

Feb. 19, 1952

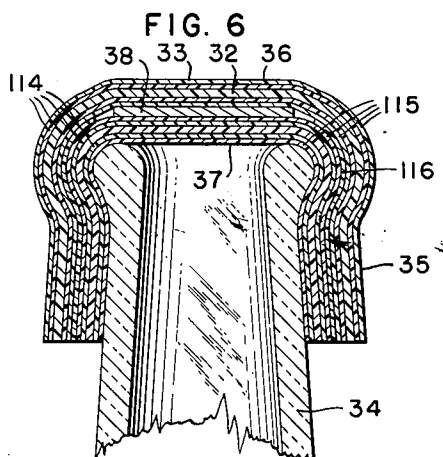
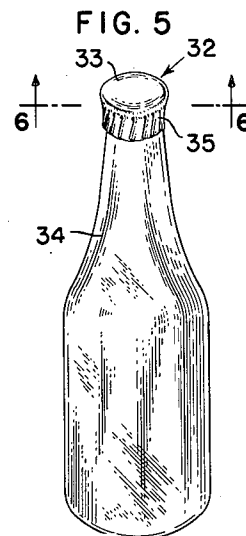
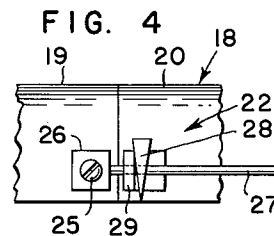
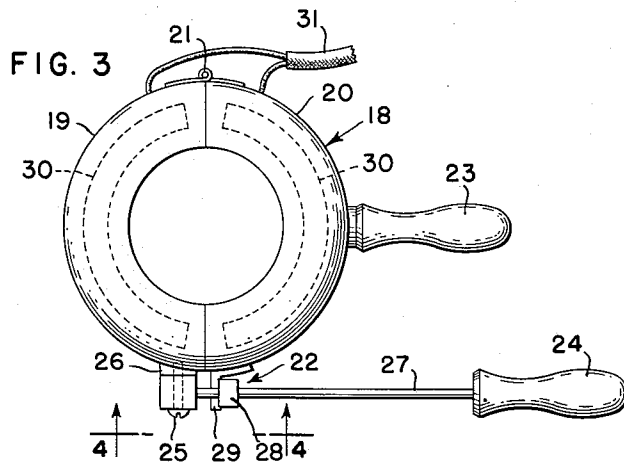
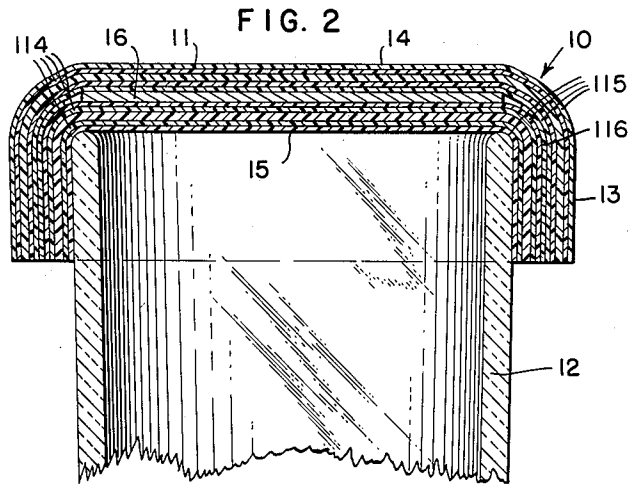
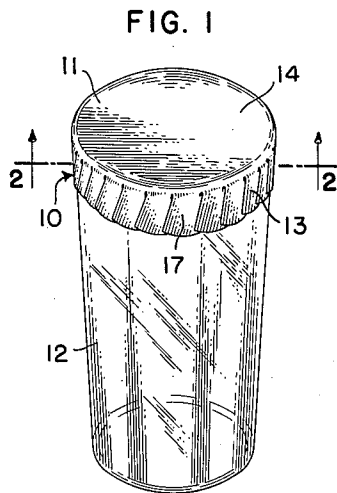
G. W. STOCKBURGER

2,586,446

RECEPTACLE CLOSURE

Filed Sept. 5, 1947

3 Sheets-Sheet 1



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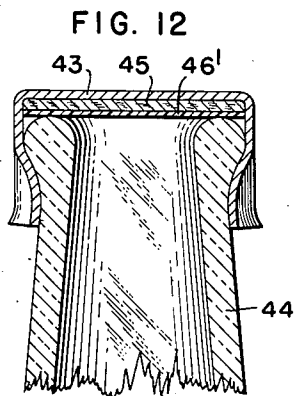
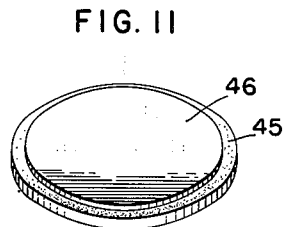
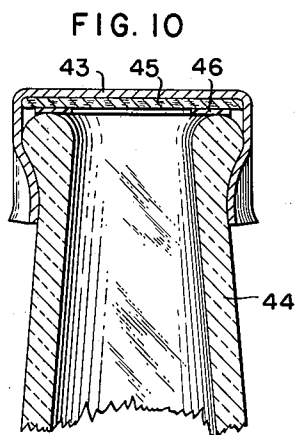
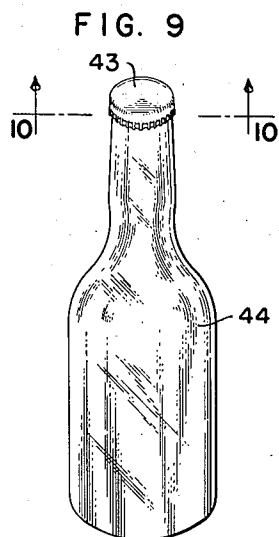
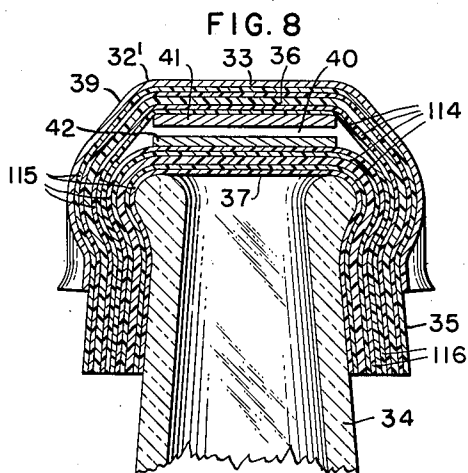
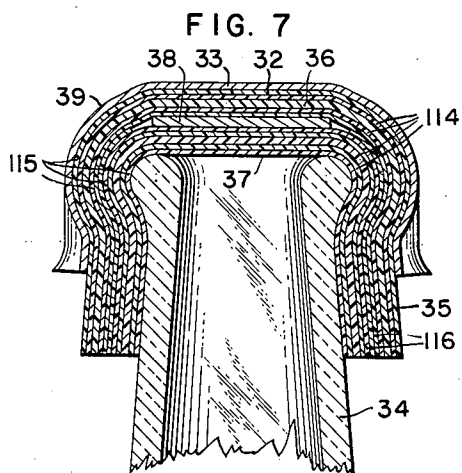
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RECEPTACLE CLOSURE

Filed Sept. 5, 1947

3 Sheets-Sheet 2



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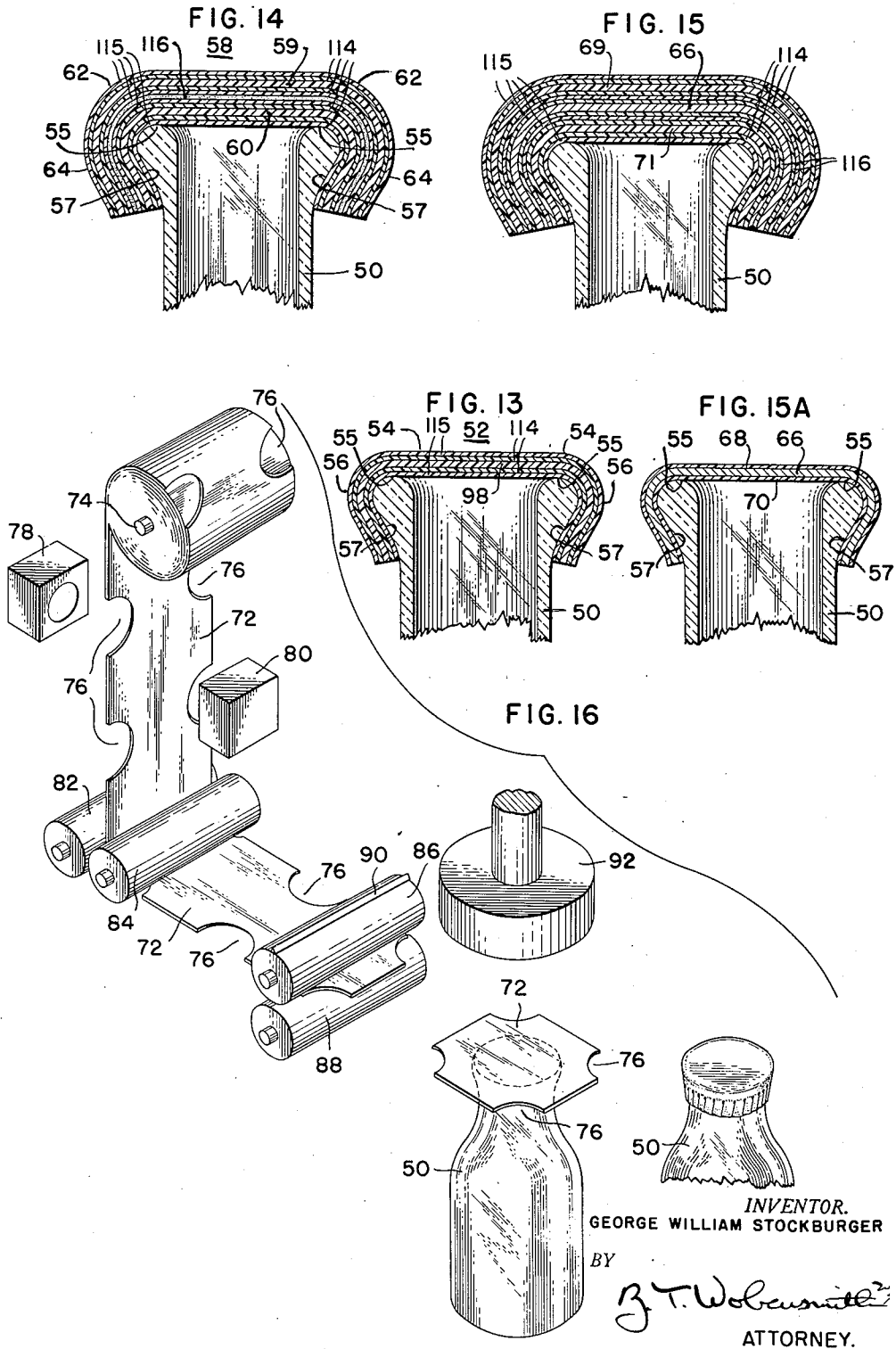
G. W. STOCKBURGER

2,586,446

RECEPTACLE CLOSURE

Filed Sept. 5, 1947

3 Sheets-Sheet 3



UNITED STATES PATENT OFFICE

2,586,446

RECEPTACLE CLOSURE

George W. Stockburger, St. Louis, Mo.

Application September 5, 1947, Serial No. 772,378

5 Claims. (Cl. 215—38)

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This invention relates to new and useful improvements in receptacle closures, and has more particular reference to a plastic film cap closure.

More particularly, the invention contemplates a plastic film closure and a new method for applying same to a receptacle.

This is a continuation-in-part of my co-pending application Serial No. 460,617, filed October 3, 1942, now abandoned, for "Film Cap for Receptacles."

Insofar as the film closure is concerned it is contemplated forming the same of a disc of plastic film having a central portion for engaging across the top of a receptacle, and a skirt portion for being cemented to the sides of the top of the receptacle. Insofar as the method is concerned, it is proposed to apply heat and pressure to the skirt portion of the film while it is being cemented in position to insure a tight closure.

In accordance with this invention the new plastic film cap may be used on beer bottles or other beverage bottles containing liquids which are gassy or are free from gases, or beverages which must be sterilized. It will be found that the new plastic film cap when used as a closure for beer bottles will withstand the pasteurization treatment which requires submerging the bottle in heated water held at 145° F. for a period of twenty minutes. It will be found that no gas bubbles appear to leak or to pass through the film or through the cement or the wrinkles of the film at the sides of the receptacle.

Experimentally, several beer bottles have been sealed in accordance with this invention and were subjected to pasteurization treatments several times for each bottle without any deleterious effects to the plastic closure. Other tests were conducted to ascertain whether there were any objectionable effects on the beverage, but no such effects could be detected.

Still further the invention contemplates various modified forms of the plastic film cap. In one form of the invention the cap may comprise several layers with cardboard reinforcement discs interposed therebetween. In other forms the new closure may be used internally or externally of the standard bottle caps generally used on beverage bottles. However, it is not necessary to use the cork disc of the bottle cap.

For further comprehension of the invention, and of the objects and advantages thereof, reference will be had to the following description and accompanying drawings, and to the appended claims in which the various novel features of the invention are more particularly set forth.

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In the accompanying drawings forming a material part of this disclosure:

Fig. 1 is a perspective view of a drinking glass provided with a plastic film closure in accordance with this invention.

Fig. 2 is a fragmentary vertical sectional view taken on the line 2—2 of Fig. 1.

Fig. 3 is a plan view of an improvised heating and pressing device which may be used in carrying out the method for applying the closure upon the receptacle.

Fig. 4 is a fragmentary enlarged elevational view looking in the direction of the line 4—4 of Fig. 3.

Fig. 5 is a perspective view of a beer bottle provided with a closure constructed in accordance with this invention.

Fig. 6 is a fragmentary vertical sectional view taken on the line 6—6 of Fig. 5.

Fig. 7 is a sectional view similar to Fig. 6 but illustrating another embodiment of the invention.

Fig. 8 is another sectional view similar to Fig. 6 but illustrating a still further modified form of the invention.

Fig. 9 is a side elevational view of a beverage bottle constructed in accordance with another form of this invention.

Fig. 10 is a fragmentary sectional view taken on the line 10—10 of Fig. 9.

Fig. 11 is a perspective view of the cork disc used in Fig. 10.

Fig. 12 is a sectional view similar to Fig. 10 but illustrating another modified form of the invention.

Fig. 13 is another sectional view similar to Fig. 10 but illustrating a still further modified form of the invention.

Fig. 14 is another sectional view similar to Fig. 10 but illustrating a still further modified form of the invention.

Fig. 15 is another sectional view similar to Fig. 10 but illustrating a still further modified form of the invention.

Fig. 15A is another sectional view similar to Fig. 10 but illustrating a still further modified form of the invention, and

Fig. 16 is a diagrammatic view of a capper head, a film that is cut into short lengths from which closures are made by the capper head, and a mechanism to advance the film relative to the capper head.

In certain of the views there is distortion because of the showing in a necessarily exaggerated manner of the thickness of the films and other thin sheet material and coatings thereon.

The plastic film cap for receptacles, in accordance with the form of the invention illustrated in Figs. 1 and 2, includes a disc of plastic film 10 having a central portion 11 for engaging across the top of the receptacle 12, and a skirt portion 13 for being cemented to the sides of the top of the receptacle 12. The disc 10 is illustrated formed from adjacent layers of plastic film 14 and 15. The film layers 14 and 15 each has, on each face thereof an inner anchor or primer coating 114 and an outer or cement coating 115, as hereinafter more fully described. A cardboard disc 16 is interposed between these layers 14 and 15 for reinforcing the central portion 11. The layers 14 and 15 are cemented together with a layer of plastic cement 116, which may be of the same composition as the coating 115. The skirt portion 13 is formed with the necessary wrinkles 17 to firmly engage it about the sides of the top of the receptacle 12. The cement of the coating 115 is used for securely adhering the skirt portion to the receptacle.

In order to avoid leaks, both of gas and liquids, it is necessary that pressure and heat be applied during the cementing. This may be accomplished with an improvised device such as illustrated in Figs. 3 and 4, or more elaborate mechanism may be produced. The device, as illustrated, has a collar 18 for engaging around the skirt portion 13 and formed from two sections 19 and 20 hingedly connected at one side by the hinge 21 and provided with a clamp 22 at its other side for securely clamping together the said half sections. The section 20 is provided with a handle 23 by which it may be manipulated. The section 19 is provided with a handle 24. This handle 24 is pivotally mounted by a pintle 25 upon the lug 26 on the section 19. The stem 27 of the handle 24 is provided with a cam 28 engaging a bracket 29 on the section 20 by which the sections 19 and 20 may be forced together. The collar 18 is provided with an electric heater 30 which is connected to the electric cables 31 which may be connected with a source of power.

Immediately after the plastic cement is engaged upon the plastic film cap the heated collar 18 is engaged over these parts, and heat and pressure is applied for producing the hermetic water-proof seal desired.

In Figs. 5 and 6 another embodiment of the invention has been disclosed in which the new plastic film cap 32 includes a central portion 33 for engaging across the top of a receptacle 34, such as a beverage bottle, and a skirt portion 35 for being cemented to the sides of the top of the receptacle 34. The cap 32 is formed from two layers 36 and 37 of plastic film, having coatings 114 and 115 as before, and cemented together by a layer of cement 116. A cardboard disc 38 is interposed between the central portions of these layers.

In Fig. 7 another form of the invention is disclosed which is identical to the form shown in Figs. 5 and 6, with the exception that a standard bottle cap 39 having a crimped skirt wall which is engaged over the film cap. In other respects this form of the invention is identical to the previous form and like parts are indicated by like reference numerals.

In Fig. 8 still another modified form is disclosed which is similar to Fig. 7, distinguishing merely in the fact that the plastic film cap 32' has the central portions of its layers 36 and 37 separated a sufficient distance to provide a small air chamber 40 between these parts. Cardboard discs 41

and 42 are cemented, by a layer of cement 116, to the opposed faces of the said layers 36 and 37. The air within the chamber 40 is entrapped because the skirt portions of the layers 36 and 37 are sealed to each other. This entrapped air forms a cushion. The standard bottle cap 39 having a crimped skirt wall which is engaged over the plastic film cap exerts a pressure which is transferred by the air cushion to the top of the receptacle, insuring a tight closure.

In Figs. 9 to 11 another form of the invention is disclosed in which the new closure comprises a standard bottle cap 43 mounted on a receptacle 44. This bottle cap has the usual cork disc 45. However, it is provided with a spot of plastic film 46 or plastic cement 116 upon its bottom face which engages against the top edge of the receptacle 44 to insure a tight closure.

In Fig. 12 another form of the invention is shown which distinguishes from the prior form in that the plastic film 46', or plastic cement 116, is extended across the entire bottom face of the cork disc 45.

The tests involving the use of a plastic film for closures may be classified generally as follows:

1. The application of a plastic closure to a receptacle shaped like a water glass, glass jar, bottle, etc., exerting no internal pressure.

2. The application of a plastic closure to a receptacle, such as a bottle of beverage, exerting internal pressure.

3. The application of a plastic closure supported by a metal back with a cushion or back of cork, rubber, cellulosic material, plastic material, etc., exemplified by a plastic film spot or sheet forming a lining for the inner surface of bottle crowns, rigid bottle closures, etc.

The tests showed that the plastic closure thus applied to the mouth of the beverage bottle is leakproof; that pressure was maintained within the bottle. Experimentations have proven at high pressure of say, up to eighty pounds per square inch, that no distortion could be observed on the plastic closure.

In Fig. 13 the numeral 50 denotes a receptacle to which a cap or closure, provided by the present invention, may be applied. That closure is denoted generally by the numeral 52; and it has a generally plane central portion that spans the opening at the mouth of the receptacle 50, it has a circular section 54 that bends down and over the top 55 of the receptacle 50, and it has a skirt 56 which can be bent inwardly against the side 57 of the receptacle. This cap is a multi-layer sheet wherein the central layer is a plastic film 98, and wherein the two outer layers 115 on each face of the film 98 are plastic cement; and the cap normally has hard, dry inner and outer surfaces. In the presence of heat and pressure, the plastic cement forming those surfaces, softens and can be pressed against the glass or other material of the receptacle 50 until it seals the cap 52 to that receptacle, thus forming an airtight seal between the cap 52 and the receptacle 50. This is a unique result; for although many claims have been made for air-tight seals between caps and receptacles, such seals have not heretofore been attained.

With the closure provided by the present invention, however, it is possible to provide a seal between the receptacle and the closure which will remain air-tight despite vibration, movement, shock, heating, cooling, or the existence of pressure within the receptacle. In addition, the closure is resilient enough to retain its form and

configuration despite frequent removal and replacement, and to be able to confine liquids even though the receptacle containing those liquids is inverted. This ability to retain its form and this ability to form an air-tight seal is attained by pressing the closure onto the receptacle, in the presence of pressure and sufficient heat to cause the plastic cement coating 115 on the inner surface of the closure to seal to the closure and to cause the plastic cement coating 115 on the outer surface of the closure to soften and then harden into adhering relation with other portions of the closure. The amount of heat required to make the plastic cement coating 115 adhere to the receptacle is not excessive, but it is greater than the temperatures required to bond two cement-coated surfaces together. For example, one cement-coated sheet that bonds to itself at one hundred and seventy five (175) degrees Fahrenheit must be heated to two hundred and twenty (220) degrees Fahrenheit before it can be bonded to a glass receptacle. Once the closure has been properly heated, it will form two distinct seals with the receptacle; one seal at the end of receptacle and the other seal at the side of the receptacle. The closure itself will be made of gas-impervious material which is pliable enough so it can be bent without cracking; and since the seals are gas-impervious, no air or gas can pass into or out of the receptacle.

The plastic cement coating 115 of the closure can be made adherent to the receptacle but it will have a greater adherence to the material of the closure than it has to the receptacle; as a result it will pull free from the receptacle when the closure is removed. This avoids unnecessary washing of the top and sides of the receptacle by the consumer and the user of the receptacle.

In addition to being air-tight and gas-tight, and in addition to being pull-free, the closure of the present invention is tamper proof and is sterile. The relatively high heat and the pressure required to make the closure adhere to the receptacle makes it difficult for the closure to be re-sealed to the receptacle. Thus, if the air-tight seal is broken, the consumer knows the receptacle has been opened. The relatively high heat used in making the closure adhere to the receptacle is also useful in tending to sterilize the top of the receptacle.

The seal which is provided between the closure and the sides of the receptacle is located below the rounded lip at the top of the receptacle. That seal is formed by the plastic cement coating 115 on the crimps or pleats which lie against the sides of the receptacle below the lip of the receptacle. When the closure is removed from the receptacle, the seals between the closure and the receptacle are broken, but the adherence between adjacent crimps or pleats is not completely broken. As a result the closure retains the form it was given on the receptacle, even after the closure is removed from that receptacle. In fact, the closure retains that form to such an extent that it can snap itself back into position on the receptacle as it is being reapplied to the receptacle. As a matter of actual test, the closures of the present invention can be removed from the receptacle, replaced on that receptacle, and then hold the liquid contents of that receptacle against leaking even though the receptacle is inverted.

It will be noted that although the receptacle 50 of Fig. 13 is provided with an internal shoulder of the type commonly found in milk bottles, the

closure of the present invention does not utilize that shoulder in forming its seals with receptacle 50. In fact, the closure of the present invention does not even touch that shoulder. That internal shoulder, which is intended to receive a disc of treated paper, which is a collecting place for dirt and bacteria, and which is hard to clean, can be eliminated from receptacles with which the closure of the present invention is used.

The closure 52 in Fig. 13 is a single multi-layer sheet wherein the inner and outer layers 115 were plastic cement; the cement of the inner layer sealing to the receptacle 50, and the cement of the outer layer adhering to the crimps or wrinkles of the skirt 56. The closure 58 in Fig. 14 is similar to the closure of Fig. 13, but it is made of two single multi-layer elements that are bonded together. The outer element 59 has coatings 114 and 115 on each face thereof and it is bonded to the inner element 60 by an adhesive layer 116 that will adhere to the plastic cement coating 115 on the abutting surfaces of the elements 59 and 60. Many such adhesives for the layer 116 could be used but one very useful adhesive is polyvinyl chloride. The two elements 59 and 60 are readily deformable to the shape shown in Fig. 14; the elements 59 and 60 having portions 62 that engage and bend down over the top 55 of the bottle 50, and having skirt portions 64 that are pressed into sealing engagement with the sides 57 of the receptacle or bottle 50. The plastic cement coating 115 on the inner surface of the multi-layer element 60 and the plastic cement coating 115 on the outer surface of element 59 will soften with heat; and when the closure is suitably pressed against the receptacle 50, the plastic cement coating 115 on element 60 will seal to the top 55 and sides 57 of receptacle 50, and the plastic cement coating 115 on element 59 will adhere to the wrinkles and crimps in the skirt 64. The adhesive layers 116 that bonds the two multi-layer elements 59 and 60 together will also soften with heat; this softening action serving to permit the closure to move into very intimate sealing engagement with the top 55 and sides 57 of the receptacle 50. When that adhesive layer 116 cools, it will provide a certain amount of additional stiffness for the closure; which stiffness helps the closure keep its shape despite frequent removal and replacement. The closure of Fig. 14 will be thicker than the closure of Fig. 13, but it will be thin enough to permit ready passage of heat therethrough; thus facilitating the heating of the cement on the inner surface of the closure.

In Fig. 15A a closure is shown that is a sheet 66 of parchment provided with a heat softenable coating 68 adhering to its outer surface and a heat softenable coating 70 adhering to its inner surface. The coatings 68 and 70 may be in the form of plastic cement. The parchment sheet 66, as shown in Fig. 15, may have exterior layers in the form of single multi-layer elements 69 and 71 of the types shown in Fig. 13. Where the coatings 68 and 70 are of plastic cement, that cement will be suitably applied to the opposite surfaces of the parchment 66 and permitted to harden. In such a case the closure of Fig. 15 would be identical to the closure of Fig. 13 except for the substitution of parchment 66 for the plastic film of that closure. Where single multi-layer elements 69 and 71 are employed, those elements will be secured to the parchment by a suitable adhesive layer 116; as for example, polyvinyl chloride or polyvinyl acetate. The sheet 66 of parch-

ment will provide considerable stiffness and strength for the closure, thus enabling the closure to confine materials under pressure and also enabling the closure to retain its form despite frequent removal and replacement; but the parchment will be thin enough so the closure is not too thick to rapidly transmit heat to the inner surface thereof.

Fig. 16 shows a diagrammatic view of a roll of plastic film that is being fed to a capper head as short lengths, and is being formed into closures and sealed to receptacles by that capper head. The film, which may be of the type shown in Figs. 13, 14 and 15, is denoted by the numeral 72; and that film is formed as a roll and is supported on a rod 74. The film 72 has a series of arcuate indentations 76 in the opposite edges thereof; and the indentations in the opposite edges of the film 72 are set in register with each other. The film 72 extends downwardly from the roll on rod 74, and it passes between a housing 78 for a source of radiation and a housing 80 for an element responsive to radiation. The source of radiation ordinarily will be an incandescent electric lamp, and the element responsive to radiation will ordinarily be a photo-cell of the selenium type; however, any suitable source of radiation and any suitable element responsive to radiation can be used. The housings 78 and 80 are so positioned relative to the film 72 that the arcuate indentations 76 will permit radiations to pass but the portions of the edge of film 72 which are between the indentations 76 will act to impede the passage of radiations. The film 72 may be partially or completely transparent; and thus the portions of the edge between indentations 76 will not completely interrupt radiations passing between the housings 78 and 80. However, those portions of the edge of film 72, which are between the indentations 76, will sufficiently affect the passage of radiation so the element in housing 80 can provide a usable response to the position of indentations 76. That response, which may be in the form of an electrical pulse, will pass to a suitable electro-mechanical system, not shown; and that system will control the rotation of film advancing rolls 82 and 84. These rolls grip the film 72 and pull it downwardly off of the roll on rod 74. The rod 74 is provided with suitable retarding devices, not shown, that will keep the film 72 taut. If desired, additional tensioning devices may be provided adjacent the film 72 to keep that film taut as it passes to advancing rolls 82 and 84.

Positioned adjacent to the advancing rolls 82 and 84 are cutter rolls 86 and 88. The roll 86 carries a blade 90 which is sharp and will coast with roll 88 to cut the film 72 into short lengths. The rolls 86 and 88 are interrelated with advancing rolls 82 and 84 so the rolls 82 and 84 and the rolls 86 and 88 can operate in synchrony. Where this is done, the rolls 82 and 84 and the rolls 86 and 88 will advance the film a predetermined distance, and the rolls 86 and 88 will cut off a segment of that film. This movement of the film 72 will be controlled by the electro-mechanical system, not shown, and will advance the film 72 the distance between adjacent indentations 76. By setting the rolls 86 and 88 relative to the indentations 76, it is possible to have the blade 90 sever each segment from the film 72 at the desired point. That point can be a line extending between the midpoints of the indentations 76.

The severed piece of film will be moved by belts or fingers, not shown, to a position between a

capper head or die 92 and a bottle 50. This capper head is preferably of the type shown and described in my copending application Serial No. 732,553, filed March 5, 1947, now abandoned, and entitled "Dies." That capper head is heated to a temperature above the temperature at which the plastic cement on the film 72 will be adherent to the bottle 50; and the head has a recess which presses the center of the severed piece of film firmly onto the top 55 of the receptacle 50, and it has radially movable fingers that press the skirt of the closure firmly against the sides 57 of receptacle 50. Thus the capper head 92 enables the closure to form two air-tight seals with the bottle 50. Such seals can also be formed by the capping device of Figs. 3 and 4, but that device is not suitable for the rapid capping operations required in modern bottling plants.

The operation of the capper head 92 will be correlated with the action of advancing rolls 82 and 84 and cutting rolls 86 and 88 in such a way that when the capper head 92 and bottle 50 are moving toward each other or are in engagement with each other the rolls 82 and 84 and the rolls 86 and 88 will be stationary. Only when the capper head 92 and the bottle 50 are separated can the rolls 82 and 84 and the rolls 86 and 88 advance the film 72. As the capper head 92 moves upwardly, or as the bottle 50 moves downwardly, a pulse should be supplied to the electro-mechanical system to start rolls 82 and 84 and rolls 86 and 88 into motion; and when the next indentation 76 in the edge of film 72 comes into register with housings 78 and 80, a second pulse should be sent to the electro-mechanical system that will halt rolls 82 and 84 and rolls 86 and 88. The belts or fingers, not shown, will be interlocked with rolls 86 and 88 so they can move the severed piece of film into position between the capper head 92 and the bottle 50.

The indentations 76 serve a dual purpose; they facilitate precise control of the advancement of the film 72, and they provide a generally circular configuration for the severed piece of film. This generally circular configuration makes it possible for the closure to have a trim appearance on the bottle and to be free of elongated portions that extend considerably below the rest of the skirt of the closure. Such elongated portions do not affect the ability of the closure to provide an airtight seal with the bottle, but they detract somewhat from the smart appearance of the closure. The indentations 76 are shown as being the arc of a circle. However, those indentations could be made polygonal with straight or curved lines of various dimensions, as long as the indentations serve their dual purpose. If the indentations at one edge of the strip were made deep enough, the indentations at the other edge could be eliminated.

The arrangement shown in Fig. 16 is the quickest and most economical way of applying closures to bottles. Where this is done, the closure is simultaneously formed and applied to the bottle. Bottles, filled with the appropriate contents, and the sheet of film are moved toward the capper head, and capped bottles move from the capper head. However, the closures may be pre-formed prior to their application to the bottles, receptacles or containers; and in such instances they can be given a regular circular configuration and can be partially crimped. Such an arrangement is desirable if the closure is not of uniform thickness throughout; as shown in Figs.

1, 2, 5 and 6 where a disc of paper or other material, of diameter equal to the diameter of the bottle, is bonded between two larger plastic films. To precisely center the disc on the bottle it is preferable to pre-form the closure.

With the arrangement shown in Fig. 16, the closures can be applied to the bottles 50 at a rate of from one hundred and twenty (120) to two hundred (200) closures per minute. In most instances, the thickness of the film 72 will be such that at those rapid rates of capping, a temperature of two hundred and fifty (250) degrees Fahrenheit in the capper head 92 will be sufficient to make the inner coating of the closure adhere to the bottle. For example, the film 72 need only be one one-thousandth (0.001) of an inch thick where the film 72 is to form closures of the type shown in Fig. 13; the center layer of plastic film being about eighty-eight one-hundred thousandths (0.00088) of an inch thick, and each of the two coatings of plastic cement being about six one-hundred thousandths (0.00006) of an inch thick. Such a film readily transmits heat from the capper head to the inner coating of the closure; and the capper head need not be much hotter than the temperature at which the plastic cement will seal to the receptacle. The closure in Fig. 14 is twice as thick as that in Fig. 13; but it is still quite thin since its thickness is only about two one-thousandths (0.002) of an inch. The closure of Fig. 14 will require only a slightly higher temperature for the capper head. The closures of Figs. 1, 2, 5, 6, and 15 will be even thicker than the closure of Fig. 14; the presence of the cardboard, paper or parchment layers increasing the thickness of those closures. For example, where the closures are provided with a layer of parchment which weighs twenty-seven (27) pounds for each three thousand (3000) square feet of area, that layer will increase the thickness of the closure by about two one-thousandths (0.002) of an inch. However, the total thickness of those closures will only be about five one-thousandths (0.005) of an inch; and the heat will pass through such a thickness with ease and rapidity. By making it possible to use low temperatures for the capper head, the present invention makes it possible to avoid charring, burning or otherwise damaging the closure; even though the film advancing system were to slow down or stop.

In the event the thickness of the film 72 must be increased still further, as is the case where the closure is to confine heavy pressures, the temperature of the capper head may be held above two hundred and fifty (250) degrees Fahrenheit, or a source of heat can be positioned adjacent the film 72 to preheat that film as it is moved toward the cutting rolls 86 and 88. The amount of heat supplied by this source must be insufficient to cause the film 72 to adhere to the rolls 86 and 88, and yet it can easily be sufficient to reduce the amount of heat transmitted through the film 72.

As used herein the term "plastic film" comprehends any of the thin, pliable, relatively inelastic, strong films made of materials which are generally known as plastics. For example, plastic film comprehends regenerated cellulose films such as the film sold by the E. I. du Pont de Nemours Company under the name "cellophane," it comprehends cellulose acetate films, and it includes other similar films. As used herein the term "plastic cement" comprehends any of the normally non-tacky, heat softenable cements made

from the class of materials generally known as plastics. For example, plastic cement comprehends the mixture of a cellulose derivative, plasticizer, blending agent, and wax which is used by the E. I. du Pont de Nemours Company as the coating in "M. S. T. cellophane," it comprehends the mixture of a cellulose derivative, plasticizer, blending agent, wax, and primer that is used by the E. I. du Pont de Nemours Company as the coating for "M. S. A. T. cellophane," it comprehends vinyl acetate and vinyl chloride copolymers, it comprehends polyvinyl acetate, it comprehends polyvinyl chloride, it comprehends polyethylene sold by the E. I. du Pont de Nemours Company under the name "Polythene," it comprehends rubber hydrochloride, it comprehends polystyrene, and many similar materials. The plastic films should not be elastomeric, because such films cannot maintain an air-tight seal when the receptacle confines material under pressure, and cannot maintain an air-tight seal in the presence of heating, cooling, movement, shock, or vibration. Moreover such films could not enable the closures to retain their form and be replaced on the receptacle to confine the material therein.

The plastic cement for the coating 115 should normally be hard and non-tacky, it should be insoluble in the material confined in the receptacle, it should not affect the purity or taste of the material confined in the receptacle, it must be capable of being softened by heat and of being pressed into sealing engagement with the receptacle, it must be capable of being readily loosened from the receptacle, it must have a greater adherence to the plastic film than it has to the receptacle, and it must not stick to the die that presses it against the receptacle. This plastic cement is preferably coated onto the opposite surfaces of the plastic film; the cement coating 115 on the inner surface forming air-tight seals with the top and sides of the receptacle, and the cement coating 115 on the outer surface providing tight adherence between the crimps or pleats of the closure.

One very useful and satisfactory plastic cement includes the following:

	Per cent
Nitrocellulose	6.44
Gum dammar	2.17
Dibutyl phthalate	2.40
Paraffin (M. P. 60°-61° C.)	0.52
Zinc stearate	0.17
Ethyl acetate	55.85
Toluene	28.70
Acetone	0.15
Benzene	0.01
Ethanol	3.59

This cement is the coating shown at 115 for the "M. S. A. T. cellophane" made by the E. I. du Pont de Nemours Company, and it bonds to the "anchor" coating shown at 114 of that material. The "anchor" or primer coating 114 is a phenol-aldehyde or urea-aldehyde resin; and it secures the coating 115 to the regenerated cellulose plastic film of the "cellophane" so strongly that prolonged exposure to moisture cannot separate the plastic film and its outer coating.

In applying the closure to a receptacle, the closure, either in the form of a sheet or in the form of a pre-crimped closure, is interposed between the top of the receptacle and the bottom of a heated die. This closure may or may not be preheated, depending on its thickness, its thermal mass, and the rate of capping. Thereafter, the

die and receptacle are moved relative to each other, and the die is caused to press the central portion of the closure onto the top of the receptacle and also to press the skirt of the closure against the sides of the receptacle. In doing so, the die imparts heat to the closure, thus heating the "plastic cement" on the inner and outer surfaces thereof to adhering temperatures, it bends the skirt of the closure down along the sides of the receptacle, stretching the closure as it does so, and then it presses the heat softenable plastic cement on the inner surface of the closure into sealing engagement with the top and sides of the receptacle; the plastic cement on the outer surface of the skirt being pressed into adhering engagement with the crimps or pleats. The receptacle will usually be cool relative to the plastic cement; and in the milk and dairy industry the receptacles will usually be about seventy (70) degrees Fahrenheit. The coolness of the receptacles will cause the plastic cement to harden and cool almost immediately; and even though the die is removed promptly, the closures will remain taut and in air-tight relation with the receptacles.

The plastic films will in most instances be water tight per se, although some of them may permit gradual passage therethrough of water vapor. The resistance of those films to water will be reinforced, and can even be made sufficient to prevent passage therethrough of water vapor, by coating them with a suitable plastic cement. Consequently, when the plastic films are formed into multi-layer closures suitable for sealing to receptacles, as by coating them with plastic cement, those films can become even more resistant to water. Where desired, the plastic cement can be chemically formulated in such a way as to enable the closure to be specially resistant to the action of the material in the receptacle. For example, a plastic cement can be formulated that will be particularly resistant to lactic acid; and such a cement will increase the ability of closures to resist the action of milk and related products in the milk and dairy industry.

A closure, as provided by the present invention, may be a single multi-layer element which includes a plastic film and a coating of plastic cement 115 on one or more of the surfaces of that film held in place by an anchor coating 114, as in Fig. 13. A thicker and heavier closure, provided by the present invention, may be made by bonding two or more single multi-layer elements together to form a multi-element closure as in Fig. 14. Another sturdy closure may be made by bonding two or more single multi-layer elements to the opposite surfaces of a sheet of paper as in Fig. 15A.

In each instance however, care must be taken to keep the thickness of the closure as small as possible; thus keeping the thermal capacity of the closure as small as possible, and also reducing the tendency of the closure to take a "set" when it is removed from a receptacle. This latter requirement is of great importance because the area of contact between adjacent wrinkles and crimps in the skirt of the closures is small; and yet those wrinkles and closures must enable the closure to retain its form despite frequent replacement and removal of the closures. If the closures are too thick, the resilience of the plastic cement on the wrinkles and crimps of the skirts of the closures will be unable to restore the original small diameters of the skirts after those diameters have been momentarily increased to enable them to pass the lips of the receptacles. This

problem is particularly acute with metal foil; where that foil is thick enough to confine gases, it is so thick that it takes a "set" when it is removed from the receptacle. In those instances where closures must confine liquids and gases under pressures of around eighty (80) pounds per square inch, the closures must have appreciable thickness and yet they must be capable of ready removal and replacement. The present invention solves this problem by increasing the thickness of the central portion of the closure while keeping the skirt thin, as for example in Figs. 1, 2, 5 and 6. Those closures may have central portions with an overall thickness of three one-hundredths (0.03) of an inch while the skirt has an overall thickness of only two one-thousandths (0.002) of an inch.

In such closures, the rate at which heat is transmitted from the outer to the inner surface of the skirt is quite rapid; and the transmitted heat will soften the plastic cement in contact with the top as well as the sides of the receptacle. As a result the temperature of the caper head need not be excessive. This is a considerable advance over prior closures which were so thick that unduly high temperatures had to be applied to the outer surfaces of the closures to heat the inner surfaces properly. For example, paraffin-impregnated wax hoods which are to be applied to milk bottles, must be heated so hot that if the hood-applying machines slow down or stop, the heat from the machines will char and burn the hoods.

For milk and other liquids which do not generate sizable vapor pressures in receptacles, and for solid foods, closures of the type shown in Figs. 13, 14, 15A and 15 are preferred. In making those closures it is desirable to use "M. S. A. T. cellophane" made by the E. I. du Pont de Nemours Company, or an equivalent material, as the single multi-layer element; it is desirable to use polyvinyl chloride, polyvinyl acetate, phenol-aldehyde or urea-aldehyde as the adhesive layer 116 for bonding the elements together, and in the closure of Fig. 15 or 15A it is desirable to use parchment that weighs twenty-seven (27) pounds or thirty-five (35) pounds per three thousand (3000) square feet of area. Furthermore, it is desirable to keep the thickness of the skirts of all of these closures about three one-thousandths (0.003) of an inch or less. Where this is done, the closures will be very satisfactory.

For liquids which generate sizable vapor or gas pressures, as for example carbonated beverages and beer, it is desirable to use a closure that is formed from two (2) or more sheets of "M. S. A. T. cellophane" made by E. I. du Pont de Nemours Company which are laminated together with a suitable adhesive layer 116 and to have a paper disc, of the approximate diameter of the top of the bottle, between two of the sheets as shown in Fig. 6. Such a closure has held eighty (80) pounds per square inch and more of pressure.

The seals between the closures of the present invention and the receptacles to which they are applied are air-tight; and yet the closures are easily removed from those receptacles without the use of can or bottle openers. The seals can easily be broken by grasping the closures and giving them a sharp twist; and the average housewife can easily do this with her hands. The seals can also be broken by pulling the skirt of the closures away from the sides of the receptacles; and thereafter working the closures off of the receptacles. These seals, which are so easily

broken by the ultimate consumer, cannot be broken accidentally by jostling the receptacles or by striking the receptacles against other objects, as for example the case in which the receptacles are carried.

Except in instances where the bottler wants the closure to be destroyed as it is being removed from the bottle, as is the situation in the beer industry, the closure need not be discarded until the contents of the bottle are consumed. The crimps and wrinkles in the skirt of the closure will yield somewhat as the closure is removed from the bottle, and they will then restore themselves to a diameter smaller than the lip of the bottle. The closure can be replaced on the bottle by pressing it over that lip; and at such time the wrinkles or crimps will momentarily yield and then restore themselves to hold the closure on the bottle. This holding action can be so strong that it is possible to invert the full or partly full bottle and still have the closure hold the contents of the bottle against leakage. The ability of the skirt to hold the closure in place can be increased by using a thermo-setting material as part of the coating of single multi-layer elements or by using a thermo-setting material as the adhesive for multi-layer elements which are bonded together. As a matter of fact, it is the thermo-setting characteristic of the phenol-aldehyde or urea-aldehyde primer of "M. S. A. T. cellophane" that makes that "cellophane" able to hold the skirt of the closures in shape. The primer is partially set when it is applied to the "cellophane" and is finally set when the closure is heat sealed to the receptacle.

As used herein the phrase "air-tight" means a seal that is capable of preventing efflux of air, gas or liquid from the receptacle and is capable of preventing influx of gas, air, or liquid into the receptacle under pressure conditions that are more severe than those customarily met in actual practice. For example, closures of the type shown in Fig. 6 are considered as providing air-tight seals with receptacles since those closures can hold eighty (80) pounds per square inch pressure although the pressure in receptacles for beer and carbonated beverages is usually about thirty-five (35) pounds per square inch. Similarly, the closures of Figs. 1, 2, 13, 14, 15A and 15, which will probably not be used to confine pressures of the magnitude experienced in receptacles for beer and carbonated beverages but instead will probably be used to confine solid foods or non-gassy liquids such as milk and fruit or vegetable juices, are considered as providing air-tight seals with receptacles since those closures pass the strict tests in the milk and dairy industry. One of those tests includes holding a capped, but empty, receptacle under a foot or two head of water and determining whether air leaks out. A more formal test is the "immersion" test and in that test a receptacle is filled with water, a closure is affixed to the receptacle, and the capped receptacle is placed for twenty-four (24) hours in water which is held at forty (40) degrees Fahrenheit in a refrigerated cabinet. Thereafter, the capped receptacle is removed from the cabinet, inverted, shaken, and otherwise tested to see if it has leaked or will leak. Several prior disclosures can not pass this test, but the closures of Figs. 1, 2, 13, 14, 15A and 15 pass it easily. A more difficult test is the "Blue Test" used by the Board of Health of the city of New York, N. Y.; and that test includes directing a stream of water, colored with methylene blue, down onto

a capped bottle at a point between the center and periphery of the cap. This water passes along the cap, bounces on the edge of the cap and on the shoulder of the bottle, and then runs off. As it bounces on the edge of the cap and on the shoulder of the bottle it creates a fine spray that tends to work its way up between the cap and the bottle. If the cap is not sealed to the bottle in an air-tight seal, the colored water will enter the bottle and discolor the contents of that bottle. The test is sometimes made with clear water where the bottle is empty. At the time the closure of Fig. 15 passed the "Blue Test" given it by the Board of Health officials of the city of New York, it was the first closure to ever pass that test. Perhaps the most difficult test for closures in the milk and dairy industry is used by the Board of Health of the city of St. Louis, Mo.; and that test includes placing two inverted capped bottles in a container, placing two capped bottles upright in the container, and then covering those bottles with crushed ice made from water containing a water-soluble dye known as fluorescein. The container is then left for four (4) hours; and if the closures are not sealed to the bottles in air-tight seals the fluorescein will enter those bottles. One drop of the fluorescein is sufficient to discolor the contents of a milk bottle. When the closure of Fig. 15 passed the test given it by the Board of Health officials of the city of St. Louis, it was the first closure to ever pass that test. In these and other tests, the closures provided by the present invention have proved their strength and air-tightness.

One of the reasons many closures can not provide an air-tight seal to receptacles is that the surfaces of the receptacles are not perfectly smooth. This is a condition found in most receptacles and it is generally accepted as a condition that can not be corrected. The closure of the present invention can form an air-tight seal with almost any receptacle that is usable in the food industry. It can do so because it is made of very thin, very pliable material, and because the adhesives and cements used therein soften when heated during the process of applying the closures to the receptacles.

While I have illustrated and described the preferred embodiments of my invention, it is to be understood that I do not limit myself to the precise constructions herein disclosed and the right is reserved to all changes and modifications coming within the scope of the invention as defined in the appended claims.

Having thus described my invention, what I claim as new, and desire to secure by United States Letters Patent is:

1. A gas impervious and liquid tight closure for a glass receptacle having side wall portions surrounding an end opening in the receptacle and an end wall at the extremities of said side wall portions, said closure comprising regenerated celulosic sheet material having an adherent thermosetting anchor coating of a material from the group consisting of phenol aldehyde and urea aldehyde covering the faces thereof, and a normally dry heat softenable plastic cement coating of a material from the group consisting of plasticized nitrocellulose, vinyl acetate and vinyl chloride copolymer, polyvinyl chloride, polyethylene, rubber hydrochloride, polystyrene and plasticized nitrocellulose and gum dammar, in adherent engagement with each of the anchor coatings, said closure having a flat central por-

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tion disposed over the end opening of the receptacle and with the cement coating thereon in adherent engagement with said end wall and having a skirt extending downwardly from said central portion and disposed along the outer side wall portions of the container surrounding said end opening and with the cement coating thereon in adherent engagement with said side wall portions, said skirt having along the lower margin thereof a multiplicity of crimps in overlapping relation and with the cement coating thereon in adherent engagement with the cement coating on adjacent portions of said skirt, said anchor coatings being in heat set condition and maintaining the shape of the closure and enhancing the rigidity thereof, and said cement coating having greater adherence to the anchor coating than to said receptacle.

2. A closure as defined in claim 1 having a plurality of layers of said coated sheet material in adherent engagement.

3. A closure as defined in claim 1 having a plurality of layers of said coated sheet material in adherent engagement with a reinforcing disc interposed between said layers above said open end.

4. A closure as defined in claim 1 having a plurality of layers of coated sheet material in adherent engagement with a reinforcing disc interposed between said layers above said open end, the outer of said layers of sheet material being transparent.

5. The method of forming a closure for a glass receptacle having side wall portions surrounding an end opening in the receptacle and an end wall portion at the extremities of said side walls from cellulosic sheet material having on each face thereof a thermosetting anchor coating of a material from the group consisting of phenol aldehyde and urea aldehyde covering the faces thereof and a normally dry heat softenable plastic cement coating of a material from the group consisting of plasticized nitrocellulose, vinyl acetate and vinyl chloride copolymer, polyvinyl chloride, polyethylene, rubber hydrochloride, polystyrene and plasticized nitrocellulose and gum dammar, in adherent engagement with the anchor coating, which comprises pressing said sheet material

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with a flat central portion disposed over the open end of the receptacle, forming a skirt with a plurality of crimps around the side margins of the receptacle surrounding the open end, sealing with heat and pressure the cement coating on one face thereof in adherent gas and liquid tight engagement with the end wall portion and the outer side wall portions of the receptacle and simultaneously sealing the cement coatings on the crimps in engagement with the portions of the skirt therebetween, and simultaneously setting the anchor coatings to maintain the shape of the closure and increasing the rigidity of the closure.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
78,474	Norton	June 2, 1868
656,548	Hughes	Aug. 21, 1900
827,667	Reed	July 31, 1906
1,094,639	Brown	Apr. 28, 1914
1,269,773	Baker	June 18, 1918
1,351,438	Pease et al.	Aug. 31, 1920
1,353,398	Ingram et al.	Sept. 21, 1920
1,508,261	Tooke et al.	Sept. 9, 1924
1,652,595	Weeks et al.	Dec. 13, 1927
1,685,744	Haas	Sept. 25, 1928
1,693,455	Meldrum	Nov. 27, 1928
1,792,593	Lippold	Feb. 17, 1931
1,905,356	West	Apr. 25, 1933
2,077,992	Eisen	Apr. 20, 1937
2,131,438	Jensen	Sept. 27, 1938
2,133,861	Huntley	Oct. 18, 1938
2,144,592	Gehman	Jan. 17, 1939
2,159,007	Charch et al.	May 23, 1939
2,176,057	Burkardt	Oct. 17, 1939
2,188,946	Gutmann	Feb. 6, 1940
2,326,722	Burkardt	Aug. 10, 1943

FOREIGN PATENTS

Number	Country	Date
3,344	Austria	Feb. 11, 1901
419,684	Great Britain	Nov. 16, 1934