secured to the retainer 66 as by screws 82.

Although the nozzle 76 may be of any suitable dimensions, according to one illustrative embodiment, it has an inside bore diameter of five-eighths of an inch, an inside length of one inch, with the length of orifice 79 being approximately one-eighth of an inch and having a diameter of approximately thirty-three seconds of an inch.

Means are provided to actuate the piston 41 and valve member 42 and to relieve the gas under pressure in the liner 61 at the end of the filling cycle. To this end, as shown, passages 82 and 83 are provided in the flange portion 13 leading respectively from the chamber 24' between the top surface of piston 41 and flange 13 of casing 11 to a port 84 and from the annular chamber 62 between the casing 11 and the liner 61 to a port 85.

With the slide plate 55 in open position, and the hopper 58 filled with the material to be packaged, illustratively pulverulent material such as powdered coffee, which will flow into the liner 61 which defines a magazine, to fill the latter, a container R is positioned in a holder H on a support S beneath the nozzle 76. The end of the nozzle extends into the mouth of the container to the desired level at which the container or cavity filling is to begin and the diameter of plate 78 is less than the inside diameter of the container R to permit escape of gas from the latter.

To control the operation of the equipment, a valve V is provided which has a port P-1 connected to port 85 and a port P-2 connected to port 84. The valve has a pressure inlet port P-3 and an exhaust port P-4. In the "blow" position of the valve V as shown, ports P-2 and P-4 are connected, and in the "normal" position of the valve, ports P-2 and P-3 are connected and ports P-1 and P-4 are connected.

With the valve V in the normal position, gas under pressure in the chamber to 100 p.s.i. is applied through ports P-3, P-2 to port 84, the ports P-1 and P-4 also being connected, so that port 85 is connected to atmosphere to exhaust the annular chamber 62.

As the upper surface area of the piston 41 exposed to the air pressure in chamber 24' from port 84 is greater than the undersurface area of the valve member 42 exposed to gas pressure in reservoir 17 which is charged to the same pressure as that applied to port P-3, the piston 41 will be normally retained in its downward position so that the valve member 42 engages the gasket 46 to provide a seal between the reservoir 17 and the annular chamber 62.

To operate the unit, the slide plate 55 is closed and valve V moved to the "blow" position shown.

As a result, ports P-2 and P-4 will be connected to cut off the gas under pressure to port 84 and chamber 24' and vent said chamber to atmosphere and port 85 will be closed. Consequently, the greater pressure against the valve member 42 due to the gas pressure in reservoir 17 will rapidly lift the valve member 42 to provide communication from reservoir 17 and port 37 through port 36 to the annular chamber 62. This surge of gas under pressure will flow through the porous liner 61, which is preferably of greater permeability at its upper portion, to react against the top and sides of the column of material in the liner, forcing such material downwardly into the nozzle 76.

By reason of the gas pressure against the material in the liner 61 and by reason of the relatively small outlet port 79, the material forced into the nozzle will compact therein and the gas pressure will instantly build up. However, by reason of the porosity of the nozzle and the relatively great surface area thereof so compared with the area of port 79, a large percentage of the interstitial, as well as entrained gas in the nozzle will vent through the porous wall thereof and only a small amount of gas pressure will be available at the outlet port 79 which, however, is sufficient to force the material through the port 79 rapidly to be discharged into the container R to fill the latter.

As substantially all of the interstitial, as well as the entrained gas under pressure has been vented, there is substantially none entrained with the material which is discharged from the nozzle and hence there is no spouting or dusting of such material as it fills the container.

The material discharge into the container will be relatively compact therein and such compaction may be enhanced by jolting the support S on which the container rests during the filling operation.

When the level of the material in the container reaches the level of the port 79 in the lower end of the nozzle, further discharge of material from the port 79 will be stopped. This is due to the fact that the slight residual gas pressure available at the port 79 to cause discharge of the material therethrough is not sufficient to overcome the blocking action of the material already discharged into the container which now abuts against the port 79 of the nozzle, which material tends to resist lateral movement at a substantial angle to its normal vertical axis.

After the container R is filled, before moving it away from the nozzle, the valve V is actuated to "normal" position which will again connect the source of gas under pressure to port 84 which will recluse valve member 42, the vent 41 permitting downward movement of the latter, and which will connect port 85 through ports P-1, P-4 of valve V to atmosphere to release the gas in the liner 61, the latter, by reason of its porosity, permitting passage of gas therethrough but restraining escape of the pulverulent material.

Thereupon, the container R may be removed, no material discharging from the outlet port 79 of the nozzle by reason of the compaction of the material remaining within the nozzle 76.

In the embodiment of Fig. 2, the nozzle 91 desirably comprises a sleeve 92 which has an annular flange at its upper end with portions extending inwardly and outwardly as at 93 and 94. The lower end 95 of the sleeve is an axial bore 97 therethrough defining an outlet port or orifice and the sleeve 92 has a port 98 between its ends.

Positioned in the sleeve 92 is a filter liner 99 preferably of porous material such as sintered metal, such as bronze or the like, the liner illustratively being an elongated
tapering sleeve of length such that its wider mouth end will seat in an annular recess 101 in flange portion 93 and its outlet end 102 will seat in a recess 103 in plug 96 coxial with outlet port 97. Preferably the permeability of liner 99 is greater at its lower portion than at its top portion to prevent excessive compaction at such upper portion which might prevent the desired rate of flow of material from port 97. The nozzle 91 which may be used in conjunction with the equipment shown in Fig. 1, replacing the nozzle 76 is of length such that it may reach substantially the bottom of the container R' to be filled, the latter being mounted in a holder H' positioned on a support S'. The diameter of sleeve 92 is less than that of the container R' to permit passage of gas therefrom.

In the operation of the equipment shown in Fig. 2, the nozzle 91 is initially positioned in container R' so that the outlet port 97 is slightly spaced from the bottom thereof, the cross-sectional area of port 97 being less than one-quarter of the cross-sectional area of container R'.

The support S' on which the container R' rests is vertically movable in the illustrative embodiment shown and during the filling operation the support S' is moved downwardly at a rate less than the rate at which the container is being filled with material from the outlet 97 of the nozzle 91, and if desired, the support S' may be repeatedly jolted during its downward movement to enhance compaction.

Thus, as the container R' fills with material from the bottom up, the level of the material will reach the outlet 97 of the nozzle to stop further discharge of the material therefrom as previously described with respect to the embodiment shown in Fig. 1, the nozzle 96 serving as a spreader to level the material discharged into the container R'. As the support S' carrying the container R' moves downwardly, the top surface of the material thus far discharged into the container will move away from the outlet of the nozzle to permit further discharge therefrom. This is continued until the material in the container reaches the desired level. The complete filling operation above described may occur in a fraction of a second or much more slowly as desired.

Inasmuch as the lower end of the nozzle is initially near the bottom of the container R', the degree of compaction of the material discharged thereafter will be relatively high and as the distance from the outlet port 97 to the top of the material throughout the filling operation remains small, the relatively high degree of compaction will be maintained throughout the filling operation.

The equipment is especially suitable for the simultaneous filling of a large number of containers each with its own nozzle.

Thus, for example, using nozzles 91 of the type shown in Fig. 2 with each nozzle in an associated container R', the containers will fill in the manner described and continue during the downward travel of support S' until the material in all the containers has reached the same desired level which is determined by the relative uppermost position of the outlet ports 97 with respect to the associated containers.

Such measured filling of a multiplicity of containers is thus accomplished without the need of individual valves to stop discharge into each container.

After all the containers have been filled, as previously described, valve V can be actuated to "normal" position to connect the source of gas under pressure to port 84 to again actuate the piston 41 to effect downward movement of the latter to move the valve member 42 to closed position to stop further discharge of gas through port 36, and the chamber 62 is vented to atmosphere to release the pressure.

If it is desired to clear the inner surface of liner 99, a source of low pressure gas may be applied to port 98 for this purpose.

With the equipment above described, no gas seal is required between the mouth of the container and the filling nozzle, yet there will be no spouting or dusting of material from the container with resultant waste thereof and possible health hazard to the operator.

The air under pressure forced through the liner 61 in addition to effecting downward movement of the material therein by the pressure against the upper portion of the column of such material, will also tend to move the material away from the inner wall surface of the liner to act as a lubricant that will facilitate such downward movement of the column of material. Such downward movement of the material is enhanced by having the liner 61 of substantially greater permeability at its upper end with the permeability decreasing from the upper end to the lower end.

As the surface area of the porous portion of the nozzle through which gas can escape is considerably greater than that of the outlet port thereof, most of the interstitial and entrained gas may be vented to atmosphere before the material is discharged through the outlet port or orifice of the nozzle, and hence there is no build-up of pressure which would cause a large quantity of gas to escape, and with the material discharged from the outlet port with resultant undesirable spouting and dusting thereof.

If desired, instead of venting the air escaping from ports 85 and 98 to atmosphere, where inert gas is used, such gas may be reused.

The dimensions of the nozzle 76 hereinafter given are illustrative of one typical embodiment of the invention and are in no way to be construed as limiting, for depending upon the nature of the material, the relation between the area of the porous portion of the nozzle through which the gas may be vented and the outlet port may be as desired to achieve the desired results.

With the equipment above described, using a given gas pressure and a given nozzle, the volume and degree of compaction and hence the weight of a given type of material will be substantially constant from container to container.

As many changes could be made in the above method and construction, and many apparently widely different embodiments of this invention could be made without departing from the scope of the claims, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. The method of filling pulverulent material into a receptacle which comprises positioning the receptacle with its mouth in communication with the outlet nozzle of a magazine containing such material, applying a gas under pressure greater than atmosphere against the material in the magazine which is filled sufficiently, to at least completely cover the inlet to such outlet nozzle, with a quantity of such material greater than that required to fill the receptacle, thereby to force some of the material downwardly through such outlet nozzle into the receptacle and simultaneously venting gas from the material through the nozzle wall to the exterior of the receptacle during the course of the travel of the material through the outlet nozzle into the receptacle whereby the material charged into the receptacle will be in compacted form.

2. The method set forth in claim 1 in which the receptacle is jolted while it is being filled to enhance the compaction of the material being discharged thereinto.

3. The method set forth in claim 1 in which the gas under pressure in the magazine is released prior to opening of the magazine for filling thereof.

4. The method set forth in claim 1 in which the outlet is in non-pressure gas-tight relationship with the receptacle.

5. The method set forth in claim 1 in which the receptacle is filled to the level of the outlet.
6. The method set forth in claim 1 in which the outlet end of the nozzle is positioned adjacent the bottom of the receptacle for discharge of material from the nozzle, and while the receptacle is being filled, relative movement is effected between the receptacle and the nozzle.

7. The method set forth in claim 6 in which the maximum rate of fill of the material discharged into the receptacle is greater than said rate of movement between the receptacle and the nozzle so that the material will abut against the outlet of the nozzle to progressively decrease the rate of discharge therefrom.

8. The method set forth in claim 1 in which the gas pressure against such material in the magazine is removed when the material in the receptacle has reached a desired level, whereby the filled receptacle can then be removed.

9. Equipment for filling pulverulent material into receptacles comprising a magazine for such material, said magazine having an outlet, a nozzle having an inlet secured to said outlet, said nozzle having an outlet port, means to apply a source of gas under pressure against the contents of said magazine to force material therefrom through the outlet into the nozzle and through the nozzle out of the outlet port thereof, said nozzle being of sintered material, whereby as such pulverulent material is forced through said outlet port, said material will be vented through the wall of said nozzle yet the passage of such material through said nozzle wall will be restrained.

10. The combination set forth in claim 9 in which said nozzle has its outlet port at one end and the surface area of the sintered portion of the nozzle is many times greater than the area of said outlet port.

11. The combination set forth in claim 9 in which said nozzle is a sleeve having a plate secured to one end thereof, said plate having an axial bore defining the outlet port and being of area greater than the cross sectional area of the nozzle.

12. The combination set forth in claim 11 in which the plate is of non-porous material.

13. The combination set forth in claim 11 in which the plate is of non-porous material and has a release agent on its undersurface.

14. The combination set forth in claim 9 in which said nozzle comprises an elongated member having its inner wall surface tapering inwardly from the inner of the nozzle toward the outlet port thereof.

15. The combination set forth in claim 9 in which said nozzle comprises an elongated sleeve of rigid material, a liner of sintered material is positioned in said sleeve extending axially thereof and laterally spaced therefrom to define a chamber therebetween, means to apply gas under pressure to the contents of said magazine to force material therefrom through the outlet into the nozzle and through the nozzle out of the outlet port thereof, said nozzle having at least part of its wall of filter material, the passages therebetween being smaller than said particle size, whereby as such pulverulent material is forced through said outlet port, said gas will be vented through the filter portion of said nozzle, yet the passage of such material through the filter portion of said nozzle will be restrained.

References Cited in the file of this patent

UNITED STATES PATENTS

<table>
<thead>
<tr>
<th>Patent Number</th>
<th>Name</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>38,546</td>
<td>Beall</td>
<td>May 19, 1863</td>
</tr>
<tr>
<td>280,478</td>
<td>Hunter et al</td>
<td>July 3, 1883</td>
</tr>
<tr>
<td>494,979</td>
<td>Dawson</td>
<td>Apr. 4, 1893</td>
</tr>
<tr>
<td>1,016,498</td>
<td>Heybach</td>
<td>Feb. 6, 1912</td>
</tr>
<tr>
<td>1,266,706</td>
<td>Nickle</td>
<td>May 21, 1918</td>
</tr>
<tr>
<td>2,352,663</td>
<td>Sewden</td>
<td>July 4, 1944</td>
</tr>
<tr>
<td>2,339,026</td>
<td>Goldberg</td>
<td>Sept. 26, 1944</td>
</tr>
<tr>
<td>2,488,394</td>
<td>Goldberg</td>
<td>Nov. 15, 1949</td>
</tr>
<tr>
<td>2,564,969</td>
<td>Goldberg</td>
<td>Aug. 21, 1951</td>
</tr>
<tr>
<td>2,611,938</td>
<td>Hansberg</td>
<td>Sept. 30, 1952</td>
</tr>
<tr>
<td>2,613,864</td>
<td>Carter</td>
<td>Oct. 14, 1952</td>
</tr>
<tr>
<td>2,639,072</td>
<td>Goldberg</td>
<td>May 19, 1953</td>
</tr>
<tr>
<td>2,689,674</td>
<td>Goldberg</td>
<td>Sept. 21, 1954</td>
</tr>
<tr>
<td>2,756,906</td>
<td>Carter</td>
<td>July 31, 1956</td>
</tr>
</tbody>
</table>