United States Patent [19]

Arfert

[11] **3,752,387**

[45] **Aug. 14, 1973**

[54] **SEALED CONTAINER**

[75] Inventor: **Horst F. W. Arfert,** Richmond, Va.

[73] Assignee: **Reynolds Metals Company,** Richmond, Va.

[22] Filed: **July 14, 1972**

[21] Appl. No.: **272,059**

Related U.S. Application Data

[60] Division of Ser. No. 49,492, June 24, 1970, which is a continuation-in-part of Ser. No. 854,108, Aug. 29, 1969, abandoned.

[52] **U.S. Cl.** ..... **229/43,** 229/3.5 MF **53 329,**

[51] **Int. Cl.** **B65d 5/64,** B65d 43/00

[58] **Field of Search** ..... 229/43, 3.5 MF; 99/171 TC; 18/19 BE; 53/22, 39, 42

[56] **References Cited**

UNITED STATES PATENTS

3,498,525	3/1970	Zinkgraf	229/43
3,070,446	12/1962	Seiferth et al.	99/171 TC
1,904,920	4/1933	Hothersall	18/19 BE UX
2,875,563	3/1959	Moore	53/39
2,916,861	12/1959	Lehmann	53/42
2,975,931	3/1961	Harrison	220/24
3,060,652	10/1962	Eckman	53/22
3,160,999	12/1964	Lee	53/39
3,348,358	10/1967	Sternay	53/42

FOREIGN PATENTS OR APPLICATIONS

1,131,941	6/1963	France	
980,020	1/1965	Great Britain	229/3.5 MF
1,003,169	9/1965	Great Britain	
1,072,185	6/1967	Great Britain	
1,190,381	5/1970	Great Britain	
1,244,320	8/1971	Great Britain	

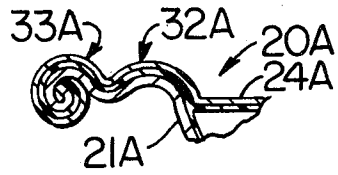
Primary Examiner—Davis T. Moorhead

Attorney—Glenn, Palmer, Lyne, Gibbs & Thompson

[57] **ABSTRACT**

A closure having a peripheral flange portion provided with an annular bottom surface is sealed by the application of heat and pressure to a dish-like container having a peripheral flange portion provided with a cooperating annular top surface so as to define a high quality bonded lamination comprised of the flange portions. The outer portion of the lamination is then curled to form a high strength annular bead which defines the peripheral outline of the side wall of a sealed container.

8 Claims, 23 Drawing Figures



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8 Sheets-Sheet 1

FIG-1

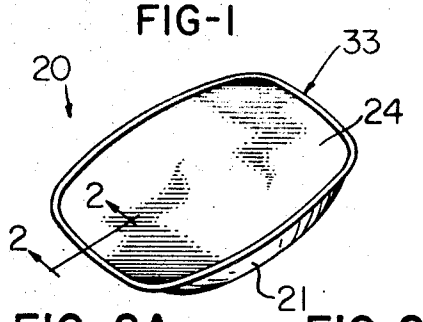

FIG-2

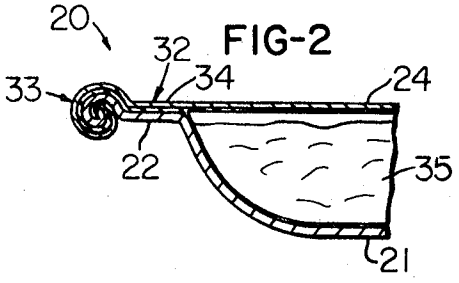

FIG-2A

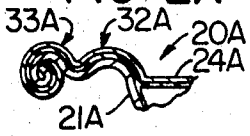

FIG-2B

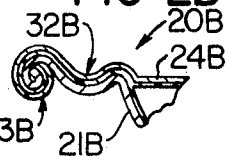

FIG-3

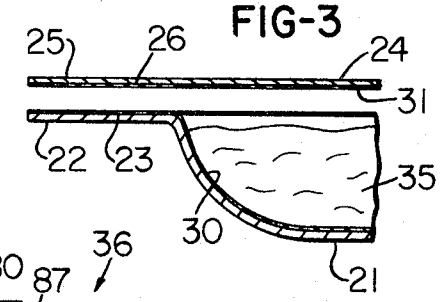

FIG-2C

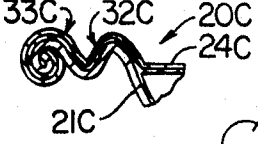

FIG-4

FIG-5

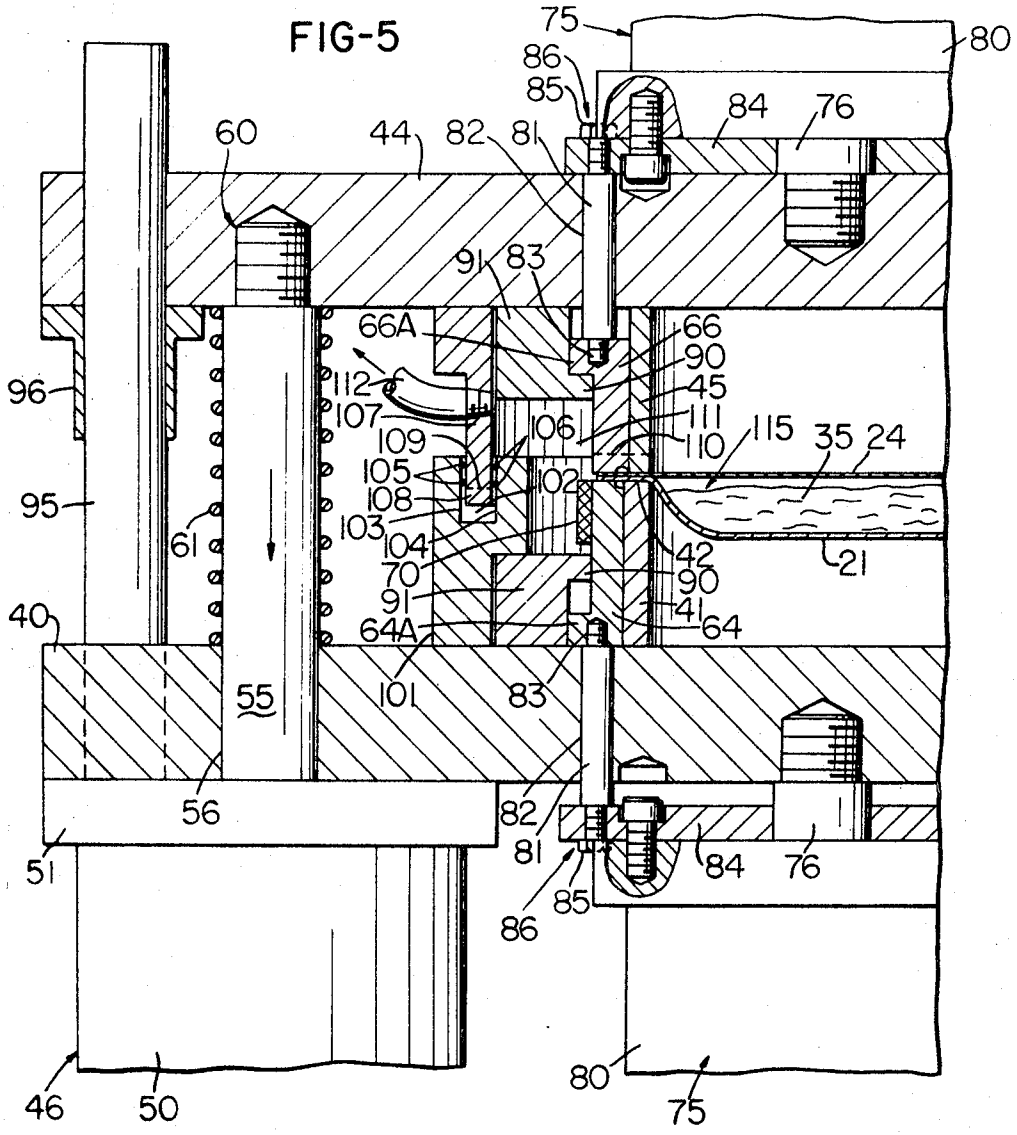
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FIG-6

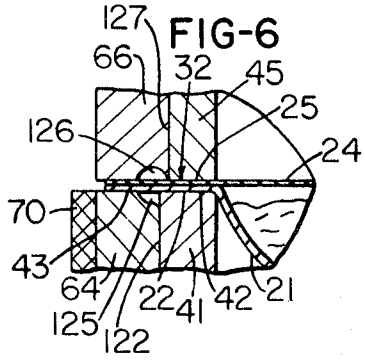
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FIG-7

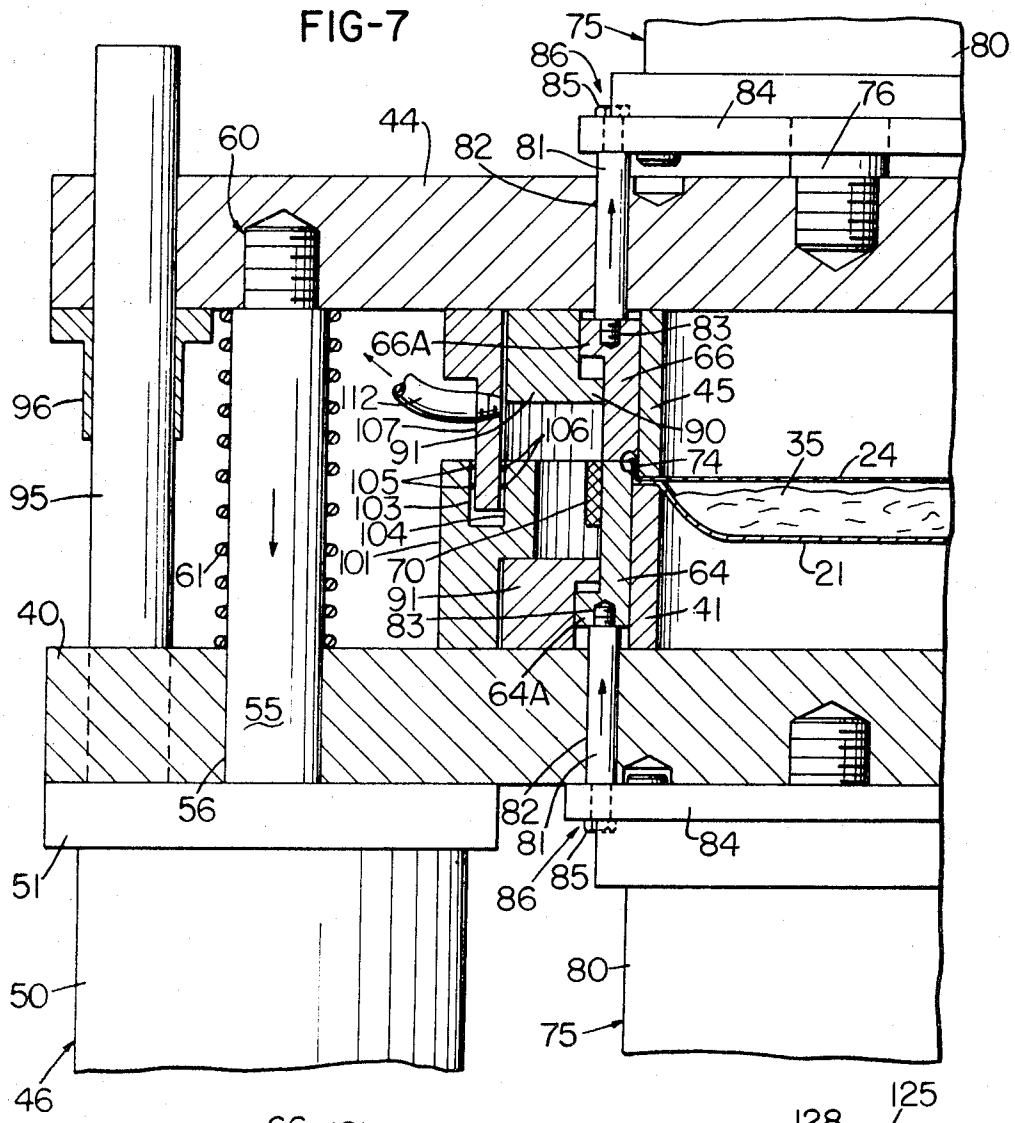

FIG-8

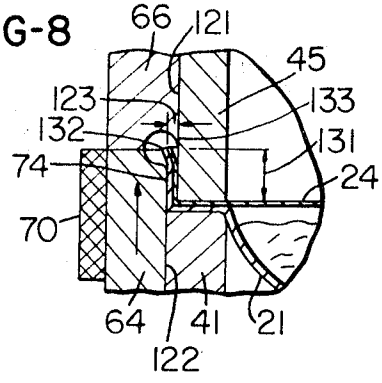

FIG-8A

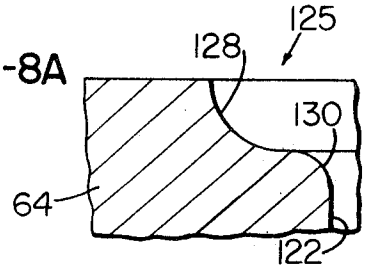

FIG-9

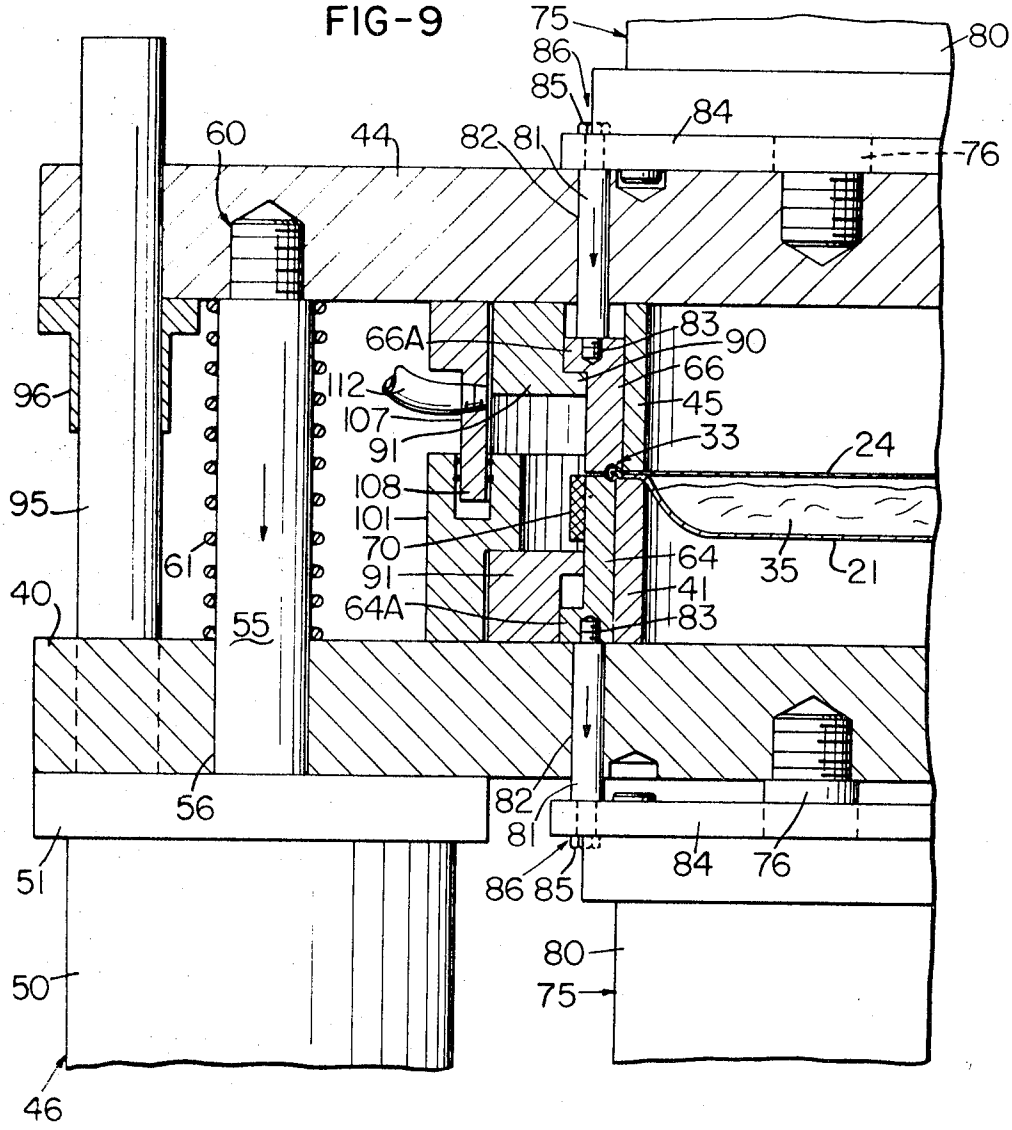
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FIG-10

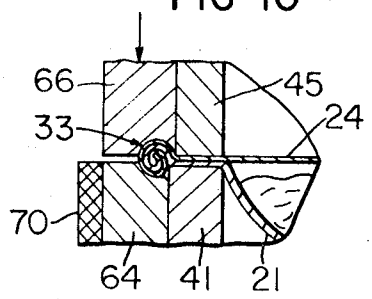
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FIG-11

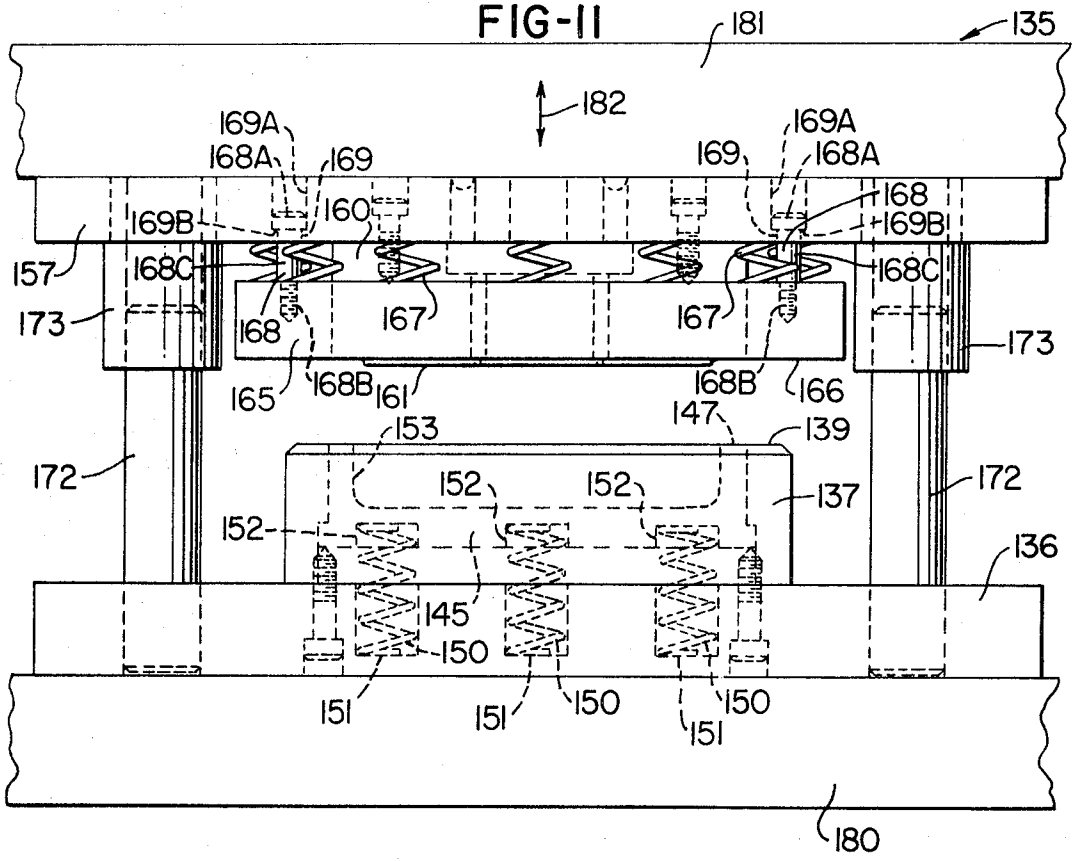
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FIG-12

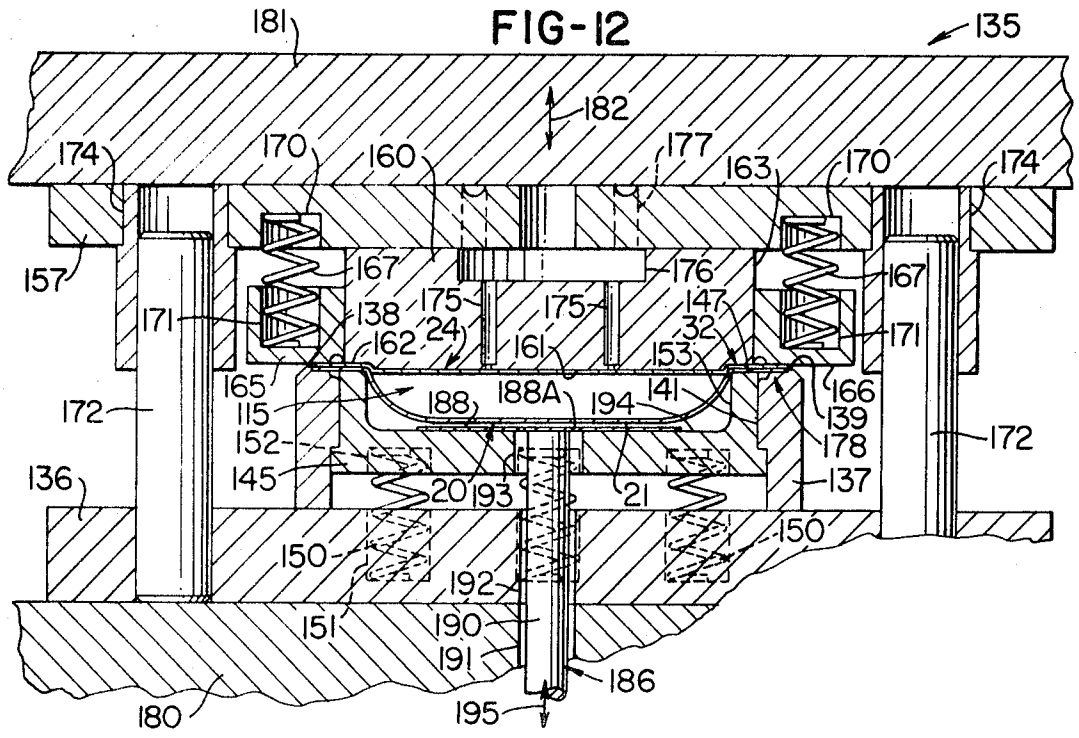
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FIG-13

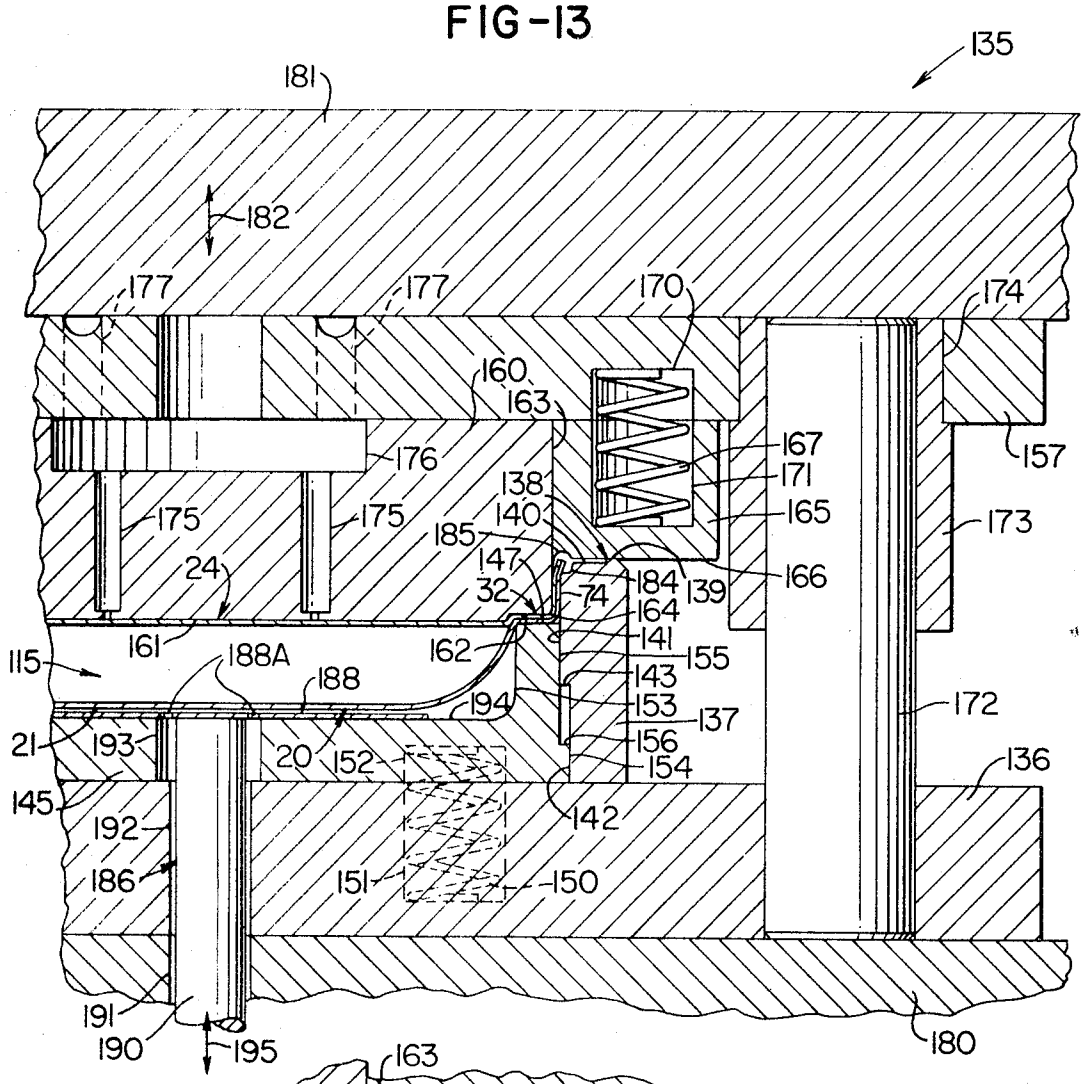
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FIG-14

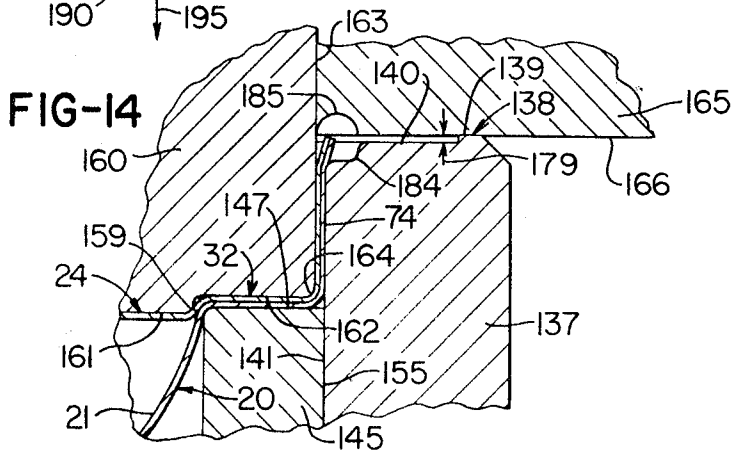
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FIG-15

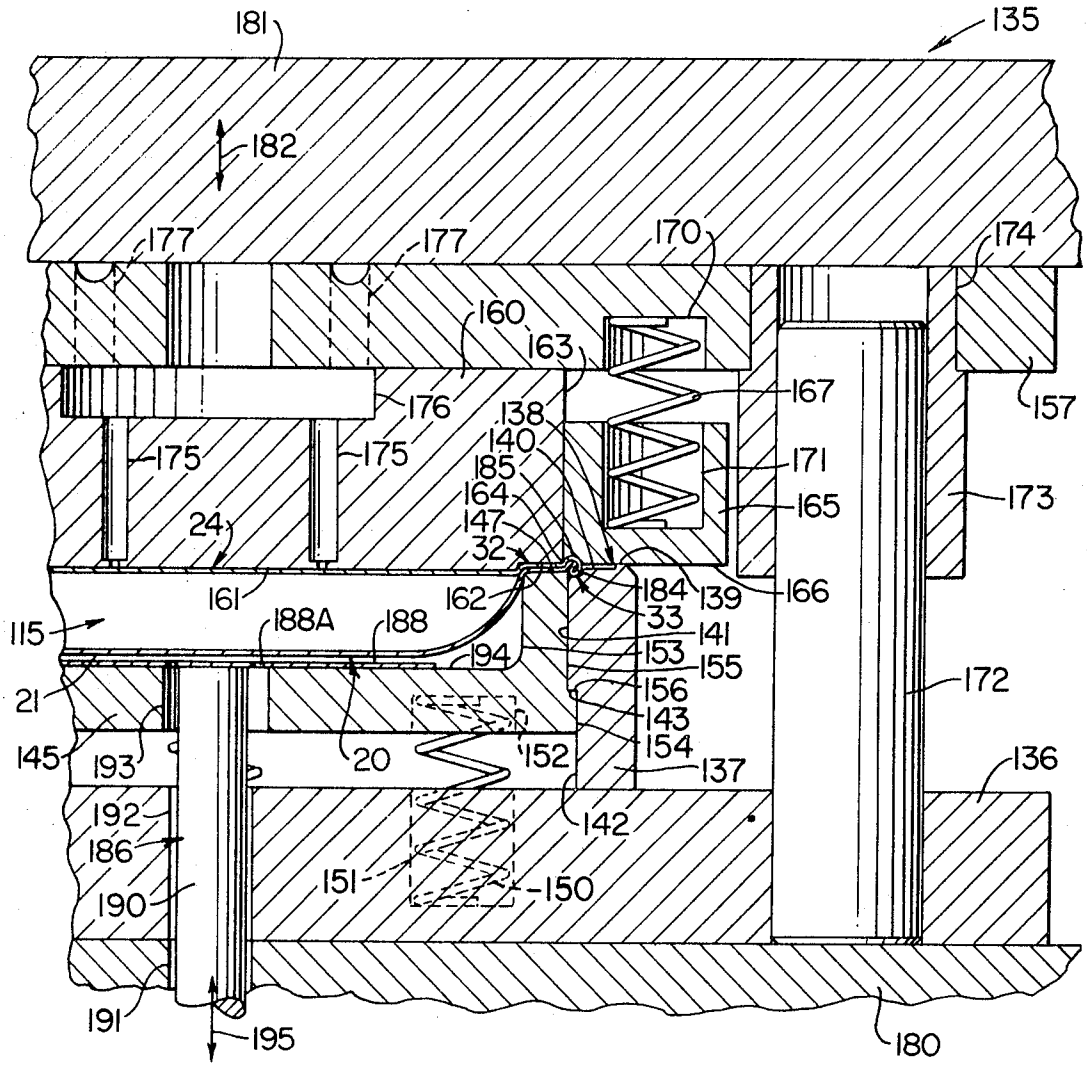
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FIG-16

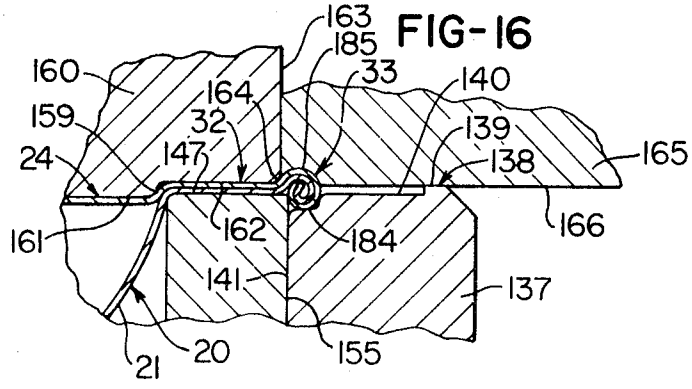
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FIG-17

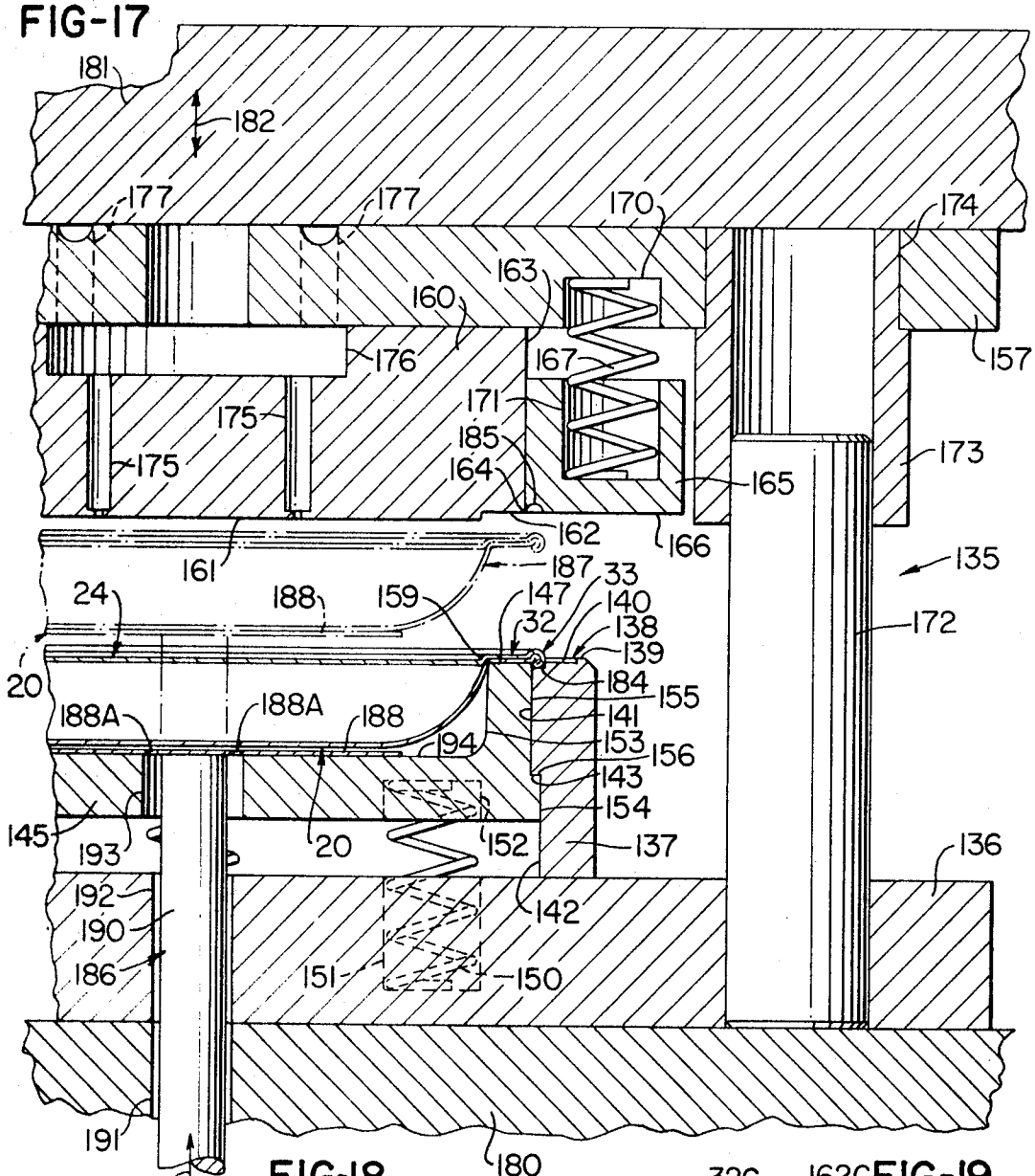


FIG-18

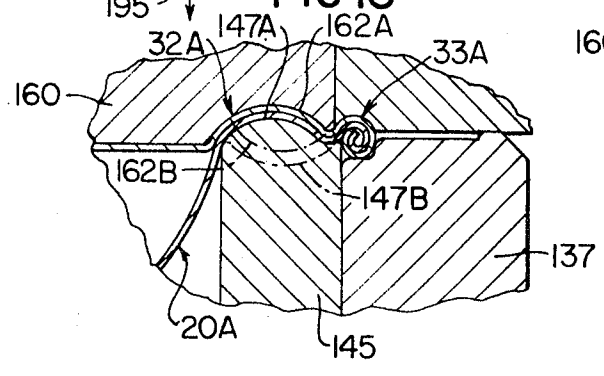
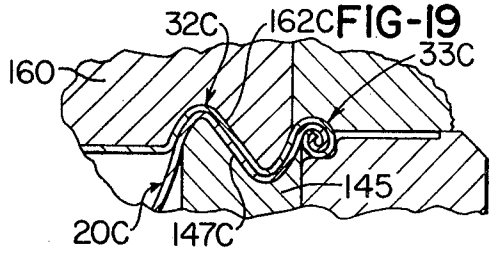


FIG-19



SEALED CONTAINER

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a divisional of applicant's copending U.S. Pat. application Ser. No. 49,492, filed June 24, 1970 which is in turn a continuation-in-part of applicant's now abandoned U.S. Pat. application Ser. No. 854,108, filed Aug. 29, 1969.

BACKGROUND OF THE INVENTION

In packing food products in disposable containers, for example, it is important that the container in which each food product is packaged be sealed in a high strength manner to minimize the likelihood of air leakage into the container which may cause spoilage of the food product. In addition, the container should have sufficient structural strength to assure it will not be easily damaged.

Many apparatus and methods have been proposed heretofore for making and sealing disposable food containers; however, many of these previously proposed apparatus and methods rely entirely on a mechanical swaging action, or the like, to provide a seal between a container closure and an associated container and such mechanical swaging has only proven satisfactory for comparatively expensive containers which have comparatively thick walls. Other apparatus and methods use heat sealing techniques to fasten a closure in position and the heat sealing is generally achieved after the associated closure has been mechanically attached in position which does not assure the provision of an optimum seal between the container and its closure and it is very undesirable to provide a seal in this manner because it tends to also heat the packaged food product which may be detrimental thereto.

SUMMARY

This invention provides an improved sealed container and apparatus for and method of making same wherein the container has a closure which is sealed in position to a dish-like member in a high strength manner so as to bond flange portions of the closure and dish-like member together under heat and pressure to define a high quality bonded lamination. The outer portion of such lamination is curled to form a high strength annular bead which defines the peripheral outline of the side wall of the sealed container with the inner portion of the lamination serving to hold the annular bead in spaced relation from such side wall as a protective shield therefor and said inner portion may be arranged substantially in one plane, or may have an arcuate or undulating configuration as viewed in cross section.

Other details, uses, and advantages of this invention will become apparent as the following description of the exemplary embodiments thereof presented in the accompanying drawings proceeds.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings show a present exemplary embodiment of this invention, in which

FIG. 1 is a perspective view of an exemplary sealed container of this invention comprised of a dish-like member having a substantially flat sheet-like closure bonded in position thereon to define a lamination or flange means;

FIG. 2 is a fragmentary cross-sectional view of the exemplary embodiment of the container of FIG. 1 taken essentially on the line 2—2 of FIG. 1 and showing, in an exaggerated manner, the heat-sealable material provided on the inside surfaces of the dish-like member and closure.

FIGS. 2A, 2B, and 2C are fragmentary cross-sectional views similar to FIG. 2 illustrating three additional exemplary embodiments of the container of this invention wherein the container of each embodiment is substantially identical to the container of FIG. 1 with the exception of the cross-sectional configuration of the inner portion of its bonded lamination and a recess in its top closure;

FIG. 3 is a fragmentary cross-sectional view similar to FIG. 2 and prior to sealing the sheet-like closure in position and forming an annular bead in the outer edge portion of such lamination;

FIG. 4 is a cross-sectional view with parts broken away illustrating one exemplary embodiment of the apparatus of this invention which may be used to define the sealed container of FIG. 1;

FIG. 5 is an enlarged view with parts in cross section, parts in elevation, and parts broken away illustrating the apparatus of FIG. 4 with the closure being urged tightly against the peripheral flange of the dish-like container;

FIG. 6 is an enlarged fragmentary cross-sectional view particularly illustrating a multiple thickness annular portion defined by a peripheral flange portion of the dish-like container held aginst a cooperating flange portion of the closures and adjoining portions of the apparatus;

FIG. 7 is an enlarged view similar to FIG. 5 illustrating the action of the die comprising such apparatus moved so as to fold the multiple thickness annular portion shown in FIGS. 5 and 6 to define a substantially tubular heat laminated section which is subsequently curled to define an annular bead;

FIG. 8 is a view similar to FIG. 6 and illustrating the tubular section and adjoining portions of the apparatus;

FIG. 8A is a greatly enlarged fragmentary cross-sectional view illustrating surface portions defining an annular cutout in the lower forming die;

FIG. 9 is a view similar to FIG. 5 and illustrating the dies and container after forming the outer portion of the tubular section to define an annular bead having a roughly circular cross-sectional configuration;

FIG. 10 is a view similar to FIG. 6 particularly illustrating the annular bead and adjoining portions of the apparatus;

FIG. 11 is a fragmentary view in elevation illustrating another exemplary embodiment of the apparatus of this invention which may be used to provide a peripheral bead in a dish-like container and sealed closure to define the container of FIG. 2;

FIG. 12 is a view similar to FIG. 11 with parts in cross section, parts in elevation, and parts broken away, illustrating cooperating dies and rings urged together to sandwich peripheral flange means of a dish-like container therebetween at the beginning of an operating cycle used to form an annular bead in the outer portion of such flange means;

FIG. 13 is an enlarged fragmentary view illustrating the action of the apparatus in folding the flange means of the dish-like container to define a substantially tubu-

lar section which is subsequently curled to define an annular bead;

FIG. 14 is a greatly enlarged fragmentary cross-sectional view illustrating the tubular section and adjoining portions of the apparatus;

FIG. 15 is a view similar to FIG. 13 and illustrating the apparatus after forming the outer portion of the tubular section to define an annular bead therein;

FIG. 16 is a view similar to FIG. 14 particularly illustrating the formed annular bead and adjoining portions of the apparatus;

FIG. 17 is a view similar to FIG. 15 and particularly illustrating the operation of a device used to lift the dish-like container away from the supporting ring and its associated lower die;

FIG. 18 is a view similar to FIG. 16 illustrating by solid lines a modification of the apparatus of FIGS. 11–16 which may be used to define the container of FIG. 2A and illustrating by dotted lines a modification of such apparatus which may be used to define the container of FIG. 2B; and

FIG. 19 is a view similar to FIG. 18 and particularly illustrating a modification of the apparatus which may be used to define the container illustrated in FIG. 2C of the drawings.

DESCRIPTION OF ILLUSTRATED EMBODIMENTS

Reference is now made to FIGS. 1–3 of the drawings which illustrate one exemplary embodiment of a sealed container of this invention which is designated generally by the reference numeral **20**. The container **20** comprises 1 dish-like container portion or member **21** having a peripheral flange portion **22** provided with a planar top annular surface **23** and a closure **24** having a peripheral flange portion **25** provided with a cooperating planar bottom annular surface **26**. The dish-like member **21** may be made of a suitable material such as a metallic foil containing aluminum and has a coating or layer **30** of heat-sealable material defining its inside surface of the closure **24** comprises a sheet-like closure which may also be made of metallic foil and has a coating or layer **31** of a heat-sealable material defining its inside surface.

The layers **30** and **31** of the heat-sealable material extend over planar surface portions or surfaces **23** and **26** and define what amounts to adhesive means which serve to bond such surfaces together in a high strength manner and provide a high quality bonded lamination **32** comprised of the associated flange portions **22** and **25**. The container **20** also has an annular bead **33** formed in the peripheral outer portion of the lamination **32** and with the inner portion **34** of such lamination lying substantially in one plane.

The inner portion **34** of the lamination **32** serves to hold the annular bead **33** in spaced relation from the main portion or substantially vertically arranged peripheral side wall of the dish-like member **21** and thereby effectively uses the annular bead **33** as a protective shield for such main portion. It will also be appreciated that the bead **33** has a substantially circular cross-sectional peripheral outline and inasmuch as the container **20** has a roughly oval peripheral configuration the bead **33** has a substantially toroidal configuration which has high hoop strength and is capable of withstanding comparatively high external loads applied against the bead **33** to provide maximum protection for the container **20** even under conditions where the container is made of comparatively thin materials such as metal foil, laminated paper, and the like.

The flange portion **22** and **25** of members **21** and **24**, respectively, are heat laminated together utilizing those portions of the heat-sealable layers **30** and **31** provided on their planar surfaces as adhesive means by the application of heat and pressure to thereby provide a high quality seal about the entire outer periphery of the sealed container **20**. The annular bead **33** is defined in container **20** after sealing the closure **24** in position whereby the product **35** contained within container **20** is assured of being maintained in a sealed condition and the subsequent provision of the annular bead **33** serves to provide added structural integrity for the container **20** without disrupting the character of the seal defined between closure **24** and the dish-like member **21**.

The container **20** is preferably formed utilizing the apparatus and method of this invention and an exemplary apparatus and method is presented in FIG. **4** of the drawings and designated generally by the reference numeral **36**. The apparatus **36** comprises a fixed support in the form of a plate **40** which has a container supporting member or ring **41** carried by support **40** and preferably fixed in position thereon. The ring **41** has a planar top annular surface **42**, see FIG. **5**, which is adapted to support the top peripheral flange **22** of container **20** with a terminal edge portion **43** of such flange extending beyond the peripheral edge of the annular surface **42**. The apparatus **36** also has a movable support which is in the form of a movable support plate **44** and the plate **44** has a clamping ring **45** suitably fixed thereto. The clamping ring **45** is particularly adapted to clamp both the peripheral flange **25** of closure **24** and the peripheral flange **22** of member **21** together against the top surface **42** of ring **41**.

The movable plate **44** is moved toward and away from the fixed plate **40** by an actuating device comprised of a pair of direct acting fluid cylinders **46** and each cylinder **46** has an outer housing **50** which terminates in a mounting flange **51** which has a plurality of openings **52** therein which are adapted to receive a threaded bolt **53** therethrough and each threaded bolt is received in a cooperating threaded opening provided in the fixed plate **40** to thereby support each housing **50** and cylinder **46** in a fixed manner against the lower surface of plate **40**. Each fluid cylinder **46** has a piston **54** and an axially slidable piston rod **55** fixed to such piston and extending outwardly in sealed relation through the flange portion **51** and through an opening **56** in the fixed plate **40** with the terminal outer end of each rod **55** being threadedly connected in the movable support plate **44** as indicated at **60**. Each cylinder **46** has a compression spring **61** acting between the bottom surface of the movable plate **44** and the top surface of the fixed plate **40** and the springs **61** tend to urge plate **44** away from plate **40**.

Each cylinder **46** is provided with a suitable fluid, such as air, under regulated pressure from a suitable source and upon supplying air through a supply conduit **62** in each housing **50** the associated piston rod **55** is urged outwardly to move the movable plate **44** away from the fixed plate **40**. The movable plate **44** and its associated components are moved toward the fixed plate **40** by supplying air under pressure through supply conduits **63** extending through housings **50** of cylinders **46**.

The apparatus 36 has die means shown as a pair of cooperating dies each carried by an associated support or plate and each die is movable relative to its associated plate. One of the dies shown in the drawings as a lower die 64 is supported around the container supporting member or ring 41 and is axially movable relative to ring 41 and essentially along a central vertical axis 65 through the apparatus 36. The other die 66 of the previously mentioned pair of dies is supported around clamping ring 45 and is also axially movable relative thereto.

The lower die 64 in this example of the invention has heating means shown as a substantially annular electrical heating device 70 fixed to the outer surface of its top portion, as viewed in FIG. 4. The heating device 70 serves to heat the die 64 and adjoining ring 41 to define the previously mentioned bonded lamination 32 and in a manner to be described in more detail subsequently.

The apparatus 36 may be provided with suitable automatic means to place each closure 24 in position over an associated dish-like container or member 21 in an aligned manner or such closure may be placed in position manually. Once a particular closure is placed in position the cylinders 46 are energized through a suitable control system to move the clamping ring 45 and die 66 toward ring 41 and die 64 to define the multiple thickness annular portion or bonded lamination 32 essentially as illustrated in FIGS. 5 and 6 of the drawings.

The rings 41 and 45 and dies 64 and 65 are urged together in a manner as illustrated in FIG. 6 and the heating device 70 serves to heat the outer portions of the die 64 and ring 41 as well as the flange portions 22 and 25 of dish-like member 21 and closure 24, causing their respective heat-sealable layers 30 and 31, seen in FIG. 3, adjoining annular surfaces 23 and 26 to be heat sealed together. The heat sealing is thus achieved under conditions of both heat and pressure to define the bonded lamination 32 which will also be referred to as a multiple thickness annular portion. The dies 64 and 66 have suitable actuating means and are operated in a manner now to be described to define a substantially tubular heat laminated section 74 which is then formed to define the annular bead 33 shown in FIGS. 9 and 10.

As seen particularly in FIG. 4, each die 64 and 66 has an actuator shown in each instance as an air cylinder 75. Each cylinder 75 is a reverse acting cylinder which has a piston rod 76 provided with one end fixed to an associated support plate either 40 or 44 and its opposite end fixed to a piston 77. Each air cylinder 75 has a tubular outer housing 80 attached to an associated die, either 64 or 66, by a plurality of pins 81 which are axially slidable through associated openings 82 in an associated plate either 40 or 44. Each pin has one end threadedly connected to its associated die as indicated at 83 and an opposite threaded end attached to a flange 84 fixed to the base of its associated tubular housing 80 by a plurality of nuts 85 as indicated at 86. Thus, each cylinder 75 in essence has its piston rod 76 and piston 77 fixed with respect to an associated support plate while the housing portion 80, together with pins 81 and its attached die (either 64 or 66) move with respect to the associated support plate and rod 76.

Each air cylinder 75 is supplied with air under regulated pressure from a suitable pressure source to either one or the other of a pair of conduits 87 or 88 operatively connected to housing 80 on opposite sides of piston 77. As air is supplied to each outermost conduit 87, the housing 80, its pins 81, and associated die fixed to such pins are moved outwardly relative to the associated support plate until the bottom surface of the associated die engages the inside surface of the associated support plate. Similarly, when it is desired to move a particular die inwardly or away from the inside surface of its associated support plate, air under regulated pressure is supplied through conduit 88 to thereby urge the associated die inwardly or toward the center of the apparatus 36 and in essence toward the dish-like member 21 and its closure 24.

This arrangement of reverse acting air cylinders enables the utilization of commerically available components while providing the application of forces on a broad stable base defined by the outside periphery of the tubular housing 80 and such stable base may be further increased in peripheral outline by using flange 84 and placing the pins 81 in the flange 84 in a predetermined pattern corresponding to the peripheral configuration of the associated die, whether it be lower die 64 or upper die 66.

The dies 64 and 66 have annular projections 64A and 66A respectively defining the base portion thereof and each projection 64A and 66A is adapted to engage an associated inwardly extending annular flange 90 comprising an integral part of an associated die holder 91. Each die holder 91 with its annular flange 90 is fixed to an associated support plate by a plurality of threaded bolts 92 which extend through associated openings in the particular support plate and through cooperating threaded openings 93 in the die holder 91 and each annular flange 90 serves to limit movement of an associated die relative to its support plate.

The apparatus 36 also has suitable guide posts 95 which have their lower ends suitably fixed in the fixed plate 40 and each guide post 95 has its upper end extending through an associated sleeve bearing 96 fixed to the movable plate 44 and through an associated aligned opening in the plate 44. As the movable plate 44 is moved toward and away from the fixed plate 40, the guide posts 95 provide the guiding function in a manner well known in the art.

The apparatus 36 has a vacuum ring 101 suitably fixed to the fixed plate 40 outwardly of the die 64 and die holder 91, see FIG. 5. The vacuum ring 101 has an annular groove 102 defined therein and the groove 102 has a substantially rectangular peripheral outline comprised of a pair of vertical surfaces 103 and 104. The ring 101 has a pair of seal-supporting grooves extending inwardly therein from each of its surfaces 103 and 104 and a pair of sealing rings 105 and 106 respectively are suitably supported in such grooves. The apparatus 36 also has a vacuum ring 107 suitably fixed to the movable plate 44 and the ring 107 has a lower end portion 108 which is adapted to be received within the groove 102.

The vacuum rings 101 and 107 have a combined height which is greater than the combined height of the rings 41 and 45 such that upon moving the movable plate 44 toward the plate 40 to a position where the terminal lower end of end portion 108 is moved to the dotted line position indicated at 109 in FIG. 5, the terminal lower ends of the clamping ring 45 and die 66 are at the dotted line position illustrated at 110 whereupon the vacuum rings 101 and 107 enable the forming of a sealed chamber 111 prior to clamping the closure 24 in position against the dish-like member 21.

As seen in FIG. 4, the apparatus 36 also has means for providing a vacuum in the chamber defined by the rings 101 and 107 and such means comprises a conduit 112 which extends through ring 107 and is operatively connected to a suitable vacuum pump 113. Once the movable plate 44 is positioned so that vacuum ring 107 is in the dotted line position 109 and the clamping ring 45 is in position 110, see FIG. 5, the entire chamber 111 surrounding the dish-like container and the space indicated at 115 between the sheet-like closure 24 and the dish-like member 21 will be evacuated upon starting the vacuum pump 113. The apparatus 36 then operates to seal the closure 24 in position in a manner to be subsequently described in more detail to define the annular bead 33 in the outer periphery of the sealed container 20.

The apparatus 36 may also be provided with means for supplying an inert fluid such as an inert gas into the evacuated chamber 111 and into the space 115 of the container 20 prior to sealing the closure 24 in position and such means may comprise a conduit 116 which may be supplied with an inert gas such as nitrogen from any suitable source such as a supply tank 120, see FIG. 4.

As seen particularly in FIG. 8 of the drawings, the clamping ring 45 has an outer surface 121 which defines the inside surface of the tubular section 74 and the die 64 has an inner surface 122 corresponding in configuration to and being spaced outwardly from the outer surface 121 by a controlled distance indicated at 123 determined by the thickness of the multiple thickness annular portion 32 and hence the thickness of the tubular section 74. The die 64 is moved upwardly after defining the multple thickness annular portion 32 to define the tubular section 74 and the die 66 is then moved downwardly to define the annular bead 33.

As seen particularly in FIG. 6 of the drawings, the die 64 has an annular cutout 125 adjacent the outer edge of its inside surface 122 and the die 66 has an annular cutout 126 adjoining the outer portion of its inside surface 127. The annular cutouts 125 and 126 cooperate to define a substantially toroidal inside surface which defines bead 33 upon moving the dies in a manner to be described subsequently.

The annular cutout 125 is defined by an outwardly concave surface portion 128 and an outwardly convex surface portion 130 adjoining the inner edge of the outwardly concave surface portion 128 at one end and the outer edge of the inside surface 122 of die 64 at its opposite end to thereby define a roughly S-shaped surface on the outer edge portion of the die 64, see FIG. 8A. The die 64 is adapted to be moved by its actuator or cylinder 75 by a controlled fixed distance indicated at 131 to thereby define a terminal end portion 132 in the tubular section 74 which tends to flare outwardly into cutout 125 and is more easily engaged by the inner edge 133 of the die 66 to thereby enable easier formation of the bead 33.

Having described the various component parts of apparatus 36 in detail, a brief presentation will now be made to highlight the simplicity with which the apparatus and method of this invention enable the sealing of closure on an associated dish-like container in a high strength manner. In particular, it will be seen that the dish-like member 21 is supported in position on the supporting ring 41 and a sheet-like closure 24 may be placed in position thereon or suitably held as by vacuum or the like against the lower surface of the clamping ring 45. The cylinders 46 are then energized to move the vacuum rings 101 and 107 in aligned and sealed end-to-end relation to define vacuum chamber 111 while keeping the clamping ring 45 and die 66 spaced away from the top of the dish-like member 21. The vacuum pump 113 evacuates the air from the vacuum chamber 111 thus defined and from the area 115 between closure 24 and a product 35 contained in dish-like member 21. If desired at this point an inert gas such as nitrogen may be introduced into the chamber 111 and suitably introduced into the container 20 by holding the closure 24 spaced from member 21 for a short time interval.

The cylinders 46 are then actuated until the clamping ring 45 and die 66 engage and sandwich the peripheral flange portion 25 of the closure 24 against flange portion 22 of dish-like member 21 which is supported by ring 41 and die 64, see FIGS. 4 and 5, and air at a pressure of roughly 100 psig is supplied through conduit 88 of the upper cylinder 75 to hold the die 64 with its lower surface substantially coplanar with the lower surface of the clamping ring. The heating device 70 is in operation so that a heat seal is provided utilizing both heat and pressure which efficiently seals the closure 24 to the dish-like member 21 in a high strength and optimum manner to define the multiple thickness annular portion 32 illustrated in FIG. 6.

With the cylinders 46 still actuated, air under pressure in upper cylinder 75 is suitably switched from conduit 88 to conduit 87 and decreased to a level of about 20 psig. Simultaneously, air at a pressure of roughly 100 psig is supplied through conduit 88 of the lower air cylinder 75 causing movements of the dies 66 and 64 from their positions shown in FIGS. 5 and 6 to positions illustrated in FIGS. 7 and 8 to thereby form the heat laminated tubular section 74.

Once the section 74 has been defined the air under pressure supplied to the lower cylinder 75 is suitably switched from its conduit 87 to its conduit 88 and reduced from 100 psig to a pressure generally of the order of 20 psig while simultaneously the air under pressure in the upper cylinder 75 is changed from its conduit 87 to its conduit 88 and increased from roughly 20 psig to 100 psig. This switching action causes movement of the dies 64 and 66 from their positions shown in FIGS. 7 and 8 to new positions illustrated in FIGS. 9 and 10 whereby the substantially toroidal inside surface defined by cooperating cutouts 125 and 126 forms the annular bead 33 which is spaced from the vertical side wall of the container 20 by the annular planar portion 34 of lamination 32 and serves as a shield for such side wall.

The curling action illustrated in FIGS. 9 and 10 of the drawings which defines the peripheral bead 33 is such that a substantial curling effect takes place. However, it will be appreciated that the curling may be precisely controlled simply by controlling the length of the tubular section 74 and the configuration of the cutouts 125 and 126 in a manner well known in the art.

In this example of the invention the heating device 70 is shown as an electrical heating device and provided adjoining the upper portion of the die 64. However, it will be appreciated that any suitable means may be provided for heating the heat-sealable material provided on flange portions 22 and 25 of members 21 and 24 re-

spectively. In addition, the heating device **70** may be carried by the die **66**, if desired.

The various cylinders **46** and **75** illustrated in this example of the invention are shown as air cylinders and the air pressures previously mentioned as being used with certain cylinders were only given for explanatory purposes. It will also be appreciated that any suitable actuator may be provided whether it be a fluid operated actuator, an electric motor driven actuator, or the like. In addition, the closure **24** may be placed in position using any suitable automatic or manual means, as desired.

In this example of the invention suitable controls and associated control circuitry have not been illustrated and described for moving the various components to provide heat sealing of the closure **24** on the dish-like member **21**. However, it is to be understood that any suitable control means may be provided for sequencing the components such as the cylinders, heating elements, vacuum pump, etc., to provide either semiautomatic or substantially fully automatic sealing of each closure on an associated dish-like member. Further, suitable conveyor means may also be provided to enable automatic loading of dish-like members and closures into the apparatus **36** and unloading of sealed containers **20** therefrom.

In this example of the invention the entire inside surface of the dish-like member **21** and the inside surface of the closure **24** is shown as having a heat-sealable material bonded thereagainst as a layer. However, it will be appreciated that the heat-sealable material may be provided only on one of such inside surfaces or only on one or both of the peripheral flange portions **22** and **25** of the members **21** and **24** respectively, if desired. Further, any suitable heat-sealable material may be used and typical materials which may be used inlude hot melt adhesives, polyvinyl chloride, polypropylene, and polyethylene, for example.

After forming the multiple thickness bonded portion **32** in this exemplary presentation of the invention, the dies **64** and **66** are first moved upwardly, as seen in FIG. **8**, to define the tubular section **74** and then such dies are moved downwardly to define the integral annular bead **33** around the container **20**. However, it will be appreciated that in some applications of this invention it is preferable that the dies **64** and **66** and associated components be suitably modified and such dies operated by being first moved downwardly to define a substantially tubular section, similar to section **74**, which extends beneath the main portion of the multiple thickness bonded portion **32**. The modified dies **64** and **66** are then suitably moved upwardly to define an annular bead which is substantially identical to the bead **33**.

The apparatus **36** has been described above as being used to define the exemplary dish-like container **20** illustrated in FIGS. **1**, **2**, and **3**; however, it will be appreciated that the apparatus **36** may be used to define the dish-like container illustrated in FIGS. **2A**, **2B**, or **2C** by suitably modifying various component portions thereof in a manner now to be described. In particular, it will be appreciated that the ring **41** may have its top annular surface **42** suitably modified to be either upwardly convex, upwardly concave, or undulating while modifying the oppositely arranged bottom surface of the clamping ring **45** in a cooperating manner so as to be either downwardly concave, downwardly convex, or undulating respectively to thereby enable forming of dish-like containers having peripheral flange means as illustrated in FIGS. **2A**, **2B**, and **2C**.

Because the containers of FIGS. **2A**, **2B**, and **2C** are very similar to the container **20** they will be designated by the reference numerals **20A**, **20B**, and **20C**. For ease of presentation and understanding, the various component portions of each container have also been designated by the same reference numerals as in the container **20** followed by the letter designation A, B, or C, corresponding to the particular letter designation of the dish-like container being referred to; and, it is to be understood that the previous detailed description of each component of container **20** is in general fully applicable to each container **20** A–C and thus will not be repeated.

Another exemplary embodiment of the apparatus of this invention is illustrated in FIGS. **11–17** of the drawings and such apparatus is designated generally by the reference numeral **135**.

The apparatus **135** is particularly adapted to form a bead in the peripheral portion of the lamination or flange means **32** of the dish-like container **20**. The apparatus **135** receives the dish-like container after its closure **24** has been sealed in position thereagainst in a similar manner as previously described and forms an annular bead **33** in the peripheral portion of such flange means; however, it will be appreciated that the apparatus **135** may be suitably modified to incorporate the necessary heating means similar to the heating device **70** to enable placing of the dish-like portion or member **21** in position within the apparatus **135** and then sealing the closure member **24** thereagainst. Further, it will be appreciated that suitable means may also be incorporated in the apparatus **135**, if desired, to evacuate the space **115** within the container prior to sealing the closure **24** in position, as well as supplying means for introducing an inert gas such as nitrogen from any suitable source into the container **20** prior to sealing the closure **24** in position.

The apparatus **135** comprises a lower support **136** which carries a container supporting ring **137** which is fixed thereto using any suitable technique and the ring has a stepped top surface indicated generally by the reference numeral **138** and is comprised of an outer portion **139** and an inner portion **140** both of which will be described in more detail subsequently. The top surface **138** is particularly adapted to support the outer portion of the flange means **32** of the dish-like container **20**. The ring **137** also has an inside cylindrical surface **141** defined by a bore therethrough and a cylindrical surface **142** of large diameter which is defined by a counterbore in the lower portion of ring **137** to thereby define a stop in the form of an annular surface **143** extending between the top edge of surface **142** and the bottom edge of surface **141**.

The apparatus **135** has a lower member which will be referred to as a lower die **145** which is carried by the lower support **136** concentrically within ring **137** and die **145** is axially movable within such ring. The die **145** has an annular top surface **147** and means in the form of a plurality of compression springs **150** acting between the lower support **136** and the die **145** yieldingly urging the die **145** so that the top surface **147** is substantially coplanar with the outer portion **139** of the stepped top surface **138** of ring **137**. Each compression spring **150** has a lower end thereof received within a cavity or bore **151** in the lower support **136** and has an

upper end thereof received within a cooperating bore **152** in the lower die **145** and the bore **152** which is arranged in axial alignment with the bore **151** of the lower support **136.**

The lower die has a cavity **153** defined therein which is particularly adapted to receive an unbeaded container comprised of member **21** having a closure **24** sealed thereagainst to enable forming the peripheral bead **33** in the peripheral portion of the flange means **32.** The lower die **145** also has a lower comparatively large diameter cylindrical surface **154** which engages and supports the die **145** for sliding movement along surface **142** of ring **137** and has a smaller diameter cylindrical surface **155** which supports such die for sliding movement along the surface **141.** A surface **156** extends between the top edge of surface **154** and the bottom edge of surface **155** and defines a projection or stop which engages the stop surface **143** to limit the outward movement of the lower die **145** and thereby control the extent that the compression springs **150** may yieldingly urge the lower die **145** upwardly.

The apparatus **135** has an upper support **157** which has an upper die **160** suitably fixed thereto for movement therewith. The upper die **160** has a bottom surface **161** which is surrounded by an adjoining surface which will be referred to as an annular peripheral bottom surface **162** which is arranged above and substantially parallel to the surface **161.** The upper die **160** has a cylindrical outside surface **163** wich adjoins the outer edge surface **162** with a small arcuate surface **164** being provided therebetween. The surfaces **161** and **162** enable a recess **159** to be defined in the closure **24** of container **20** which allows for outward expansion of such closure without damaging the container in the event of a pressure build-up in the container or expansion of its contents by freezing.

The apparatus **135** also has what will be referred to as clamping ring **165** which is supported around the upper die **160** and the ring **165** is axially movable relative to the upper die **160.** The ring **165** has an annular bottom clamping surface **166** and a plurality of compression springs **167** are provided and act between the upper support **157** and the clamping ring **165** to yieldingly urge the ring **165** so that its clamping surface **166** is substantially coplanar with the annular surface **162** of the upper die **160.**

Each compression spring **167** has an upper end received within a cylindrical bore **170** in the upper support **157** and a lower end received within a bore **171** in the clamping ring **165** which is arranged in axial alignment with bore **170.** The clamping ring **165** is provided witha suitable stop means defined by bolts **166** each having a head portion **168A**, a threaded lower portion **168B** threadedly received within the clamping ring **165,** and an intermediate smooth rod-like portion **168C**, see FIG. **11.** Each rod-like portion extends through an opening or bore **169** in the upper support **157** and each bore **169** has a counterbore **169A** which receives a head portion **168A** of an associated screw therethrough with an annular stop surface **169B** being defined between each bore **169** and counterbore **169A.** The compression springs **167** yieldingly urge the ring **165** outwardly until the lower surfaces of the bolt head portions **168A** engage stop surfaces **169B** whereby the clamping surface **166** is initially held substantially coplanar with annular surface **162** and during a part of the beading operation to be subsequently described the springs **167** are overridden and the top surface of ring **165** is urged tightly against the bottom surface of the support **157,** see FIG. **13,** with the bolt heads **168A** moved upwardly within their associated counterbores **169A.** However, it will be appreciated that the stop means or stop for ring **165** may be constructed in a similar manner as the stop for the lower die **145,** if desired.

The apparatus **135** has a plurality of guide posts **172** which have their lower ends suitably fixed to the lower support **136** and have their upper ends slidably received within an associated sleeve bearing **173** which is fixed to the upper support **157** by press fitting, welding, or the like, as shown at **174.** The apparatus **135** normally holds its supports in the open or spaced position illustrated in FIG. **11** so that it can receive a dish-like container which is to be beaded therewithin whereby the upper end portions of the guide posts **172** engage only the lower portions of the sleeve bearings **173.** Upon moving the supports **136** and **157** together in a manner to be subsequently described, the upper ends of the guide posts **172** are received within the sleeve bearings **173** initially as illustrated in FIG. **12** and then as illustrated in FIG. **13** whereby the supports **136** and **157** and their associated components are moved while being held in precise vertical alignment to enable forming of the peripheral bead **33** in the peripheral flange means of the dish-like container.

The upper die **160** has a plurality of vertical passages **175** extending from the lower surface thereof to a central chamber **176** in such die and chamber **176** in turn has suitable passage means **177** interconnecting such chamber to ambient. The passages **175** and **177** with their associated chamber **176** assure that as the upper die **160** is brought into position toward the closure member of the dish-like container there will be no air trapped between such upper die and the upper portion of the container which would tend to prevent proper operation of the apparatus **135.**

The exemplary apparatus **135** has its lower support **136** and its upper support **157** suitably fixed to plates **180** and **181** respectively which may comprise a lower and upper platen respectively of a standard press. Accordingly, any suitable moving means, whether mechanical (such as a standard mechanical device used to provide reciprocating movements), hydraulic, or pneumatic may be utilized to relatively move the plates **180** and **181** and, hence, their respective supports **136** and **157** toward and away from each other.

For simplicity of presentation, a double arrow **182** has been shown on the plate **181** to indicate moving means for moving such plate and its support **157** vertically in either direction with the lower plate **180** and support **136** being held stationary. However, it will be appreciated that the upper plate and its support may be held stationary and only the lower plate and its support relatively moved toward and away therefrom or both upper and lower supports and their associated plates may be moved toward and away from each other.

The container supporting ring **137** has what will be referred to as a first annular cutout **184** adjoining both the outer edge of its inside cylindrical surface **141** and the inner edge of surface **140.** Similarly, the clamping ring **165** has a second annular cutout **185** adjoining both its cylindrical surface **163** and the inner edge of its surface **166.** The cut-outs **184** and **185** cooperate to define a substantially toroidal inside surface which is

used to form the bead 33 in the container 20 in a manner to be subsequently described, see FIG. 14.

Having described the cooperating component portions of the apparatus 135 iin detail, a detailed presentation will now be made of the manner in which the components of apparatus 135 and their associated surfaces cooperate to define the bead 33 in the bonded lamination or flange means 32 to define the completed container 20.

The apparatus 135 is opened to the position illustrated in FIG. 11 and an unbeaded sealed container is moved in position so that its flange means 32 is supported on the outer annular surface portion 139 of the stepped surface 138 of the supporting ring 137 with the inner portions of such flange means being supported on the surface 147. The moving means for the upper plate 181 and support 157 is then actuated to thereby initially relatively move the supports and, hence, the dies and rings toward each other and clamp the flange means 32 therebetween essentially as illustrated in FIG. 12. In this position the outer portion of the flange means 32 is clamped tightly in position between the surface 139 and surface 166, as shown at 178, to assure that once the cooperating dies and rings are moved further together the outer portion will not slip or "flap" in a detrimental manner.

With further movement of the supports 136 and 157 toward each other, the outer portion of the flange means is moved between surfaces 140 and 166 which exert sufficient pressure to prevent wrinkling and yet allow slipping movement. The vertical distance or gap indicated at 179, see FIG. 14, between surfaces 139 and 140 will vary depending upon the particular container being beaded; however, in one application wherein the thickness of the flange means or lamination was 0.012 — 0.015 inch the gap at 179 was 0.010 inch.

The dies and rings cooperate to first define a substantially tubular section which is also designated by the reference numeral 74 as in the previous description in connection with the apparatus 36 and as shown in FIGS. 13 and 14 of the drawings. Upon moving the supports away from each other, the dies and rings cooperate to form the section 74 in the form of the annular bead 33 which has a roughly circular cross-sectional outline as illustrated in FIGS. 15 and 16 of the drawings.

The action of the apparatus 135 is such that once the supports 136 and 137 are moved together in the manner illustrated in FIG. 12, the peripheral annular surface 162 of the upper die 160 is arranged generally opposite the annular top surface 147 of the lower die 145, with the inner portion of the annular clamping surface 166 of clamping ring 165 being arranged generally opposite the stepped surface 138 of the container supporting ring. In this position, it will be seen that the peripheral portion of the flange means 32 is tightly clamped between the surface 139 and the clamping surface 166 so that during subsequent movement of the upper die 160 within the ring 137 the flange means 32 is firmly held during the initial movement used to form the tubular section 74, as previously mentioned.

The ring 137 has its inside surface 141 spaced outwardly from the outside surface 163 of the upper die 160 by a controlled thickness which is determined by the thickness of the flange means 32. Thus, after initially moving the supports 136 and 157 together to clamp the flange means in a forming position in the manner described above, further relative movement of the supports 136 and 157 toward each other causes the upper die to override lower compression springs 150 and causes the container supporting rings 137 to override the compression springs 167 and thereby vertically move the entire filled and sealed dish-like container beneath the stepped surface 138 of the ring 137, see FIG. 14, to define the tubular section 74. In this position the upper end of the tubular section 74 is within the substantially toroidal surface defined by surfaces 184 and 185.

Upon actuation of the moving means so that the plates 180 and 181 and, hence, their associated supports 136 and 157 are relatively moved apart, the now compressed compression 150 operate to move the lower die 145 in a telescoping manner upwardly while the compression springs 167 operate to move clamping ring 165 downwardly causing the outer portion of the tubular portin 74 to engage surfaces 184 and 185 and define the annular bead 33 essentially as illustrated in FIGS. 15 and 16 of the drawings.

The apparatus 135 also has a device designated generally by the reference numeral 186, refer to FIGS. 13 and 17, which is particularly adapted for lifting the now beaded container 20 away from supporting ring 137 to the dotted line position indicated at 187 in FIG. 17. The device 186 comprises a comparatively thin flat plate 188 carried within the cavity 153 in the lower die 145 and plate 188 has a rod 190 suitably attached thereto, such as against the lower surface thereof. The rod 190 extends through aligned openings 191, 192, and 193 in the plate 180, support 136, and lower die 145 respectively and such rod may be actuated by a suitable actuator of known construction to raise the plate 188 and the beaded container 20 once the the beading operation has been completed and then lower such plate back into position against a surface 194 defining the bottom of the die cavity 153. The actuator for rod 190 and action thereof is represented schematically by the double arrow 195.

The rod 190 may be synchronized with the operating movement of the plate 181 so as to automatically raise the beaded container when the beading operation has been completed. Further, the rod 190 preferably raises the beaded container sufficiently above the ring 137, as shown at 187 in FIG. 17, to enable removal of such container by a lateral transfer mechanism essentially in a horizontal direction substantially parallel to the top surface of the plate 188.

The upper die 160 and its associated components have been provided with suitable passage means to prevent air from being trapped between the closure 24 and the upper die 160 during the beading operation. Similarly, the plate 188 may also have suitable openings 188A provided therein communicating with passages 193, 192, and 191 to prevent air from being trapped between the dish-like container and the lower die 145.

The exemplary apparatus 135 has been illustrated and described with its supports 136 and 157 suitably fixed to plates 180 and 181 respectively comprising a standard press. However, it will be appreciated that the plates 180 and 181 may be suitably modified to define supports 136 and 157 without requiring the provision of the separate supports 136 and 157.

As previously indicated, the apparatus 36 may be suitably modified to define contains 20A, 20B, or 20C.

It will also be appreciated that the apparatus **135** may also be suitably modified to define such containers and particular attention is now directed to FIGs. **18** and **19** of the drawings. FIG. **18** illustrates the manner in which the top surface of die **145** and the peripheral surface portion of the upper die **160** may be modified as indicated by solid lines and designated respectively by the reference numerals **147A** and **162A** to enable forming the beaded container **20A** of FIG. **2A** having the inner portion of its flange means **32A** defined in an upwardly convex configuration with the bead **33A** at the terminal end of such flange means. FIG. **18** also illustrates the manner in which the top surface of lower die **145** and the peripheral surface portion of the upper die **160** may also be suitably modified as indicated by dotted lines and designated respectively by the reference numerals **147B** and **162B** to enable forming the beaded container **20B** of FIG. **2B** having the inner portion of its flange means **32B** defined in an upwardly concave configuration with the bead **33B** at the terminal end of such flange means.

As seen in FIG. **19**, the lower die **145** may also have its annular top surface made as an undulating surface **147C** with the annular peripheral surface portion of the upper die **160** made as a cooperating undulating surface **162C** to thereby define a dish-like container having its bonded lamination or flange means **32C** made in the form of an undulating configuration, as viewed in cross-section, with the bead **33C** at the end of such flange means. It should be emphasized that by forming the inner portion of the flange means or bonded lamination, either to an arcuate configuration or to an undulating configuration, the annular bead formed in the outer periphery of its associated dish-like container is held in spaced relation from the side walls of the dish-like container with greater strength and rigidity and thereby provides optimum shield-like protection for such side walls. In addition, the roughly toroidal configuration of the peripheral bead greatly strengthens such bead and assures such bead and its adjoining flange means cannot be deformed radially inwardly against the container.

Certain words and phrases such as "top," "bottom," "inner," "outer," "upwardly," "downwardly," etc., have been used throughout this specification and claims to indicate various positions of certain parts and surfaces as illustrated in the drawings; however, it is to be understood that these parts and surfaces may be suitably arranged in any desired manner. For example, the overall apparatus disclosed herein may be inverted and the unbeaded sealed container may be suitably repositioned for forming to take this into account.

While present exemplary embodiments of this invention, and methods of practicing the same, have been illustrated and described, it will be recognized that this invention may be otherwise variously embodied and practiced within the scope of the following claims.

What is claimed is:

1. A container adapted to contain a product therein comprising, a dish-like member having a flange portion provided with an annular top surface, a closure member having a peripheral flange portion provided with a cooperating annular bottom surface, adhesive means between said surfaces, said adhesive means bonding said surfaces together to define a bonded lamination comprised of said flange portions, and an annular bead formed in the peripheral outer portion of said lamination with the inner portion of said lamination holding said annular bead in spaced relation from the main portion of said dish-like member to thereby use said annular bead as a protective shield for said main portion, said inner portion having an arcuate configuration as viewed in cross section which holds said annular bead in said spaced relation with greater strength and rigidity.

2. A container as set forth in claim **1** in which said arcuate configuration comprises an upwardly convex configuration.

3. A container as set forth in claim **1** in which said arcuate configuration comprises an upwardly concave configuration.

4. A container comprising, a dish-like member having a flange portion provided with an annular top surface, a closure member having a peripheral flange portion provided with a cooperating annular bottom surface, adhesive means between said surfaces, said adhesive means bonding said surfaces together to define a bonded lamination comprised of said flange portions, and an annular bead formed in the peripheral outer portion of said lamination with the inner portion of said lamination holding said annular bead in spaced relation from the main portion of said dish-like member to thereby use said annular bead as a protective shield for said main portion, said inner portion having an undulating configuration as viewed in cross section which holds said annular bead in said spaced relation with greater strength and rigidity.

5. A container adapted to contain a product therein comprising, a dish-like member having a flange portion provided with an annular top surface, said flange portion terminating in a peripheral edge, a closure member having a peripheral flange portion provided with a cooperating annular bottom surface, said closure member having its flange portion terminating in another peripheral edge which is arranged substantially in alignment with said first-named peripheral edge over its entire peripheral outline, adhesive means between said surfaces, said adhesive means being subjected to heat and pressure to bond said surfaces together in a high strength manner to define a bonded lamination comprised of said flange portions, said lamination having a substantially uniform multiple thickness throughout its entire area, and an annular bead formed in the peripheral outer portion of said lamination with the inner portion of said lamination lying substantially in one plane, said inner portion of said lamination holding said annular bead in spaced relation from the main portion of said dish-like member to thereby use said annular bead as a protective shield for said main portion.

6. A container as set forth in claim **5** in which said adhesive means comprises a heat-sealable material.

7. A container as set forth in claim **5** in which said closure member comprises a substantially flat sheet-like member, said members are made of metallic foil containing aluminum with at least one of said members having a heat-sealable material defining its inside surface, and said heat-sealable material defines said adhesive means.

8. A container adapted to contain a product therein comprising, a dish-like member having a flange portion provided with an annular top surface, said flange portion terminating in a peripheral edge, a closure member having a peripheral flange portion provided with a cooperating annular bottom surface, said closure member

having its flange portion terminating in another peripheral edge which is arranged substantially in alignment with said first-named peripheral edge over its entire peripheral outline, adhesive means between said surfaces, said adhesive means bonding said surfaces together in a high strength manner to define a bonded lamination comprised of said flange portions, said lamination having a substantially uniform multiple thickness throughout its entire area, and an annular bead formed in the peripheral outer portion of said lamination with the inner portion of said lamination holding said annular bead in spaced relation from the main portion of said dish-like member to thereby use said annular bead as a protective shield for said main portion.

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