METHOD OF MAKING GASKETED MOUNTING CUPS FOR PRESSURIZED AEROSOL CONTAINERS

Filed March 9, 1966

FIG. 1

1. Band of gasket material
2. Swell band in non-solvent
3. Apply swollen band to cup
4. Release band to circumscribe cup
5. Remove non-solvent from band

FIG. 2

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Filed Mar. 9, 1966, Ser. No. 533,601

Int. Cl. B29c 27/22

U.S. Cl. 264—249

9 Claims

This invention pertains to a method of making gasketed closure elements and in particular, relates to a method of producing gasketed mounting cups for pressurized aerosol containers.

Aerosol dispensing containers have found widespread use, the packaging of fluid materials including a variety of both liquid and powdered particulate products. Such containers are provided with a valve-controlled discharge orifice and operate by the action of a volatile propellant which is confined within the container together with the product to be dispensed. Because the propellant has an appreciable vapor pressure at room temperature, the product in the closed container is maintained in a supersaturated or super-atmospheric pressure. When the valve is opened, the propellant forces the product upwardly through the discharge orifice.

A typical aerosol unit comprises a hollow cylindrical container which is tightly closed at one end and is provided with an opening at its opposite end for receiving a dispensing valve assembly. A mounting cup serves as a closure for the container and also as a support for the valve assembly. The mounting cup comprises a panel having an aperture for receiving the valve assembly, a skirt depending from the periphery of the panel, and an annular channel extending outwardly from the lower edge of the skirt. When the cup is inverted in a sealing position on the container, the channel is positioned over the bead surrounding the container opening and the lower portion of the skirt adjacent the channel is flared outwardly against the container wall adjacent the bead. To ensure adequate sealing between the closure and the container, the cup is provided with a gasket which may reside in the annular channel or predominantly in the channel of the cup. Preferably, however, the gasket is positioned exclusively on the lower portion of the skirt so that when the cup is crimped on the container, the gasket forms a seal in the seam produced between the skirt and the container wall.

The method most commonly employed in preparing mounting cup gaskets has consisted of forming the gaskets in situ from liquid gasket-forming compositions comprising an elastomer dispersed or dissolved in a volatile organic liquid vehicle. In the manufacture of these gaskets, the liquid composition is deposited in the desired configuration in the cup while the liquid vehicle passes beneath a metering nozzle through which the composition flows. The deposit is then converted into a dry solid sealing mass by expelling the liquid vehicle at elevated temperatures.

Although the technique of flowing gaskets into place has been extremely efficient and is used commercially today, it is still desirable to achieve further improvements in the art of mounting aerosol gaskets, for example, by further simplifying the mechanical operations involved and providing greater latitude in the types and choice of sealant materials employable.

According to the present invention, a method is provided wherein gaskets can be applied to aerosol mounting cups in a rapid, simple and efficient manner to form gasketed closures exhibiting excellent sealing performance. Specifically, the present invention provides a method of applying a gasket to an aerosol mounting cup comprising a top panel, a skirt depending from the periphery of the top panel and an annular channel extending outwardly from the bottom edge of the skirt which comprises positioning a band of gasketing material over the outside surface of the skirt so that its lower edge overlies the juncture where the skirt and channel merge, said gasket consisting of a circular band of heat-shrinkable material having a diameter slightly greater than the outside diameter of the skirt of the cup but less than the inside diameter of the annular channel, and heating the cup carrying the positioned band of material at a temperature and for a time sufficient to shrink the band of material into frictional engagement with the skirt.

The present invention will be more clearly understood from a reference to the attached drawings and the discussion relating thereto:

FIGURE 1 schematically illustrates the present method of fabricating gasketed aerosol mounting cups.

FIGURE 2 shows in axial section a mounting cup prepared according to the method of FIGURE 1.

FIGURE 1 shows the successive steps employed to apply the gasket. In general, there is first provided a circular band of gasket material having a diameter slightly smaller than the outside diameter of the skirt of the cup. This band is swollen to a diameter slightly larger than the outside diameter of the skirt of the cup but less than the inside diameter of the annular channel of the cup, by immersing in a liquid swelling agent which is a non-solvent for the gasket material. The swollen band is then slipped over the outside surface of the skirt of the cup and released in a position so that its lower edge overlies the juncture where the skirt and channel merge. Thereafter, the liquid swelling agent is removed from the gasket material so that the band will come into tight frictional engagement with the skirt.

FIGURE 2 is an axial sectional view of the gasketed mounting cup shown in inverted position relative to its placement in the assembled container and produced according to the steps illustrated in FIGURE 1. The cup, generally designated at 10, comprises a circular panel 11 having integral skirt 12 depending from its periphery. The free edge of skirt 12 is outwardly flanged at 13 to form an annular channel 14 for receiving the bead surrounding the container opening (not shown) when the cup is positioned thereon. The inner portion of panel 11 is countersunk to form a tubular recess, generally designated at 16, which has a dependent circular wall 17 integrally joined with an apertured horizontal wall 18. When the cup is placed in sealing position, the tubular recess 16 acts as a pedestal for the valve unit and the valve stem is admitted into the container through apertured wall 18.

Gasket 19 is disposed on the exterior surface of the skirt 12 and extends upwardly for a distance from the skirt-channel juncture 13 to approximately the midpoint between the top panel 11 and the juncture 13. This portion of the cup between the midpoint of the skirt 12 and its juncture 13 with the channel 14 is commonly referred to in the aerosol art as the shoulder of the cup.

The band of material employed for the gasket must be capable of swelling at least about 15% in diameter when immersed in a liquid swelling agent to permit application to the closure and to form a friction fit with the closure skirt when the non-solvent is removed. Unless the band forms a reasonably tight fit with the skirt, it will slip out of sealing position when the cup is inverted and placed over the mouth of the container prior to crimping. The band of material used must also provide a gasket which is sufficiently deformable under the pressures encountered during crimping to flow into and fill the tiny passages or voids in the seam without cracking.
Bands having these characteristics may be composed of an elastomeric polymer, a resinous polymer, or if desired, a mixture of polymers may be used to obtain the proper balance of properties required for application to the cup and for forming an effective seal. Also, the polymeric material used for the band may contain pigments, fillers, curing agents, processing aids and other conventional compounding ingredients.

Illustrative of elastomeric polymers useful in fabricating bands suitable for present purposes are natural rubber and synthetic rubbers, such as polymers of conjugated diolefins, e.g. polybutadiene-styrene copolymers; butadiene-acrylonitrile copolymers; butadiene-styrene-acrylonitrile terpolymers; polymers of chlorine-substituted conjugated diolefins, e.g. polychloroprene, 2-chloro 1.3-butadiene-acrylonitrile copolymers; and polymers of non-conjugated systems, e.g. polyisobutylene, polyisoprene, isobutylene-isoprene copolymers and isobutylene-butadiene copolymers. Other synthetic rubbers which may be used include elastomeric polyacrylates, polyorganosilicones, polysulfides, ethylene-propylene copolymers and polyesters, such as polyurethanes. Useful resinous polymers include vinyl resins, e.g. polystyrene, polyvinyl chloride, vinyl chloride-vinyl acetate copolymers; polyether resins, e.g. polyethylene terephthalate; and polyacrylates.

The liquid swelling agent used to expand the diameter of the band depends upon the particular gasket material employed. Besides having a substantial swelling effect on the composition, the liquid should be a non-solvent for the gasket material so that it will not dissolve the gasket material and it should be volatile so that it can be easily removed from the band after the band has been placed in sealing position. Aliphatic and aromatic hydrocarbons boiling below about 220°F are useful swelling agents for most elastomeric materials. Specific swelling agents suitable for natural rubber and most synthetic rubbers include hexane, toluene and trichloroethylene while ethyl acetate and methyl isobutyl ketone are suitable for vinyl and polyester resins.

The exact diameter of the band material used depends primarily upon the size of the closure, but in all cases, the normal, i.e. unswollen diameter of the band must be smaller than the outside diameter of the closure so that when being positioned upon the cup, the band will frictionally engage the closure when the liquid swelling agent is evaporated. As is well known in the art, conventional gaskets have a standard filling opening of 1.000±0.004 inch, and the cups used with these cups have a skirt diameter of about 0.991 inch and a channel diameter (inside diameter) of about 1.253 inches. Thus, the bands used for standard mounting cups generally have a normal diameter (inside) between about 0.500 and 0.900 inch and are swollen to a diameter between about 0.995 and 1.250 inches.

The width and the thickness of the bands employed are substantially the same as the width and thickness desired in the assembled gaskets since there is no significant change in these dimensions after the band has been applied to the cup. To provide an effective and lasting seal, the gasket should cover the shoulder of the cup since this part of the closure is flared outwardly and forced against the container wall adjacent the container opening when the cup is crimped on the container. Thus, the band of material should be wide enough to cover that portion of the skirt extending between the skirt-channel juncture and about the midpoint of the skirt between the top panel and skirt-channel juncture. Though the band may be wider so that the gasket extends above the skirt midpoint, no further benefit is achieved with respect to sealing.

The thickness of the band used on standard cups varies between about 2 and 10 mils since a gasket thickness in this range is essential for establishing a satisfactory seal. A thickness of at least 2 mils is necessary to assure that enough material is present to completely seal the irregularities in the crimped seam produced between the skirt and container wall. Above about 10 mils, the gasket may be damaged when the closure is placed on the container. In instances where tolerances between the closure skirt and container opening are very close.

The apparatus used in carrying out the present method may be of any design suitable for immersing the band in a liquid swelling agent and then applying and releasing the band in position on the closure. For most gasket materials an immersion time of a few minutes is sufficient for swelling the band to the desired diameter. Removing the swelling agent may be carried out by allowing the liquid to evaporate at room temperature, or the cups with the positioned gaskets may be heated for a few minutes at elevated temperatures to accelerate removal of the liquid especially where the swelling agent has a relatively high boiling point.

The following examples are given to further illustrate the present invention. All quantities are in parts by weight unless otherwise specified.

**EXAMPLE 1**

A group of several aerosol mounting cups having gaskets positioned exclusively on the shoulder of the closures were prepared by cutting gasket material in the form of tubing into suitable lengths and then placing the resulting bands in sealing position on each cup. The gasket material employed was a cured natural rubber composition composed of 100 parts by weight natural rubber, 11.6 parts by weight zinc oxide, 4 parts by weight sulfur and 4 parts by weight zinc dibutyldithiocarbamate. The tubing had an inside diameter of 0.750 inch and a wall thickness of 0.7 mils.

The closures employed were those commonly used for test purposes where the aperture in the horizontal pedestal wall for receiving a valve unit is omitted. A valve mechanism is not employed on test packs due to weight loss of propellant through the valve. The cups, otherwise, were standard in design and dimensions and had a skirt diameter (outside) of about 0.991 inch and a channel diameter (inside) of about 1.253 inches.

In preparing the gasketed closures, bands about 0.185 inch in width were cut from the cured rubber tubing, and then immersed in hexane until the diameter of each band had expanded to between about 0.995 and 1.250 inches. After swelling, each band was positioned over the outside surface of the skirt of each cup so that its lower edge overlapped the juncture where the skirt and channel merged. Thereafter, the cups carrying the gaskets were allowed to stand at room temperature until substantially all of the swelling agent had evaporated and the bands had come into frictional engagement with the closure skirts.

In all of the closures produced, the gaskets extended from the skirt-channel juncture to about the skirt-midpoint. The thickness of the resulting gaskets was substantially the same as the initial thickness of the bands.

When the performance of the gaskets was tested at conventional crimps on a standard propellant pack consisting of a mixture of 60 parts by weight trichloromono-fluoromethane ("Freon") and 40 parts by weight dichlorodifluoromethane ("Freon 12"), it was found that all of the gasketed closures prepared above gave satisfactory mechanical seals. The average weight loss after one day for the group of cups was 0.005 gram as based on an initial quantity of propellant ranging between 20 and 45 grams. In comparison, test packs closed with aerosol mounting cups without gaskets showed a total loss of propellant in one day.

The maximum permissible weight loss for acceptable mechanical sealing with the above propellant is set at 0.015 gram per day since this value represents the amount of this "Freon 11"/"Freon 12" propellant ordinarily lost.
through the valve assembly on commercial packs during the same period.

EXAMPLE 2

Another group of aerosol mounting cups having shoulder gaskets were prepared by cutting bands of gasket material about 0.185 inch wide from tubing composed of 100 parts by weight polyvinyl chloride, 40 parts by weight dioctyl adipate and 40 parts by weight dioctyl phthalate. The tubing had an inside diameter of 0.875 inch and a wall thickness of about 5 mils.

In preparing the gasketed cups, each band was immersed in ethyl acetate until its inside diameter had expanded to about 1.0 inch which required 1½ to 1½ minutes. After swelling, each band was slipped over the outside surface of the skirt of each cup and released in a position so that its lower edge overlaid the juncture where the skirt and channel merge. The cups used were similar to those employed in Example 1. After the band had been positioned, the ethyl acetate was then removed by evaporation at room temperature.

In all of the closures produced, the gaskets formed a tight friction fit with the closure skirt and were coextensive with the shoulder of the cup between the skirt-channel juncture and skirt midpoint. The thickness of the gaskets was about 5 mils.

When the performance of the gasketed closures was tested on “Freon 11”/“Freon 12” propellant packs as in Example 1, it was found that the average weight loss was 0.005 gram for a period of one day.

It is apparent from the above examples that the present invention offers a rapid and simple method of producing gasketed aerosol mounting cups where the gasket is positioned exclusively on the shoulder of the closure. The bands used for the gasket may be easily fabricated by cutting segments of the desired width from suitable gasket material in the form of tubing, or they may be prepared in any other convenient manner. After swelling the bands can be positioned on the closures quickly and accurately and the swelling agent readily removed to give uniform and effective seals without concern for variations in dimensions or displacement of the gasket during handling or on the pack.

We claim:

1. A method of applying a gasket to an aerosol mounting cup comprising a top panel, a skirt depending from the periphery of the top panel and an annular channel extending outwardly from the bottom edge of the skirt which comprises swelling a band of gasket material having a diameter slightly smaller than the outside diameter of the skirt, and the outside diameter of the skirt but less than the inside diameter of the annular channel of the cup by immersing the band in a liquid swelling agent which is a non-solvent for the gasketing material, positioning the swollen band of material over the outer surface of the skirt so that its lower edge overlaps the juncture where the skirt and channel merge, and removing the liquid swelling agent from the band of gasketing material to bring the band into frictional engagement with the skirt.

2. A method according to claim 1 wherein said band of gasket material is of sufficient width to cover the skirt between its midpoint and its juncture with the channel.

3. A method according to claim 2 wherein said closure skirt has an outside diameter of about 0.991 inch and said closure channel has an inside diameter of about 1.253 inches.

4. A method according to claim 3 wherein said band of gasket material has a normal inside diameter less than 0.991 inch and is swollen to a diameter between about 0.995 and 1.250 inches.

5. A method according to claim 4 wherein said band of gasket material has a wall thickness between about 2 and 10 mils.

6. A method according to claim 5 wherein said band of gasket material is composed of an elastomeric polymer.

7. A method according to claim 6 wherein said band of gasket material is composed of a cured natural rubber composition and the swelling agent is hexane.

8. A method according to claim 5 wherein said band of gasket material is composed of a resinous polymer.

9. A method according to claim 8 wherein said band of gasket material is composed of a polyvinyl chloride composition and the swelling agent is ethyl acetate.

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U.S. Cl. X.R.
156—69, 83, 86; 215—40, 48; 264—343