United States Patent [19]

Jaeger

[11] **3,802,056**

[45] **Apr. 9, 1974**

[54] **METHOD OF MAKING SELF-REFRIGERATING AND HEATING FOOD CONTAINERS**

[75] Inventor: **Wilbert J. Jaeger,** Orange, Calif.

[73] Assignee: **Chandler Research Institute**

[22] Filed: **Nov. 26, 1971**

[21] Appl. No.: **202,672**

Related U.S. Application Data

[60] Division of Ser. No. 1,239, Jan. 7, 1970, Pat. No. 3,726,106, which is a continuation-in-part of Ser. No. 737,121, June 14, 1968, abandoned.

[52] **U.S. Cl.** ..... **29/422,** 53/36, 62/457, 113/120 H

[51] **Int. Cl.** **B23p 17/00**

[58] **Field of Search** ..... 29/422; 53/36; 126/263, 126/262; 99/171; 62/294, 457, 371, 372, 331; 113/120 H

[56] **References Cited**

UNITED STATES PATENTS

2,185,799	1/1940	Blake et al.	62/94
2,338,094	1/1944	Calleson et al.	113/120 H
2,339,763	1/1944	Calleson et al.	113/120 H
2,815,152	12/1957	Mills	53/36 X
3,285,033	11/1966	Warner	62/457 X
3,320,767	5/1967	Whalen	62/294
3,338,067	8/1967	Warner	62/371 X
3,417,573	12/1968	Warner	62/457
3,696,633	10/1972	Mills	62/294

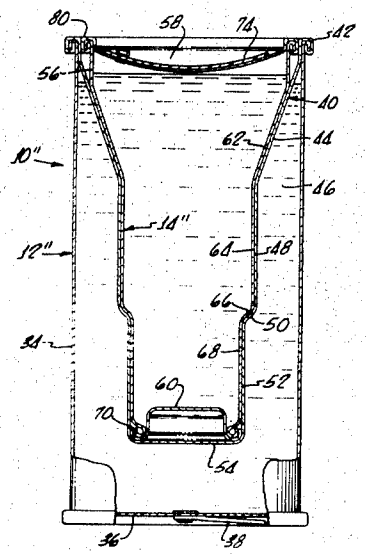
Primary Examiner—Charles W. Lanham
Assistant Examiner—Victor A. DiPalma
Attorney, Agent, or Firm—Raymond L. Madsen; Richard M. Jennings

[57] **ABSTRACT**

There is disclosed a method of forming a container comprising the steps of providing a strip of material, cutting the strip to a predetermined size, forming the cut strip into a hollow cylinder having two open ends, providing a plug of malleable material, pressing the plug into an elongated hollow body, connecting one end of the hollow body to one end of the cylinder to form an enclosure, and filling the enclosure with a product. In addition, further steps are disclosed comprising providing a second plug of malleable material, pressing the second plug into a second elongated hollow body capable of nesting within the first mentioned hollow body, the hollow body having two open ends, providing a closure for one open end, lock sealing the closure to the end of the hollow body, filling the hollow body in a high pressure environment with coolant providing a closure and valve assembly and sealing the closure and valve assembly to the other open end of the second hollow body.

There is disclosed an alternate method for forming a container comprising the steps of providing a plug of material, pressing the plug into an elongated hollow body having a threaded section, providing a strip of material, pressing the strip into a threaded closure, engaging the threaded closure with the hollow body, providing a second strip of material, forming the second strip into a hollow cylinder, inserting the hollow body into the hollow cylinder, connecting the cylinder with the outer edge of the threaded closure, filling the interior of the hollow body with a coolant, providing a closure and valve assembly and sealing the open end of the hollow body with the closure and valve assembly. Additional steps are disclosed providing filling the enclosure between the hollow cylinder and the hollow body with a product and providing a closure to seal the product within the enclosure.

5 Claims, 43 Drawing Figures



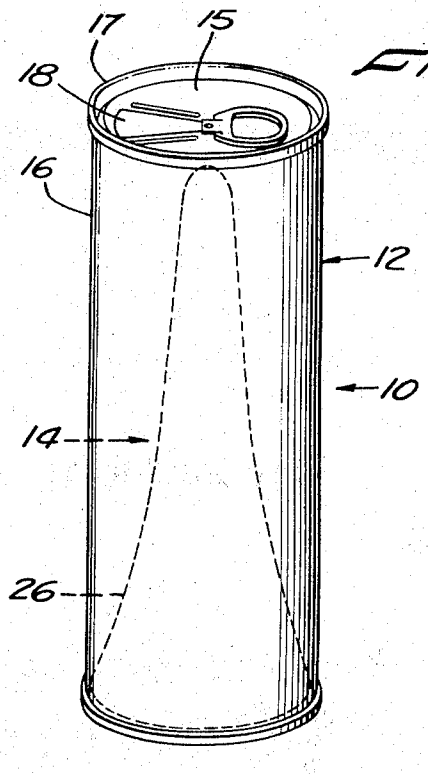


FIG. 1.

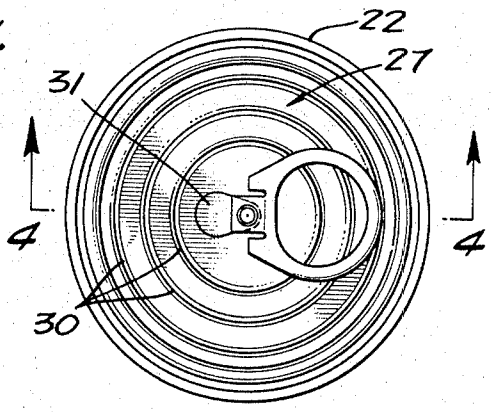


FIG. 3

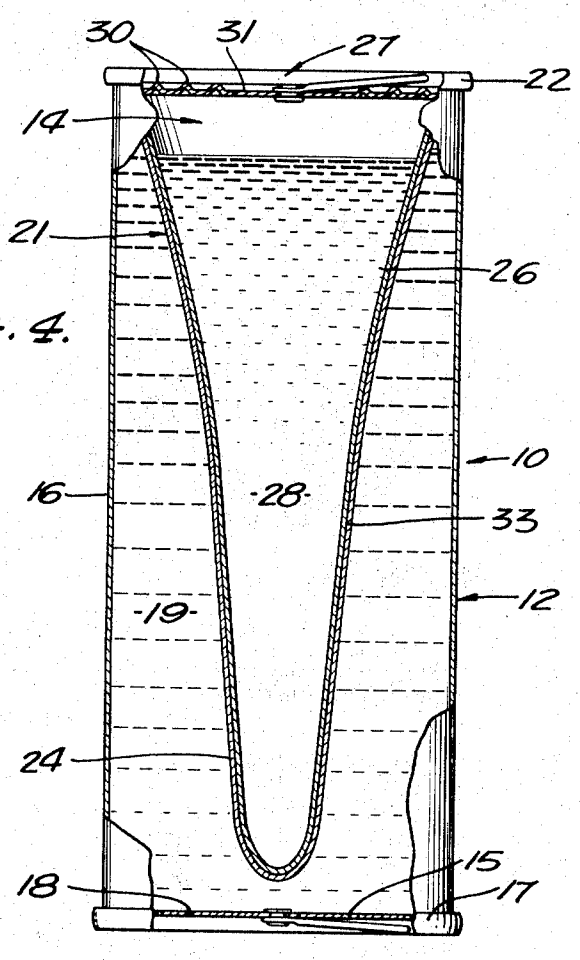


FIG. 4.

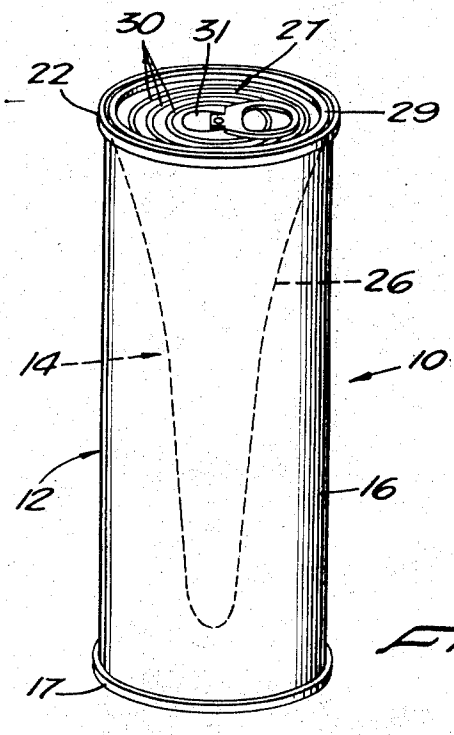


FIG. 2.

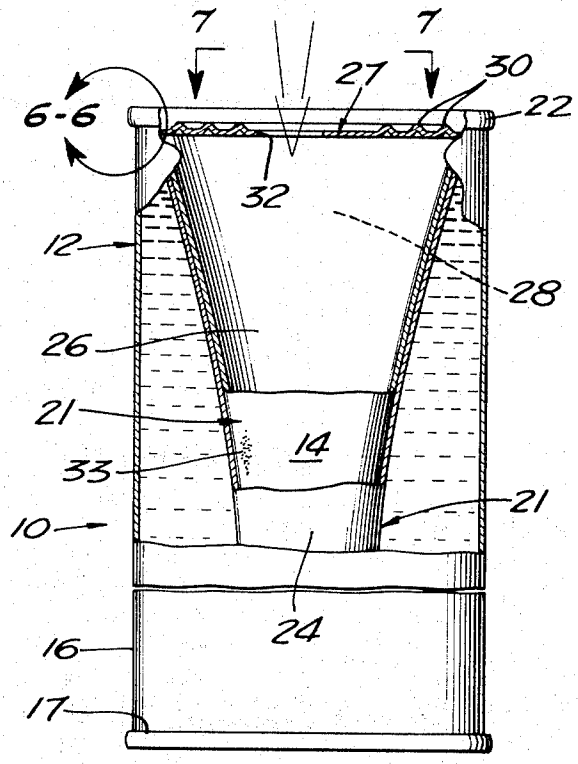


FIG. 5.

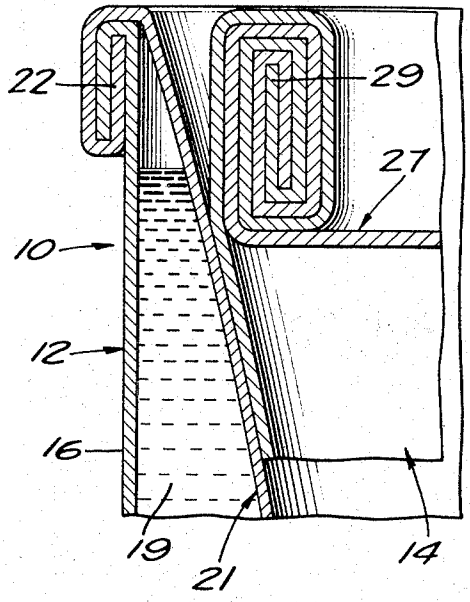


FIG. 6.

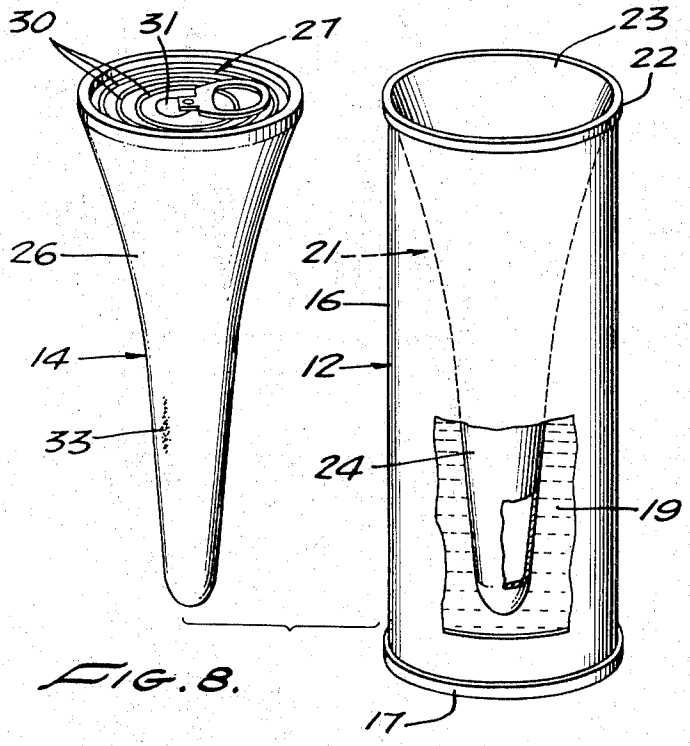


FIG. 8.

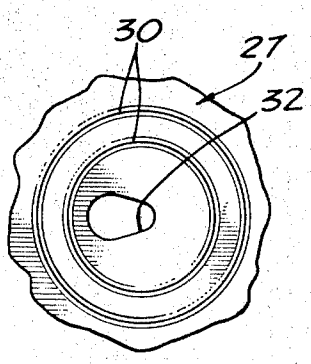


FIG. 7.

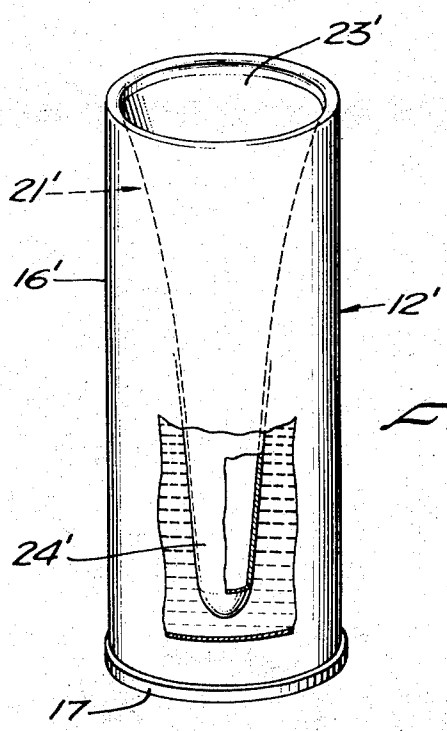


FIG. 9.

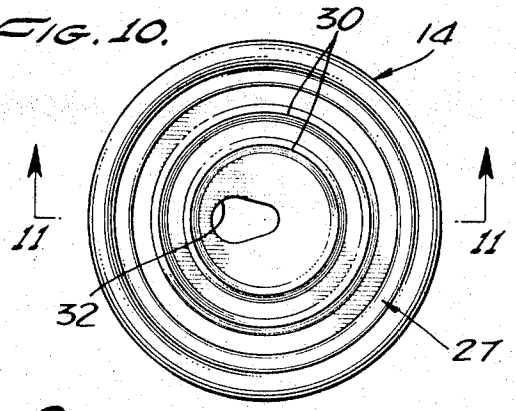


FIG. 10.

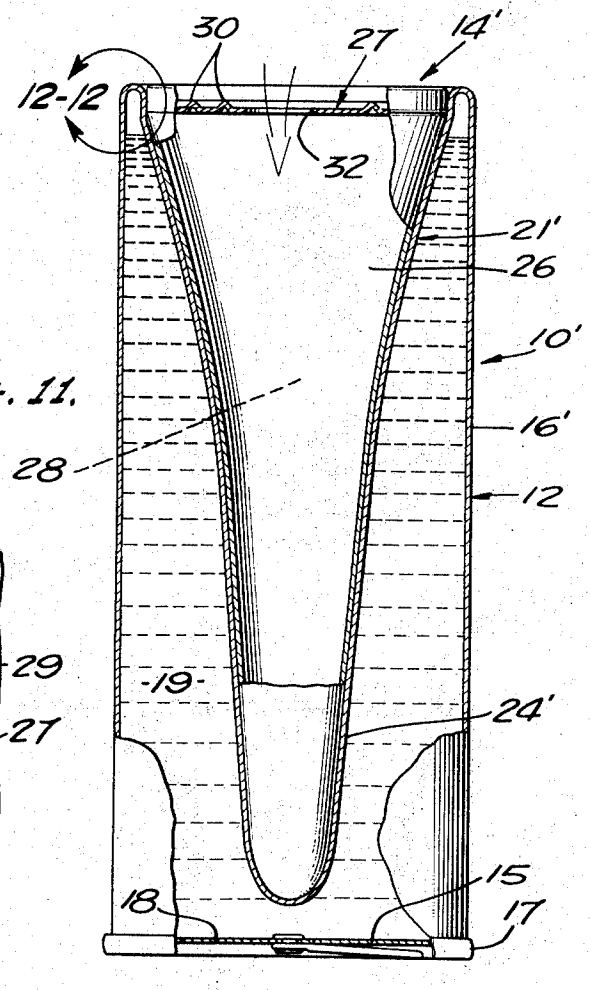


FIG. 11.

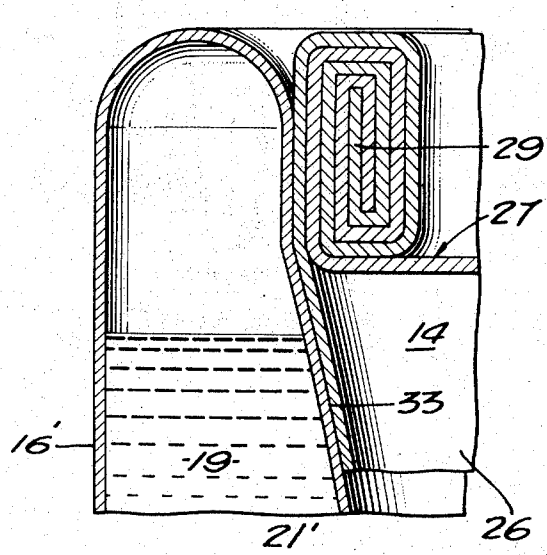


FIG. 12.

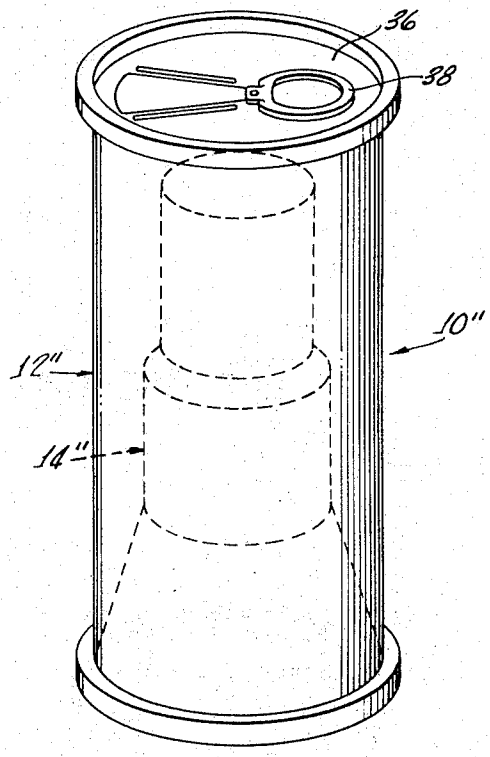
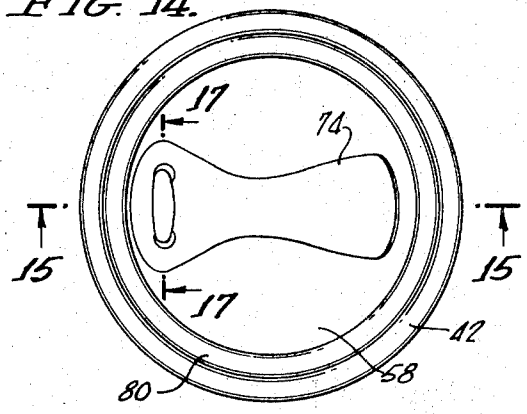


FIG. 13.

FIG. 14.



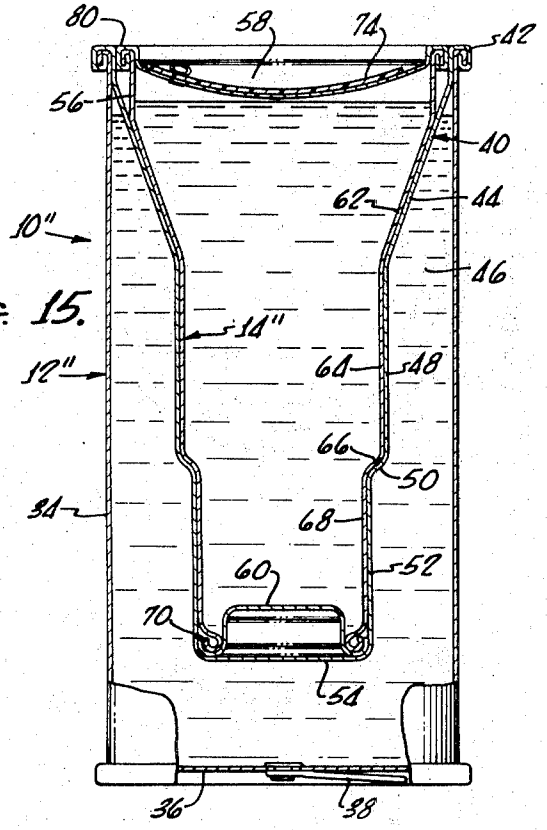
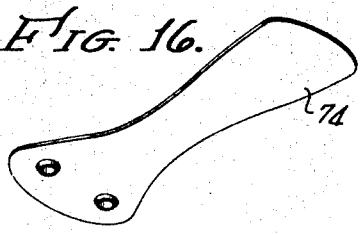


FIG. 15.

FIG. 16.



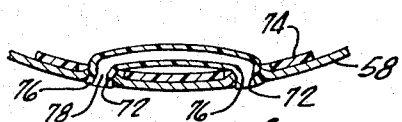


FIG. 17.

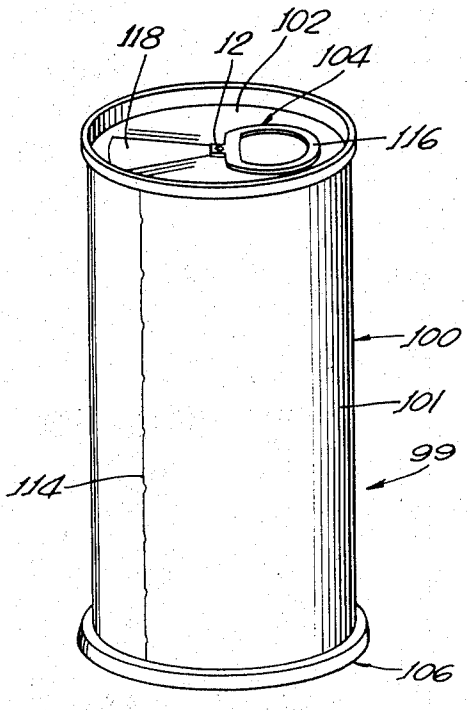


FIG. 18.

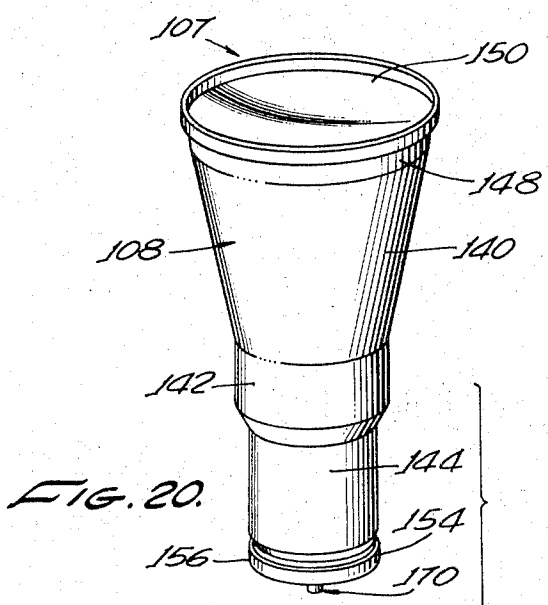


FIG. 20.

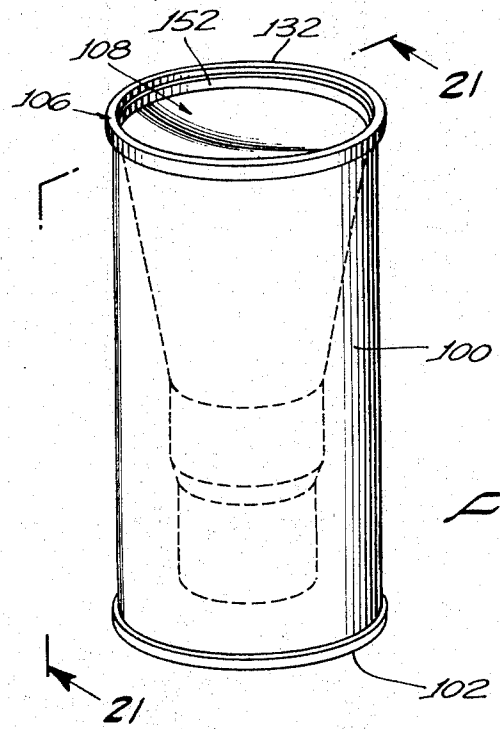
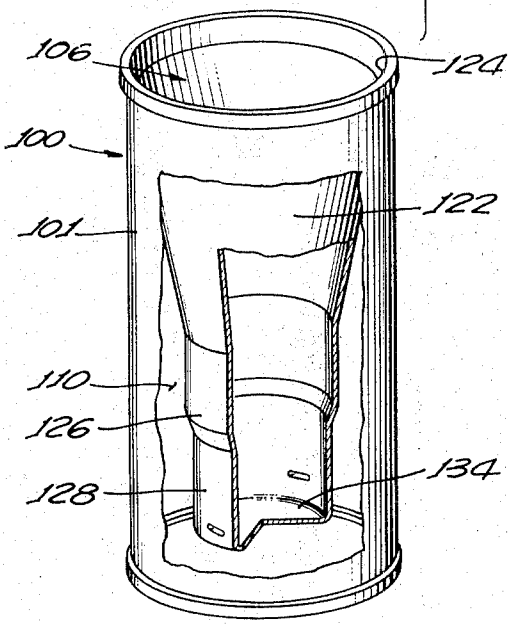


FIG. 19.



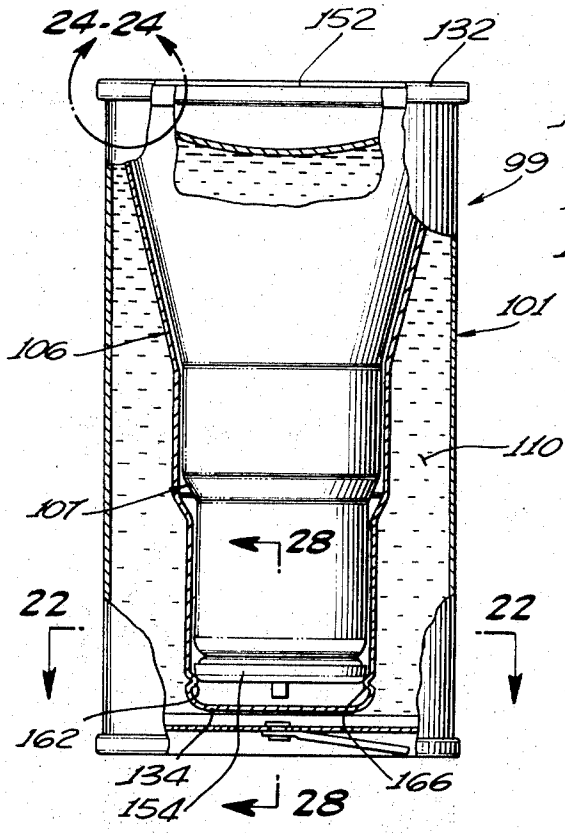


FIG. 21.

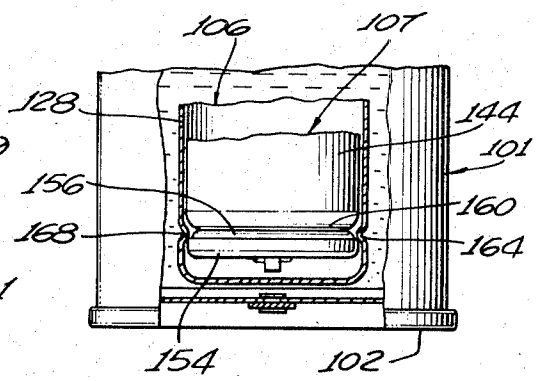


FIG. 23.

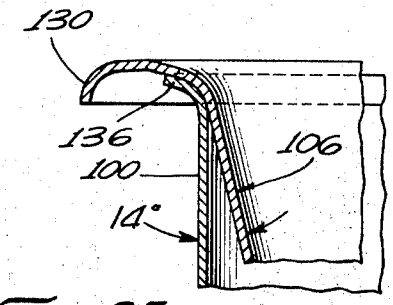


FIG. 25.

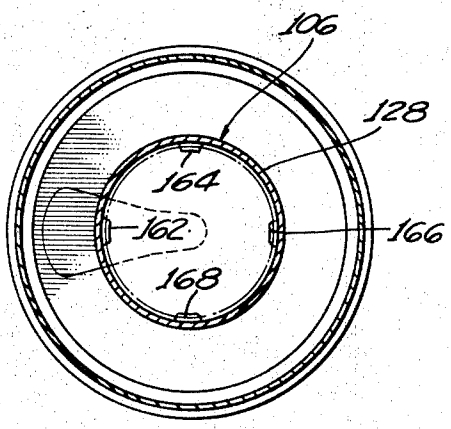


FIG. 22.

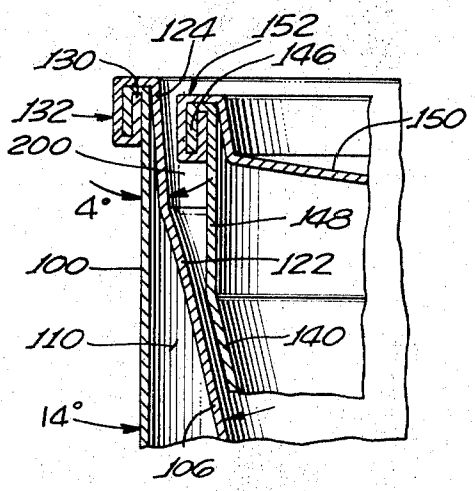


FIG. 24.

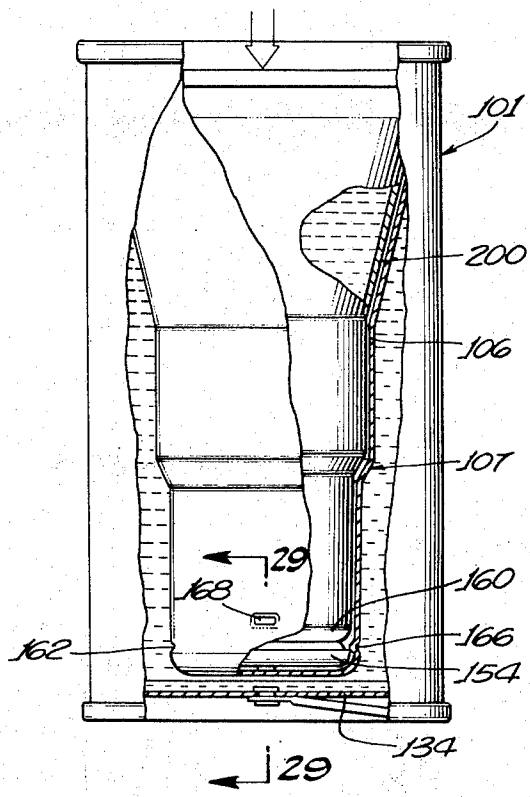


FIG. 26.

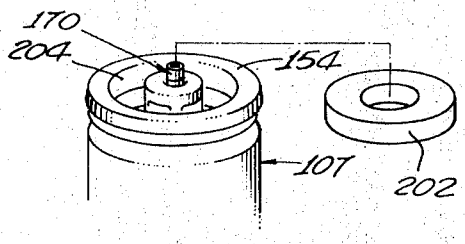


FIG. 27.

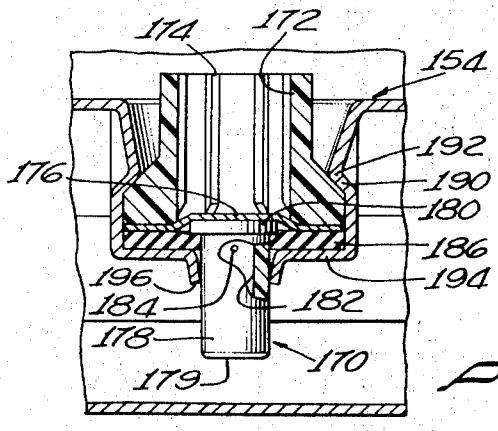


FIG. 30

FIG. 28.

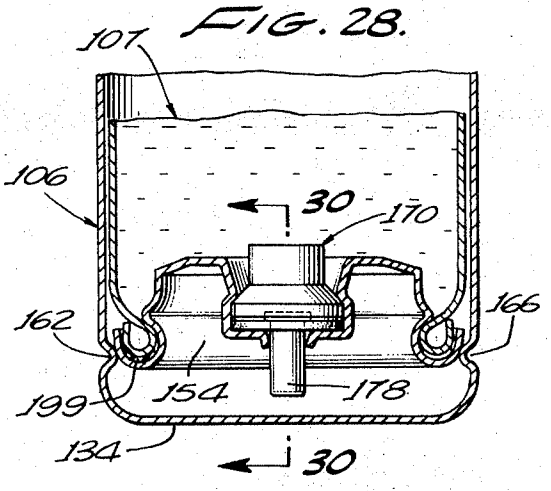


FIG. 29.

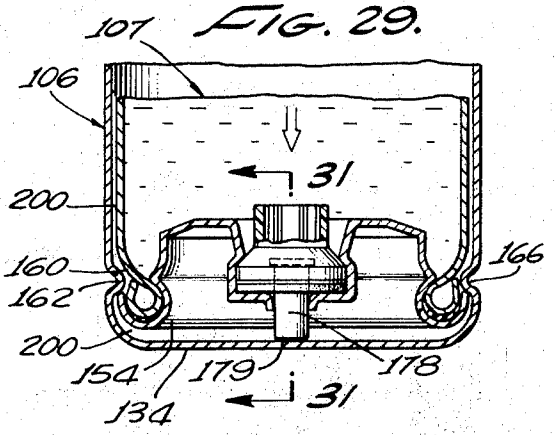
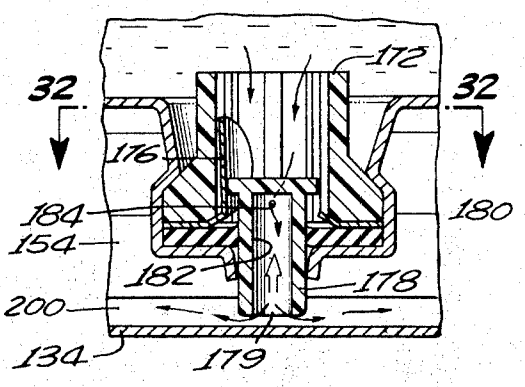


FIG. 31.



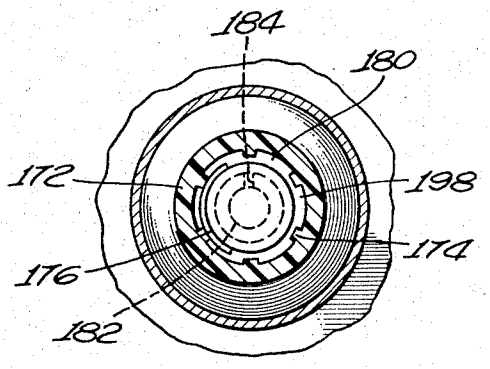


FIG. 32.

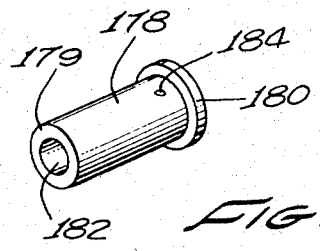


FIG. 33.

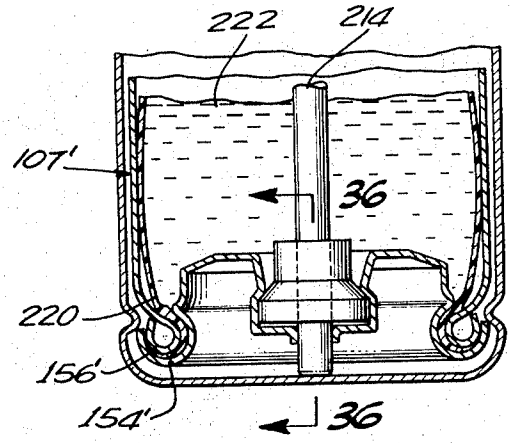


FIG. 35.

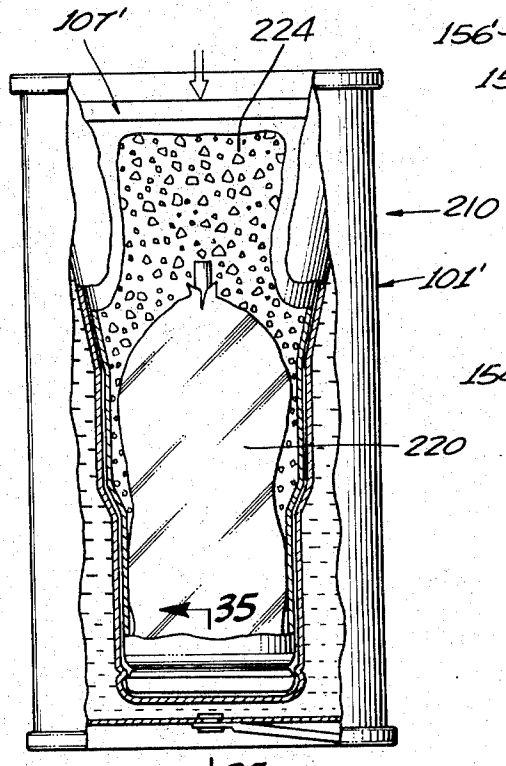


FIG. 34.

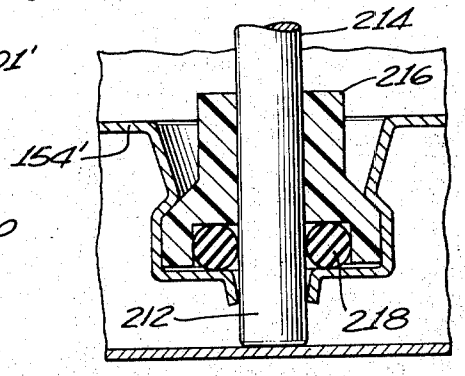


FIG. 36.

FORMING CONTAINER FOR PRODUCT TO BE COOLED
300
FORMING CLOSURE HAVING SHAPE SIMILAR TO COOLANT CONTAINER
302
CONNECTING CLOSURE AND CONTAINER
304
306
FORMING COOLANT CONTAINER
308
LOCK SEAMING A CLOSURE TO THE CONTAINER
310
FILLING CONTAINER WITH COOLANT
312
SEALING CONTAINER WITH CLOSURE HAVING VALVE ASSEMBLY
314
316
INSERTING COOLANT CONTAINER INTO PRODUCT CONTAINER
318
ADDING PRODUCT TO PRODUCT CONTAINER
320
SEALING PRODUCT CONTAINER
322

FIG. 37.

150'
108'
106'
101'

FIG. 43.

FIG. 38.

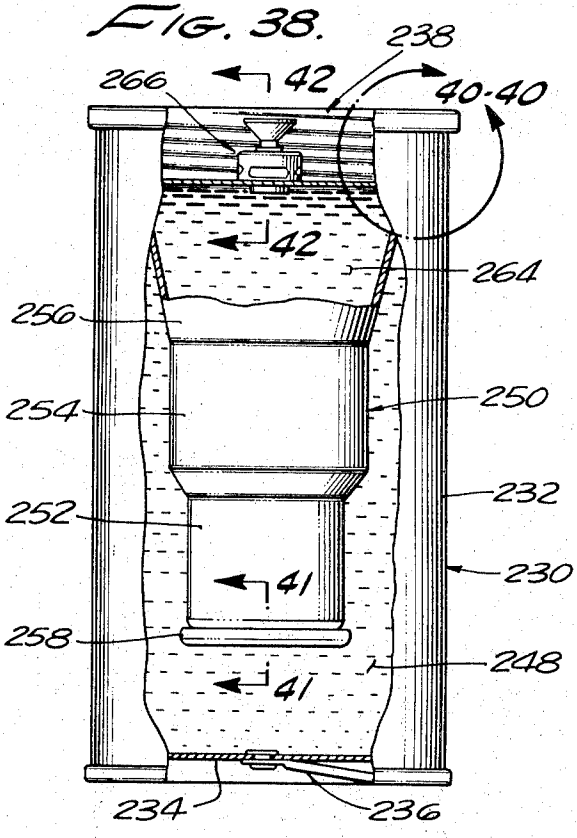


FIG. 40.

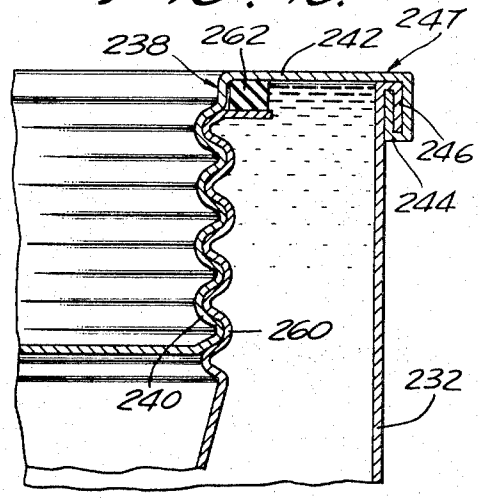
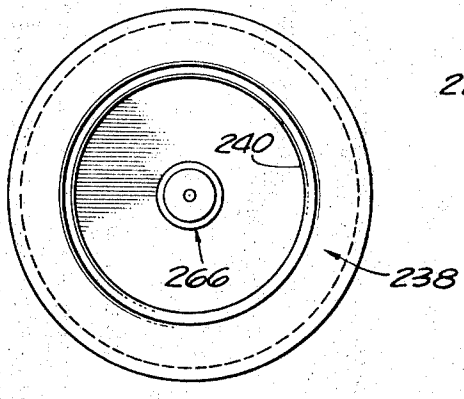


FIG. 39.



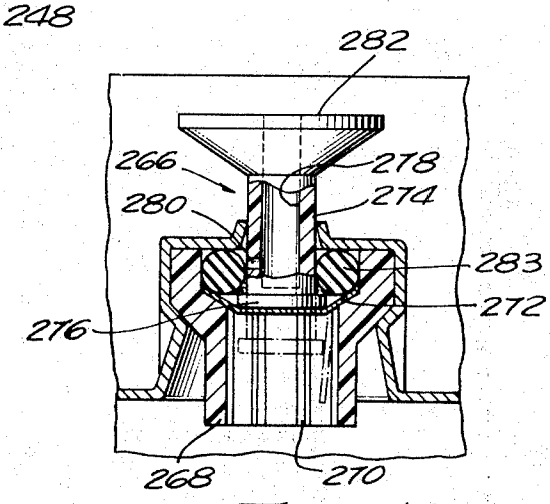


FIG. 42.

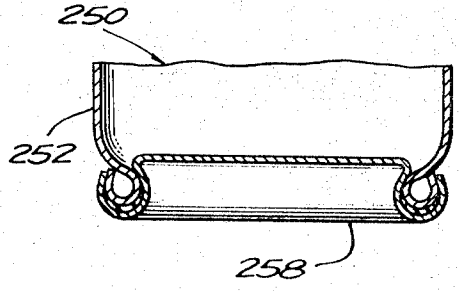


FIG. 41.

METHOD OF MAKING SELF-REFRIGERATING AND HEATING FOOD CONTAINERS

CROSS REFERENCE

This is a division of application Ser. No. 1,239, filed Jan. 7, 1970, for "Self-Refrigerating and Heating Food Containers and Method for Making Same" by Wilbert J. Jaeger, now U. S. PAT. No. 3,726,106, which is a continuation-in-part of Ser. No. 737,121, filed June 14, 1968 for "Self-Refrigerating and Heating Food Containers" by Wilbert J. Jaeger, now abandoned.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to self-refrigerating and heating containers and more particularly to containers having an independent heating or cooling portion and product portion and to the method of forming, assembling and using such containers.

2. Description of the Prior Art

Although self-refrigerating and heating food containers have been long known and long desired, there has not been a commercial development because of various economic, health, and safety problems.

For example, the following United States Patents, Whalen 3,320,767, Warner 3,285,033, Palaith 2,460,765 and Blake et al, 2,185,799, have all shown devices comprising a single walled partitioned container for separating a heating or cooling substance from a food product. The health hazard due to possible mingling of the food product and the chemical used for heating or cooling is too great, and the containers cannot be made cheaply enough for low cost mass produced items; both of these factors have contributed to the lack of commercialization of the containers disclosed in the above-mentioned patents.

In a later Warner Pat. No. 3,338,067 a double walled unit was disclosed with separate containers for the food product and for the cooling chemical. While this construction appears to abate the health problem, there is still the problem of economics in that the container described cannot conveniently be manufactured on equipment which is presently used to manufacture food cans. It is to be understood that a large investment exists in present can making and assembling equipment, and it is highly desirable that any container developed has the ability to be manufactured on the existing equipment or at least not require expensive modification of the equipment.

Additionally, any self-cooling or self-heating food container must also be of such construction as to allow processing of the food after it has been packed and sealed; one such further processing step is the pasteurization of beer, for example. Subjecting a container having a chemical coolant to pasteurization temperatures would cause sufficiently high pressures to make a safe container for the coolant prohibitively expensive.

Generally, while it is obvious that a self-heating or self-cooling container would be more expensive than conventional container, an analysis of the costs involved in cooling soft drink containers, such as in supermarkets, reveals that it costs approximately a penny a day per can based on an average shelf life of four to five days. It is noted that this cost does not include the cost that the consumer has in storing such cans in a home refrigerator. Complementing this cost is further expense of ice and other cooling devices when the cans are to be kept cool outdoors as on a picnic for example. Finally, there are certain regions where refrigeration is not even available and cooled drinks just do not exist.

SUMMARY OF THE INVENTION

The present invention overcomes the disadvantages of the prior art mentioned above by providing a container having an enclosure adapted to include means for selectively changing the temperature of the content within another enclosure of the container comprising a first elongated hollow body having first and second ends; a first closure sealed to said first end; a second closure sealed to said second end of said first hollow body and extending into said first hollow body and having a surface at least a portion of which has a conical shape said first and second closures and said first elongated body forming said first mentioned enclosure; a second elongated hollow body having first and second ends and a surface having at least a portion with a conical shape, said surface of said second elongated hollow body is closely disposed to said surface of said second closure and parallel thereto, said second body forming said other enclosure; and means communicating the other closure of said second hollow body with the environment about said first hollow body. In addition the present invention includes among several methods a method of forming the container comprising the steps of providing a strip of material; cutting said strip to a pre-determined size; forming said cut strip into a hollow cylinder having two open ends; providing a first plug of material; pressing said first plug into a first elongated hollow body having two ends and having a portion adjacent one end with a conical shape and a portion adjacent the other end with a cylindrical shape; connecting said one end of said first hollow body and one end of said cylinder to form a first enclosure; providing a second plug of material; pressing said second plug into a second elongated hollow body having two ends and having a portion of cylindrical shape and a portion of conical shape; providing a closure; lock seaming said closure to an end of said second hollow body; filling said hollow body in a high pressure environment with a coolant; sealing said other end of said filled second hollow body; and inserting said second hollow body into said first hollow body so that said second hollow body is locked into position slightly spaced from said first hollow body.

An object of the present invention is to provide a self-cooling or heating container which is safe, convenient to use, and economical to manufacture because of its adaptation to existing manufacturing equipment.

Another object of the present invention is to provide a self-cooling or heating container having a construction which reduces the health hazard of mingling the product to be heated or cooled and the chemical which provides the heating or cooling.

Still another object of the present invention is to provide a self-cooling or heating container which allows the product to be heated or cooled to be disposed within the container within a sealed enclosure as part of a process which is independent of the formation, filling and sealing of the cooling or heating section of the container.

A further object of the present invention is to provide a self-cooling or heating container which has efficient heat transfer properties and when in the cooling mode has the ability to form ice within the product to be cooled.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view partially in phantom of an embodiment of a self-cooling or heating container oriented in an upright position.

FIG. 2 is a perspective view partially in phantom of the self-cooling or heating container of FIG. 1 oriented in an inverted position.

FIG. 3 is a plan view of the container of FIG. 2 showing a "pop" top.

FIG. 4 is a longitudinal partially broken away, partially sectional view taken along line 4—4 of FIG. 3.

FIG. 5 is a longitudinal partially broken away, partially sectional view of the self-cooling or heating container after the pop top has been removed.

FIG. 6 is a partial enlarged sectional view taken along curved line 6—6 of FIG. 5.

FIG. 7 is a fragmentary plan view taken along line 7—7 of FIG. 5.

FIG. 8 is a perspective view partially broken away of the inner and outer sections of the container of FIG. 1.

FIG. 9 is a partially broken away perspective view of the FIG. 1 embodiment shown in integral form.

FIG. 10 is a bottom view of the FIG. 9 container showing both the inner and outer sections.

FIG. 11 is a longitudinal partially broken away, partially sectional view taken along line 11—11 of FIG. 10.

FIG. 12 is a partial enlarged sectional view taken along curved line 12—12 of FIG. 11.

FIG. 13 is a perspective view of another embodiment of a container partially in phantom.

FIG. 14 is a bottom view of the container of FIG. 13 showing a pull tab.

FIG. 15 is a longitudinal partially broken away, partially sectional view taken along line 15—15 of FIG. 14.

FIG. 16 is an isometric bottom view of the pull tab of FIG. 14.

FIG. 17 is a sectional view taken along line 17—17 of FIG. 14.

FIG. 18 is a perspective view of another embodiment of a container oriented in an upright position.

FIG. 19 is a perspective view partially in phantom of the container shown in FIG. 18, oriented in an upside down position.

FIG. 20 is a partially exploded, partially broken away perspective view of the container oriented as in FIG. 19.

FIG. 21 is a longitudinal partially broken away, partially sectional view taken along line 21—21 of FIG. 19 illustrating the inner container in its first position.

FIG. 22 is a plan sectional view taken along line 22—22 of FIG. 21.

FIG. 23 is a fragmentary longitudinal view as shown in FIG. 21 rotated 90°.

FIG. 24 is a partial enlarged sectional view taken along curved line 24—24 of FIG. 21.

FIG. 25 is a partial enlarged sectional view of the embodiment shown in FIG. 24 before the container body and the closure have been connected.

FIG. 26 is a longitudinal partially broken away, partially sectional view of the embodiment shown in FIG. 21 illustrating the inner container in its second position.

FIG. 27 is a partially exploded perspective view of the valve assembly and closure for the inner container.

FIG. 28 is a fragmentary enlarged partially sectional view taken along line 28—28 of FIG. 21.

FIG. 29 is a fragmentary enlarged partially sectional view taken along line 29—29 of FIG. 26.

FIG. 30 is a fragmentary enlarged sectional view taken along line 30—30 of FIG. 28.

FIG. 31 is a fragmentary enlarged sectional view taken along line 31—31 of FIG. 29.

FIG. 32 is a plan sectional view taken along line 32—32 of FIG. 31.

FIG. 33 is a perspective view of the plunger element of the valve assembly.

FIG. 34 is a longitudinal partially broken away, partially sectional view of the container of FIG. 20 modified to provide heating for the container.

FIG. 35 is an enlarged partially sectional view of the valve assembly taken along line 35—35 of FIG. 34.

FIG. 36 is an enlarged sectional view taken along line 36—36 of FIG. 35.

FIG. 37 is a block diagram of a method of forming the embodiment shown in FIG. 20.

FIG. 38 is a longitudinal partially broken away, partially sectional view of another embodiment of a container.

FIG. 39 is a plan view of the embodiment shown in FIG. 38.

FIG. 40 is a fragmentary enlarged sectional view taken along the curved line 40—40 of FIG. 38.

FIG. 41 is a sectional view taken along line 41—41 of FIG. 38.

FIG. 42 is a sectional view of the valve assembly taken along line 42—42 of FIG. 38.

FIG. 43 is a fragmentary enlarged sectional view similar to FIG. 24 illustrating the container in integral form.

DESCRIPTION OF THE EMBODIMENTS

Referring first to FIGS. 18, 19 and 20 there is illustrated a container 99 having an outer container section 100 and an inner container section 107. The outer container 100 comprises a hollow, elongated body 101 in the form of a conventional beverage can having a closure 102 with a conventional pop top 104 connected to the body 101 at one end and a uniquely shaped recessed or concave closure 106 connected to the other end; according to usual usage the closure 102 is at the top of the can and the recessed closure 106 is at the bottom. As seen in FIG. 20, the inner container 107 includes an elongated hollow body 108 having a shape very similar to that of the recessed closure and cooperates with the outer container 100 to fit within the recessed closure. The inner container forms an enclosure for a heating or cooling chemical which when activated will heat or cool the content within an enclosure 110 formed by the outer container 100.

As mentioned, the hollow body 101 is shaped as a conventional beverage container and, as such, has a cylindrical shape which is formed by having a strip of suitable material, usually a properly coated metal, cut to a pre-determined size dependent upon the size of the can

desired; the strip is then rolled into the cylindrical shape and retained by a suitable connection such as spot welding to form a seam **114.** The hollow body **101** is connected to the top closure **102** by a standard rolling operation to form a lock seam. The pop top **104** includes a ring portion **116** and a tear portion **118.** The tear portion is formed by having the closure **102** partially cut in the shape of an opening desired, usually triangular or rectangular, while the ring **116,** which is attached by a spot weld designated **120,** is pulled by a user when it is desired to have access to the content of the outer container.

The closure **106** is comprised of a large conical portion **122,** FIG. **20,** a small conical portion **124** (better seen in FIG. **24**), a large diameter cylindrical portion **126,** and a small diameter cylindrical portion **128.** In addition the closure **106** has a first end portion **130,** FIGS. **24** and **25,** which forms with the hollow body **101** the lock seam **132,** FIG. **24,** and a second end portion **134,** FIG. **20,** which is integrally connected to the cylindrical portion **128** and forms a flat surface, generally transverse to the direction of the longitudinal axis of the container **99.**

Referring now to FIG. **24,** there is shown in more detail the two conical portions **122** and **124** of the recessed closure **106.** The conical portion **122** is sloped at an angle of about 14° from the vertical, while conical portion **124** is sloped at an angle of about only 4°. The difference in angle is due primarily to the conventional machines used to form the lock seam **132** to connect the recessed closure to the cylindrical body **101.** The lock seaming machine grips the cylindrical body **101** and the closure **106,** thereby deforming the closure's original 14° conical portion **122** and causes the two elements to rotate while the locking seam **132** is formed by rolling the end **130** of the recessed closure and an end **136** of the cylindrical body **101.** A different variation of the connection between the cylindrical body and the closure is shown in FIG. **43** wherein the cylindrical body **101'** is made integral with the closure **106'** so that no lock seam is necessary.

The conical portion **122** and the cylindrical portions **126** and **128** may be made by a process which is commonly called "drawing." The drawing process begins by providing a plug of material, such as a malleable metal, which is processed through a series of pressing operation to progressively form the desired shape as shown in FIG. **20,** for example. Generally the first pressing operation would form the conical portion **122** by having a male die enter a female die which are dimensioned to allow the plug of material to expand through a restricted spacing between the two dies so as to form a tubular conical structure. After the conical portion **122** is formed, progressive punching with different sets of male and female dies creates the remaining cylindrical portions **126** and **128** and the end portion **134.** It is to be understood that material other than metal may be used to form the outer container **100** so that other processes may be used dependent upon the choice of materials. For example, a molding operation might be used to form the outer container if the material is a synthetic resin. And it is to be understood that some other process may be used if desired when metal is the material.

Again referring to FIG. **20,** the inner container **107** has a shape similar to the shape of the closure **106** and comprises a conical portion **140,** a large diameter cylindrical portion **142,** and a small diameter cylindrical portion **144.** The conical portion **140** is located adjacent a first end **146,** FIG. **24,** and between the end **146** and the conical portion **140** there is still another cylindrical portion **148.** A closure **150,** FIG. **20,** is connected to the hollow body **108** with a lock seam **152** in a fasion similar to that described for lock seam **132.** However, once again referring to FIG. **43** the hollow body **108'** may be made integral with the closure **150'** so as to obviate the need for a lock seam. Another closure **154** is positioned over the second end **156** of the body **108.**

The hollow body **108** of the inner container **107** may be made in a manner analogous to that of the closure **106** of the outer container **101.** That is, except for dimensional variation, the same drawing process which is used for closure **106** may be used for the hollow body **108.** Since the closures **150** and **154** are of simpler design and substantially flatter than the body **108,** they may be stamped from sheet metal in the conventional fashion.

Referring now to FIG. **23,** there is illustrated in more detail the interior of the container near its top closure **102.** As the cylindrical portion **144** approaches the end **156,** there is formed an angular recess **160,** which cooperates with the closure **154** to form a means for retaining the inner container **107** within the outer container **101** as shown in FIG. **21.** Helping to retain the inner container **107** are four projections or indentations **162, 164, 166** and **168,** FIG. **22.** As seen in FIG. **22,** the projections are evenly spaced around the inner circumference of the cylindrical portion **128** of the closure **106.** However, as seen in FIGS. **21** and **23,** which are views separated by 90°, two of the projections **162** and **166** are spaced from the other two projections **164** and **168** in a direction parallel to the longitudinal axis of the container **99.** This may best be seen when comparing the recess **160** and closure **154** in FIGS. **21** and **23.** In FIG. **21** the projections **162** and **166** are shown abutting the closure **154** so as to prevent the movement of the inner container **107** toward the end portion **134** of the closure **106.** However, when the vantage point is rotated 90°, as is done when moving from FIG. **21** to FIG. **23,** it is noted that the projections **164** and **168** fit within the recess **160.** Thus, in the position shown in FIGS. **21** and **23** the inner container **107** is locked within the outer container **101** unable to be separated due to the combination of the projections **164, 168** and the recess **160** and unable to move further into the closure **106** because of the abutment of the projections **162, 166** and the closure **154.** This position is the first or storage position of the inner container **107** relative the outer container **101.**

Referring now to FIG. **26,** the second or activating position of the inner container **107** relative the outer container **101** is illustrated. The inner container **107** has been pushed further into the closure **106** so that the closure **154** is spaced closely to the end portion **134** of the closure **106.** In this second position the projections **162** and **166** are located within the recess **160** while the projections **164** and **168** have been permanently distorted. The significance of the first and second positions for the inner container **107** will be explained in detail hereinbelow. The projections **162, 164, 166** and **168** may be formed in the closure **106** by a simple crimping operation if the material of the closure **106** is

metal or may be molded integrally if the material is a synthetic resin.

In the storage position, the seam **152** of the inner container **107** is disposed inwardly of the seam **132** to prevent accidental activation of the container should a force be applied against the bottom of the container during transportation or handling. The slightly inward position of the inner container so as to leave the seam **132** in a protective position is shown clearly in FIGS. **19** and **32.**

Referring to FIGS. **20** and **27,** there is illustrated a portion of the valve assembly **170,** which is connected to the closure **154** of the inner container **107.** In FIG. **30,** the valve assembly **170** is shown in more detail. The valve assembly comprises a generally tubular sleeve **172** having plurality of longitudinally extending ribs **174** spaced about the interior circumference of the sleeve, a frangible diaphragm **176,** a tubular plunger **178,** (also see FIG. **33**), which includes a bottoming head **179** and a flanged head **180,** a longitudinal opening **182,** and a small control aperture **184,** which is positioned perpendicular to the longitudinal opening **182** and proceeds through the body of the tubular plunger **178.** Additionally, a seal such as an O-ring (not shown) or a resilient washer **186** is provided to sandwich the diaphragm **176** between itself and the sleeve **172.** The washer **186** also seals an opening **196** about the plunger **178** to prevent leakage of the content of the inner container **107.**

The valve assembly **170** is held together by the closure **154** by having one shoulder **190** of the closure **154** abut a slanted shoulder **192** of the valve sleeve **172** while a second shoulder **194** of the closure **154** abuts the washer **186;** by press forming the closure **154** about the valve assembly opposing forces are created by the shoulders **190** and **194** to form a fluid tight, operable valve assembly. During manufacture the valve assembly **170** is positioned so that the plunger **178** fits through the opening **196** in the closure **154** and then the shoulders **190** and **194** may be crimped about the valve assembly.

In the views shown in FIGS. **28** and **30,** the flanged head **180** is positioned adjacent the diaphragm **176,** but has not yet broken the diaphragm so that the content within the container **107** fills the interior of the sleeve **172.** As illustrated in FIG. **28** the container **107** is in its first position relative the closure **106** and has the closure **154** abutting the projections **162** and **166.** When pressure is applied to the inner container **107** as indicated by the arrow in FIG. **26,** such as by a user pressing down with his thumbs on the closure **150,** FIG. **20,** with sufficient force to move the inner container further into the closure **106,** the plunger **178** of the valve assembly will come into contact with the end portion **134** of the closure **106** as shown in FIGS. **29** and **31.** It has been found that with a conventionally shape can having an eight (**8**) ounce beverage compartment and a four (**4**) ounce coolant compartment (twelve ounces total) and conventional can material, about **4.5** pounds of force is necessary to move the inner container from its first to second positions. When the bottoming head **179** of the plunger **178** abuts the end poı tion **134,** the actuating force is transmitted to the flanged head **180** which breaks through the diaphragm **176** and moves upward into the sleeve **172.** Movement of the plunger **178** is relatively easy because of the sliding relationship established between the flanged head **180** and the ribs **174** of the sleeve **172.** As the flanged head moves into the sleeve, the content of the inner container begins to communicate with the longitudinal opening **182** by way of the control aperture **184** as can be seen by the arrow in FIG. **31** and by the plan view in FIG. **32.** The flanged head is slightly spaced from the ribs and there are spaces, such as that designated **198,** FIG. **32,** which surround the plunger to allow movement of the container content around the flanged head, into the control aperture, through the longitudinal opening and past the bottoming head.

When the inner container **107** is pushed beyond the projections **162** and **166,** the projections are somewhat distorted and the closure **154** is flexed sufficiently so that the projections retain a sufficient protrudence inwardly toward the inner container to move into the recess **160,** thereby retaining the inner container in its second or activating position. The flex of the closure **154** is attained by the inherent flexibility of the material used and by a seal **199** disposed between the closure and the end of the inner container.

As mentioned earlier, the content of the inner container may be any chemical compound which will create the desired heating or cooling effect. For cooling, a preferred compound is Freon 12, which is a gas at room temperature and becomes liquid at about −21°F. However, there is a pressure-temperature relationship, which will allow the boiling point temperature of Freon to be raised if the Freon is contained in a vessel where the pressure is greater than one atmosphere pressure (about 15 psi). Thus, if Freon is placed within the inner container **107** with a pressure of 109.24 pounds per square inch the Freon will be a liquid up to a temperature of 100°F. If the Freon in the inner container communicates with the ambient environment, which may be assumed to be at a pressure of about 15 psi then the boiling point temperature of the Freon drops to its normal −21°F. Since in almost all cases, the environment about the Freon will be at a temperature much greater than −21°F, the Freon will change from its liquid phase to its gaseous phase and boil off; during this time the Freon will increase in temperature as a liquid and then while at the same temperature change from a liquid to a gas. However, the Freon will be absorbing heat during the entire process with most of the heat being absorbed during the Freon's change of phase, the quantity of heat per unit mass that must be supplied to a material at its boiling point to convert it completely to a gas at the same temperature, being called the heat of vaporization of the material. It is this process of absorbing heat from the surrounding to change the Freon from a liquid to a gas that provides the Freon with the quality of being able to lower the temperature of the immediate environment. Ideally, given enough Freon and a small enough environment to cool, the Freon will continue to absorb heat until an equilibrium has been reached at −21°F. However, for purposes of cooling a beverage for example, if a certain amount of Freon can lower the temperature of the beverage environment to the range of about 32°F to 38°F that is all that is necessary.

Referring now to FIGS. **21, 26, 29** and **31,** there is illustrated the way in which the Freon within the inner container **107** is selectively exposed to atmospheric pressure to cause the Freon to boil and absorb heat from the content within the enclosure **110.** As shown in FIG. **31,** once the plunger **178** breaks the diaphragm

176 the Freon is able to communicate through the opening 184 to a spacing designated 200 between the inner container and the closure 106. This spacing is about the plunger 178 as shown in FIG. 31, continues around to the side of the inner container as shown in FIG. 29, continues along the entire length of the inner container as shown in FIG. 26, and continues finally to the environment about the container 99 as shown in FIG. 24. It is noted that in addition to locating the inner container in its first and second positions the projections 162, 164, 166 and 168 also position the inner container within the closure 106 to provide for the spacing 200. The only points of contact between the inner container and the closure 106 are those made by the projections. The spacing 200 is important as it affects the cooling efficiency of a given amount of Freon relative to a given amount of product within the outer container 101. In a similar manner the diameter of the control aperture 184 is also important in regard to the efficiency of the cooling process and is a function of the coolant used. For example, for Freon the control aperture has a diameter of 0.013 inches, while the spacing 200 is 0.005 inches (distance between the inner container surface and the surface of the closure 106) for a container having the size of a conventional 12 ounce beverage can. It is also noted that for Freon, the inner container should have a volume approximately one-third the volume of the outer container when the outer container contains a beverage and for best heat exchange efficiency the heat exchange surface should be s large as possible, however, taking manufacturing considerations and conventional styling considerations into account, the part conical, part cylindrical shape of the inner container and closure 106 with the inner container extending almost the full longitudinal length of the outer container has been found most effective.

The embodiment shown in FIGS. 18 through 33 also has the unique advantage of being able to selectively form ice within the beverage in the enclosure 110 if it is found desirable. For example, if the beverage in the enclosure is beer, it is normally undesirable to have any ice formation, however, if the beverage is a soft drink or certain types of liquor, such as scotch, the formation of ice may be highly desirable. Since Freon will boil at the surface which is in communication with the low pressure environment if the container 99 is activated in an upside down position as shown in FIG. 26, liquid Freon will escape through the valve assembly 170 into the spacing 200. Initially the liquid Freon will immediately start absorbing heat and will boil while adjacent the closure 134 and cylindrical portion 128. As more liquid Freon is supplied the temperature of the beverage in the region about the closure 134 and the portion 128 will drop below 32°F and ice will be formed. As the temperature drops in that region less heat exchange occurs so that the liquid level of the Freon slowly creeps upwardly in the spacing 200 progressively cooling the beverage throughout the enclosure 110. The reason that there is less heat exchange as the temperature is reduced is that a temperature differential between two objects is the driving force to cause a transfer of heat from the object at the higher temperature to the object at the lower tmeperature. The liquid level may reach the seam 152 in a cool environment while in a warm environment the liquid level may only proceed partly along the longitudinal length of the container. However, since liquid Freon will always be present adjacent the closure 134 and the portion 128 during the cooling process, the beverage in the region adjoining the closure and the portion 128 will be cold enough to form ice. After the cooling process has been accomplished, the user turns the can upright and pulls the pop top 104 so that he can drink the beverage; ice that has formed will be immediately under the pop top to insure that the user receives a very cool and refreshing drink.

If ice is not desired then activation of the inner container may be accomplished while holding the container in the position shown in FIG. 21, using the thumbs against the closure 105 to push the inner container deeper into the closure 106, or activation may be accomplished while the container is in a position shown in FIG. 18. If the former method is used, and it appears to be the easier of the two mentioned methods, then as soon as the plunger 178 of the valve assembly 170 has broken the diaphragm 176, the container should be rotated to the position shown in FIG. 18. When this is done boiling of the liquid will occur within the inner container because of the clearance or head room provided between the liquid Freon and the valve assembly. The head room amounts to about 17 to 20 percent of the volume of the inner container and is provided as a safety precaution to prevent a dangerously high level of pressure existing within the inner container. Under these circumstances cooling is not concentrated at any one portion or region along the container. However, heat is transferred from the beverage to the Freon in a slower more evenly distributed manner so that the final temperature of the beverage using this second activation process is about the same as when using the first mentioned activation process thus when beer is the beverage within the enclosure 110 a temperature of 38°F has been achieved using either of the activation processes.

The particular shapes of the inner container and the closure 106 provide unique advantages in that they are conveniently manufactured by the same type of machines presently used in the can industry and may be attached to conventional can bodies using presently available machines and yet provide a relatively large surface area through which heat exchange may be accomplished. Since the heat transfer occurs at a much faster rate around the cylindrical portion 128 of the closure 106, there is less need for large heat exchange surface relative the amount of beverage in the vicinity. However, as the coolant proceeds along the closure 106 to the cylindrical portion 126 and to the conical portion 122 there is a lesser rate of heat exchange occurring so that a larger heat exchange surface area is necessary relative to the amount of the beverage. The advantage of the geometric structure illustrated is best seen in FIG. 24 where as the heat transfer surface area reaches a maximum the amount of beverage to be cooled reaches a minimum due to the conical portions 122 and 124.

It is also noted that in either method of operation of the cooling process there is little likelihood of Freon in the liquid state being spilled upon the user's hands. As mentioned, such events have occurred with prior art devices and is very undesirable from a product liability standpoint because of the frostbite occasioned by contact of liqUid Freon and skin. The use of a control aperture 184, 0.013 inch in the example mentioned, the specific coolant, Freon 12, the spacing 200, 0.005 inch in the example mentioned, and the specific shape

of the inner container to give the heat exchange surface all combine to provide the proper and necessary cooling without the usual disadvantages such as the frostbite just mentioned. Another advantageous feature of the embodiment shown in FIG. **20** is the double walled construction between the refrigerant and the beverage. In case either fluid should lead from its respective enclosure, it would be to the external environment rather than mingling with the other fluid. Thus, there is a definite health advantage and an avoidance of product liability disadvantages should a coolant and beverage mix and be consumed unknowingly.

A still further advantage is achieved when the present invention is used with a beverage whose flavor is a function of temperature. For example, beer is generally thought to have the best taste when it is at a temperature between 38°F and 42°F. Generally most refrigeration units in stores and at home cool beer to about 38°F. However, when the beer can is removed from the refrigeration unit, the excellent heat conducting properties of the metal can immediately transfers heat from the environment to the beer. Within 30 seconds after a beer can is opened the temperature of the beer is about 42°F and continues to climb thereafter. One reason for the rapid temperature increase is that water vapor in the environment will condense on the can and cause an even greater heat transfer than usual because water conducts heat much better than air. Hence, beer, for example, is rarely consumed at its most flavorful temperature.

The container of the present invention provides the cooling while the container is in the environment. Generally all that is needed to cool 8 ounces of liquid is about 19 Btu; 4 ounces of Freon 12 will generate about 27 Btu so that extra cooling "power" is available to offset the immediate heating from the environment and to cool the inner container and outer container themselves. Once the cooling process is complete, the inner container and the outer container will continue to act to retard and to offset the heating effect of the environment and thereby keep the beer below the 42°F level for a longer period of time. At 70° F, 45 percent relative humidity, beer will remain at or below 40° F for up to 5 minutes. Of course, the same advantage is achieved when using the present invention for heating purposes.

Referring again to FIG. **27** there is illustrated a variation of the inner container to adapt it for heating purposes. The modification includes simply adding a toroidal shape tablet **202** to an annular recess **204** formed in the closure **154** about the valve assembly **170.** If the proper chemical compound is provided within the inner container then upon release of the chemical within the inner container there will be an exothermic chemical reaction to provide heat for the content within the enclosure **110.** For example, the tablet **202** may be comprised of sodium thiosulfate or potassium thiosulfate while the material within the inner container is a solution of Freon and hydrogen peroxide. The Freon is used to eject the hydrogen peroxide from the inner container. Experiments have shown that with an eight percent hydrogen peroxide solution in the inner container a temperature of 120°F can be reached in the beverage situated within the enclosure **110.** If the solution is 10 percent the temperature reached is 140°F; if the solution is 12 percent the temperature reached is 160°F; and if the solution is 14 percent the temperature reached is 180°F, a temperature that is higher than necessary for most heated foodstuff.

Referring now to FIGS. **34, 35** and **36** there is shown another version of a container **210** which may be used to heat a product. The structure of the outer container **101'** is identical to that shown in FIG. **18.** Likewise the structure for the inner container **107'** is identical to the structure of inner container **107** in the embodiment shown in FIG. **18,** except for the valve assembly and the chemicals used. As illustrated in FIG. **36,** the valve assembly **212** includes an elongated rod **214** moveable through a tubular sleeve **216** and a seal **218** which is to prevent leakage. Included within the inner container **107'** are two separated chemicals, the chemicals being separated by a flexible bag **220,** FIG. **34,** made of a suitable material such as a synthetic resin which is attached to an end **156'** of the inner container by being sandwiched between the inner container and a closure **154'.** The inner container has both storage and activation positions analogous to the inner container **107.** In the storage position the rod **214** is completely contained within the bag **220.** However, in the activating position the rod is moved a sufficient distance to pierce the bag **220** as is shown in FIG. **34,** thereby allowing the chemical **222** within the bag to mix with the chemical **224** outside the bag. Since many chemicals give off heat when reacting without the need of exposure to atmospheric pressure, there is no need to have any communication with the environment about the container **210** in order to have a heating effect. An example of a suitable chemical for being within the bag is hydrogen peroxide while suitable chemicals to be placed within the inner container include sodium thiosulfate crystals.

Referring now to FIGS. **38** through **42,** there is illustrated another embodiment of the present invention. The container **230** comprises an outer cylindrical body **232,** a closure **234** with a pop top **236** located at one end of the cylindrical body and a second closure **238** located at the other end of the cylindrical body **232.** The closure **238** has a generally cylindrical portion **240** which is formed into a male threaded section. Integral with the cylindrical portion **240** is an annular ring portion **242** which is deposed generally perpendicular to the cylindrical portion **240** and connects at an end **244** to an end **246** of the cylindrical body **232** to form a lock seam **247** similar to that described for the embodiment of FIG. **18.**

The method of forming the cylindrical body **232** may be identical to that used to form outer container **101.** The same is true of the methods forming the closure **234** and the closure **102.** The closure **238** may be pressed into a generally cup shape with one set of dies and then threads formed with another set of dies. The male die of the second set of dies is removed with a twisting motion thereby causing the cylindrical portion **240** to be threaded. A consumable beverage or other foodstuff may be located within the enclosure **248** formed by the cylindrical body and the closures **238** and **234.**

A second inner container **250** is positioned within the container **230** and has a shape very similar to the inner container **107.** For example, the container **250** is comprised of a first cylindrical portion **252** integrally connected to a larger cylindrical portion **254** which in turn is integrally connected to a conical portion **256.** A closure **258** is sealed to the cylindrical portion **252.** The other end of the inner container is comprised of a gen-

erally cylindrical portion **260**, FIG. **40**, which is formed into a set of female threads to allow engagement with the male thread **240** of the closure **238**. To insure a fluid type connection an O-ring seal **262** is provided between the closure and the inner container. Within the enclosure **264** formed by the inner container is a refrigerant, such as the Freon **12** mentioned above.

Also connected to the closure **238** is a valve assembly comprising a tubular sleeve **268** having spaced ribs **270**, a frangible diaphragm **272**, a tubular plunger **274** having a flanged head **276**, a longitudinally extending opening **278**, a transversely extending control aperture **280**, a pressure platform **282** and an O-ring seal **283**. Operation of the valve assembly **266** is identical to that described earlier for the valve assembly **170**. The pressure platform **282** is the only different element, which is provided because the valve assembly is located in a different position and is activated by a user pressing upon the pressure platform to cause the plunger and therefore the flanged head to break through the diaphragm. The breaking of the diaphragm allows communication of the content within the enclosure **264** to communicate through the control aperture **280** and through the longitudinal opening **278** with the external environment. The inner container **250** may be formed by the same drawing process used for the inner container **107** with the additional step of forming the threads within the cylindrical portion **260**.

Operation of the valve assembly **266** is desirable when the container **230** is situated in a position as shown in FIG. **38**. If the container were turned upside down, there would be the possibility of leaking liquid coolant on the user. Because there is only a single wall separating the enclosure **248** from the enclosure **264** and because the inner container will be constructed of a good heat conducting metal, there is excellent heat transfer between the product within the enclosure **248** and the refrigerant in enclosure **264** once the valve assembly has been activated. To assemble the container **230**, the inner container **250** is formed by drawing while the closure **238** is pressed. The closure **238** is then engaged to the inner container to form a fluid tight seal. The cylindrical body **232** is formed and lock seamed to the closure **238**. A vacuum is created, Freon is inserted into the inner container and the closure **258** is sealed to enclose the Freon. The beverage is then added to enclosure **248** and the container is sealed with the closure **234**. To conform to existing practices the containers are usually shipped from a can manufacturer to a bottler before the beverage is added to the container.

Current production of beer and soft drinks in metal cans occur in a two step manufacturing procedure. Generally, a can company will manufacture a portion of the finished can, while a bottling company fills the can and completes the can structure. Usually, a can company will receive a roll of metal, which is coated twice and cut to a pre-determined size to form the cylindrical can body. In a separate operation the pop top closures are formed and are mated to the can body by lock seaming. Generally, the cans will also be imprinted with appropriate labels. The cans are then pelletized and forwarded to a bottling company, which then sends the partially completed can through further processes to insure cleanliness before they are filled and sealed.

In keeping with the traditional two step manufacturing process a method has been devised for forming a container, such as the embodiment illustrated in FIG. **18**. The method comprises, providing a strip of material, which is then cut to a pre-determined size to allow the formation of a hollow cylinder, such as the cylindrical body of the outer container **101**, FIG. **18**. There is also provided a plug of material, which, as mentioned earlier, is pressed into an elongated hollow body by the above mentioned drawing process which includes a series of pressing operations. The elongated hollow body may be formed with a configuration identical to the closure **106**, FIG. **20**, which includes two conical sections **122** and **124** and two cylindrical portions **126** and **128**. The formation of the container, the formation of the closure and their connection is graphically described in FIG. **37** in the rectangular figures designated **300**, **302** and **304** respectively. It is, of course, understood that the projections **162**, **164**, **166** and **168** may also be crimped into the closure during its forming process. The three rectangular figures, **300**, **302** and **304**, are surrounded by a larger rectangular figure drawn in phantom designated **306** to indicate that those steps may be accomplished by one manufacturer while the remainder of the method to be described may be accomplished by others.

A second container, such as the inner container **107**, may be formed by a manufacturer totally divorced from the manufacturer forming the conventional container, or the inner container may be formed on another forming line by the same manufacturer of the conventional can. Forming a container having a unique shape, such as the inner container **107**, may be accomplished by providing a plug of material and then drawing that material by the progressive pressing steps as already described. A closure is then stamped out of sheet metal and connected to the coolant container body by a lock seaming process. These two steps are described graphically by the rectangular figures designated **308** and **310** respectively. Next the inner container is filled with a coolant under pressure if the coolant responds in a manner analogous to Freon. This step is designated **312**. The coolant filling step may be accomplished by any standard aerosol filling machine. After filling the inner container, the container is then sealed as designated **314**. The large rectangular figure drawn in phantom line and designated **316** is used to indicate the separate manufacturing operations necessary to form the coolant cartridge. The coolant container may then be inserted into the product container in a bottler's plant or prior to reaching the bottler's plant depending upon convenience. For example, if the manufacturer forms the outer product container and the inner coolant container, then economics would probably dictate that he insert the inner container into the outer container before shipment to the bottler. Regardless of the approach followed, the step is designated **318**. The insertion of the inner container into the outer container may be accomplished by a magnet attaching itself to a closure, such as closure **150**, if the closure is made of tin plated steel so as to be magnetic. The remainder of the container may also be steel or could be aluminum if an all metal container is desirable.

Once within the bottler's plant the additional operation of filling the product container and sealing the container may be accomplished in the usual way. Rectangular Figures **320** and **322** designate respectively

these last two processinng steps. It is to be noted, however, that in bottling some products such as beer, it is undesirable to have the coolant container inserted within the product container until after the beer is sent to a pasteruization station subjecting the beer to a relatively high temperature which would usually be detrimental to a coolant such as Freon 12. Thus, an advantage of the embodiment shown in FIG. 18 is that the coolant container may be added to the product container after the product container has been filled, completely processed and sealed in a fashion which would not require any changes from present day processing.

The process above described for forming the various containers may be altered somewhat should material other than metal be used or if it is found desirable for other reasons not to follow the more traditional approach. For example, using the drawing process described, it is possible to press a hollow, elongated body that includes the outer cylindrical and the uniquely shaped closure as an integral element. The cylindrical portion, which eventually forms the outer body of the container, is then rolled under heat and pressure in a fashion similar to turning one's sock partially inside out. This is known as a outer wall reversed draw. In an analogous fashion an inner wall reversed draw may be used to "stuff" the portion representing the closure into the large cylindrical portion, which eventually forms the outer body. As mentioned earlier, should plastic be used the various parts may be molded or extruded and then fastened together.

Referring now to FIGS. 1 through 4 a container comprises an outer container 12 for depositing a product andd an inner container 14 for housing a cooling or heating compound. In the interest of clarity the self-refrigerating or heating container 10 will be described as a self-refrigerating device for a liquid food or beverage 19, FIG. 4. However, it will be readily apparent as the description proceeds, and as will be explained subsequently, that the container 10, may be utilized to regulate the temperature of solid or liquid foods so as to either heat or cool the food. Further it will be understood that the inner container 14 may be charged with a heat producing substance or a refrigerant depending on the selected application of the container 10. It is to be understood, however, that the container described could also be used to store other than foodstuff and could be used to heat or cool any one of a number of items.

The outer container 12 has a top closure 15 sealed to a cylindrical side body 16 in a conventional manner such as by a rolled seal 17; and the top closure 15 may include a conventional pull pop top opening arrangement 18 scored into the outer surface thereof as already described. The outer container 12 is closed after the beverage 19 has been placed therein, by the attachment of the bottom closure 21, FIG. 4 to the lower end of the side body 16. As seen best in FIG. 6, the side body 16 may be attached to the closure 21 by a rolled seal 22, for example. The closure 21 has a generally conical configuration with a relatively large head portion 23, FIG. 8 and a tapering seam portion 24, with the seam portion 24 extending into the side body 16 the greater part of the length of the side body, and preferably substantially the entire length of the side body.

The coolant inner container 14 comprises a closure 27, FIG. 8 and a tank 26 which is adapted to contain a quantity of liquid coolant 28 under pressure, for example. The inner container 14 is designed to withstand more pressure than the outer container 12 and therefore the tank 26 and the closure 27 may be constructed from stronger or thicker material than the corresponding members of the outer container 12. Further to insure a pressure tight vessel the seal 29, FIG. 6 between the tank 26 and the closure 27 may be formed by double rolling these surfaces inwardly of the periphery of the closure; a gasket material or sealant (not shown) may be disposed between the surfaces of the folded portions of these just mentioned members. A plurality of ridges 30, FIGS. 2 and 3 are formed in the closure 27 to increase the rigidity thereof. It is important for best performance of thhe container 10 that the configuration of the tank 26 be similar to the configuration of the closure 21, but of slightly smaller dimensions so that close contact may be maintained between the closure 21 and the inner container.

Means for venting the interior of the inner container 14 to the atmosphere is attached to the closure 27, and for the selected embodiment the venting means is shown as a pull pop top arrangement 31, FIG. 8 scored into the closure. The pull-tab arrangement 31 may be of conventional type with the depth of the scoring slightly reduced so that the lid may withstand greater pressures and with the size of the resulting opening 32 being adapted for a selected cooling rate as will be expalined subsequently. Although the venting arrangement 31 has been selected herein as a "one-shot" type just as the valve assembly 170 it will be understood that in accordance with the subject invention any suitable venting assembly may be incorporated into the closure, including those of the manually controllable valve type assembly that the inner container 14 may be more readily recharged if it should be desired that the unit be reusable.

As noted previously, one of the primary objects and advantages of the subject invention is that the container may be processed with the least possible modification of existing manufacturing equipment, in which equipment the industry presently has a large capital investment. It should be noted that in accordance with the subject invention that the outer container 12, before the closure 21 is attached thereto, may be filled by standard equipment without modification. However, it will be recognized that since the closure 21 will displace a given volume within the outer container 12 that the volume of the liquid filling each container should be reduced proportionally. For example, the filling machine should be set so as to place 12 ounces of beverage in a standard 16 ounce can. An important advantage of the conical configuration of the closure 21 is that it may be nested (stacked) in a modified closure feeder machine and then inserted into the outer container so that the seal 22 may be subsequently formed in the conventional manner at the normal high rate of production.

As with the FIG. 18 embodiment, since the outer container 12 and the inner container 14 are structurally independent, the filled outer container may be processed without concern as to the effects of such processing on the coolant.

The inner container 14 may be assembled by placing the required amount of coolant 28 into the tank 26 and then spinning the closure 27 onto the tank so as to form the double seal 29. Once again the structural indepen-

dence of the beverage container **12** and the coolant container **14** is advantageous, as the coolant container may be assembled at a completely different facility under the most favorable environmental conditions.

The amount and type of coolant is determined by the requirements of the particular application and the beverage selected. In addition to Freon **12,** propane, butane or a mixture thereof are satisfactory refrigerants. It will be understood, however, that the subject invention is not limited to the proportions or type of coolants stated by way of example and that any suitable coolant may be utilized in the inner container in accordance with the principles of the subject invention.

After the outer container **12** has been filled, sealed and processed, the inner container **14** may be adhered to the outer surface of the closure **21** by means of any conventional adhesive such as epoxy. However, since conventional epoxy is a poor heat conductor only small quantities should be utilized. Preferably, the inner container **14** may be bonded to the outer surface of the closure **21** by a thermal conductive adhesive **33,** such as Thermo-mastic for example, disposed between the closure **21** and the tank **26.** The use of the conductive adhesive **33** as a bonding agent has the advantage of increasing the thermal conductivity between the tank **26** and crown **21** as well as compensating for any minor irregularities in the surfaces that may otherwise prevent close contact therebetween.

In the embodiment of the container **10'** shown in FIGS. **9** through **12,** the conically shaped bottom member or conical section **21'** of the outer container **12'** is formed as an integral part of the side body **16'.** In formation the same drawing processes may be employed as described for the FIG. **18** embodiment. One advantage of the container **12'** is that it may bee filled from the top end in exactly the manner now conventionally employed in the industry, and the closure **15** may be sealed to the side body **16'** without any modification of existing equipment. For the embodiment shown in FIGS. **9** through **12** the inner container **14'** (which is identical to unit **14**) may be mounted within the opening formed by the outer surfaces of the closure structure **21'** in an identical manner to that described previously.

Shortly before the beverage **19** is to be consumed, the user may vent the inner container **14** by means of the pull-tab arrangement **31;** and the pressure within the coolant container **14** is quickly reduced towards atmospheric pressure through the opening **32.** The coolant such as Freon **12** will boil causing the structure of the inner container **14,** the closure **21** and therefore the beverage **19** to be cooled. It should be noted that the rate of cooling may be controlled by the relationship of the size of the head of the tank **26** and the size of the opening **32.** These just mentioned parameters are selected so that the beverage is uniformly cooled as quickly as possible without degrading the flavor. As the beverage **19** is cooled it will settle towards the closure **15,** the container being then inverted, and the resulting convection current of the beverage will help provide uniform cooling. Also, since the lower portion of the stem **24** will retain the coolant longest, the portion of the beverage near the closure **15,** which will be consumed first will be cooled first. Further, the beverage adjacent to the expanded portion **23** of the closure **21** which will be consumed last will tend to be maintained cooler longer due to this larger heat transfer area.

The container **10** may be utilized as a self heating device by the simple expedient of using a heat producing substance instead of a refrigerant in the tank **26** of the inner container **14.** In the heating application a mixture of phosphorus and magnesium filings for example may be loaded and sealed into the unit **14** in such a manner as to form an inert environment. Shortly before the food is to be served the user may vent the unit **14** by means of the pull-tab arrangement **31** allowing air to oxidize the phosphorus which in turn ignites the magnesium. The heat produced by the burning of this mixture is transferred through the tank **26,** the conductive adhesive **33** and the closure **21** in a manner similar to that described previously for the cooling application. The amount of heat generating compound which is loaded into the unit **14** is selected so as to heat the food contained in the unit **12** to a desired temperature.

Referring to FIGS. **13** through **17,** another embodiment of the self-refrigerating and heating container of this invention is illustrated. Again, container **10''** comprises beverage outer container **12''** and coolant inner container **14''.**

Referring principally to FIG. **15,** which is a longitudinal section through container **10'',** the beverage unit comprises can body **34** which is a conventional, commercially available lock seam can body. At the bottom of FIG. **15,** which is the top of container **10'',** closure **36** is sealed to the end of the body. Closure **36** is provided with a conventional pop-top opener **38.** Bottom closure **40** is secured to body **34** by means of lock seam **42.** In view of the fact that the bottom closure **40** is of a special configuration, it may be preferable that the bottom closure be first sealed onto the can body, followed by the can being filled and sealed by adding the closure **36.** In either event, one of the closures is secured to the body, the can is filled with its food material and the other end is sealed.

Bottom closure **40** has a conical portion **44** which provides a beverage space **46** between the bottom closure and the can body. Beyond the conical portion **44** is a cylindrical portion **48** which is integral through transition portion **50** to a cylindrical portion **52.** The entire bottom closure **40** may be drawn so that it has an integral closure head **54** thereon. Thus, with the two closures sealed in place upon can body **34,** the outer container **12''** is created.

Inner container **14''** is formed of a body **56,** closure **58** and closure **60.** Body **56** has a tapered or conical portion **62** which is of such angle and such diameter as to closely fit against the outside of conical portion **44.** Additionally, body **56** has cylindrical portion **64** which extends through transition portion **66** into cylindrical portion **68,** which respectively fit closely adjacent the corresponding portions **48, 50** and **52** of the closure **40.** These respective parts lie closely together as is practical, consistent with convenient and economical manufacturing processes, such as tolerances and the like. The end of cylindrical portion **68** is finished off in a rolled edge **70** which is of such dimensions as to accept closure **60.** Furthermore, the diameter of cylindrical portion **68** and the size of closure **60** is such that unit **14''** can be filled in a standard under-the-cap pressure can filling machine.

Such machines engage around the neck of a vessel adjacent the open end through which the pressurized contents are to be inserted. The pressurized fluid is placed in the vessel, and while the seal is maintained

around the neck, in this case cylindrical portion **68**, the cap **60** is put in place and rolled down to close in the pressurized material.

Of course, closure **58** is already installed on the body **56** of the inner container, and thus filling is the last step in producing the inner container **14''**. Closure **58** can be of convenient and standard manufacture. It is provided with an opening **72** in which is inserted a plug device **74**. Opening **72** is of such size as to provide for a proper rate of discharge of the refrigerant material to provide for the proper rate of cooling, as is described above. Plug **74** includes a pull-tab and a tube of synthetic resin which is effected by heat. The tube of resin has each end **76** disposed through corresponding openings in the tab. The openings also correspond to the opening **72** through which the tube ends also fit. Upon the application of heat, the tube expands to fill the openings and provides a fluid tight seal by squeezing the region **78** adjacent the tube ends **76**.

However, the resiliency of the material is such that in overpressure situations, the material around the groove will not hold, and the tube will blow out of the opening **72** to provide safety relief. Furthermore, lifting of the handle on closure **74** will pop the tube out of openings **72** to permit the voluntary release of the refrigerant material therein. Closure **74** may be placed in opening **72** either before or after closure **58** is sealed on body **56** by means of lock seam rolled edge **80**, but in either event it is put in place before the filling of the inner container from the other end.

Accordingly, the beverage unit **12''** and the heat transfer unit **14''** are separately completed and filled, and separately processed until they are each completed and ready for joining. As described above, a thermally conductive adhesive can be placed between the units to fill any interstices that may result from manufacturing tolerances. By this means, thermal conductivity between the units is good.

I claim:

1. A method of forming a container comprising the steps of:

a. providing a strip of material;
b. cutting said strip to a predetermined size;
c. forming said cut strip into a hollow cylinder having two open ends;
d. providing a plug of malleable material;
e. pressing said plug into an elongated hollow body having an interior adapted to receive and mate with a slightly smaller and substantially similarly shaped body member, said hollow body having portions of tubular conical shape and of cylindrical shape, said hollow body having two ends, one end being the open larger end of a tubular conical section, and the other end being the integrally closed end of a cylinder section; and
f. inserting said hollow body member into said hollow cylinder and connecting the edge of said open larger end of said tubular conical section of said hollow body to the edge of one end of said cylinder thereby closing said one end of said cylinder to form an enclosure between the inner wall of said hollow cylinder and the outer wall of said hollow body, the other end of said hollow cylinder being open.

2. A method of forming a container described in claim **1** further including the steps of:

a. providing a second plug of malleable material similar to said first mentioned plug;
b. pressing said second plug into a second elongated hollow body substantially similar to but slightly smaller than said first mentioned elongated hollow body, said second hollow body having portions of cylindrical shape and tubular conical shape which mate with and nest within said cylindrical portions and said tubular conical portions of said first mentioned hollow body, respectively, said second hollow body having two open ends, one open end being the open larger end of a tubular conical section and the other end being the open end of a cylinder section;
c. providing a closure; and
d. lockseaming said closure to the open end of said tubular conical section of said second hollow body.

3. A method of forming a container as described in claim **2** further including steps of:

a. filling said second hollow body in a high pressure environment with a coolant;
b. providing a closure and valve assembly; and
c. sealing the open end of said cylinder section of said second elongated hollow body with said closure and valve assembly.

4. A method of forming a container as described in claim **3** further including the step of inserting said second hollow body into said first mentioned hollow body so that said second hollow body nests into position within and slightly spaced from said first mentioned hollow body and so that when said second hollow body is further pushed into said first mentioned hollow body said valve assembly is actuated to release coolant from said second hollow body to cool the contents of the enclosure formed between said first mentioned hollow body and said hollow cylinder.

5. A method of forming a container comprising the steps of:

a. providing a plug of material;
b. pressing said plug into an elongated hollow body having cylindrical portions and tubular conical portions disposed between and connecting said cylindrical portions, said hollow body having two ends, one end being the open end of a first cylinder section and the other end being thhe open end of a second cylinder section, said second cylinder section being larger in diameter than said first cylinder section, said second cylinder section also having a female threaded portion adjacent the open end thereof;
c. providing a strip of material;
d. pressing said strip into a closure having a cylindrical portion, said cylindrical portion having one closed end and an integral annular ring extending radially outward from the edge of the other open end, said closure having a male threaded portion on said cylindrical portion adjacent said annular ring corresponding to said threaded portion of said second cylinder section of said hollow body;
e. engaging said threaded sections of said closure and said hollow body;
f. providing a second strip of material;
g. forming said second strip into a hollow cylinder open at both ends and slightly larger in diameter than said second cylinder portion of said hollow body;

h. inserting all of said hollow body into said hollow cylinder;

i. connecting the outer edge of said annular ring of said closure to the edge of one end of said hollow cylinder to form an enclosure between the outer walls of said hollow body and the inner walls of said hollow cylinder;

j. filling the interior of said hollow body with a coolant; and

k. providing a closure and valve assembly and sealing the open end of said first cylinder section of the filled hollow body with said closure and valve assembly.

* * * * *