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METHOD AND EQUIPMENT FOR FILLING OPEN MOUTH RECEPTACLES WITH PULVERULENT MATERIAL

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Fig. 1

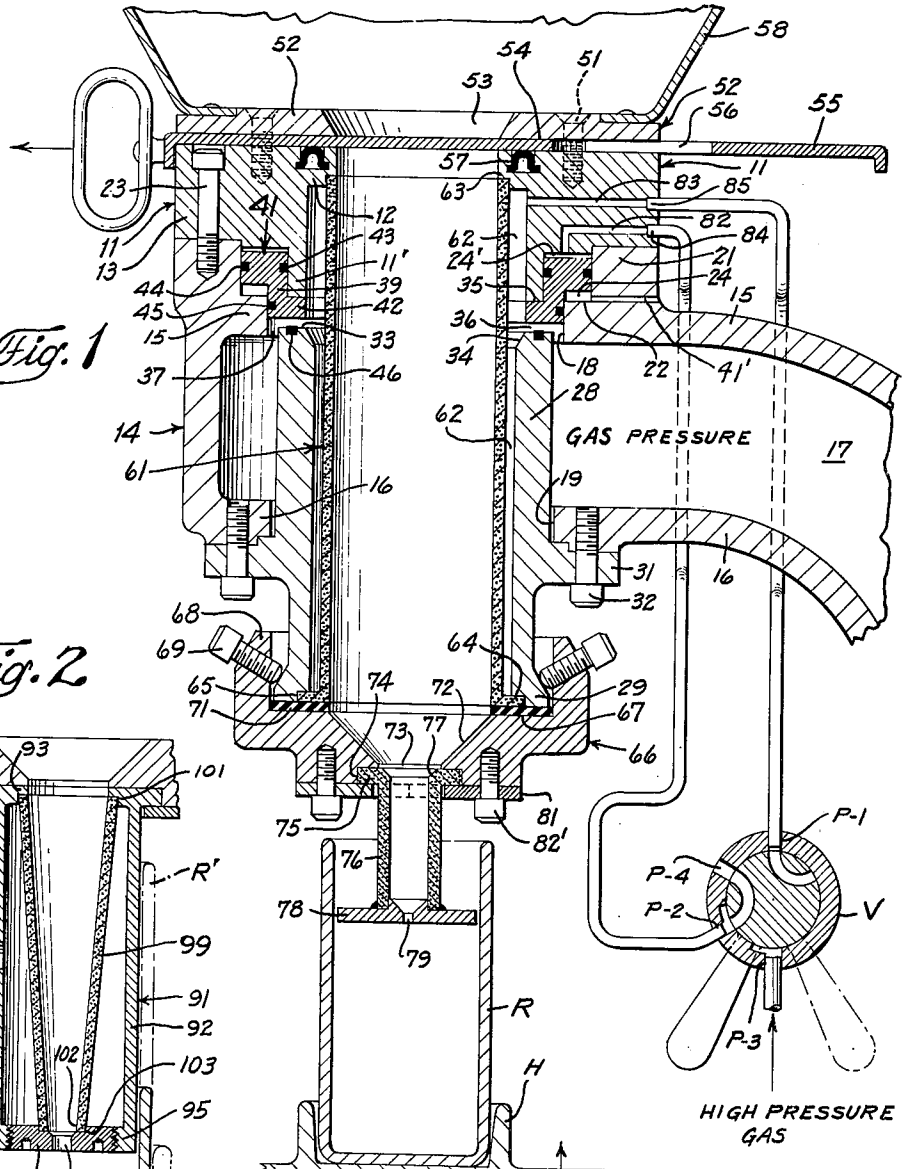
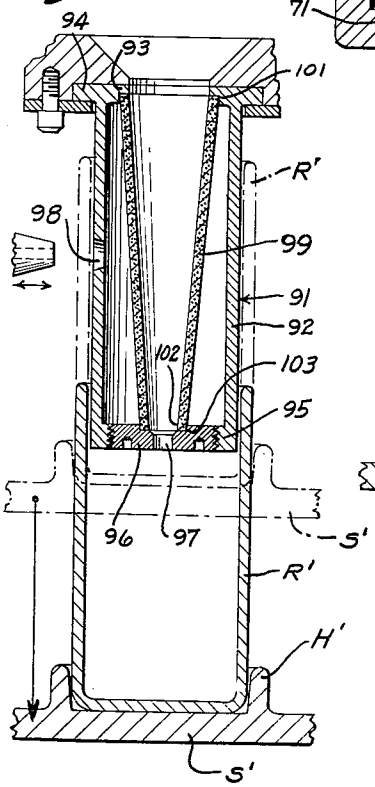


Fig. 2



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METHOD AND EQUIPMENT FOR FILLING OPEN MOUTH RECEPTACLES WITH PULVERULENT MATERIAL

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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, powdered coffee and other finely ground materials are charged into open mouth containers or cavities such as bags or bottles by sifting 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 material, the weight of a given volume varies from container to container.

Where, 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 of 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**.

Extending 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** adjacent 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 vertically spaced from the lower end **35** of casing **11** to define an annular port **36**, 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** as shown.

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 an aperture **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 hopper **58** is mounted on the top surface of the cover plate **52**.

Positioned in the casing **11** and sleeve **28** and extending coaxial 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 sleeve **28**.

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 beveled portion of end **29** being engaged by inclined screws **69** through rim **68**

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 port 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 pupose 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-eights 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 three-thirty 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, passageways 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 order of 30 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 the 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 reclose 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 92 is internally threaded to receive a plug 96 which has 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** coaxial 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 plug **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 thereinto 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 gas 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 be entrained 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** heretofore 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 prior to 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 receptable is greater than the rate of relative 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 nozzle, gas in the 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 elnogated member having its inner wall surface tapering inwardly from the inlet 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 securely to mount said liner in said sleeve, said nozzle having an outlet port at one end axially aligned with the liner.

16. The combination set forth in claim 15 in which said sleeve has a port leading into said chamber.

17. The combination set forth in claim 15 in which the liner has its inner wall surface tapering inwardly toward the end of the nozzle having the outlet port, a plug is secured in said end, said plug having an axial bore defining said outlet port, said liner being securely retained between the plug and the other end of the sleeve.

18. The combination set forth in claim 15 in which the permeability of the liner is greater at the portion thereof adjacent the outlet port than at the portion thereof remote from the outlet port.

19. The combination set forth in claim 9 in which said magazine comprises a rigid substantially cylindrical casing, a cylindrical liner in said casing extending axially thereof and spaced therefrom defining a chamber therebetween, said liner having at least the upper portion thereof of permeable material, means to close the upper end of said liner, means to apply a source of gas under pressure to said chamber, whereby said gas under pressure will flow through the permeable portion of said liner to react against the contents thereof, said magazine outlet being at the lower end of said liner.

20. The combination set forth in claim 19 in which said nozzle and permeable portion of said liner are of sintered material.

21. The combination set forth in claim 19 in which substantially the entire length of the liner is of permeable material and the upper portion is of greater permeability than the lower portion thereof.

22. Equipment for filling pulverulent material of fine particle size into receptacles, comprising a magazine for such material, said magazine having an outlet, a rigid 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 having at least part of its wall of filter material, the passageways through said wall being smaller than said particle size, whereby as such pulverulent material is forced through said nozzle, gas in the material 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.

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