Dec. 31, 1946. W. C. KESLER ET AL 2,413,453

CONTAINER CLOSURE

Filed Nov. 24, 1943

Fig. 1.

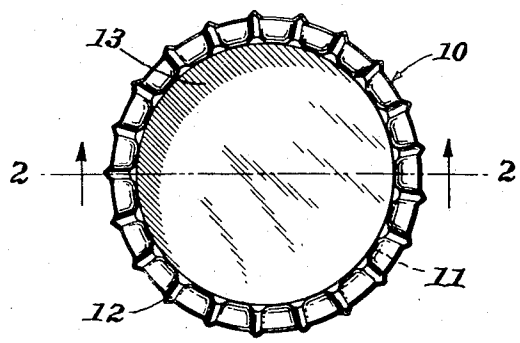
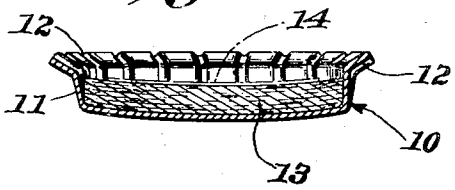


Fig. 2.



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CONTAINER CLOSURE

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Application November 24, 1943, Serial No. 511,616

1 Claim. (Cl. 215—40)

1

This invention relates to container closures notably "crown" caps for sealing pressure beverages. Such a cap includes a metal shell, and a cushion liner positioned therein, usually of cork or cork composition. The liner provides the required compressibility and resilience to assure that the cap will form a substantially permanent, leak-proof seal with the lip of the container to which it is applied by a crowning pressure generally of the order of about 700 pounds or more.

The primary object of this invention is to provide a cap with a cushion liner of paper board having compressibility and resilience comparable to the customary cork liner.

Another object of the invention is to provide a cap in which the paper board liner has critical characteristics of (*a*) thickness, (*b*) apparent density and (*c*) proportions of fibres, which each contribute to the effectiveness of the closure sealing element.

A further object of the invention is to provide a method of preparing the liner material wherein the fibres are beaten to have a critical range of hydration or freeness to the end that a product having uniform sealing properties is obtained.

In carrying out the invention, a preferred stock consists of a mixture of sulfate (kraft) pulp and waste (or overissue) news.

The proportions of the mixture are critical for a satisfactory liner and comprise substantially 15 to 25% kraft pulp and substantially 85 to 75% waste news. Within this range a liner is produced which is neither too compressible or too hard for cap sealing purposes.

Similar attention to the critical proportions recited should be given in the case of other equivalent mixtures of fibres which may be used.

The fibres are mixed with water and are beaten and thereby become hydrated, i. e., take up water, and the degree of hydration increases with the length of time of beating. Up to a certain point, the beating increases the strength but, more particularly, the resilience of the fibre. We find the amount of hydration to be critical and we accurately measure the same by a standardized method known as the Schopper-Riegler wherein the hydration is expressed as the number of cc. of free water. Hereinafter, the hydration will be stated in terms of cc. "freeness." The freeness decreases as the hydration increases, and hence, the lower the freeness, the higher the degree of hydration.

We have discovered that the critical limits of "freeness" of the fibres above mentioned for a

2

preferred liner material are between about 544 cc. and about 736 cc. (free water on the Schopper-Riegler 2 gram-1,000 cc. test), the outside critical limits being between substantially 525 cc. and 765 cc.

The difference in time required to obtain a prescribed freeness on kraft and waste news is so great that each stock is preferably beaten separately to the required freeness, and mixed after beating. We find in practice that when the stocks are beaten together to the required freeness, the kraft pulp is under-hydrated and the news is considerably over-hydrated, so that the resultant board is unsatisfactory. Pulps cannot and should not be beaten for a prescribed time because the time required to reach a prescribed freeness varies in the different pulps and in the same pulp from the same mill. Two pulps will rarely, if ever, beat in the same time, especially if they contain different amounts of water. Hence beating to a prescribed freeness is a critical consideration.

It is necessary to beat each pulp separately, but it is not necessary to beat each pulp to the prescribed freeness of the final mixture. One pulp can be beaten toward the high freeness (736 cc.) and the other toward the low freeness (544 cc.) and when they are mixed, the freeness of the final mixture will fall between the prescribed limits. Boards made in this manner are quite satisfactory.

The beating of the pulps to our prescribed "freeness" limits represents a magnitude of hydration not heretofore carried out in board making. We regard this step of controlling hydration (or freeness) to be critical in insuring the correct compressibility and, especially, resiliency.

The "original thickness" of the prepared board, i. e., the thickness of the liner before being subjected to sealing compression is important as evidenced by our discovery that a sealing liner of kraft-news pulp stock having a thickness of between about 0.049" and 0.063" is uniformly successful, whereas when these critical limits are departed from and the liner made thicker or thinner, it was not useful as a sealing member.

"Apparent density" of the prepared board, namely, the weight per unit volume and expressed as "the weight in pounds per square yard per point of thickness" is also a critical consideration. A "point" of thickness is 0.001."

The critical limits of "apparent density" for a satisfactory liner are between about 0.019 and 0.027 pound per square yard per point. Outside of these limits the products were unsatisfactory

as was demonstrated in the case of the liner made from kraft and waste news.

The apparent density is controlled by the regulation of the pressure on the "press rolls" and by the number of "plys" in the sheet plus one nip of the calender.

We find that 5 and 6 ply sheets give the best results, although a satisfactory board may also be made in 4 and 7 ply. Preferably the board is produced on a cylinder paper making machine whereby a cylinder sheet of not less than 4 nor more than 7 ply is made.

In order to make a satisfactory pressure seal, a board must be compressible enough to yield under capping pressure and form a tight seal and, at the same time, be resilient enough to push back and hold internal gas pressure without leaking. All boards falling within the limits prescribed above make satisfactory pressure seals, because they have the proper compressibility and resiliency. Compressibility and resiliency are functions of, and depend upon "freeness" and "apparent density."

There is no convenient method of measuring resiliency in absolute units when a cap is applied to a container such as a bottle, and, therefore, to measure the compressibility, expressing it in terms of "residual thickness," under 700 and 860 lbs. capping pressures, we employed a female die hollowed out to the exact dimensions and contour of a standard beverage cap and a male plunger of the exact shape and size of a standard beverage bottle neck. The board disc was inserted in the die and pressure was then applied to the plunger and the thickness was measured while the sample was under pressure. The die and plunger set-up permitted compressing the material in a laboratory test exactly as it is compressed in commercial capping.

In making the test, 47 samples of satisfactory boards were selected which varied over the range of critical limits in freeness, thickness and apparent density above set forth.

We find from these tests that the critical limits of residual thickness are between about 0.016" and 0.030" for a 700 pound capping pressure and between about 0.014" and 0.028" for an 860 pound capping pressure.

All boards in which the residual thickness lies beyond the critical limits prescribed above are unsatisfactory for pressure sealing. Moreover, when the residual thickness is less than the minimum prescribed, the apparent density is less than the minimum prescribed above; and when the residual thickness exceeds the maximum, the apparent density will also be in excess of its prescribed maximum.

In the accompanying drawing, we have illustrated a crown cap for a "Standard crown beverage bottle" and it is to be understood that other types of closure caps are similarly improved by use of the present invention.

Referring to the drawing:

Figure 1 is an elevation of the inside of a crown cap showing the cushion liner assembled therein; and

Figure 2 is a section on the line 2—2 of Figure 1.

The cap shown in Figure 1 includes a metal shell 10 having a skirt 11, as shown in Figure 2, and formed with crimps or corrugations 12. In the case of a "Standard crown beverage bottle," such caps are usually described as "Standard 26 mm. crown" which means that the diameter taken from the inside perpendicular

wall of the skirt 11 is 26.7818 mm. or 1.0545 inches. The invention is equally satisfactory with other types of crowns of both larger and smaller diameters. The cushion liner is in the form of a circular disc 13 and is assembled in the shell and secured thereto in any suitable manner.

In Figure 2, the cushion liner is shown having its uncompressed or original total thickness. The exposed surface of the cushion liner 13 has adhered thereto a spot facing 14 of metal foils and coated papers, such as varnished papers, Vinylite coated papers, Cellophane and cellulose acetate films, chlorinated rubber and rubber hydrochloride coated papers, resin coated papers and the like, and suitable coatings of resistant material such as vinyl resin or chlorinated rubber. This facing 14, in some cases, extends over the entire exposed surface of the liner so as to give overall coverage.

The critical conditions described above are subject to variation within the limits stated and the invention will, therefore, be illustrated by a simple example indicating the results when the proportions of fibres are varied within such limits. A stock was prepared from 15% kraft and 85% waste news, another from 20% kraft and 80% waste news, and a third from 25% kraft and 75% waste news. The "freeness" (amount of hydration) was of the order of 666 cc. and the apparent density was 0.0216 in a board of 0 050 inch thickness made on a cylinder paper making machine in each case. Each pulp was beaten separately and mixed. All of the boards made satisfactory cushion liners for crown caps.

Similar favorable results were obtained in the example just given where the freeness was about 544 cc. in one case, and about 525 cc. in another.

Likewise satisfactory boards were produced under the aforesaid varying conditions where the thickness of the board was varied from about 0.049 inch to about 0 063 inch.

Also under the aforesaid exemplified variations board having an apparent density of between substantially 0.019 and 0.027 pound per square yard per point of thickness was produced which was successful for cap cushion liners.

While we have referred and prefer a board made on a cylinder machine, satisfactory boards can be made on a Fourdrinier paper making machine.

Products prepared in accordance with the present invention possess compressibility and resilience comparable to liners of natural and composition cork, and form satisfactory sealing liners for crown and other types of caps.

By "sulfate (kraft) pulp" we mean the accepted and understood definition of this material as found in the Dictionary of Paper which gives the following definition:

"Kraft is a very strong paper made from unbleached sulfate wood pulp by prolonged boiling under low pressure, thus preserving strength because the stock has received less drastic chemical treatment. It is smooth, of a characteristic light brown color, strong and flexible and highly resistant to sudden strain; and now also imitated in various ways. The word is also used in many combinations, such as kraft brown, that is, brown wrapping paper made according to this process which in fact is usually understood by the term kraft paper; kraft pulp, a variety of sulfate wood pulp made from spruce, other conifers, for the production of kraft wrapping paper."

Or as found on page 94 of Sutermeister's Chem-

istry of Pulp and Paper Making (1941), which states:

"The sulfate process is an alkaline process and is so called because alkali lost during the cycle of operations is replaced by sodium sulfate. Actually it is a misnomer, and it would be better to call it the sulfide process because of the important part played by sodium sulfide in the cooking liquor. This sulfide is derived from the sulfate by reduction during the recovery of alkali, and its presence makes the operation of digesters, smelters, and causticizing plants different from that usual in the older soda process.

"There is more or less confusion in the use of the terms 'sulfate' and 'kraft' as applied to the process and products. Sulfate may be considered a general term applying to any cooking process in which the loss of alkali is made up by adding sodium sulfate, while kraft is that subdivision of the sulfate process in which the pulp is intentionally undercooked in order to produce very strong fiber. The products of the sulfate process vary according to the cooking conditions from dark brown, unbleachable kraft fiber, to a soft, easy bleaching stock. Either bleached or unbleached papers made from sulfate pulps range from a coarse, tough, rattly sheet to a soft, pliable, opaque paper depending on cooking treatment and wood."

From this description it is plainly evident that all kraft papers are sulfate.

Or taken from page 56 of Classification and Definitions of Paper (1928), Clarence J. West, vice chairman, Committee on Classification of the Technical Association of Pulp and Paper Industry, which states:

"*Kraft pulp.*—Pulp of wood, by a chemical caustic cooking process; used in connection with a large number of kinds of wood; process differs from soda process in the addition of sodium sulphide; generally a strong brown pulp."

Or from Chamber's Technical Dictionary, which states:

"*Kraft (paper).*—Brown paper made from high class sulphate wood pulp."

By "waste (or overissued) news" we mean as defined in the Dictionary of Paper, which states:

"*Overissue news.*—Newspapers which have been printed but not circulated by the publishing plant, hence clean and uncontaminated. Distinguished from folded news—that is, unsold newspapers from news stands—and crumpled news, which is newspapers segregated from waste gathered from other sources.

"Overissue news, grade No. 1. Clean, fresh, dry overrun and unsold newspapers not over 60 days old, from newspaper offices. Must be free from excessive rotogravure sheets and colored supplements."

Or from the Classification and Definitions of Paper under the section on waste paper dealing with the standard classification for waste paper adopted by the National Association of Waste Material Dealers, which states:

"*Newspapers.*—Shall contain dry, clean newspapers, free from all foreign substances not suitable for the manufacture of paper."

Or as defined in the Dictionary of Paper as "folded news" and "crumpled news."

Waste or overissue news pulp employed by us is "the mechanical pulp resulting from the disintegration or reduction of waste or overissue news as defined above."

We claim:

A cap having a cushion liner formed of a mixture of about 15 to 25% kraft pulp and about 85 to 75% waste news pulp, said liner having a thickness of between about 0.049 inch and 0.063 inch, and an apparent density between substantially 0.019 and 0.027 pound per square yard per point of thickness.

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