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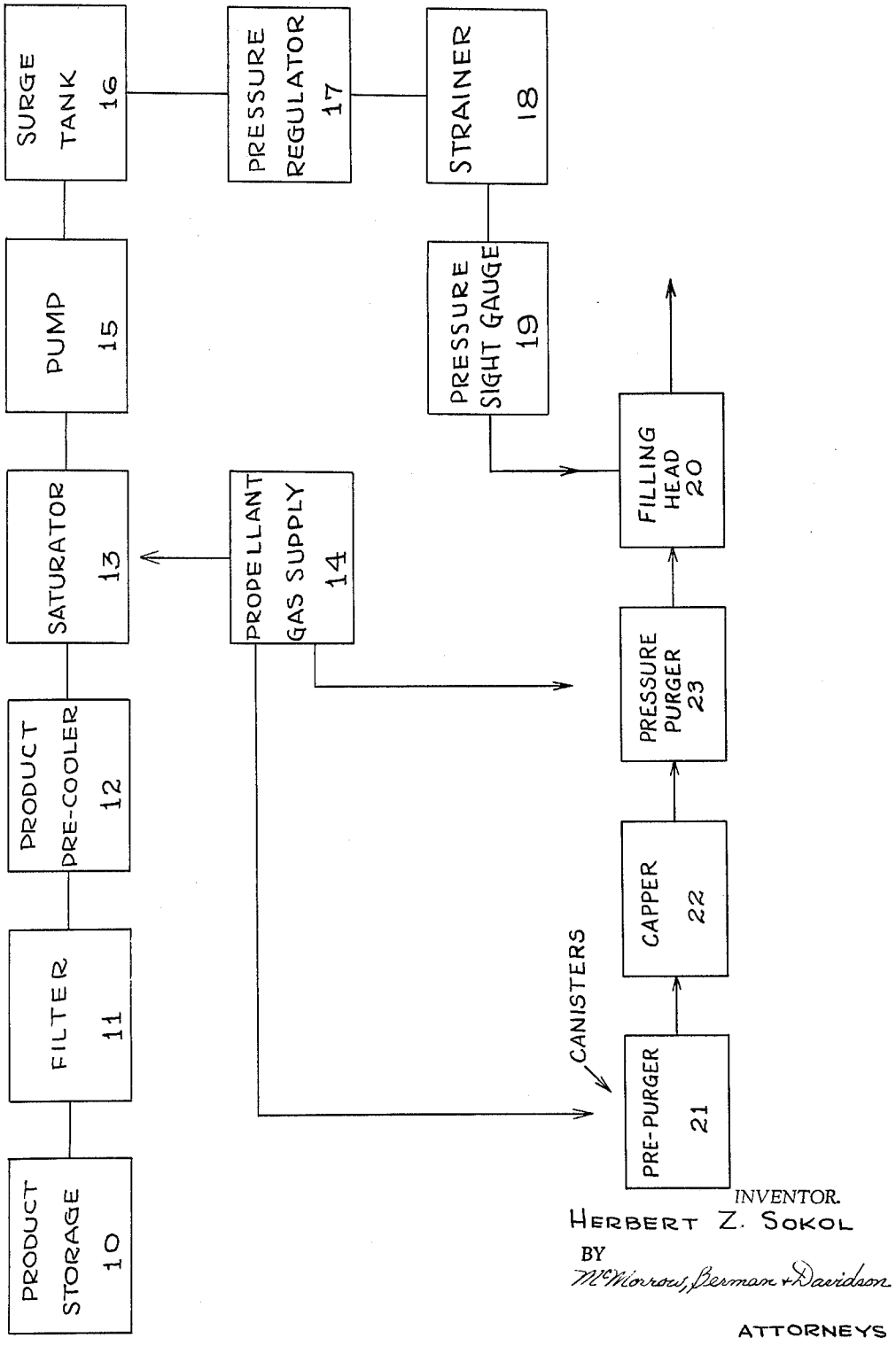

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METHOD AND APPARATUS FOR FILLING AEROSOL DISPENSERS

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The present invention relates to a method and system of apparatus for filling aerosol dispensers. More specifically, the present invention relates to method and apparatus for the filling of aerosol dispensers with a liquid product and a normally gaseous propellant which is soluble in the product.

In recent years, aerosol dispensers have come into widespread use. Among the typical applications of aerosols are the spraying of paints, lacquers and other coatings. Many medicinal, cosmetic and food products are also now available in the form of aerosol sprays. In view of the rapid growth of the market for aerosol products, considerable attention has been devoted to the development of techniques and apparatus for filling aerosols, so that they can be efficiently mass produced at high rates of speed.

According to one conventional method for filling aerosols, the desired amount of liquid product is metered into the aerosol canister. The open canister is then generally purged of air by the introduction of a stream of gas. Usually, the purging gas is the same as the gas which is to be used as the propellant in the final product. The canister is then fitted with a valved closure which is ordinarily crimped in place over the open mouth of the canister. Next, the canister is advanced to a propellant filling head where a gaseous propellant, soluble in the liquid product, is forced through the valve into the canister.

Since the propellant gases do not immediately dissolve in the product in the canister, the dispenser is intermittently shaken during the propellant introduction until enough propellant is introduced to provide excess gas in the head space in the canister under a head pressure of about 100 p.s.i.g.

By such a process, from about 20 to 40 seconds are required to charge a canister of average size, i.e., of about 14 oz. capacity to the desired pressure, usually from about 80 to 110 p.s.i.g.

In addition to being slow, another disadvantage of the filling method just described stems from the fact that it is essentially a non-continuous process. Each canister must be partially charged with propellant, shaken to dissolve the gas in the product and then charged with additional increments of the propellant until the necessary amount has been introduced. The interruption for shaking, therefore, holds up the entire process and results in considerable inefficiency, especially where large scale production is involved.

Where flammable hydrocarbon propellant gases are employed, the previously described, conventional filling method is very hazardous. The presence of free propane, butane, isobutane, dimethyl ether, methyl chloride or other flammable propellants for purging or at the filling head presents a serious danger of fire or explosion. The use of such propellants in common filling methods, therefore, requires special safety precautions and equipment to minimize the danger.

Therefore, the known aerosol filling methods, exemplified by the one described above, have been characterized by lack of speed, by being non-continuous and by the necessity for intermittent shaking of the canister to bring about solution of the propellant gas in the product. A danger of fire or explosion has also been present where the soluble propellant gas is of a flammable nature.

Accordingly, it is an object of the present invention to provide a method and apparatus for filling aerosol containers in a manner which meets the needs of assembly line or mass production operations.

Another object of this invention is to provide a method and apparatus for filling aerosol dispensers at a much higher speed than is possible by conventional procedures.

A further object of the present invention is to provide a method and apparatus for continuously filling aerosol containers with a liquid product and a propellant gas which is soluble in the product.

Another object of the invention is the provision of a method and apparatus for filling an aerosol container with a liquid product and a propellant gas soluble in the liquid without the need for intermittent shaking of the container to dissolve the gas as it is introduced.

An additional object of this invention is to provide a method and apparaus for filling aerosol containers which substantially lessens the hazard of fire or explosion when a flammable, soluble propellant gas is employed.

The manner in which the above-noted objects and many other highly desirable objects and advantages of the invention are achieved will be fully apparent in the light of the following detailed description of the invention and the accompanying drawing which represents, by way of example, a preferred embodiment of the present invention.

In the drawing, the single figure is a flow diagram of the process of the invention and is a schematic representation of the system of apparatus employed for carrying out the process.

In general, the present invention comprises precooling the liquid product, saturating the product with the desired amount of propellant gas, purging the canister, capping the canister with a conventional valved closure and then introducing the saturated product through the valve into the canister under high pressure.

Referring to the figure of the drawing for a more detailed understanding of the invention, it will be seen that the system comprises a storage tank **10** for the liquid product. The product is continuously withdrawn from tank **10** during operation of the system and is preferably passed through a filter **11** before being fed through pre-cooler **12**. The pre-cooler **12** has the capacity to cool a sufficient quantity of liquid product to the desired temperature so that the filling head will have an uninterrupted and ample supply of product during operation.

The temperature of the product is generally reduced below room temperature, the particular temperature depending upon the specific product-propellant system being employed. For most common systems of product and propellant, a temperature in the range of from about 0° F. to 60° F. is satisfactory.

The pre-cooler **12** may consist of a heat-exchanger and a refrigerator compressor or other suitable cooling means.

After the pre-cooler **12**, the liquid next passes through a saturator **13**. Soluble propellant gas from storage unit **14** is also fed into the saturator and is intimately mixed with the pre-cooled product to insure rapid solution. The propellant is preferably supplied to the saturator under a pressure of from 5 to 150 p.s.i.g. The saturator may be insulated to minimize temperature change during saturation. Carbon dioxide, nitrous oxide, nitrogen and mixtures thereof are among the most commonly employed and most satisfactory propellant gases.

When the product is saturated with the desired amount of propellant gas, it is forced by pump **15** under high pressure to filling head **20**. A surge tank **16**, pressure regulator **17**, strainer **18** and sight gauge **19** may be inserted between the pump **15** and the filling head **20**. The surge tank **16** dampens pressure variations due to the pump cycle. The pressure regulator **17** and gauge **19** enable the line pressure to be controlled and monitored

so that the operator can verify that the proper filling pressure is obtained. The strainer, of course, eliminates any foreign bodies which might clog the filling equipment or the valves of individual canisters.

Pump **15** is operated so as to provide a pressure on the output or filling head side of from about 400 to 700 p.s.i.g. This keeps the propellant in solution and enables the canisters to be filled through their valves at high speed.

Before arriving at the filling head **20**, the individual open canisters are preferably advanced to a pre-purger **21** where the air is purged by a low-pressure flow of purging gas, preferably propellant gas. Next, the canisters are moved to a capper **22** where a valved closure is crimped in place, thus closing the open mouth of the canister. Then, the canister is advanced to a pressure-purger **23**. In this instance, purging is accomplished by the introduction of propellant gas through the valve under a positive pressure of from about 0.1 to 50.0 p.s.i.g.

Finally, the purged canister is moved to the filling head **20** where pre-cooled product saturated with soluble propellant gas is forced through the valve under high pressure in the range of from about 400 to 700 p.s.i.g.

The filling head may comprise an adjustable electronic timer for controlling the length of the filling cycle to suit the volume of the canister and the nature of the product propellant system being charged. The filling head itself is simply a device which is capable of engaging the valve of the canister and opening it so that the canister may be filled with material pumped through the filling head.

By the present method, only about 2 or 3 seconds are required to fill an 14 oz. canister to a pressure of from about 80–110 p.s.i.g. as compared with from 20 to 40 seconds required for filling aerosol containers according to the conventional methods described above.

Where a flammable propellant gas is to be employed, the prepurging may be eliminated to reduce the fire hazard. The pressure purging may also be omitted when such propellants are employed, and the can may simply be evacuated prior to filling. Alternatively, the canister may be evacuated, pressure-purged and then filled. In any event, the danger of fire or explosion is substantially reduced by virtue of the pre-saturation of the product with the propellant. Since the propellant is in solution throughout most of this filling process, the likelihood of fire or explosion is minimized.

The purging of the canister may also be varied as described in the preceding paragraph, even where non-flammable propellants are utilized. The pre-purging and pressure-purging gases may be the same as the propellant gas in which case it may be convenient to use purging gas from supply tank **14**.

In general, a void or space of from about 20% to 25% of the canister volume is maintained after filling so that the complete contents can be discharged under sufficient pressure to produce a satisfactory spray pattern.

Canisters may be filled by the present method while in either the upright or inverted position. Of course, in the inverted position, more dissolved propellant gas escapes from the saturated product than when the canister is filled in the upright position. In the upright position, the newly introduced product arrives below the level of the previously charged product so that the gas must bubble up through the first part of the product. This tends to hold the gas in solution.

It will be obvious to one skilled in the art that various propellant gases may be employed other than those previously mentioned. Likewise, the invention is useful with products having a wide variety of liquid bases including water, alcohols, saturated hydrocarbons and the like. Liquid dispersion, emulsions and mixtures may also be filled according to this method.

In practicising the invention, a number of variables may be controlled to arrive at the proper filling of the canisters. For example, by manipulating the pre-cooling temperature, the pressure of the propellant gas in the saturator and the amount of gas introduced into the can during purging, the final pressure in the filled can may be controlled.

While the present invention has been described with reference to certain preferred embodiments, it will be obvious to those skilled in the art that various changes and modifications may be made in both the method and system without departing essentially from the spirit of the invention or the scope of the following claims.

What is claimed is:

1. A method for filling an aerosol dispenser with a liquid product and a propellant gas which is soluble in said product comprising
- pre-cooling said product,
- saturating said pre-cooled product with said propellant gas,
- purging said dispenser to remove air, and
- pumping said pre-cooled product saturated with said propellant gas into said dispenser under high pressure.

2. A method for filling an aerosol dispenser having a valve with a liquid product and a propellant gas which is soluble in said product comprising
- pre-cooling said product,
- saturating said product with said propellant gas,
- purging said dispenser to remove air, and
- introducing said pre-cooled product saturated with said propellant gas through said valve and into said dispenser under high pressure.

3. A method for filling an aerosol dispenser having a valve with a liquid product and a propellant gas which is soluble in said product comprising
- pre-cooling said product,
- saturating said pre-cooled product with propellant gas under a pressure of from about 5 to 150 p.s.i.g.,
- pre-purging said dispenser while still open to remove air by displacing said air with a low pressure flow of a purging gas other than air,
- closing said dispenser,
- pressure-purging said dispenser by introducing a purging gas other than air through said valve under a pressure of from 0.1 to 50 p.s.i.g., and
- pumping said pre-cooled product saturated with propellant gas through said valve and into said purged dispenser under a high pressure of from 400 to 700 p.s.i.g.

4. The method of claim **3** wherein said propellant gas is one selected from the group consisting of carbon dioxide, nitrous oxide and nitrogen.

5. The method of claim **3** wherein said purging gas is the same as said propellant gas.

6. The method of claim **3** wherein said product is pre-cooled to a temperature in the range of from about 0° F. to 60° F.

7. The method of claim **3** further comprising filling said dispenser to from 75% to 80% of capacity and to a pressure of from 80 to 110 p.s.i.g.

8. A method for filling an aerosol dispenser having a valve with a liquid product and a propellant gas which is soluble in said product comprising
- pre-cooling said product,
- saturating said pre-cooled product with a propellant gas which is soluble in said product,
- evacuating said dispenser and
- pumping said pre-cooled product saturated with said propellant gas through said valve and into said dispenser under a pressure of from about 400 to 700 p.s.i.g.

9. The method of claim **8** wherein said propellant is a flammable gas.

10. A system for rapidly and continuously filling an aerosol dispenser having a valve with a liquid product and a propellant gas which is soluble in said product comprising

cooling means for receiving and pre-cooling said product,

saturating means for receiving said pre-cooled product from said cooling means and saturating said pre-cooled product with said propellant gas and

means for receiving said pre-cooled product saturated with said propellant gas from said saturating means and introducing said saturated pre-cooled product into said dispenser under high pressure.

11. A system for rapidly and continuously filling an aerosol dispenser having a valve with a liquid product and a propellant gas which is soluble in said product comprising

a heat exchanger for receiving and pre-cooling said product,

a pressure chamber for receiving said pre-cooled product from said heat exchanger and for dissolving said propellant gas in said pre-cooled product under pressure,

means for purging air from said dispenser, and

means for receiving said pre-cooled product saturated with said propellant from said pressure chamber and introducing said saturated, pre-cooled product through said valve into said dispenser under high pressure.

12. The system of claim **11** wherein said means for introducing said saturated, pre-cooled product into said dispenser comprises a pump and a filling head.

13. A system for rapidly and continuously filling an aerosol dispenser having a valve with a liquid product and a propellant gas which is soluble in said product comprising

a heat exchanger for receiving and pre-cooling said product,

a pressure chamber for receiving said pre-cooled product from said heat exchanger and dissolving said propellant gas in said pre-cooled product under pressure,

means for purging air from said dispenser while said canister is still open,

means for capping said dispenser with a cap having a valve therein,

means for further purging said dispenser by introducing purging gas through said valve, and

means for receiving said pre-cooled product saturated with said propellant gas from said pressure chamber and introducing said saturated, pre-cooled product through said valve and into said dispenser under high pressure.

14. A method for filling an aerosol canister having a valve with a liquid product and a propellant gas which is soluble in said product comprising

pre-cooling said product,

saturating said pre-cooled product with a propellant gas which is soluble in said product,

evacuating said canister, and

pumping said pre-cooled product saturated with said propellant gas into said canister under high pressure.

15. A system for filling an aerosol container having a valve with a liquid product and a propellant gas which is soluble in said product comprising

cooling means to lower the temperature of said product,

means saturating said pre-cooled product with a propellant gas,

means to evacuate said container, and pump means for forcing said pre-cooled product saturated with said propellant gas into said container under high pressure.

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