

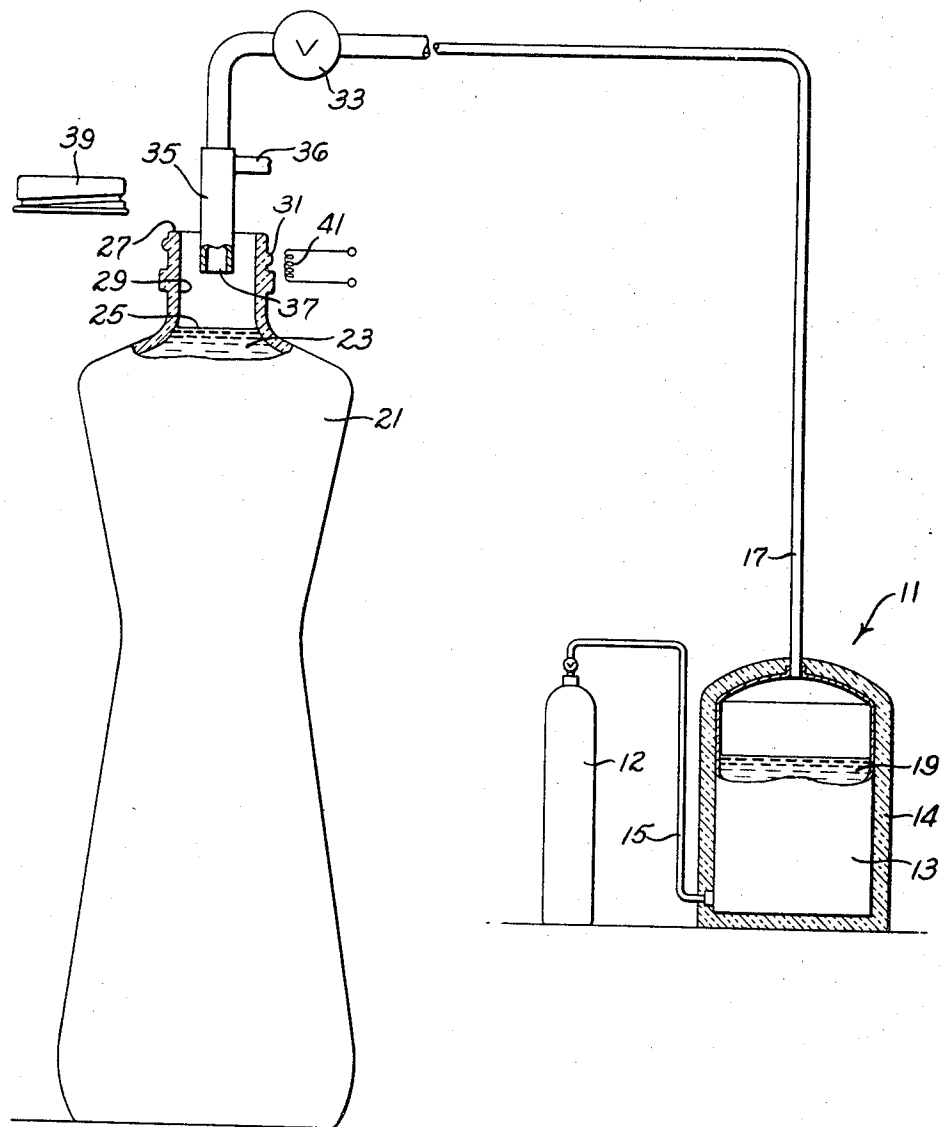
Oct. 15, 1968

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3,406,079

PACKAGING OF SALAD OILS AND THE LIKE

Filed April 2, 1965



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3,406,079

PACKAGING OF SALAD OILS AND THE LIKE
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Filed Apr. 2, 1965, Ser. No. 445,027

16 Claims. (Cl. 99-171)

ABSTRACT OF THE DISCLOSURE

Air is displaced from the headspace of a container before capping by discharging into the headspace a chilled inert gas having a density significantly greater than that of air. The inert gas may be heated thereafter.

This invention relates to a process for sealing a product which is subject to deterioration in the presence of an oxygen atmosphere in a container. More particularly, this invention relates to a process for displacing the air from the headspace of a container packaging such product and replacing it with a gas which is inert as to the product.

As is well known, many products are packaged in containers so that the product substantially fills the container leaving only a small headspace at the top thereof. Numerous products including edible materials such as salad oil deteriorate in the presence of oxygen and, accordingly, it is desirable to exclude air from the headspace of these containers.

Generally, prior art methods have attempted to purge or evacuate the air from the headspace and to inject thereinto an inert gas that has a density about the same or less than the density of the ambient air. These methods are unsatisfactory because the relatively heavy ambient air tends to force the inert gas out of the headspace in the interval between injecting the inert gas and sealing of the container. In addition, injection of inert gas into the headspace tends to induce ambient air through the open top of the container and into the headspace. Because the inert gas has a density about the same as or less than the air, the latter tends to remain in the headspace and to force the inert gas out of the container through the open top end. Also rapid movement of the container immediately prior to closure, e.g. between the filling and closure stations tends to induce additional air into the headspace. Thus, these methods do not adequately purge the air from the headspace or prevent entry of air therein prior to sealing of the container.

Another prior art method is to insert a tube through the open top of the container, through the headspace, and into and at least partially through the product. An inert fluid is then discharged through the open end of such tube in an attempt to purge the air from the container. This method is also undesirable because of the difficulty or impossibility of inserting such a tube through a viscous, granular or solid product and because particles of such products tend to clog the open end of the tube. Furthermore, additional time is required to withdraw the tube substantially the full length of the container and during such interval of time, air may enter the headspace.

A primary object of this invention is to discharge an inert gas which is heavier than the air in the headspace into the headspace of a container above the product contained therein. The heavier-than-air gas displaces the air in the headspace forcing it out the open top of the container. Because the density of the inert gas exceeds the density of the air, being preferably 1.1-2.3 times heavier than the air in all uses of the process as later described, air cannot enter the headspace through the open top of the container in the interval between the discharge of the inert gas and capping or at any other time. Likewise, any

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air which may be induced by the discharge of the heavier than air inert gas into the headspace will be expelled in a similar manner. This process also eliminates the need to evacuate the headspace prior to injecting the heavier than air inert gas. Because the discharge of the greater density inert gas occurs above the level of the product, this process is not subject to the disadvantages noted above in connection with discharge of an inert fluid beneath the level of the product.

Another object of this invention is to severely chill an inert gas to increase the density thereof until it is greater than air and then discharge a stream thereof into the headspace to expel air therefrom. When the high density inert gas is obtained through severe chilling, heating thereof by the ambient air subsequent to capping creates a superatmospheric pressure within the headspace which further decreases the possibility of air entering the headspace after capping. More particularly, it is an object of this invention to discharge a stream of cold nitrogen gas into the headspace of a container. Nitrogen gas at a temperature above its boiling point can be employed. For some products, nitrogen gas cooled to a temperature at least about -125°C . but usually not greater than about -150°C . has been found particularly advantageous.

According to another object of this invention, a stream of severely chilled inert gas is discharged into the headspace of a container and then minutely heated prior to the closing of the container to expand the chilled inert gas to push away any air surrounding the open top of the container.

Still another object of this invention is to severely chill nitrogen gas by direct heat exchange with liquid nitrogen and discharging a stream of the severely chilled nitrogen gas into the headspace of a container to force the air therefrom.

A particular object of this invention is to provide a process for sealing salad oil in an open-topped container which includes substantially filling the container with salad oil leaving a small headspace filled with air; providing a stream of cold nitrogen gas, as by severely chilling a stream of nitrogen gas to produce a gas having a density of approximately 1.1 to 2.3 times, usually about 1.9 to 2.3 times, greater than the density of the air in the headspace of the container; discharging such stream of cold nitrogen gas into the headspace of the container above the salad oil until the air in the headspace is displaced and the headspace is filled to the top of the container with cold nitrogen gas; and then sealing the open top of the container. The aforementioned density range is particularly suited for the packaging of salad oils and similar liquid products. It can be a wider range in packaging granular materials such as coffee.

The invention, both as to its organization and method of operation, together with further objects and advantages thereof, will be more fully understood by reference to the following description taken in connection with the accompanying drawing which illustrates diagrammatically an apparatus for carrying out the novel process of this invention.

Referring to the drawing, a headspace purging apparatus 11 includes a pressurized inert gas storage tank 12, and a heat exchanger or enclosure 13 insulated by insulation 14 having an inlet line 15 and an insulated outlet line 17. The enclosure contains a cold liquid such as a liquefied gas 19. The liquefied gas 19 is preferably an inert fluid such as liquid nitrogen.

The pressured gas in the storage tank 12 is usually at ambient temperature. A stream thereof enters the heat exchanger 13 through the inlet line 15, bubbles through the liquefied gas 19 in direct heat exchange relation therewith to severely chill the inert gas, and leaves via the outlet line 17 in its severely chilled state. Although it is

preferred to utilize a direct type heat exchanger, it is within the scope of this invention to employ an indirect heat exchanger to cool the inert gas or to otherwise produce the stream of severely chilled gas used in the invention, e.g. by applying heat to a stream of liquid nitrogen flowing along a pipe or by flashing nitrogen gas from liquid nitrogen by pressure reduction under controlled conditions. For example, nitrogen gas may be derived from liquid nitrogen by using a suitable steam or electric vaporizer arranged so as to discharge cold gas into the headspace.

The outlet line 17 conducts a stream of the severely chilled inert gas, which desirably is exclusively gaseous without the presence of any significant amount of liquid droplets, to a container 21 having the interior thereof substantially completely filled with a product 23 such as salad oil. The product 23 fills the container to an upper product level 25 which is near an open top end 27 of the container leaving a headspace 29 therebetween. This headspace is normally filled with air and open to the atmosphere at substantially atmospheric pressure. Screw threads 31 surround the exterior of the container 21 at the headspace 29. The product 23 is any one of a large number of products which tend to deteriorate or become unstable in the presence of oxygen and the container 21 may be of any shape and material which can conveniently be used to package such products. For example, the process described herein has been found particularly advantageous for packaging salad oil in glass bottles.

A stream of the severely chilled inert gas flows through a control valve 33, a filling tube 35 having a positioning means 36, and a discharge orifice or port 37 of the filling tube. The filling tube 35 may be slidable vertically along an end portion of the line 17 to provide the proper spacing between the fluid level 25 and the discharge port 37 and to permit withdrawal of the filling tube from the headspace 29 under the action of the positioning means 36. The discharge port 37 may extend downwardly as shown in the drawing or laterally through the wall of the filling tube 35 above a closed lower end thereof. Of course, various filling line techniques may be employed with the process described herein.

As shown in the drawing, the discharge port 37 of the filling tube 35 is positioned in the headspace 29 above the upper product level 25. Preferably, however, the discharge port 37 is positioned a distance further upward from the upper product level 25 than as shown in the drawing with the best results being achieved when it is positioned close to the plane of the open top end 27. In some instances it can be even slightly above the open top end. In all such instances the discharge port 37 may be positioned axially of the headspace 29 or off-center near one side of the headspace.

A stream of the inert gas, e.g. nitrogen that has been chilled by the heat exchanger 13 so that its density is greater than the density of the oxygen-containing gas in the headspace 29, is discharged as permitted by the control valve 33 through the discharge port 37 into the headspace 29. Such discharge is continued until the air in the headspace is displaced and the headspace is filled to the open top end 27 with a quantity of such greater-density inert gas at substantially atmospheric pressure. The supply of cold gas is preferably continued during any withdrawal of the lower end of the filling tube 35 from the headspace so that there is no entry of air compensating for the volume of the headspace previously occupied by the walls of the filling tube 35. Alternatively, if a shallow layer of air should enter the extreme upper end of the headspace as a result of the withdrawal of the filling tube, this will be displaced by the subsequently mentioned heating or expansion of the main body of inert gas in the headspace.

The container 21 is suitably sealed at a time when the headspace is filled to the open top end 27 with the inert gas. Because the surrounding ambient air is less dense than

the cold inert gas, the air cannot enter the headspace during the interval between filling of the headspace with the inert gas and capping. Sealing of the container can be effected by closing the open top end 27 with a sealing means such as a cap 39 which is screwed onto the threads 31. Such a cap may be attached to the container in an ambient atmosphere. However it is a feature of the invention that the cap can be applied in the open atmosphere, with or without laving of the cap with an inert gas during its approach to and seating on the container. Any air or laving gas entrapped in the cap as it is applied to the container will be progressively expelled through the threads as the cap is tightened.

Heat transmitted to the cold inert gas in the headspace during the capping can serve a valuable function in this or other relationships. Heat from the atmosphere or from a separate heating source is exemplified in the drawing by a heater 41 close to the headspace. If a separate heater is employed it may be of any suitable type operating quickly to heat the inert gas minutely to such extent as to cause it to expand.

Such heating may be used during capping to flush away between the threads any residual air or laving gas entrapped in the cap and that has not previously been displaced between the threads during the capping. For example heat may be transmitted to the cold body of inert gas throughout the time that the cap is being lowered and seated. Alternatively the lowering of the cap can be stopped at a position just prior to the time of seating and heating can be continued, first applied or accentuated at this just before the final seal is effected, thus further flushing all air from the headspace.

Heating can also be employed in a sequence in which the flow of the cold high-density inert gas into the headspace 29 is stopped a short time before the headspace is completely filled or the container is closed. Heating of the cold inert gas in the headspace at this time causes it to expand and force any residual air from the open top end 27 of the container or between the threads if the cap has already been placed in position on the container but not yet completely seated.

Finally, any heat transmitted to the still-cold inert gas entrapped in the headspace after sealing will slightly expand the gas and create a small superatmospheric pressure in the headspace, which is often desirable. This can be very important in certain uses of the invention. By use of a severely chilled inert gas it is only necessary to expose the sealed container to ambient temperature to create this superatmospheric pressure, which will remain until the container is opened.

The inert gas may be nitrogen, carbon dioxide, the noble gases such as helium, neon, argon, etc., or nitrous oxide. Nitrogen gas is considered particularly advantageous. For nonfood packaging, butane, isobutane, and propane are satisfactory inert gases.

The inert gas is chilled by the heat exchanger 13 or otherwise to a sufficiently low temperature so that the density thereof will be greater than the density of the air in the headspace 29. In the preferred embodiment, the air in the headspace 29 is substantially at standard room or ambient temperature and pressure and therefore it is usually sufficient to cool the inert gas so that the density thereof is greater than air at such temperature and pressure. Because the headspace 29 is open to the atmosphere adjacent the container 21, the pressure of the inert gas in the headspace prior to capping will tend to be substantially equal to the air pressure around the container. In the preferred embodiment, this pressure is substantially atmospheric pressure.

To determine precisely the desired ratio of density of inert gas to air requires consideration of numerous production parameters such as the kind of product in the container, the temperature of the product in the container, the filling speed, etc. The density of the inert gas should be more than only slightly greater than the density of the

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air in the headspace. Generally stated, the inert gas should be sufficiently dense so that it will readily displace the air in the headspace. For example, if the density of the inert gas were only approximately .1% greater than the density of air in the headspace, no adequate displacement action would occur. By way of exemplification, a density ratio of inert gas to air of approximately 1.9 to 2.3 has been shown to be satisfactory for production packaging of salad oil when the inert gas is nitrogen. For coffee and some other foods a wider density range is appropriate.

The temperature to which the inert gas is cooled by the heat exchanger 13 depends upon the required density thereof and the kind of gas employed. By way of illustration when nitrogen gas is used, a temperature range of from about -125° C. to about -150° C. has been found particularly desirable for certain applications.

It is also within the scope of this invention to utilize an inert gas which is sufficiently heavy at normal packaging temperatures and pressures to displace the air in the headspace 29 without requiring chilling thereof. Typically, this will be an inert gas having a density at ambient temperature and atmospheric pressure greater than the density of air at such temperature and pressure. Octafluorocyclobutane and argon are suitable in this connection.

Thus, the process of the present invention purges oxygen more completely from the headspace of a container than was possible with prior art methods. Utilizing the method of this invention entry of air during the interval between such purging and the capping of the container is prevented. The greater density inert gas literally falls into the headspace and forces the air therein out through the open top end 27 of the container 21. By utilizing the heater 41 or ambient heat to increase the temperature of the inert gas within the headspace 29 prior to capping, air surrounding the open top 27 of the container is pushed away by the expanding inert gas. The small superatmospheric pressure created in the headspace caused by heating of the inert gas by the ambient air provides an additional safeguard against entry of air after capping. The entire process is carried out without the disadvantages inherent in inserting the discharge port 37 into the product 23.

Many changes, modifications, and substitutions may be made by those having ordinary skill in the art without departing from the spirit and scope of this invention.

What is claimed is:

1. A process for sealing salad oil in an open topped bottle comprising:
 - substantially completely filling the interior of said bottle with said salad oil while leaving a small headspace filled with air open to the atmosphere and at substantially atmospheric pressure, the salad oil being in contact with the air at an oil-air interface,
 - providing a quantity of liquid nitrogen;
 - bubbling a stream of nitrogen gas through said quantity of liquid nitrogen to chill said nitrogen gas until the density thereof is approximately 1.1 to 2.3 times greater than the density of air;
 - discharging a stream of said chilled and greater density nitrogen gas into said headspace of said bottle above the oil-air interface produced by the salad oil therein and thus avoiding mixing of the gas with the salad oil;
 - continuing such discharge until the air in said headspace is displaced and the headspace is filled substantially to the top of said bottle by a quantity of said greater density nitrogen gas at substantially atmospheric pressure; and
 - sealing the open top of said container while the nitrogen gas in the headspace is still at a temperature to maintain its density greater than that of air to entrap said greater density inert gas in said headspace of the now-closed bottle.
2. A process for sealing a product in an open-topped container, which process comprises:

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substantially completely filling the interior of said container with said product while leaving above the product level a small headspace filled with air;

providing a quantity of liquified gas at low temperature; flowing a stream of an inert gas in heat-transfer relationship with said liquified gas to chill said inert gas until the density thereof is significantly greater than air;

displacing the air from said headspace by discharging a stream of said chilled and greater density inert gas at a discharge position that is between a lower position within said headspace but above the product level and an upper position above but near the open top of the container; and

then closing the top of said container while the inert gas is still at a temperature to maintain its density greater than that of air to entrap said greater density inert gas in said headspace of the now-closed container.

3. A process as defined in claim 2 in which said stream of inert gas is cooled by indirect heat transfer with said liquified gas.

4. A process as defined in claim 2 in which said inert gas is the same gas as said liquified gas, in which heat is transferred therebetween by bubbling the stream of inert gas through the liquified gas, and in which the resulting stream of chilled and greater-density inert gas is maintained free of any particles of liquid at the time it is discharged into said headspace.

5. A process for sealing a liquid product in an open-topped container, said liquid product being of a character to deteriorate in the presence of oxygen, which process includes the steps of:

substantially completely filling the interior of said container with said liquid product while leaving above the product level a small headspace filled with an oxygen-containing headspace gas;

providing a quantity of liquefied gas at low temperature;

flowing a stream of an inert gas in heat-transfer relationship with said liquefied gas to chill said inert gas until the density thereof is significantly greater than said headspace gas;

displacing the headspace gas from said headspace by discharging a stream of said chilled and greater density inert gas at a discharge position that is between a lower position within said headspace but above the product level and an upper position above but near the open top of the container; and

then closing and sealing the top of said container while the inert gas is still at a temperature to maintain its density greater than that of air to entrap said greater density inert gas in said headspace of the now-closed container.

6. A process as defined in claim 5 in which said stream of inert gas is cooled by indirect heat transfer with said liquefied gas.

7. A process as defined in claim 5 in which said inert gas is the same gas as said liquefied gas, in which heat is transferred therebetween by bubbling the stream of inert gas through the liquefied gas, and in which the resulting stream of chilled and greater-density inert gas is maintained free of any particles of liquid at the time it is discharged into said headspace.

8. A process for sealing a liquid product in an open-topped container, said liquid product being of a character to deteriorate in the presence of oxygen, which process includes the steps of:

introducing a stream of said liquid product into an initially-empty, open-topped container while the top of the container is open to an ambient gas containing oxygen thereby progressively displacing gas from the top of the container into the ambient gas;

stopping such introduction when the container is filled with the liquid to a level that is near but below the top of the container, thus forming a headspace in said

container below the open top thereof, the headspace being filled with an oxygen-containing headspace gas contacting the liquid product at a gas-liquid interface at said level;

cooling an inert gas to a sufficiently low temperature to provide a severely chilled gas having a density about 1.1–2.3 times greater than the density of air, said cooling being effected at a position remote from said container and its liquid-product contents;

displacing said headspace gas from said headspace by discharging a stream of said chilled inert gas at a discharge position that is between a lower position within the headspace but above said interface and an upper position above but near the top of the container, all while avoiding mingling of the inert gas with the liquid below the gas-liquid interface; and then closing and sealing the top of said container while the inert gas is still at a temperature to maintain its density greater than that of air to entrap such inert gas in said headspace of the now-closed container.

9. A process as defined in claim 8 in which said chilled inert gas is nitrogen at a temperature in the range of about -125°C . to about -150°C .

10. A process as defined in claim 8 in which said inert gas is cooled in contact with the same inert gas in liquefied state, the cooled inert gas being free of any liquid particles at the time it enters the headspace.

11. A process as defined in claim 8 in which said inert gas is nitrogen produced at least in part by the heating of liquid nitrogen.

12. A process as defined in claim 8 in which the container is a bottle, in which the filling of the bottle is performed while the bottle is in an ambient atmosphere of said ambient gas, in which the bottle is closed and sealed by placing a cap thereon and seating the cap, and in which the cap is applied to the bottle while being laved with an inert gas during its approach to and seating on the bottle.

13. A process as defined in claim 8 in which the stream of chilled inert gas discharged into the headspace is a stream of cold nitrogen that is exclusively gaseous and that contains no significant amount of liquid droplets, at least a portion of the nitrogen of said stream of cold nitrogen being formed by reducing the pressure on a flowing stream of nitrogen.

14. A process as defined in claim 8 in which said chilled inert gas is discharged into said headspace through a downwardly-open orifice that is of sizable internal diameter relative to the internal diameter of the open top of said container.

15. A process as defined in claim 14 in which the chilled inert gas is discharged through the downwardly-open orifice while the latter is axially off-center relative to the axis of the open top of the container to initially enter the headspace near one side thereof.

16. A process as defined in claim 14 in which the filling of the container is performed while the container is in an ambient atmosphere, and in which said chilled inert gas is exuded from said orifice at a position near but above the top of the container, the chilled inert gas being of sufficient density to fall from the orifice through the ambient atmosphere and into the headspace to displace the headspace gas therefrom into the ambient atmosphere.

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