United States Patent

[11] 3,592,357

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2470 Lane Road, Columbus, Ohio 43221
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[54] **METHOD AND APPARATUS FOR DISPENSING CONTROLLED VOLUMES OF GAS**
24 Claims, 15 Drawing Figs.

[52] U.S. Cl. 222/193; 222/207, 222/402.2, 222/450
[51] Int. Cl. G01f 11/28
[50] Field of Search 222/207, 213, 402.2, 446, 447, 450, 451, 453, 209, 193, 1

[56] **References Cited**
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3,198,404 8/1965 Welches .... 222/446 X

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ABSTRACT: A method and apparatus for dispensing controlled volumes of gas at a predetermined pressure from a pressurized source. The dispensed gas may be introduced directly into a material-receiving chamber for the purpose of mixing with and ejecting material therefrom.

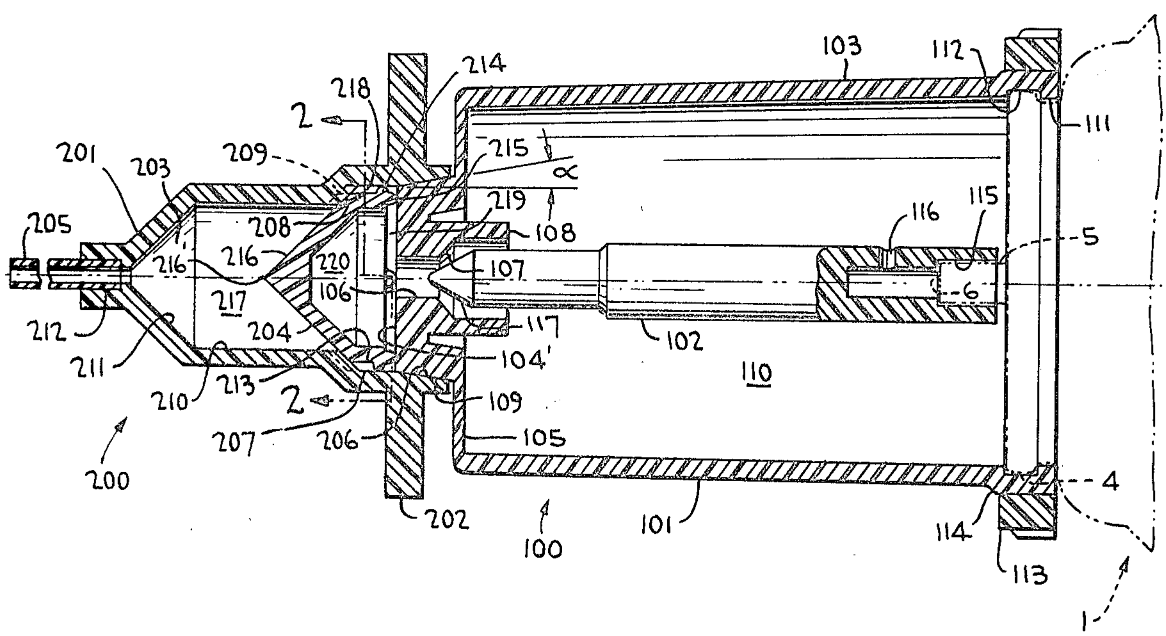


FIG. 1

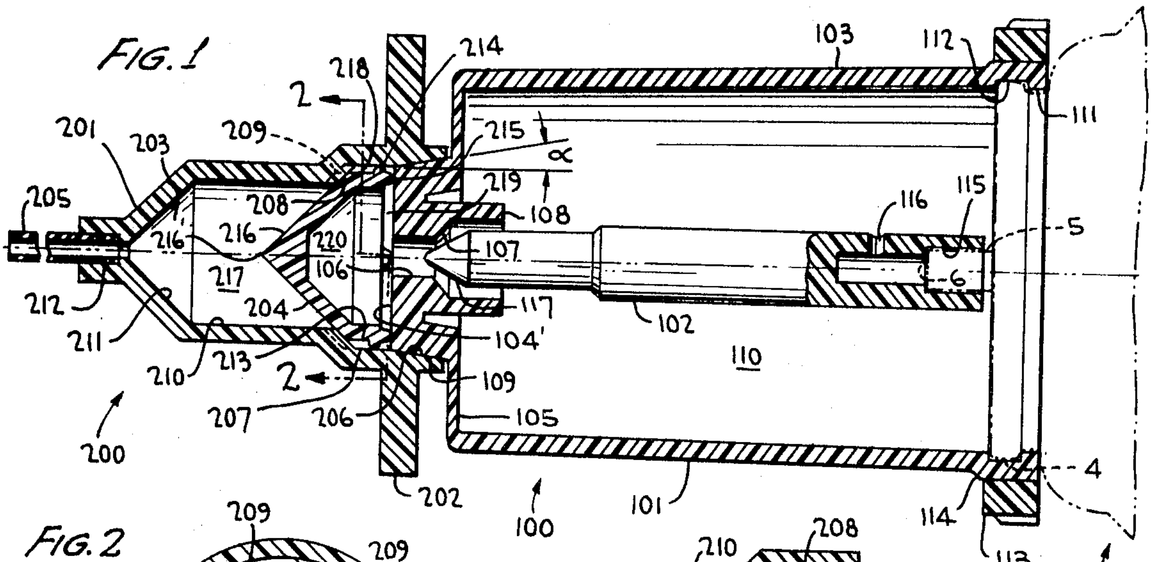


FIG. 2

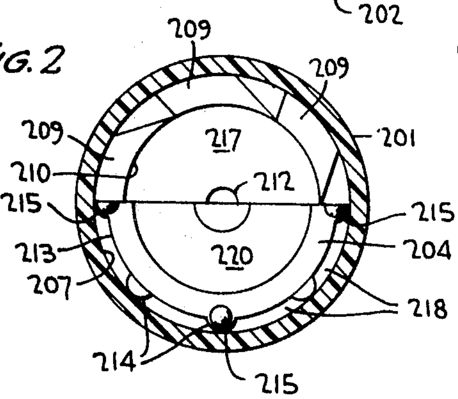


FIG. 3

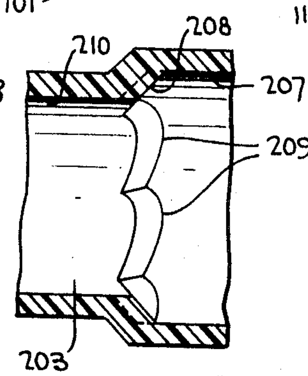
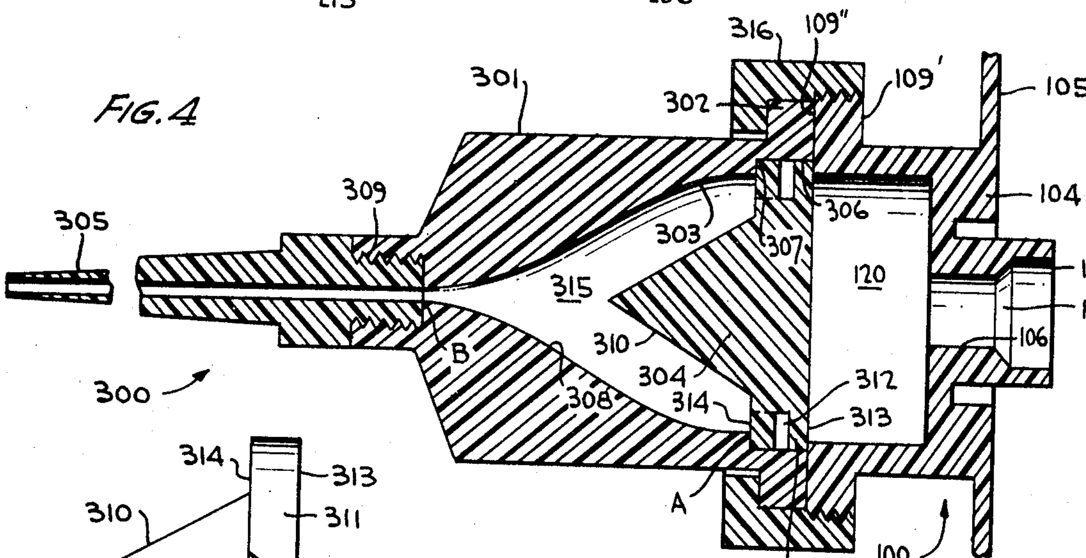


FIG. 4



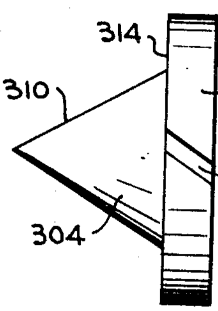


FIG. 5

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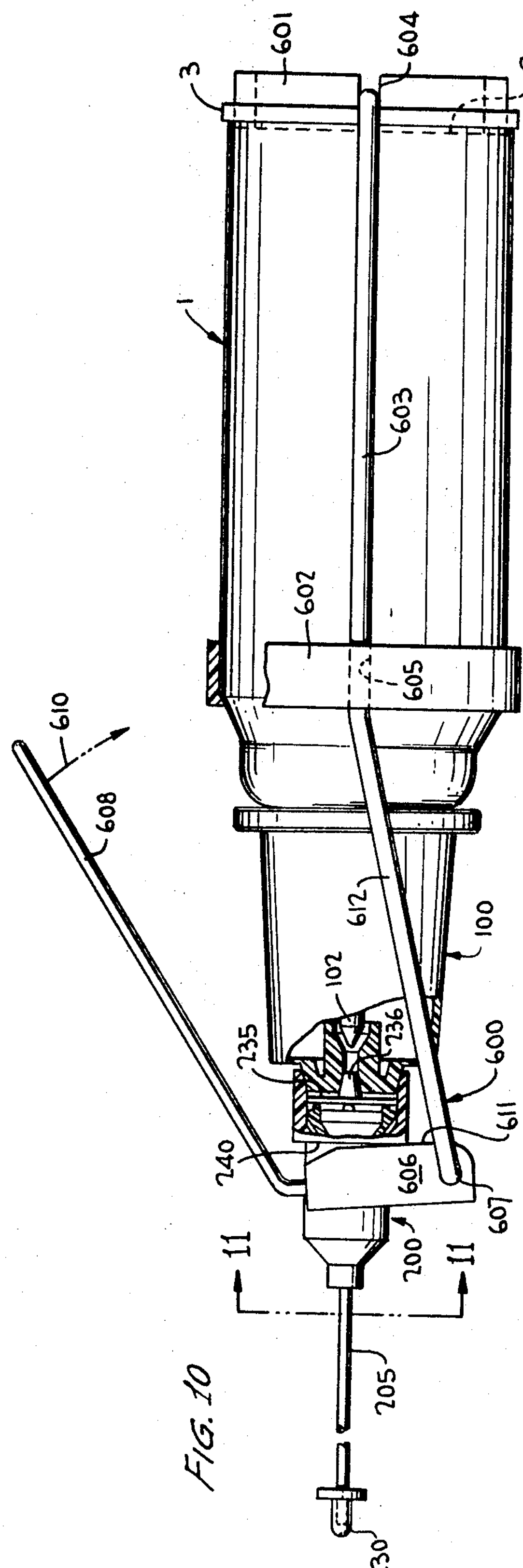

FIG. 10

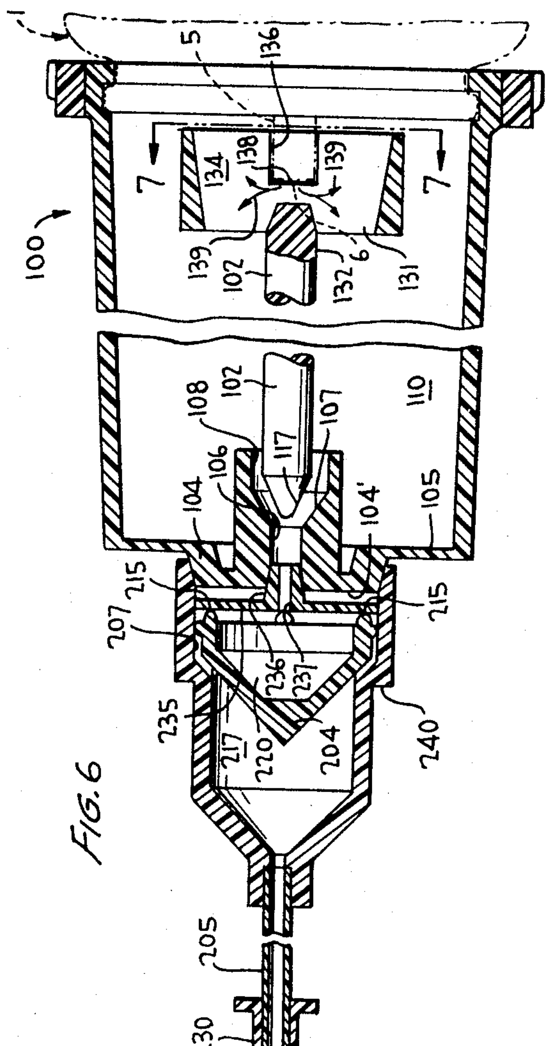

FIG. 6

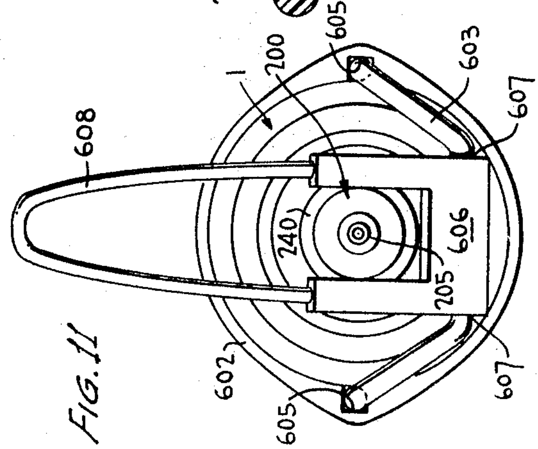

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FIG. 7

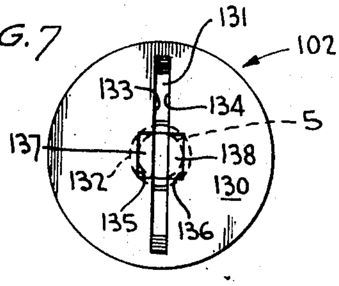


FIG. 8

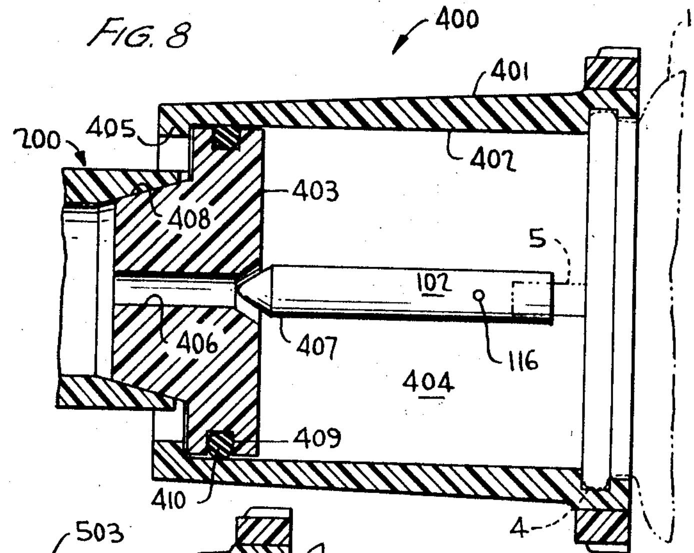


FIG. 9

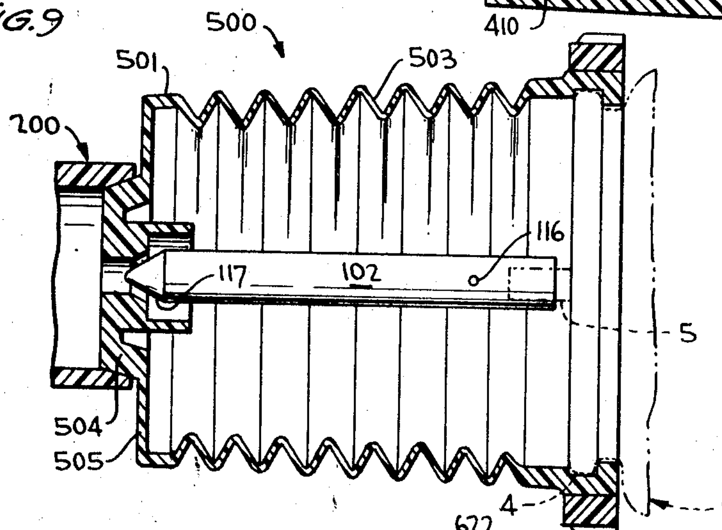
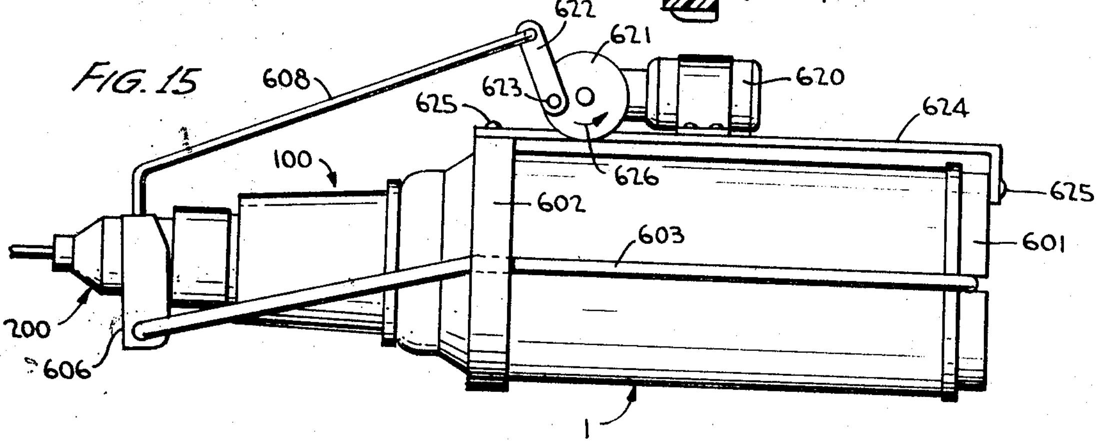


FIG. 15



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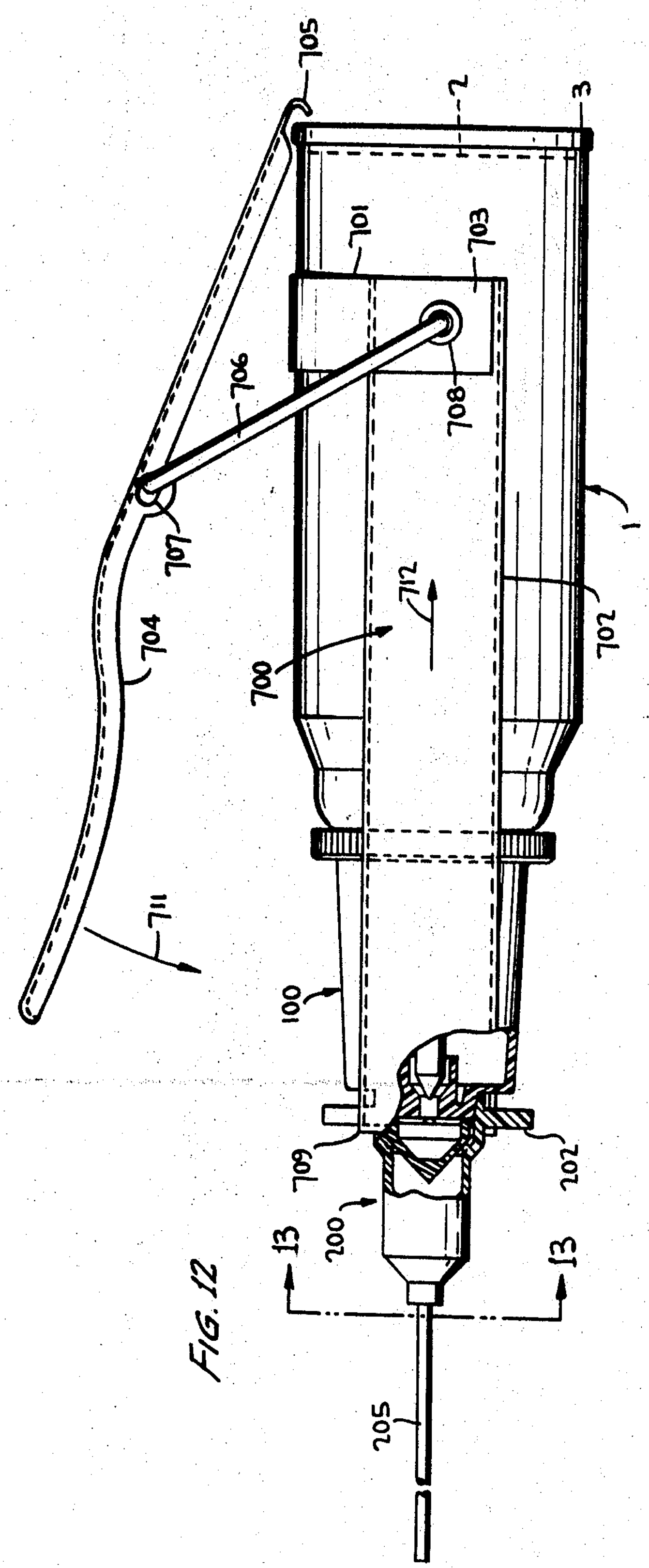

FIG. 12

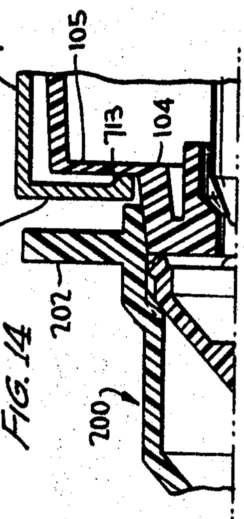

FIG. 14

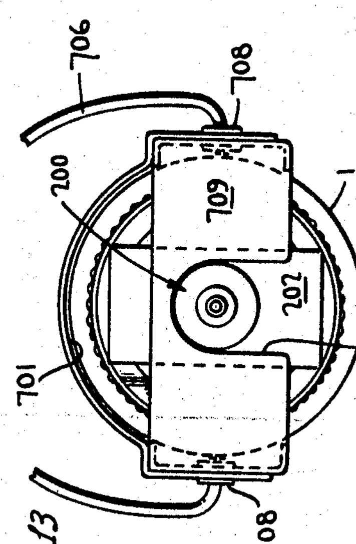

FIG. 13

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METHOD AND APPARATUS FOR DISPENSING CONTROLLED VOLUMES OF GAS

There are presently available pressurized fluid dispensers, including aerosol-type dispensers, which are adapted to dispense various types of powdered solid or liquid materials suspended in a stream of pressurized carrier gas. Conventionally, the material to be dispensed is housed within the dispenser and both the amount of material and pressurized carrier gas dispensed is determined solely by the length of time a valve or valve actuator of the dispenser is actuated by an operator. Thus, when using dispensers of this type, it has been found impossible for an operator to accurately control the quantity of material dispensed or to be assured that the ratio of material to carrier gas discharged will be maintained at a predetermined constant value each time the dispenser is operated. Additionally, in various applications, it has not heretofore been possible to employ conventional aerosol dispensers due to the incompatibility of the material and the carrier gas within the dispenser during prolonged storage periods, or due to the caking characteristics or excessive particle size of powdered material which it is desired to dispense.

The above-mentioned disadvantages have now been overcome by the present invention, which permits either a predetermined volume of material and carrier gas at a predetermined pressure to be dispensed from a conventional dispenser adapted to house both the material and carrier gas, or alternatively, permits a controlled volume of carrier gas at a predetermined pressure to be dispensed from any suitable source of pressurized gas for use in mixing with and ejecting material from a material receiving chamber formed separately from such source.

The present invention has general utility in diverse dispensing arts. The present invention does, however, possess particular utility in the treatment of both humans and animals where it is desired to apply accurately controlled amounts of medicaments as a liquid spray or fluidized powder stream. It also provides accurate control of the volume of gas dispensed with the medicament and this without special valve means. Exemplary of its use in the treatment of humans would be its use in applying accurately controlled dosages of medicaments by means of a pressurized gas directly to the eye, and nasal and respiratory passages. Also, by use of the present invention in combination with appropriate optics (such as fiber optical devices) and a suitable flexible extension tube, it is now possible to apply fluidized medicaments directly to localized areas of the stomach and intestines. In the treatment of animals, the present invention has particular commercial utility, for instance, in the fields of artificial insemination and the treatment of bovine mastitis, which occurs in dairy cattle.

Further, it is anticipated that the present invention possesses utility in nonmedical fields where it is desired to apply accurately controlled amounts of material in liquid spray or fluidized powder form, as for instance where it is desired to apply known amounts of a fertilizer or insecticide successively to each of a plurality of similar plants. By the provision of a suitable motor-driven cam assembly, the present invention may also be employed to automatically dispense known amounts of material in a periodic or cyclic manner. Periodic application or known amounts of material has applicability in many situations, such as for instance where it is desired to periodically apply known amounts of lubricating material to an engine during its operation or to apply known amounts of air freshener or insecticide to the air within an enclosure. The device also has wide application in children's toys as in water pistols, where water is supplied to the mixing chamber.

To facilitate understanding of the present invention, however, particular mention will be made to its use in the treatment of bovine mastitis.

A present method of treating bovine mastitis is disclosed in U. S. Pat. No. 3,347,473 and includes the inflating of the udder of a cow with a relatively large volume of an inert gas

having suspended therein micronized particles of one or more suitable antibacterial agents. In accordance with the practice of such method, the medicament may vary from 0.005 micron to 5 microns particle size and the inert gas employed to diffuse the medicament within the udder may vary from about 50 cc to about 3000 cc at atmospheric pressure for each quarter of the udder to be treated, depending upon the amount of treatment necessary. Apparently, as heretofore practiced, the medicament and carrier gas are both contained within an aerosol dispenser whose size is sufficient to permit exactly one treatment, since to attempt to obtain two or more treatments from the same dispenser would entail inaccurate guesswork by an operator as to the amount of medicament dispensed during each of such treatments. While employing a new aerosol dispenser for each treatment does result in accurate control of dosage, it presents the problem of providing dispenser sizes which may not be readily available on a commercial basis. Further, in that the medicament is contained within the aerosol dispenser, it is necessary to employ relatively expensive and complex valving structures designed to deliver powdered medicament into the pressurized gas within the dispenser upon actuation thereof, and ofttimes necessary to employ anticaking agents for the medicament which may be a source of inflammation. Further, the maximum particle size of the medicament is severely limited by present aerosol dispenser design considerations.

In accordance with the present invention, there is provided a metering unit which may be readily attached to an aerosol dispenser of the type disclosed for use in the practice of the method of U. S. Pat. No. 3,347,743 and which permits a plurality of accurately controlled dosages of medicament and carrier gas to be dispensed from each such dispenser.

Alternatively, and in accordance with a preferred embodiment of the present invention, it is proposed to provide a separate mixing unit adapted to contain an accurately measured dosage of medicament in combination with a metering unit and a relatively inexpensive aerosol container charged with only a desired carrier gas; the metering unit being employed to dispense accurately controlled volumes of gas from the aerosol dispenser and subsequently supply the gas to the mixing unit for the purpose of properly fluidizing the medicament and thereafter injecting it as a stream into the subject to be treated, such as the udder of a cow.

By means of the preferred embodiment of the present invention, it is now possible to both accurately control the dosage of medicament applied and the ratio of medicament to carrier gas employed. Further, since the medicament is contained within a mixing unit, which is separate from and not restricted by the design considerations of conventional aerosol dispensers, it is now possible to selectively use relatively larger particle sizes, e.g., between 10 and 100 microns, and thus permit the choice of particle size employed to be determined solely on the basis of medical or commercial considerations. Also, due to the fact that the medicament is packaged separately from the aerosol carrier gas, it may be maintained in a dry state so as to permit it to be readily fluidized without the need for employing anticaking agents.

The nature of the present invention will be more readily apparent from the following description taken with the accompanying drawings in which:

FIG. 1 is a sectional view illustrating the preferred embodiment of the present invention;

FIG. 2 is a sectional view taken generally along the line 2–2 of FIG. 1;

FIG. 3 is a fragmentary view showing flow passages provided in the mixing unit;

FIG. 4 is a sectional view illustrating a modification of the mixing unit shown in FIG. 1;

FIG. 5 is a side elevational view of the conically shaped flow guide in section in FIG. 4;

FIG. 6 is a sectional view similar to FIG. 1, but illustrating a modified valve extension design and a mixing unit sealing arrangement;

FIG. 7 is a view taken generally along the line 7–7 in FIG. 6;

FIG. **8** is a sectional view showing a modification of the metering unit illustrated in FIG. **1**;

FIG. **9** is a sectional view illustrating another modification of the metering unit illustrated in FIG. **1**;

FIG. **10** is a view showing the preferred embodiment of a manually operated device for use with the apparatus of the present invention;

FIG. **11** is a sectional view taken generally along the line **11–11** in FIG. **10**;

FIG. **12** is a view showing a second embodiment of the manually operated device shown in FIG. **10**;

FIG. **13** is a sectional view taken generally along line **13–13** of FIG. **12**;

FIG. **14** is a fragmentary sectional view illustrating a modification of the manual operator shown in FIG. **12**; and

FIG. **15** is a view showing one manner of modifying the manually operated device illustrated in FIG. **10** to permit cyclic operation of the apparatus of the present invention.

To facilitate understanding of the present invention, the preferred embodiment thereof will be described with reference to its use for applying accurately controlled dosages of powdered medicaments in the treatment of bovine mastitis, wherein the pressurized gas employed to apply the medicament and inflate the udder of a cow during treatment is supplied by a conventional aerosol dispenser or bomb, generally designated as **1** in the drawings. In the practice of the preferred embodiment of the present invention, aerosol dispenser **1** may be of any conventional design and initially charged with a suitable carrier gas or propellant selected from the group including carbon dioxide, nitrous oxide and fluorinated or fluorochlorinated saturated hydrocarbons, which are nonirritating to the tissues treated.

Illustrative of those medicaments which may be utilized in the treatment of bovine mastitis include steroids, such as prednisolone, dexamethasone, hydrocortisone, cortisone, prednisone and their derivatives, i.e., salts, esters or aldehydes; Nitrofurans, such as nitrofurazone; sulfur drugs, such as sulfisoxazole and sulfamerazine; and antibiotics such as polymixin, bacitracin, procaine, penicillin G, dihydrostreptomycin, streptomycin, neomycin, tetracycline, chlortetracycline, kanamycin, novobiocin, oxytetracycline, chloramphenicol, erythromycin and their salts and derivatives. However, any medicament which has heretofore been found effective against bovine mastitis may be utilized. It is preferred, however, to use a mixture of nitrofurazone and sulfisoxazole having a particle size ranging between 10 and 100 microns. The amount of medicament employed will, of course, vary depending upon the severity of the disease to be treated.

Now referring to FIG. **1**, it will be understood that the apparatus employed includes a metering unit 100, which may be suitably affixed to dispenser 1 and employed to discharge metered quantities of carrier gas at a predetermined pressure from the dispenser each time it is operated, and a mixing unit **200**, which may be suitably affixed to metering unit **100** and employed to form a reservoir of powdered medicament which is adapted to be ejected therefrom by a metered quantity of carrier gas upon actuation of metering unit **100**. It is anticipated that metering unit **100** will be sold with aerosol dispenser **1** as a single unit and thereafter thrown away when the latter is empty, whereas the mixing unit employed may be sold separately and employed to form an initially sealed package of a required dosage of powdered medicament, and be replaced by a new mixing unit after each operation of metering unit **100**.

While aerosol dispenser **1** may be of any desired structural design, it is shown in FIGS. **1**, **6** and **7** for purposes of reference as being of cylindrical cross section having adjacent one end a recessed bottom wall **2** bounded by a rim **3**, and having adjacent the other end thereof an annular, radially outwardly facing rim **4** which is disposed concentrically of valve body **5**. Valve body **5** is provided with an axially opening outlet **6** through which the contents of the dispenser may be discharged upon application of pressure to reciprocate the valve body axially of the dispenser. As in conventional aerosol dispenser designs, valve body **5** may include spring means, not shown, which normally tend to maintain the valve body in its inoperative or nondispensing position, shown generally in FIG. **1**.

Metering unit **100** is shown in FIG. **1** as including a generally cup-shaped plastic member **101** and a valve body extension **102**. Cup-shaped member **101** is preferably of integrally formed molded construction and includes a relatively rigid frustoconical sidewall portion **103** and a relatively rigid end wall enlargement **104**, which is disposed concentrically of and connected to the reduced diameter end of sidewall portion **103** for limited reciprocating movement axially thereof by a radially extending relatively flexible wall web portion **105**. Preferably, the axis of cup-shaped member **101** and thus the path of reciprocating movement of end wall enlargement **104** is aligned with the path of reciprocation of valve body **5** from its inoperative to dispensing positions. Although it is preferable to form side wall portion **103** in the manner described, in order to provide a relatively rigid construction, it is contemplated that side wall portion **103** may be cylindrical.

End wall enlargement **104** is provided with an aperture **106** which is disposed in alignment with the axis of cup-shaped member **101**. Wall enlargement **104** functions to define a valve seat **107**, a cylindrical guide skirt **108** for valve body extension **102**, and a frustoconicl mixing unit mounting portion **109**, each of which is disposed concentrically of aperture **106**. The surface of mounting portion **109** forms an angle α with the axis of cup-shaped member **101** which, as will more fully hereinafter be discussed, is critical to the proper functioning of the present apparatus during use.

Cup-shaped member **101**, as thus described, defines a pressure or gas metering chamber **110**, wherein the open end thereof constitutes a chamber inlet **111** and aperture **106** constitutes a chamber outlet. Cup-shaped member **101** may be mounted on dispenser **1** in any desired manner for the purpose of sealing chamber inlet **111** to thereby restrict the flow of pressurized gas from dispenser **1** passing outwardly through valve body **5** to a path in sequence through the chamber **110** and aperture **106**. For instance, there may be employed the snap fitting arrangement shown in FIG. 1, wherein a radially inwardly opening annular slot **112**, provided adjacent the enlarged diameter end of sidewall portion **103**, is adapted to receive dispenser rim **4** and form a pressure chamber inlet fluid seal therewith. Removal of rim **4** from slot **12** may be prevented by means of a locking ring **113**, which, as will be apparent from viewing FIG. **1**, may be slid axially of cup member **101** onto raised rim portion **114** disposed radially outwardly of slot **112** to prevent the undercut portion of wall portion **103** which constitutes the inlet portion of chamber **110** from flexing outwardly during use. Alternatively, cup-shaped member **101** may be adhesively or heat bonded to dispenser **1** or if desired mounted directly on valve body **5**. It will be understood that the size of chamber **110** employed will vary in accordance with both pressure of gas within dispenser **1** and the ratio of gas to medicament desired for any given treatment. Thus, in order to simplify the choice as to chamber size, it is preferable to provide dispensers adapted to supply gas at a known uniform pressure and then to employ an appropriate volume metering unit adapted to accommodate that volume of gas at the known pressure which when expanded to atmospheric pressure will provide the desired medicament to gas ratio.

Valve body extension **102** is provided adjacent one end thereof with a stepped bore opening **115**, which is adapted to receive the outwardly extending end of valve body **5**, and a radially extending passageway **116** for the purpose of affording flow communication between valve body outlet **6** and the interior of pressure chamber **110**. The other end of valve body extension **102** is provided with a frustoconical section **117**, which is adapted to cooperate with valve seat **107** to seal aperture **106**, when end wall enlargement **104** is reciprocated axially of cup member **101** in the manner to be described. While alternatively, valve body extension **102** may be formed integrally with valve body **5**, it is preferable to form the valve body extension separately to permit different volume metering units and thus different valve extensions to be utilized with the same size aerosol dispenser.

By again referring to FIG. **1**, it will be apparent that upon applying a force to cause end wall enlargement **104** to reciprocate to the right, valve seat **107** is initially forced into line surface engagement with section **117** of valve body extension **102** to effect closing of aperture **106**, whereafter valve body extension **102** and thus valve body **5** are forced to reciprocate to the right to effect dispensing of pressurized gas into chamber **110**. Assuming that pressure is maintained against end wall enlargement **104** for a sufficient period of time to permit pressure equalization across valve body **5**, the flow of gas through valve body outlet **6** will cease, and there will be disposed within chamber **110** a known volume of gas at a predetermined pressure. Normally, valve body **5** need only be maintained in a depressed position for between 2—4 seconds in order to permit pressure equalization. Upon removal of force from end wall enlargement **104**, it will be returned to its original position due to the resiliency of web portion **105** and the pressure of the gas within chamber **110** thereon, and valve body **5** and valve body extension **102** will be returned to their original positions, thereby sealing dispenser **1** due to the normal operation of the valve body. Preferably, the rate at which end wall enlargement **104** is returned to its original position is less than the normal operating rate of the valve body, so as to ensure sealing of dispenser **1** prior to the unseating of section **117** from valve seat **107**. Thus, no additional gas will be dispensed into chamber **110** subsequent to the opening of aperture **106**, thereby insuring that the amount of gas discharged through orifice **106** is constant during each operation of the metering unit. It will be apparent that the minimum normal distance between valve seat **107** and section **117** is limited to that required to permit relatively unobstructed passage of pressurized gas through aperture **106** when wall enlargement **104** is returned to its original position, illustrated in FIG. **1**, whereas the maximum distance between valve seat **107** and section **117** is limited by the maximum deflection of web portion **105** necessary to perform the dispensing operation.

At this point, it will be apparent that the metering unit as thus far described may, if desired, be provided with a suitable injection nozzle adjacent aperture **106** and employed in combination with an aerosol dispenser of the type disclosed in U.S. Pat. No. 3,347,743, which is charged with both a powdered medicament and a carrier gas for the purpose of obtaining a plurality of accurately controlled dosages from a single aerosol dispenser.

Again referring particularly to FIG. **1**, it will be seen that mixing unit **200** includes an integrally formed molded plastic body **201** having a radially extending flange portion **202** and a through axially extending opening **203**, which is aligned with the axis of metering unit **100** and adapted to receive a flow guide **204** and an injection nozzle or tube **205**. Opening **203** is defined by a tapered wall mounting portion **206**, a cylindrical wall portion **207**, a second tapered wall portion **208** having a plurality of slot recesses **209**, a second cylindrical wall portion **210**, a third tapered wall portion **211**, and a stepped nozzle supporting wall portion **212**.

Mixing unit **200** may be removably mounted on metering unit **100** by frictional engagement between the mating surfaces of tapered wall portion **206** and mounting portion **109** of wall enlargement **104**, each of which forms an angle α with respect to the axis of units **100** and **200**. It has been found that for any given materials employed in forming cup-shaped member **101** and body **201** and the pressure of the gas expected to be discharged through aperture **106**, surface angles greater than a critical angle α do not permit proper sealing between the units. For instance, where cup-shaped member **101** is formed from polyethylene body **201** is formed from polypropylene and the gas contained within dispenser **1** is Freon **12** maintained at a pressure of about 70 p.s.i. the critical angle α is found to be 7°. Alternatively, the respective units may be joined by any suitable coupling such as a bayonet joint, screw threads or a snap fitting arrangement.

Flow guide **204** is shown in FIGS. **1** and **2** as including a cylindrical wall portion **213** having a plurality of circumferentially spaced radially extending spacing projections **214** and a plurality of axially extending spacing projections **215**, and a conically shaped wall portion **216** having an apex **216'**. With guide **204** arranged within opening **203** in the manner indicated in FIG. **1**, guide **204** and body **202** cooperate to define a mixing chamber **217** which is adapted to receive powdered medicament forming the dosage to be dispensed. Guide **204** is frictionally retained within opening **203** and maintained in a centered, spaced relationship with respect to cylindrical wall portion **207** by spacing projections **214**. When thus positioned, guide cylindrical wall portion **213** cooperates with body cylindrical wall portion **207** to define an annular pressurized gas flow passage **218**, and the surface of conically shaped wall portion **216** is disposed in a parallel abutting relationship with second tapered wall portion **208** and serves to laterally close slot recesses **209** provided therein.

If desired, permanent positioning of flow guide **204** within body **201** may be effected by thermal or adhesive bonding.

It will be understood by referring to FIGS. **1**, **2** and **3** that slot recesses **209**, when laterally closed by the conically shaped surface of guide **204**, define a plurality of passageways which are adapted to direct defined streams of pressurized gas into mixing chamber **217** along lines disposed obliquely of the axis of body **201** and which preferably lie within planes substantially parallel to the conically shaped surface **216** adjacent the outlet ends of recesses **209**. Thus, the gas jets which are in initial engagement with conically shaped surface **216** at the outlet ends of recesses **209**, tend to follow the contour of surface **216** along spirallike paths which eventually tend to merge into a confined cylindrical flow adjacent the outlet end of chamber **217**. It has been found that by providing a conically shaped flow guide, which cooperates with wall portions **210** and **211** to define a chamber having a maximum cross-sectional flow area adjacent guide apex **216'**, in combination with gas jets arranged in the manner described, there is obtained an unexpected increase in the fluidizing capabilities of the jets over that normally expected from conventional tangentially arranged jets. By this arrangement there is obtained a complete fluidization and discharge of the powdered medicament enclosed within chamber **217**.

While flow guide **204** has been shown and described as having a conically shaped wall portion **216**, it will be understood that the apex portion **216'** may be cut off to define a frustoconical configuration. In this respect, it appears that the critical consideration is to provide a conical flow guide section immediately adjacent the point at which pressurized gas is introduced into chamber **217** in order to properly initiate spiral-like flow of the pressurized gas.

When mixing unit **200** is mounted on metering unit **100**, spacing projections **215** of flow guide **204** are disposed in abutting engagement with the surface **104'** of end wall enlargement **104** and cooperate therewith to define radially extending passages **219**, and to positively maintain guide **204** in surface engagement with tapered wall portion **208**.

The rearwardly facing surface of guide **204** is preferably hollowed out to form a cavity **220**, the sidewalls of which tend to equalize distribution of gas passing through aperture **106** radially of the flow guide through passages **219** in the event that inaccurate alignment between valve body extension section **117** and valve seat **107** produces a nonuniform distribution of gas passing through aperture **106**. Further, this design reduces the amount of material needed to produce guide **204** and thus the cost of its manufacture.

Due to the fact that the through passageway of nozzle **205** may be of greater diameter than the discharge passageway of a conventional medicament carrier gas aerosol dispenser, it is possible to selectively dispense relatively large sized medicament particles from chamber **217**. This is a particularly important feature of the present invention, since the medicament particle size employed may be determined solely on the basis of medical or commercial considerations. For instance, it has been found that particle sizes in the range of between 10 and 100 microns are particularly desirable, since they are not only less subject to caking but permit release of medicament over a sustained period of time. In this respect, it will be understood that conventionally employed medicament particle sizes of less than about 1 micron, when used in the treatment of bovine mastitis, are normally flushed from the udder by the first milking after treatment, whereas with the use of much larger medicament particle sizes the same dosage of medicament may be effectively retained within an udder being treated for upwards of three days.

It is anticipated that in operation of the first embodiment of the present invention, metering unit **100** has initially been attached to dispenser **1** either by the dispenser manufacturer or by the operator. Mixing unit **200** is initially provided as a separate unit in which a desired dosage of powdered medicament enclosed within chamber **217** is sealed against moisture and contamination by suitable removable sealing means, not shown, adapted to close injection nozzle **205** and the enlarged diameter end of body opening **203** adjacent the rearwardly facing surface of insert **204**. After removal of the respective mixing unit sealing means, the mixing unit may be mounted on metering unit **100** as illustrated in FIG. **1**. Thereafter, an operator may initiate the dispensing operation by applying a force, as for instance by the tips of his fingers, to body flange portion **202** in order to draw of force flange **202** in the direction of dispenser **1**. Displacement of flange **202** causes displacement or reciprocation of end wall enlargement **104** to the right, as viewed in FIG. **1**, so as to initially position valve seat **107** in surface engagement with section **117** of valve body extension **102** to effect sealing of aperture **106**, and thereafter operate valve body **5** to effect dispensing of gas into pressure chamber **110** through passageway **116**, as described above. The dispensing operation may be completed by releasing pressure from flange **202** to permit the several parts to return to their original positions shown in FIG. **1**, including closing of valve **5** and the opening of aperture **106**, whereupon gas is discharged through outlet aperture **106**, is distributed by the sidewalls of flow cavity **220** and thereafter flows in sequence radially through flow passages **219**, axially through cylindrical flow passage **218** and laterally closed slot recesses **209** into chamber **217**. In chamber **217** the gas mixes with the dosage of powdered medicament and forces the powdered medicament to be ejected from chamber **217** through nozzle **205** in a fluidized stream. Preferably, initiation of the dispensing operation to provide a charge of pressurized gas within pressure chamber **110** is effected immediately prior to the application of nozzle **205** to the cow udder to be treated in order to prevent irritation thereof occasioned by moving the nozzle during the initial portion of the dispensing operation.

Before initiating a subsequent dispensing operation, the now empty mixing unit is removed, discarded and replaced by an unused mixing unit in the manner described above.

EXAMPLE I

A device of the type illustrated in FIG. **1** was mounted on an aerosol bomb charged with Freon 12 under about 70 p.s.i. The effective volumes of the chambers of the metering and mixing units were determined to be about 20 cc. and 5 cc. respectively, and the injection nozzle had a length of about 2½ ½inches. A thoroughly mixed dosage consisting of 200 milligrams of nitrofurazone and 400 milligrams of sulfisoxazole having a weight average of 20 microns was placed in the mixing unit chamber. Thereafter, in sequence the metering unit was manually depressed for a period of 4 seconds; the injection nozzle introduced into a test udder; the metering unit released; and the injection nozzle withdrawn. It was found that the dosage was completely discharged from the mixing unit chamber and uniformly distributed throughout the test udder. The milkout time for several like treatments on live cows was found to vary from between 1 and 3 days.

EXAMPLE II

A test was conducted under conditions identical to those of example I, except the dosage placed in the chamber of the mixing unit consisted of 200 milligrams of nitrofurazone, 400 milligrams of sulfisoxaxole and 250 milligrams of lactose having an overall weight average of about 50 microns. It was found that the dosage was completely discharged from the mixing unit chamber and uniformly distributed through the test udder.

FIG. **4** shows a modified mixing unit, designated as **300**, which incorporates various possible design variations of the structure of the mixing unit employed in the practice of the preferred embodiment of the present invention. Also, in FIG. **4**, metering unit **100** is shown as being slightly modified to accommodate unit **300** by the provision of a threaded cup-shaped mixing unit mounting portion **109'**, which additionally functions to define a gas-distributing cavity **120**.

As in the case of unit **200**, mixing unit **300** generally includes a molded plastic body **301** having an integrally formed radially extending flange portion **302** and a through axially extending opening **303**, which is adapted to receive a flow guide **304** and an injection nozzle **305**.

Through opening **303** is defined by a cylindrical wall portion **306**, a radially extending shoulder defining wall portion **307**, a curved wall portion **308**, and a wall portion **309** adapted to threadably receive nozzle **305**. It will be understood that curved wall portion **308** is defined by revolving about the axis of molded body **301** a line of compound curvature having its respective ends, indicated in FIG. **4** as A and B, disposed parallel to the body axis. While various curved surface designs are possible, I have found that excellent results are obtained by revolving a compound-curved line having the coordinates tabulated below, wherein point 0 is designated as A, point 10 is designated as B and the radius is measured from the axis of body **301** to an appropriate point on the curve.

Points:	Radius
0	.437
1	.421
2	.406
3	.390
4	.312
5	.250
6	.187
7	.125
8	.093
9	.062
10	.062

In the above tabulation, the distance between points is 0.125 inches and the radius is measured in inches. The mixing unit may be modified to accommodate either increased or decreased gas flows by merely multiplying both the spacing between points and the radii given above by any desired common factor.

Flow guide **304** is shown in FIGS. **4** and **5** as being in the form of a solid body having a conically shaped portion **310** and a radially extending flange portion **311** which is provided with a pair of slot recesses **312** defining through flow passages between flange surfaces **313, 314**.

Flow guide **304** is shown in FIG. **4** as being centered within through opening **303** by cylindrical wall portion **306** in abutting engagement with radially extending wall portion **307**. When so positioned, cylindrical wall portion **306** functions to laterally close slot recesses **312**, and the conically shaped surface **310** of the guide cooperates with curved wall portion **308** to define mixing chamber **315**. The thus closed slot recesses **312** define passageways which are adapted to direct defined streams of pressurized gas into mixing chamber **315** along lines disposed obliquely of the axis of body **301** and lying within planes substantially parallel to curved surface portion **308** adjacent the outlet ends of the recesses at the point identified as A in the drawings. Thus, the gas jets, upon emerging from recesses **312**, tend to follow the surface of wall portion **308** along spirallike paths which eventually tend to merge into an axially parallel flow path adjacent to the exit end of chamber **315**.

Mixing unit **300** may be mounted on metering unit **100** by a threaded locking ring **316**, which is adapted to clamp flange **302** in fluid sealing engagement with surface **109''** of mounting portion **109'**.

The operation of a dispensing arrangement employing mixing unit **301** is identical to that described above with reference to mixing unit **200**, except that actuating pressure is applied to threaded locking ring **316**.

Now referring to FIG. **6**, it will be seen that the outlet end of mixing unit chamber **217** may be sealed prior to use by a removable cap **230**, which may be frictionally fit onto the end nozzle **205**. Initial sealing of the other end of the mixing unit chamber may be effected by means of a sealing disc **235** having an integrally formed axially extending frustoconical section **236** which is provided with an axially aligned bore opening **237**. Preferably, sealing disc **235** forms a permanent part of mixing unit **200** and is retained therein in abutting surface engagement with the axially extending spacing projections **215** of flow guide **204**, by any suitable means, such as tight frictional surface engagement with cylindrical wall portion **207**.

It will be understood that sealing disc bore opening **237** may be initially closed adjacent the inlet end thereof prior to use of the mixing unit by any suitable means, not shown, such as an integrally formed frangible web, a piece of adhesive tape or a cap similar to nozzle sealing cap **230** which is frictionally fitted on frustoconical section **236**. After opening of the initially closed bore opening **237**, the mixing unit may be mounted on metering unit wall enlargement **104** in the manner discussed with reference to FIG. **1**. When so mounted, frustoconical section **236** is disposed in tight fitting surface engagement with the walls of aperture **106** thereby serving to form a primary fluid seal between the mixing and metering units.

The mixing unit shown in FIG. **6** is identical to that shown in FIG. **1**, except that cylindrical wall portion **207** is extended to accommodate sealing disc **235**, and ridge **240** replaces flange **202** as the surface against which actuating pressure may be applied.

FIGS. **6** and **7** illustrate a modified design for valve extension **102**, which permits it to be completely formed in one molding operation. The modified valve extension **102** is provided with an integrally formed enlarged base portion **130** having a through slot opening **131** which is bridged by the base of valve extension stem portion **132**. The opposing sidewalls **133**, **134**, which bound slot opening **131**, are shown as being recessed as at **135**, **136** to define transversely extending, relatively spaced abutment or stop surfaces **137**, **138**, respectively. It will be apparent from viewing FIGS. **6** and **7** that when valve extension **102** is mounted on valve body **5**, the open end of the valve body is disposed in surface engagement with spaced abutment surfaces **137**, **138** and retained within slot opening **131** by frictional surface engagement with the walls defining recessed portions **135**, **136**. Thus, it will be understood that upon reciprocation of valve extension **102** to actuate valve body **5**, gas passing through valve outlet **6** is permitted to flow into pressure chamber **110** through slot opening **131**, as indicated by arrows **139**.

FIG. **8** shows a modified metering unit, designated as **400**, which includes a rigid plastic sleeve member **401** having a smooth cylindrical bore opening **402**, and a metering unit mounting plunger **403**, which is adapted to be slidably received within bore opening **402** and to cooperate therewith to define pressure chamber **404**. Sleeve member **401** is preferably mounted on rim **4** of aerosol container **1** in the manner described above with reference to metering unit **100**. removal of plunger **403** from bore opening **402**, subsequent to the mounting of metering unit **400** on dispenser rim **4**, may be prevented by a radially inwardly extending annular flange portion **405** formed integrally with sleeve **401**.

Plunger **403** is preferably of integrally formed plastic molded construction and is provided with an axially extending bore opening **406** which terminates in valve seat **407** and forms the outlet for pressure chamber **404**; frustoconical mixing unit mounting surface **408**; and a circumferentially extending peripheral groove **409**. Any suitable means, such as O-ring **410**, may be disposed with groove **409** for the purpose of providing a fluid seal between plunger **403** and sleeve bore opening **402**.

By viewing FIG. **8**, it will be apparent that when actuating pressure is applied to mixing unit **200**, plunger **403** is forced to slide to the right within sleeve bore **402**, whereafter in sequence valve extension section **117** is seated on valve seat **407** to seal the outlet of pressure chamber **404** and valve body **5** is actuated to dispense pressurized gas in the chamber **404** through valve extension passageway **116**. As in the case of metering unit **100**, gas will flow into chamber **404** until there is an equalization of pressure across valve body **5**. Thereafter, when actuating pressure is removed from mixing unit **200**, the pressure gas confined within chamber **404** will act to force plunger **403** to the left, as viewed in FIG. **8**, into engagement with the sleeve flange **405** so as to permit closing of valve body **5** and the opening of plunger bore opening **406**.

A further modification of metering unit **100** is generally designated as **500** in FIG. **9**. It will be apparent that modified unit **500** differs from metering unit **100**, illustrated in FIG. **1**, solely in the construction of the side and end walls of the generally cup-shaped plastic member **501**. In unit **500**, the sidewall **503** is of a flexible accordion shaped design, whereas end wall web portion **505**, which connects mixing unit mounting end wall enlargement **504** with sidewall **503**, is of rigid construction. Accordingly, unit **500** operates in a fashion identical to that of unit **100**, except that sidewall **503** permits valve-actuating movement of wall enlargement **504**.

In that some difficulty may be experienced by an operator in attempting to use only one hand to hold dispenser **1** while attempting to depress mixing unit flange **202** or ridge **240** with the tips of his fingers, due to the size and smooth cylindrical surface of the conventional aerosol dispenser, it is proposed to provide a manual force multiplying operator, which is designated as **600** in FIGS. **10**, **11** and **15**.

Operator **600** includes in combination a plastic mounting ring member **601**, which is adapted to be received within bottom rim **3** adjacent recessed bottom wall **2** of the dispenser **1**; plastic mounting ring member **602**, which is adapted to be friction fit over the cylindrical sidewall of dispenser **1**; a generally U-shaped rod member **603**, which is received within oppositely disposed slot recesses **604** and **605** provided in ring members **601** and **602**, respectively; a generally U-shaped plastic force-transmitting member **606**, which is pivotally supported adjacent the base thereof by the free ends of rod member **603**, as at **607**; and an actuating handle in the form of a generally U-shaped metal rod **608**, which has its end portions affixed to the respective end portions of member **606**, as for instance being imbedded therein during a plastic mold forming operation.

It will be apparent from viewing FIGS. **10** and **11** that when an operator moves handle **608** in the direction indicated by arrow **610**, force transmitting member **606** is forced to pivot about the free ends of rod member **603**, whereby the lower surface **611** of member **606** is brought into engagement with ridge **240**, thereby forcing mixing unit **200** to the right, as viewed in FIG. **10**, to actuate dispenser **1**. Thereafter, handle **608** may be released to permit the parts of the apparatus to return to their original position shown in FIG. **10**, whereby gas from chamber **110** is injected into mixing chamber **217** for the purpose of fluidizing and expelling material therefrom. Preferably, the legs of the U-shaped member **603** are deformed as indicated at **612** in FIG. **10**, to increase the mechanical advantage of the operator.

Operator **600** may be mounted on dispenser **1** prior to the mounting of metering unit **100** by initially positioning mounting ring **601** within bottom rim **3** and thereafter sliding mounting rim **602** to the right, as viewed in FIG. **10**, along U-shaped rod member **603** onto the cylindrical surface of dispenser **1**. Metering unit **100** may then be mounted on dispenser **1** by the manufacturer or sold as a separate unit to be assembled by a user.

An alternative embodiment of a manual force multiplying operator is designated as **700** in FIGS. **12** and **13**.

Operator **700** includes in combination a collar member **701** which is adapted to be slidably mounted on dispenser **1**; a generally U-shaped pressure-transmitting member **702**, which is affixed adjacent the ends thereof to the respective ends of collar member **701** in the area designated as **703**, as by welding; and handle member **704** which is provided with a dispenser bottom rim engaging flange **705** and movably attached to members **701** and **702** by U-shaped wire **706**. The wire **706** freely passes at its midpoint through slot opening **707** provided in handle **704** and has its respective ends journaled in aligned bearing units **708** which are in turn mounted in areas **703** within apertures, not shown, provided in the respective ends of members **701** and **702**.

Pressure transmitting member **702** is shown particularly in FIG. **13** as having an intermediate flange portion **709**, which is provided with a mixing unit receiving slot **710** and adapted to overlie mixing unit flange **202**.

It will be apparent that with operator **700** in the position shown in FIG. **12**, handle **704**, after engagement of handle flange **705** with dispenser rim **3**, may be moved by an operator in the direction indicated by arrow **711**, thereby causing wire **706** to force members **701** and **702** to slide axially of dispenser **1** as indicated by arrow **712**. Upon movement of member **702** in the manner described, flange portion **709** thereof operates to force mixing unit flange **202** to the right, as viewed in FIG. **12**, to effect dispensing of gas into metering or pressure chamber **110** in the manner described above. Thereafter, handle **704** may be released to permit all of the parts to return to their original positions, illustrated in FIGS. **1** and **12**, to permit the gas contained within pressure chamber **110** to be injected into mixing chamber **217** for the purpose of fluidizing and expelling material therefrom.

One difficulty in employing the operator structure shown in FIGS. **12** and **13** is the requirement that the pressure-transmitting member **702** must be tilted away from its position shown in FIG. **12** to remove flange portion **709** from its overlying relationship with flange **202** to permit the now empty mixing unit to be removed or replaced by a new one. In FIG. **14** there is illustrated a modification of operator **700**, which overcomes this disadvantage by providing flange portion **709** of pressure-transmitting member **702** with a depending lip or flange **713**, which bounds flange slot **710** and is adapted to bear directly on metering unit web portion **105** immediately adjacent end wall enlargement **104**. This arrangement permits force to be transmitted directly to the metering unit and the mixing unit to be positioned on or removed therefrom without disturbing manual operator **700**. To achieve more uniform distribution of force on web portion **105**, slot **710** may be replaced by a circular aperture to permit continuous line contact between lip **713** and web portion **105**.

It will be apparent that both of the mechanical operators described may also be employed with the mixing unit modification illustrated in FIG. **4**, or, if desired, to directly operate the metering unit when the latter is employed with an aerosol dispenser containing both a charge of material and a propelling gas.

The apparatus of the present invention may be readily modified, as indicated for instance in the case of manual operator **600** in FIG. **15**, to permit cyclic or periodic operation thereof, where it is desired to dispense successive small amounts of material over a desired period of time. It will be understood that when practicing the present invention in this manner, only a small portion of the overall amount of material contained within mixing chamber **200** will be dispensed during each cycle of operation. This may be accomplished by employing a relatively large volume mixing unit, a relatively small volume metering unit, a relatively low gas pressure within dispenser **1** or a combination of such features.

In FIG. **15** the arrangement for effecting cyclic or periodic operation of the apparatus is shown as including an electric or spring-operated motor **620** and an eccentric mechanism including motor driven disc **621** and a connecting arm **622**, which is apertured at its respective ends to freely receive actuating handle **608** and disc pin shaft **623**. Motor **620** may be directly mounted on aerosol dispenser **1** or, as indicated in FIG. **15**, mounted on a bar **624** which in turn is affixed to plastic mounting rings **601** and **602** by means of screws **625**. It will be understood that during operation of motor **620**, disc **621** is forced to rotate in the direction indicated by arrow **626**, to impart movement to connecting arms **622** and thus pivotable movement to force transmitting member **606** through actuating handle **608**.

While there has been described a preferred embodiment of the present invention and various modifications thereof, numerous additional variations will likely occur to one skilled in the art in view of the foregoing discussion. Exemplary of one such variation would be to attach the metering unit to a source of pressurized air, other than an aerosol-type dispenser, as for instance a compressed air line having an outlet valve controlled by the metering unit. Also, it is anticipated that the structure of the cup-shaped member of the metering unit may be modified to permit a deformation thereof other than in the manner disclosed. Further, it is anticipated that the metering unit may be modified to accommodate aerosol dispensers having tilt operated valve bodies and to permit gas to be discharged from the metering unit along a path arranged normal, rather than parallel, to the axis of the aerosol dispenser. Additionally, rather than throwing away the mixing unit after each operation, the mixing unit may be refilled by an operator or it may be modified to permit the introduction of material into the mixing chamber thereof without the necessity of removing the unit from its mounting on the metering unit. Accordingly, I wish to be limited only by the scope of the appended claims, wherein

I claim:

1. A metering unit for use in dispensing known volumes of pressurized fluid at a predetermined pressure from an aerosol dispenser having valve means mounted on one end thereof operable to dispense pressurized fluid from said dispenser through an outlet opening defined by said valve means, said valve means being mounted for reciprocation between a normal inoperative position and a depressed dispensing position, said unit including means defining a chamber having an inlet adapted to receive pressurized fluid from said dispenser through said outlet opening upon operation of said valve means, said chamber-defining means comprising:

a. a sleeve member having a cylindrical bore opening defining at one end thereof said chamber inlet and adapted to be mounted on said dispenser;

b. a plunger member forming a moving portion of said chamber-defining means and slidably received within said bore opening, said plunger member having a normally open chamber outlet through which pressurized fluid may be discharged from said chamber; and

c. an extension for said valve means adapted to be mounted thereon, said extension projecting toward said chamber outlet;

said bore opening of sleeve member (a), said chamber outlet of plunger member (b) and said extension (c) being generally disposed in axial alignment with the path of reciprocation of said valve means when said dispenser is operatively attached to said unit, said plunger portion adapted to engage said extension to close said chamber outlet and to move said extension to the valve-engaging position wherein said valve means is depressed to dispensing position to dispense pressurized fluid into said chamber.

2. A metering unit for use in dispensing known volumes of pressurized fluid at a predetermined pressure from a source of pressurized fluid having valve means operable to dispense pressurized fluid from said source through an outlet opening, said valve means being mounted for reciprocation between a normal inoperative position and a depressed dispensing position, said unit including a hollow deformable plastic body defining a chamber and having first and second end portions, said first end portion defining a chamber inlet adapted to receive pressurized fluid from said source through said outlet opening upon operation of said valve means and said second end portion defining a movable portion, and said movable portion upon deformation of said plastic body being adapted to be reciprocated along the path of reciprocation of said valve means, a normally open chamber outlet being disposed within said movable portion through which pressurized fluid may be discharged from said chamber, said movable portion being adapted to cooperate with said valve means to close said chamber outlet and while said chamber outlet is closed to operably move said valve means to dispense pressurized fluid from said chamber.

3. A metering unit according to claim 2, wherein said plastic body is of generally U-shaped configuration having a relatively rigid sidewall of revolution extending between said end portions and said second end portion additionally defines a movable web portion movably connecting said movable portion to said sidewall.

4. A metering unit according to claim 2, wherein said plastic body is of generally cup-shaped configuration having an accordion-pleated sidewall portion extending between said end portions.

5. A metering unit according to claim 2, wherein said source is an aerosol dispenser having said valve means mounted centrally on one end thereof, said valve means defining said source outlet opening and said first end portion being adapted to be attached to said aerosol dispenser at said one end thereof about said valve means.

6. A metering unit according to claim 5, wherein said unit additionally includes an extension for said valve means, said extension being mounted on said valve means and projecting therefrom toward said chamber outlet, and said movable portion being adapted to sequentially engage said extension to close said chamber outlet and while in chamber outlet closing engagement therewith, move said extension and said valve means to said depressed dispensing position.

7. A metering unit according to claim 6, wherein said movable portion defines a valve seat and guide means disposed concentrically of said chamber outlet, said guide means being adapted to guidingly direct said extension into engagement with said valve seat to close said chamber outlet upon deformation of said plastic body.

8. A metering unit according to claim 6, wherein said movable portion defines a valve seat disposed concentrically of said chamber outlet; and said extension includes first and second end portions, said first extension end portion being mounted on said valve means and forming a fluid passageway between said source outlet and said chamber, and said second extension end portion being adapted to cooperate with said valve seat to effect closing of said chamber outlet.

9. A metering unit according to claim 5, wherein said aerosol dispenser includes a radially outwardly facing annular rim disposed concentrically of said valve means, said first end portion of said plastic body is provided with a radially inwardly facing annular slot recess adapted to sealingly receive said rim and attach said plastic body to said aerosol dispenser, and said unit additionally includes locking ring means adapted to be removably positioned over said plastic body in overlying relationship to said slot recess and said rim to selectively prevent removal of said rim from said slot recess.

10. A metering unit according to claim 5, wherein said plastic body is of generally cup-shaped configuration having a relatively rigid sidewall portion of revolution extending between said end portions, said second end portion additionally defining a deformable web portion movably connecting said movable portion to said sidewall, and said unit additionally includes an extension for said valve means; said extension being mounted on said valve means and projecting therefrom toward said chamber outlet, and said movable portion being adapted to sequentially engage said extension to close said chamber outlet and while in outlet closing engagement therewith, move said extension and said valve means to said depressed dispensing position.

11. A metering unit according to claim 5, wherein said plastic body is of generally cup-shaped configuration having an accordion-pleated sidewall portion extending between said end portions; and said unit additionally includes an extension for said valve means, said extension being mounted on said valve means and projecting therefrom toward said chamber outlet, and said movable portion being adapted to sequentially engage said extension to close said chamber outlet and while in chamber outlet closing engagement therewith, move said extension and said valve means to said depressed dispensing position.

12. A dispensing assembly including a metering unit and a mixing unit for use with a source of pressurized fluid having valve means movable from a normal inoperative position to an operable position to dispense pressurized fluid from said source through an outlet opening, said metering unit including means defining a pressure chamber having an inlet adapted to receive pressurized fluid from said source through said outlet opening upon movement of said valve means to said operable position and a normally open outlet through which pressurized fluid may be discharged from said pressure chamber, said pressure chamber defining means having means movable from a first position to a second position to sequentially effect closing of said chamber outlet and while said chamber outlet is closed operably move said valve to its operative position to dispense pressurized fluid into said pressure chamber, said movable means when returned to said first position permitting return of said valve means to its inoperative position and permitting opening of said chamber outlet to dispense fluid from within said pressure chamber through said chamber outlet, said mixing unit including means defining a material receiving chamber having at least one pressurized fluid inlet and a material and pressurized fluid outlet, and means to mount said mixing unit on said metering unit with said pressure chamber outlet in flow communication with said pressurized fluid inlet of said material receiving chamber.

13. A dispensing assembly according to claim 12, wherein said material receiving chamber defining means includes a body member having a through axially extending opening and a flow guide having a conically shaped surface portion received within said opening adjacent one end thereof, the other end of said through opening defining said material and fluid outlet, said through opening and said flow guide having axes disposed in alignment with said material and fluid outlet, wall surfaces of said through opening between said flow guide and said material and fluid outlet cooperating with said conically shaped surface portion of said flow guide to define said material receiving chamber, and said flow guide cooperating with wall surfaces of said through opening adjacent said one end thereof to define said pressurized fluid inlet, said inlet being adapted to define a stream of pressurized gas passing into said material receiving chamber along a line disposed obliquely of said axes.

14. A dispensing assembly according to claim 12, wherein said means for mounting said mixing unit on said metering unit includes a frustoconical wall portion defined by said movable means and disposed concentrically of said chamber outlet and a tapered wall portion forming an opening in said mixing chamber defining means and adapted to receive said frustoconical wall portion, at least the frustoconical wall portion of said movable means being formed of polyethylene, at least said tapered wall portion being formed of polypropylene,

said tapered wall portion and said frustroconical wall portion being disposed in axial alignment and each being inclined at an angle of about 7° with respect to the axes thereof.

15. A dispenser assembly according to claim **12**, wherein said source is an aerosol dispenser having said valve means mounted centrally on one end thereof for reciprocation between said inoperative and operative positions, said valve means defining said source outlet, said pressure chamber defining means including a sleeve member having a cylindrical bore opening and a plunger member slidably supported within said bore opening, said plunger member defining said pressure chamber outlet and said movable means, said sleeve member being affixed adjacent one open end thereof to said dispenser about said valve means, and said plunger when slid within said bore opening being movable between said first and second positions along a path of reciprocation in alignment with the path of reciprocation of said valve means.

16. A dispensing assembly according to claim **12**, wherein said source is an aerosol dispenser having said valve means mounted centrally on one end thereof for reciprocation between said inoperative and operative positions, said valve means defining said source outlet, said pressure chamber defining means including a hollow deformable plastic body mounted on said one end of said dispenser about said valve means, said movable means being formed integrally with said plastic body, and said movable means upon deformation of said plastic body being movable between said first and second positions along a path of reciprocation in alignment with the path of reciprocation of said valve means to sequentially cooperate with said valve means to close said pressure chamber outlet and while said pressure chamber outlet is closed to move said valve means from said inoperative to said operative position.

17. A dispensing assembly according to claim **16**, wherein said assembly additionally includes manually operable means for deforming said plastic body, said operable means including force transmitting means removably disposed in operable engagement with said movable means, second means operably disposed in engagement with another end of said aerosol dispenser removed from said one end thereof, and means operable to move said force transmitting means towards said second means, whereby said movable means is reciprocated.

18. A dispensing assembly according to claim **16**, wherein said mixing unit includes bearing means, and said assembly additionally includes manually operable means for deforming said plastic body, said manually operable means including force transmitting means removably disposed in engagement with said bearing means, second means operably disposed in engagement with another end of said aerosol dispenser removed from said one end thereof, and third means operable to move said force transmitting means towards said second means, whereby said bearing means and thus said mixing unit is moved towards said dispenser to deform said plastic body.

19. A dispensing assembly according to claim **18**, wherein said assembly additionally includes motor means and means to operably connect said motor means to said third means, said connecting means being adapted to convert continuous operation of said motor means into cyclic operation of said third means.

20. A dispensing assembly according to claim **16**, wherein said assembly additionally includes manually operable means for deforming said plastic body, said manually operable means including in combination: a first mounting means adapted to operably engage another end of said aerosol dispenser removed from said one end thereof, a second mounting means adapted to operably engage said dispenser intermediate said ends thereof, a member having first and second end portions and a pair of interconnecting leg portions, said first member end portion being restrained by said first mounting means and said pair of interconnecting portions being restrained by said second mounting means, a force transmitting means adapted to operably engage a bearing surface on one of said mixing and metering units, said force transmitting means being supported by said member second end portion for pivotable movement towards said bearing surface, and a manually operable handle member carried on said force transmitting means.

21. A dispensing assembly according to claim **12**, wherein said source is an aerosol dispenser having said valve means mounted centrally on one end thereof for reciprocation between said inoperative and operative positions, said valve means defining said source outlet, said pressure chamber defining means including a generally cup-shaped plastic member having first and second end portions and a sidewall portion joining said end portions, said first end portion being mounted on said end of said dispenser about said valve means, said second end portion defining said movable means and a deformable web portion joining said movable means to said sidewall portion, said chamber outlet being disposed in said movable means, and said assembly additionally includes an extension for said valve means, said extension being mounted on said valve means and projecting therefrom towards said chamber outlet, and said movable means upon deformation of said web portion being movable between said first and second positions along a path of reciprocation in alignment with the path of reciprocation of said valve means to sequentially engage said extension to close said chamber outlet and while in outlet closing engagement therewith, move said extension and said valve means to said depressed dispensing position.

22. An assembly according to claim **12**, wherein said source is an aerosol dispenser having said valve means mounted centrally on one end thereof for reciprocation between said inoperative and said operative positions, said valve means defining said source outlet, said pressure chamber defining means including a generally cup-shaped plastic member having first and second end portions and an accordion-shaped sidewall portion joining said end portions, said first end portion being mounted on said end of said dispenser about said valve means, said second end portion defining said movable means, said chamber outlet being disposed in said movable means; and said assembly additionally including an extension for said valve means, said extension being mounted on said valve means and projecting therefrom toward said chamber outlet, and said sidewall portion being movable between said first and second positions along a path of reciprocation in alignment with the path of reciprocation of said valve means to sequentially engage said extension to close said chamber outlet and while in chamber outlet closing engagement therewith, move said extension and said valve means to said depressed dispensing position.

23. An assembly according to claim **13**, wherein said movable means defines said pressure chamber outlet, said body member of said mixing unit is mounted on said movable means, and disc means are disposed within said through opening intermediate said flow guide and said one end thereof, said disc means being peripherally sealed with respect to said through opening and having a frustoconical portion disposed concentrically of said through opening, and said frustoconical portion being received within said pressure chamber outlet in sealing engagement with the bounding walls thereof and being apertured to define a gas passageway between said pressure chamber outlet and said through opening.

24. A method of dispensing a predetermined quantity of powdered material in a fluidizing stream of pressurized gas, wherein the pressurized gas occupies a predetermined volume at atmospheric pressure, including the steps of providing a source of pressurized gas having value means movable between normal inoperative and operative positions to selectively dispense pressurized gas at a known pressure therefrom; providing means defining a fluidizing chamber having said predetermined quantity of powdered material disposed therein, said fluidizing chamber having an inlet opening and an outlet opening; providing means defining a metering chamber having an inlet and an outlet, the volume of said metering chamber being sufficient to accommodate a volume of gas at said known pressure which when expanded to atmospheric pressure corresponds to said predetermined volume; closing said metering chamber outlet; moving said valve means from said inoperative position to said operative position to dispense gas from said source into said metering chamber through said chamber inlet; maintaining said valve means in operative position at least until flow of gas into said metering chamber substantially ceases due to substantial equalization of the pressure of gas within said metering chamber with respect to said known pressure; returning said valve means inoperative position; opening said metering chamber outlet and directing pressurized gas passing therethrough from said metering chamber into said fluidizing chamber through said chamber inlet opening to fluidize said predetermined quantity of powered material and expel said fluidized material through said chamber outlet opening in a fluidizing stream of pressurized gas.