United States Patent

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[54] PROCESS AND APPARATUS FOR LOADING CONTAINERS

7 Claims, 3 Drawing Figs.

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137/604, 222/145
[51] **Int. Cl.** **B65b 1/04,**
B65b 3/04
[50] **Field of Search** 141/105;
137/602, 604; 222/145

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ABSTRACT: In the process of loading pressurized dispensing containers with a fluid product and a normally gaseous propellant or combination of propellants, the improvement consisting in causing pipeline streams of said fluid product and said propellant or combination of propellants to mix under critical conditions in a tee of critical design thus premixing the components before they enter said container; and apparatus for carrying out the premixing.

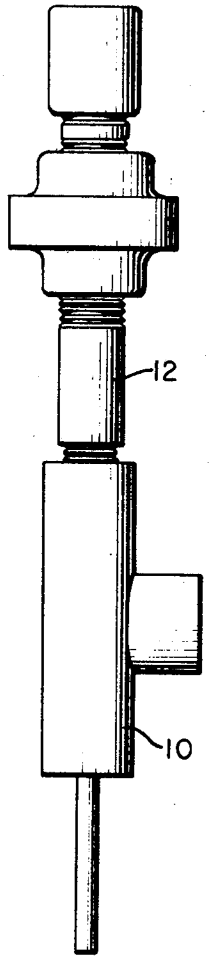


FIG. 1

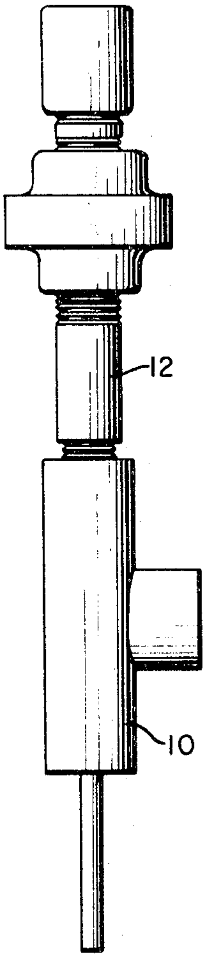


FIG. 2

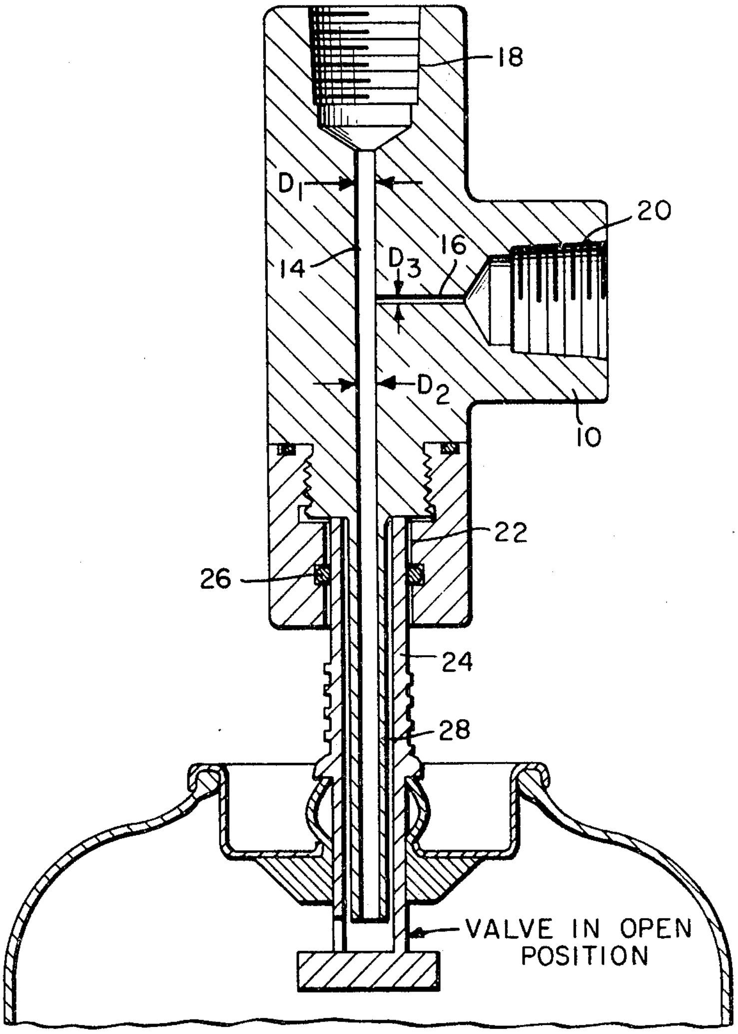
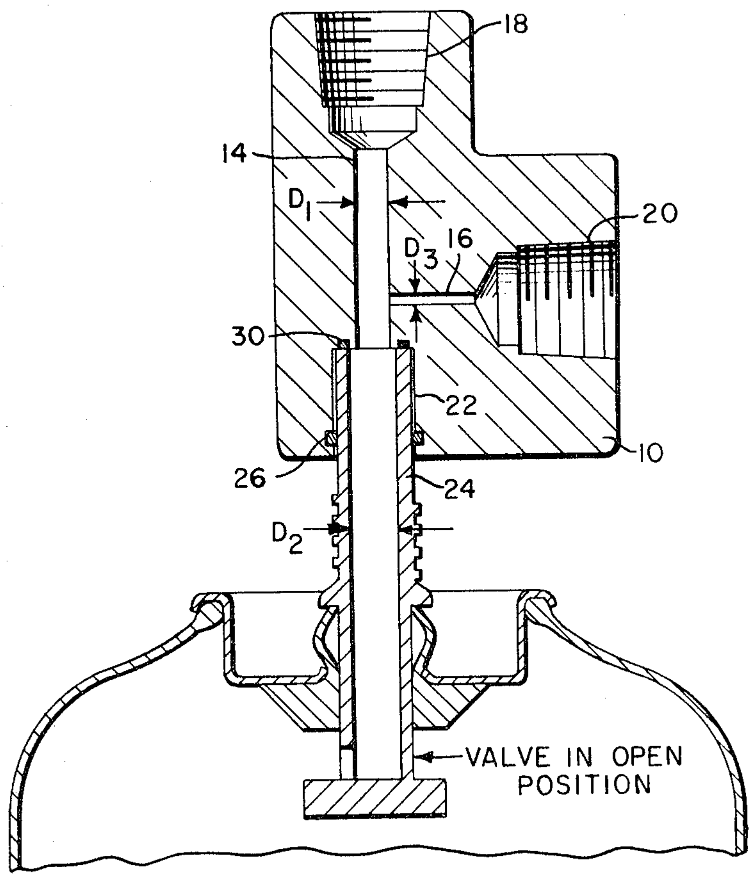


FIG. 3



PROCESS AND APPARATUS FOR LOADING CONTAINERS

BACKGROUND

The usual commercial practice of loading pressurized dispensing containers with fluid or semifluid products consists in filling a usually evacuated container at least about half full with the fluid product and then pressurizing the propellant or mixture of propellants into the partially filled container. When the container is filled through an open end and is subsequently closed by crimping the top in place, the process is called under-the-cap filling. Alternatively, the assembled container, usually evacuated, is sometimes charged in part or entirely through the valve. The large volume loader generally prefers the under-the-cap process carried out in large automatic machines. The small volume loader often prefers through-the-valve loading because of the lesser investment in machinery.

A number of propellants either alone (except as noted) or in combination are in current use: dichlorodifluoromethane, dichlorofluoromethane, 1,2-dichlorotetrafluoroethane, octafluorocyclobutane, chloropentafluoroethane, trichlorofluoromethane, chlorodifluoromethane, 1,1-difluoroethane, vinyl chloride, nitrous oxide (in mixture with liquefiable propellants), carbon dioxide, nitrogen (in mixture with liquefiable propellants), and low boiling normally gaseous hydrocarbons such as isobutane or propane.

For use in dispensing products intended for human consumption, the U.S. Food and Drug Administration allows octafluorocyclobutane, chloropentafluoroethane, nitrous oxide, nitrogen, propane, and carbon dioxide to be used as propellants.

Propellants or mixtures of propellants which are condensable at ambient temperature at a pressure less than the bursting pressure of the container can be conveniently loaded in the liquid phase without danger of bursting the container. Commonly used propellants such as carbon dioxide and nitrous oxide, however, have vapor pressures much higher than the bursting pressures of the usual commercial dispensing containers. As a rule, gases which do not condense at pressures below the allowable pressure for the container cannot be charged in sufficient quantity to expel the contents unless they are at least slightly soluble in the fluid or semifluid product. Noncondensing gases, even though soluble in the fluid product, cause difficulties in loading because of the slow rate at which they dissolve. In practice it has been found necessary to shake the container while it is being charged with soluble high vapor pressure gases either alone or (frequently) in mixture with condensable gas propellants. The high initial pressure which prevails before the soluble propellant has dissolved sometimes ruptures the container.

In loading products which foam on expulsion, such as diary cream, dessert toppings, purees and shaving soap, the containers must be shaken for up to a minute regardless of the propellants used in order to insure foaming on expulsion.

The contents of containers filled nearly full often cannot be mixed even by prolonged shaking.

Because of high initial pressure and/or inability to mix by shaking, containers for some products, for example, dairy cream, are filled only about half full.

Of all the steps of loading, the step of shaking takes the most time. Some commercial loaders have installed multiple shakers to serve a single loading line.

There was, therefore, a need and it is an object of this invention to provide a device and a process for the loading of pressurized dispensing containers with a fluid or semifluid product and a propellant or propellant mixture without shaking the container. It is a further object to provide a means for filling pressurized dispensing containers nearly full.

SUMMARY OF THE INVENTION

These and other objectives are accomplished according to the subject invention by, in a process for loading pressurized dispensing containers through the valve with fluid products and normally gaseous propellants, premixing streams of such fluid products and propellants under turbulent conditions in close proximity to said container and while en route to loading for a time sufficient to achieve substantially complete mixing.

The novel T-mixer apparatus of this invention has a substantially straight conduit or passageway in its housing for conveying the fluid product to the container; and, preferably at right angles and connecting thereto, a side inlet or conduit to feed the propellant(s) into the passageway.

Dimensions, stream velocities, pressure drops, etc., are critical dependent variables as hereinafter discussed.

BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is an overall plan view of one embodiment of the T-mixer apparatus complete with piping arrangement;

FIG. 2 is a cross-sectional view of the T-mixer embodiment of FIG. 1 in operable engagement with a dispensing container valve; and

FIG. 3 is a cross-sectional view of another embodiment of the T-mixer apparatus in operable engagement with a dispensing container valve.

DETAILED DESCRIPTION OF INVENTION

Drawings

Referring in more detail to the two embodiments shown by way of example in the accompanying drawings;

FIGS. 1 and 2 show one embodiment of the T-mixer generally comprising T-mixer housing **10**, together with a typical piping arrangement **12**, fluid product conduit or passageway **14** and propellant side inlet conduit **16**. The upstream end of housing **10** is internally threaded (at **18**) to receive a suitable piping arrangement **12**. The enlarged portion of side inlet conduit **16** is also threaded (at **20**) for connection to suitable propellant supply means (not shown). D_1, D_2 and D_3 refer, respectively, to the inner diameters of the upstream portion of conduit **14**, the downstream portion of conduit **14** and the side inlet conduit **16**. Housing **10** has a recess **22** at the downstream end adapted to slidably receive the tip of the dispensing container valve **24**. The shape of the recess (here cylindrically shaped) is determined by the configuration of the container valve. The valve shown in FIGS. 2 and 3 is a conventional Clayton valve (see U.S. Pat. No. 3,132,774 for further discussion of Clayton valves). Recess **22** is provided with O-ring **26** to slidably engage valve **24** to ensure an airtight seal when in operation. In this embodiment housing **10** has a cylindrical, elongated portion **28** concentric within and extending beyond recess **22** so that the downstream portion of passageway **14** will fit within and extend down into valve tube **24** when in loading position.

The embodiment of FIG. 3 is identical to that of FIG. 2 except that housing **10** is not provided with an elongated portion (**28**) as in FIG. 2. Instead, the dispenser valve **24** itself serves as the downstream or tailpipe section of the passageway **14**. An additional O-ring seal **30** is provided in this embodiment at the upper end of recess **22** to assure an airtight closure.

It is to be understood that this invention may be adapted to be used with various types of valves, though Clayton-type valves are preferred for foamy products. This invention may also be adapted for use in under-the-cap filling of dispensers.

In both embodiments, conduits **14** and **16** are each preferably cylindrical, i.e., have circular cross sections. However, other cross-sectional shapes (e.g. elliptical) could obviously be employed if desired.

Determination of Apparatus and Process Variables

It is found that propellants or mixtures of propellants, preferably liquefied, can be mixed with fluid or semifluid products [liquefied normally gaseous fluids are also operable] in a T-mixer of critical dimensions and under critical conditions while the components are en route to a pressurized dispensing container, thus making it unnecessary to shake said container during filling and permitting the filling of containers nearly full. The propellants listed above are typical propellants operable with this invention.

Operable fluid products include all fluid or semifluid products which can be expelled from a pressurized dispensing container. The viscosity of such products comprises the range from about 1 to about 1500 centistokes. Examples of such fluid products are dairy cream, dessert toppings, purees, shaving soap, paints, lacquers, hair sprays, perfumes, cosmetic preparations, cocktail components, fruit juices, flavors, adhesives, cleaners, etc. Products containing particulate matter may also be loaded as, for example, paint or lacquer containing metallic "glitter" such as aluminum flakes, purees containing food particles such as tomato pulp, cosmetic preparations containing talc, etc. It is understood that the particle size must be small enough to pass through the mixer.

Dimensions, stream velocities and pressure drops are critical dependent variables which must be calculated for each mixing and loading application. The loading time (time to load one container) is also usually critical (for high vapor pressure propellants) and must be found empirically for each loading application.

By low vapor pressure propellants are meant those which condense at use temperatures at pressures below the burst or allowed upper pressure of the container. Those which do not condense are high-pressure propellants.

The total pressure of the system as packed in the container depends not only on the vapor pressure of the propellant but also on the solubility of the propellant in the medium with which it is packed. For example, hydrocarbon propellants are essentially insoluble in aqueous media. Thus the gauge pressures developed in a container loaded with an aqueous product and a condensing hydrocarbon propellant will be close to the pressure the liquefied propellant would exert if it alone were in the container. On the other hand, the gauge pressure in a container packed with a hydrocarbon propellant and an organic solvent, e.g. a lubricating oil, would be much lower because of solubility of the propellant in the solvent. Fluorinated propellants are regarded as insoluble in water but soluble in some organic materials such as butter fat. Carbon dioxide and nitrous oxide are high-pressure propellants and are slightly soluble in aqueous media.

The following table shows the vapor pressures of the propellants listed above. Thus the pressures shown are approximately those one would expect to measure in a dispenser containing liquefied propellant and a fluid to be dispensed in which the propellant is insoluble. Were the propellant soluble in the fluid, the observed pressures would be lower by an amount proportional to the solubility.

Propellant	Pressure (p.s.i.g.) 70° F.	130° F.
Dichlorodifluoromethane	70.2	181.0
Dichlorofluoromethane	8.4	50.5
1,2-Dichlorotetrafluoroethane	12.6	58.0
Octafluorocyclobutane	25.4	92.0
Chloropentafluoroethane	104.4	254.0
Trichlorofluoromethane	13.3 (p.s.i.a.)	24.0
Chlorodifluoromethane	121.4	296.8
1,1-Difluoroethane	62.5	176.8
Vinyl chloride	36.7 (86° F.)	116 abs.
Nitrous oxide	745.3	Critical temp. 97.7° F.
Carbon dioxide	837.8	Critical temp. 87.8° F.
Isobutane	30.3	Critical temp. 94.7° F.
Propane	109.6	Critical temp. 259.8° F.
Nitrogen	Very high pressure—noncondensable at temperatures above −232.6° F.; its critical temperature.	

Commercial dispensing containers vary considerably in their ability to withstand internal pressure. For example, small pressurized glass dispensing bottles now in the trade are customarily pressured to not more than about 20 p.s.i.g. at room temperature. The bottles are usually coated with polyvinyl chloride as a safety precaution. On the other hand, sheet metal dispensing cans will withstand much higher pressures.

The generally accepted bursting pressure for common 3–, 6–, and 12–fl. oz. sheet metal dispensing cans is about 210 p.s.i.g.; that for 16–, 20–, and 24–fl. oz. cans is about 185 p.s.i.g.

The Interstate Commerce Commission regulates the loading and allowable pressures in dispensing containers in interstate commerce as shown in Agent T. C. George's Tariff No. 19 (issued Aug. 5, 1966) par. 73.306 (pp. 99, 100).

Compliance with regulation 73.306 (3) *ii*, which states, "-Pressure in the container must not exceed 180 p.s.i.g. at 130° F.," is illustrated below in Example 3. Dichlorodifluoromethane is an insoluble (in water), condensable propellant (i.e. most of the propellant in the can is liquefied). Therefore, the gauge pressure of the can will be essentially the vapor pressure of the propellant (the water contributes little to pressure). The vapor pressure of this propellant at 130° F. is seen in the table above to be 181 p.s.i.g., slightly over the allowable upper limit. Mixture of dichlorodifluoromethane with lower vapor pressure 1,2-dichlorotetrafluoroethane, another insoluble (in water), condensable propellant, brings the total gauge pressure below the maximum allowed by the ICC.

The pressures of mixtures of insoluble condensable propellants can be estimated by application of Raoult's Law which states that in an ideal case the partial vapor pressure of a constituent is proportional to its mole fraction in the liquid. There are also means for estimating overall pressures in systems in which the propellant is soluble in the fluid to be dispensed. In practice, it is generally more satisfactory to arrive at correct pressures in such systems by trial and error.

The high-pressure propellants, i.e. those which will not condense at pressures below the allowable pressure of the container, pose special problems. For example, nitrogen, which is only slightly soluble in any fluid medium, must be used only in small amount either alone or in mixture with other propellants of lower vapor pressure or must be used in a very strong container, impractical for ordinary dispensing of fluid products.

Nitrous oxide and carbon dioxide are high-pressure propellants which, however, are soluble in aqueous medium, the most common fluid to be dispensed. Frequently, however, it is impossible to compress enough propellant of this kind into a practical dispenser to expel the contents, without exceeding the upper pressure limit of the container. It is, therefore, generally preferred to mix these propellants with lower pressure, usually fluorinated, propellants.

Even though solubility of the above propellants alone or in mixture with, for example, insoluble propellant acts to lower the dispenser's gauge pressure, it does not follow that they can be loaded with the same ease as are the liquefied propellants. This is so because solution of the soluble propellant requires time and, in the process of the prior art, shaking of the container.

In loading propellant mixtures containing one or more soluble high vapor pressure propellants, the loading time fixes the other variables and thus must be considered first. When the pressurized mixture is injected into the container, dissolved propellant immediately begins to come out of solution and to collect in the free space of the container during the early part of the filling cycle. These gases are compressed in the head space as the container fills. Should the container be filled slowly, then high pressures analogous to the "initial pressures" of the conventional process are developed.

It has been found that initial pressure can be minimized in the process of the invention by filling containers rapidly so that the dissolved gas has little time to come out of solution. The examples below demonstrate the experimental estimation of the maximum allowable filling time for various containers and charging mixtures.

The designer in considering optimum filling time will balance, within the safe maximum filling time, considerations of output rate and the cost of pressurizing the propellant and the fluid or semifluid product.

Liquefied propellants with vapor pressures less than the containers' allowable pressure can be loaded by the process of the invention at any convenient rate whether the propellants are soluble or not. Having established the filling time, the designer fixes the inside dimensions of the, preferably circular cross section, upstream portion of straight run conduit **14** of the T-mixer, such that flow is definitely turbulent. Turbulence begins at a Reynold's number (N_{Re}) of about 2,100. However, a value of at least about 3,000 is preferred. Velocity and Reynold's number having been determined, the required value for D_1, the inside diameter of the circular upstream straight run cross section is easily calculated from any of the following three relations (in consistent units):

$$N_{\mathrm{Re}_1}=\frac{D_1V_1\phi_1}{\mu_1}=\frac{D_1G_1}{\mu_1}=\frac{4w_1}{\pi D_1\mu_1}$$

where:

D_1 = upstream diameter of conduit **14**
V_1 = fluid or semifluid product linear velocity
G_1 = fluid or semifluid product mass velocity = $V_1\rho_1$
W_1 = weight rate of fluid or semifluid product flow
ρ_1 = fluid or semifluid product density
μ_1 = fluid or semifluid product viscosity
N_{Re} = Reynold's number in upstream portion of conduit **14**

The diameter D_3) of the preferably circular cross section of the side run conduit **16** at junction with the straight run is then determinable since the mass velocity ($V_3\rho_3$) of the preferably liquid propellant should be about 2.7 times (±0.7) the mass velocity ($V_1\rho_1$) of the stream in the straight run for best mixing results. [Chilton and Genereaux in *Trans. A. I. Ch. E.*, 25, 102—22 (1930), reported 2.7 to be the optimum ratio for gases. It has since been found that the same ratio is also applicable for liquids.] Both lower and higher ratios decrease the efficiency of mixing. Higher ratios cause the propellant stream to cross the straight run stream and move without mixing along the far wall. A smaller ratio causes the propellant stream to move without mixing along the near wall. At much higher (and impractical) ratios, mixing again becomes efficient.

The section of the straight run conduit **14** downstream from the junction with the side run conduit **16**, hereinafter called the tailpipe, is ordinarily of the same diameter as the section upstream. However, if there is a large increase in viscosity of the fluid or semifluid product upon mixing with the propellant or propellant mixture, the downstream section's diameter D_2 should be modified to insure turbulent flow according to the above equation.

If the Reynold's number in the tailpipe is at least about 3,000, then a length of at least 8 diameters, preferably at least 10 diameters, is sufficient to insure substantially complete mixing (at least about 97 percent).

Because of greater mixing efficiency, it is preferred to deliver the propellant stream to the straight run section **14** in the liquid state. This consideration may affect the choice of pressure on the propellant stream. Generally, however, the pressure drop required for the delivery of the mixture to the container within the allowable filling time, rather than the condensation pressure of the propellant, is controlling.

The required pressure drop along the path of the propellant stream **16** can be calculated for various velocities (and thus filling times) by the approximate equation following (in consistent units):

$$\Delta P=\frac{1.5\phi_2V_2^2}{2g_c}+\frac{1.5\phi_3V_3^2}{2g_c}$$

The pressure drop along the straight run **14** is approximated by:

$$\Delta P=\frac{1.5\phi_1V_1^2}{2g_c}+\frac{1.5\phi_2V_2^2}{2g_c}$$

where:

V_1 = fluid velocity in the straight run
V_2 = fluid velocity in the tailpipe
V_3 = fluid velocity in the side run
ρ_1, ρ_2, ρ_3 = fluid densities
g_c = dimensional constant (gravity)
ΔP = pressure drop

In the examples, the tailpipe (downstream section of conduit **14**) was attached directly to foam valve-equipped dispensing cans for through the valve loading. The tailpipe **28** of the T-mixer embodiment of FIG. **2** was inserted into the tube of the valve **24** and a rubber ring seal **26** closed the space between the tailpipe and the tube as shown in FIG. **2**. In using the embodiment of FIG. **3**, the tube of the valve **24** itself served as the tailpipe. Closure was also effected by ring seals at **26** and **30**. Since the inside diameter of the effective "tailpipe" section was greater in the latter assembly, higher throughputs could be accommodated and larger dispensing cans could be filled without high initial pressure.

In Examples 1, 2 and 3, pressure drops through slots in the foam valve itself were insignificant. When a more viscous vegetable fat topping was loaded in Example 4, the pressure drop though the valve became significant and was considered in selecting an overall pressure drop.

EXAMPLES

The critical dimensions of the mixers used for the following examples, derived according to criteria presented above, were:

Figure 2 Embodiment

Passageway **14**:
Inside Diameter (D_1 and D_3): three thirty-second inch—no change in diameter throughout the length.
Length: for convenience 2¼ **inches (design criteria required only** 1⅝ inches).
Side Conduit **16**:
D_2: 0.015 inch diameter.

Figure 3 Embodiment

Passageway **14**:
Inside Diameter: 0.166 inch—(the inside diameter of the Clayton foam valve tube **24**.)
Length: essentially the length of the Clayton foam valve tube, approximately 1⅝ inches.
Side Conduit **16**:
D_2: 0.025 inch diameter.

Pressure drops in the loading of vegetable fat topping as in Example 4 were estimated for two conditions:

Filling time, sec.	Fluid ΔP, lbs./sq. in.	Propellant ΔP, lbs./sq. in.	Valve ΔP*, lbs./sq. in.
1	330	1,050	150
1.5	150	400	65–70

*Included in fluid and propellant ΔP-values.

EXAMPLE 1

(Using Figure 2 Embodiment)

This example demonstrates the loading of commercial Clayton foam valve (as described in U.S. Pat. No. 3,132,774) equipped dispensing cans of various sizes with pure water and a mixture of octafluorocyclobutane, an insoluble propellant, and nitrous oxide, a soluble propellant. The results are approximately those which one could expect with aqueous-based products generally.

It is seen that the initial pressure is roughly proportional to the loading time because of flashout at longer loading times.

Containers were loaded through the valve to octafluorocyclobutane-flashed cans.

Solenoid valves were installed close to the T-mixer in the straight run and in the side run lines. An electric timer opened the valves simultaneously for fixed periods.

Can pressure was measured by a pressure gauge attached to the Clayton valve.

A. 16 fluid ounce, water pressure 200 p.s.i.g.

Filling time, sec	1.0	2.0	3.0	3.5	4.0
Net weight of contents, grams	101	162	238	265	321
Approx. percent full	20	31	46	51	62
Initial pressure, p.s.i.g	35	63	90	109	[1] 114

B. 12 fluid ounce, water pressure 200 p.s.i.g.

Filling time, sec	1.0	2.5	3.0	3.3	......
Net weight of contents, grams	120	216	245	267	......
Approx. percent full	30	54	61	67	......
Initial pressure, p.s.i.g	59	125	143	165	......
Pressure after 1 hr., p.s.i.g		102	128	147	......
Pressure after 24 hrs., p.s.i.g. 40° F		69	92	106	......

C. 6 fluid ounce, 200 p.s.i.g. water pressure

Filling time, sec	1	1.5	2.0	2.5	2.7
Net weight of contents, grams	101	130	125	177	186
Approx. percent full	45	58	56	80	83
Initial pressure, p.s.i,g	43	97	125	151	166

D. 6 fluid ounce, 250 p.s.i.g. water pressure

Filling time, sec	1.0	1.5	1.7	1.9	......
Net weight of contents, grams	115	168	185	200	......
Approx. percent full	52	75	83	90	......
Initial pressure, p.s.i.g	73	126	135	158	......
Pressure after 24 hrs., p.s.i.g., 40° F	39	61	71	86	......

E. 3 fluid ounce, 250 p.s.i.g. water pressure

Filling time, sec	0.8	1.0	1.1	1.2	......
Net weight of contents, grams	97	117	122	127	......
Approx. percent full	67	81	84	88	......
Initial pressure, p.s.i.g	104	109	131	146	......
Pressure after 24 hrs. p.s.i.g., 40° F			63		......

[1] Some bulging in cans from overpressure.

EXAMPLE 2

(Using Figure 2 Embodiment)

A mixture of 40° F. dairy cream and the octafluorocyclobutane-nitrous oxide propellant mixture as in Example 1 was loaded through Clayton foam valves into octafluorocyclobutane-flushed 3 fluid ounce cans. The cream was pressured to the T-mixer at 250 p.s.i.g. After measurement of initial pressure, the containers were stored at 40° F. when the final pressure was measured.

Filling Time, sec	0.8	1.0	1.2	1.3	1.4
Net Weight of Contents, grams	89	99	114	121	128
Approx. percent full	61	68	79	84	88
Initial pressure, p.s.i.g	89	93	109	126	126
Pressure after 24 hrs., p.s.i.g., 40° F	60	62	67	81	79
Number of Containers	2	2	3	8	14

Overrun (percent) was measured on product from two 1-second filled cans before storage. Results were 276 percent and 285 percent. Overrun of hand-whipped cream is generally about 200—250 percent. Overrun is computed as follows:

$$\frac{[\text{volume of foam (cc.)} - \text{wt. of foam (gms.)}] \times 100}{\text{wt. of foam (grams)}}$$

The quantities for the calculations were obtained by filling a tared container of known volume and weighing the filled container.

Seven cans loaded as above in 1.4 seconds were stored at 40° F. and seven other cans were stored in a conventional food freezer. At various times after loading random cans were removed, equilibrated to 40° F., and stiffness and drainage were measured. After testing, the cans were returned to the refrigerator and to the freezer. Thus, all cans in the freeze-storage series except the first underwent repeated refreezing.

The stiffness of dispensed whipped cream was measured with a modified Model A Curd Tension Meter manufactured by the Cherry Burrel Corporation of Cedar Rapids, Iowa. The modification consisted in replacing the curd knife with a 1 square inch circular plunger. Stiffness of hand-whipped cream is generally about 150—200.

Drainage is expressed as the volume of drained liquid (cc.) per gram of foam in 1 hour. The measurement consists in placing a convenient amount of foam on a tared 8 mesh screen, reweighing to estimate the weight of the foam, and allowing the screen to stand for 1 hour on a funnel. The fluid which drains from the screen is collected and its volume is measured.

Stored at 40° F.

Time After Packaging (days)	Stiffness	Drainage (1 hour) (cc./gram)
2	200	0
5	230	0
7	230	0
10	230	0
12	230	0
17	250	0
19	220	0

Stored Frozen

Time After Packaging (days)	Stiffness	Drainage (1 hour) (cc./gram)
2	225	0
5	240	0
7	340	0
10	340	0
12	320	0
17	330	0
19	320	

Storage at freezing temperature increased the stiffness of the whipped cream. The stiffness was considered in all cases to be satisfactory, and all products had the appearance of conventionally whipped cream.

EXAMPLE 3

(Figure 2 Embodiment)

Loading of Pressure-Dispensed Shaving Lather:

Commercial aqueous shaving soap containing about 10 wt. percent fatty acid salts, and minor amounts of emolients and perfume, was loaded with two propellant systems. In both cases pumps supplied liquefied propellant and the aqueous soap solution to the T-mixer at 250 p.s.i.g.

Dichlorodifluoromethane was used in the first experiment. Because the vapor pressure of (insoluble) dichlorodifluoromethane exceed the 60 p.s.i.g. at 70° F. safe upper limit for commercial shaving soap dispensing containers, the foamed product was not packaged but was collected and examined at atmospheric pressure. The foam was stable and had good cell structure. (See earlier discussion regarding ICC regulations).

In a second experiment a propellant mixture of 57 wt. percent dichlorodifluoromethane and 43 wt. percent 1,2-dichlorotetrafluoroethane was used. The vapor pressure of this propellant system is 57 p.s.i.g. at room temperature and the mixture could be safely loaded into 12 fluid ounce commercial dispensing cans via the Clayton foam valve. An average net weight of 300 grams, corresponding to 77 percent full, was charged into the cans in 2.5 seconds.

The dispensed foam was of good quality.

EXAMPLE 4

(Figure 3 Embodiment)

Charging of Pressure Containers with Vegetable Fat Topping:

A typical vegetable fat topping consisting of the following ingredients was prepared.

	Wt.%
1. Vegetable oil (m.p. 92° F.)	20
2. Durkee Emulsifier S.G.M.—57 (stearyl lactic acid)	0.4
3. Polysorbate 80 (polyethylene oxide sorbitan monooleate)	0.1
4. Sugar	13.0
5. "Avicel" RC (microcrystalline cellulose)	0.5
6. "Nu-wip" L.P. (a mixture of mono- and di-glycerides and vegetable gums)	0.4
7. Sodium Caseinate	3.5
8. Water	62.1

Components 1, 2, and 3 were melted and mixed together. A mixture of components 4, 5, and 6 was added to one-half the total water. The water mixture was heated to 160° F. and while being stirred, the melted mixture of components 1, 2, and 3 were added. After stirring for 20 minutes more, the mixture was cooled to 100° F. and homogenized at 800 p.s.i. Component 7 was dissolved in the remaining water with slight heating and blended with the rest of the components.

The topping mixture and chloropentafluoroethane propellant, each supplied to the T-mixer at 250 p.s.i.g., were charged through Clayton foam valves to commercial 24-ounce dispensing cans.

Filling time, sec.	Initial pressure	Drainage, 2 hr.	Overrun, percent	Stiffness	Net wt., grams
3	45	0			387
4	85	0	110	340+	491
5	105	0	173	340+	577
5	105	0	170	300	571

The overrun was modest. Had greater overrun been desired more propellant would have been charged to the containers by supplying the propellant at higher pressure to the T-mixer and/or by enlarging the side run orifice within design criteria.

The foregoing description has been given for clearness of understanding only and no unnecessary limitations are to be understood therefrom. The invention is not limited to the exact details shown and described, for obvious modifications will occur to those skilled in the art.

I claim:

1. In a process for loading a pressurized dispensing device through a valve with fluid products and normally gaseous propellants, the improvement comprising continuously feeding and substantially premixing streams of such fluid product and propellant under turbulent conditions in close proximity to said device while en route to loading,

   1. developing the ratio of the mass velocity of the gaseous propellant to the mass velocity of the fluid product to be 2.7±0.7 or greater,
   2. causing the turbulence of the gaseous propellant and the fluid product to be at least about 3000 Reynolds number with a mixing section of at least 8 diameters in length and
   3. providing the gaseous propellant and the fluid product entry lines to be of sufficient size to permit loading the container to at least 70 percent of capacity before the pressure in the container reaches a value that is about twice the equilibrium pressure of the loaded container.

2. claim **1** wherein said propellant is in a liquid state.

3. Claim **2** wherein said propellant has a vapor pressure greater than said device's allowable pressure and wherein said streams are mixed and loaded rapidly enough to prevent substantial vaporization of said propellant.

4. Claim **2** wherein part of said premixing occurs within said valve.

5. Apparatus for continuously feeding and substantially premixing streams of fluid product and propellant in close proximity to and while en route to being continuously loaded into a pressurized dispensing device through the valve thereof comprising: A housing; a substantially straight passageway extending therethrough for continuously receiving and conveying said fluid product stream through said valve; inlet means in said housing opening into said passageway at substantially right angles for continuously receiving and conveying said propellant stream into said passageway; and a cylindrically shaped means located in the downstream end of said housing adapted to slidably receive said valve such that said valve and passageway are in register; said passageway between said inlet means and said dispensing device extending at least 8 to 10 diameters in length; said passageway having no valve for flow restriction; said inlet means and said passageway between said inlet means and said dispensing device having diameters such that a predetermined turbulent flow is achieved for a predetermined loading velocity.

6. Claim **5** wherein the diameter of said passageway for a given fluid product and desired degree of turbulence is directly proportional to the required loading velocity as determined by the relationship $D=(4w)/(\pi\mu N_{Re})$, where w is the weight rate of fluid product flow, μ is the fluid product viscosity and N_{Re} is the Reynold's number.

7. Claim **6** wherein said housing is further provided with a cylindrical, elongated passageway section concentric within and extending beyond said recess which is adapted to fit within said valve when the valve is positioned within said recess.