

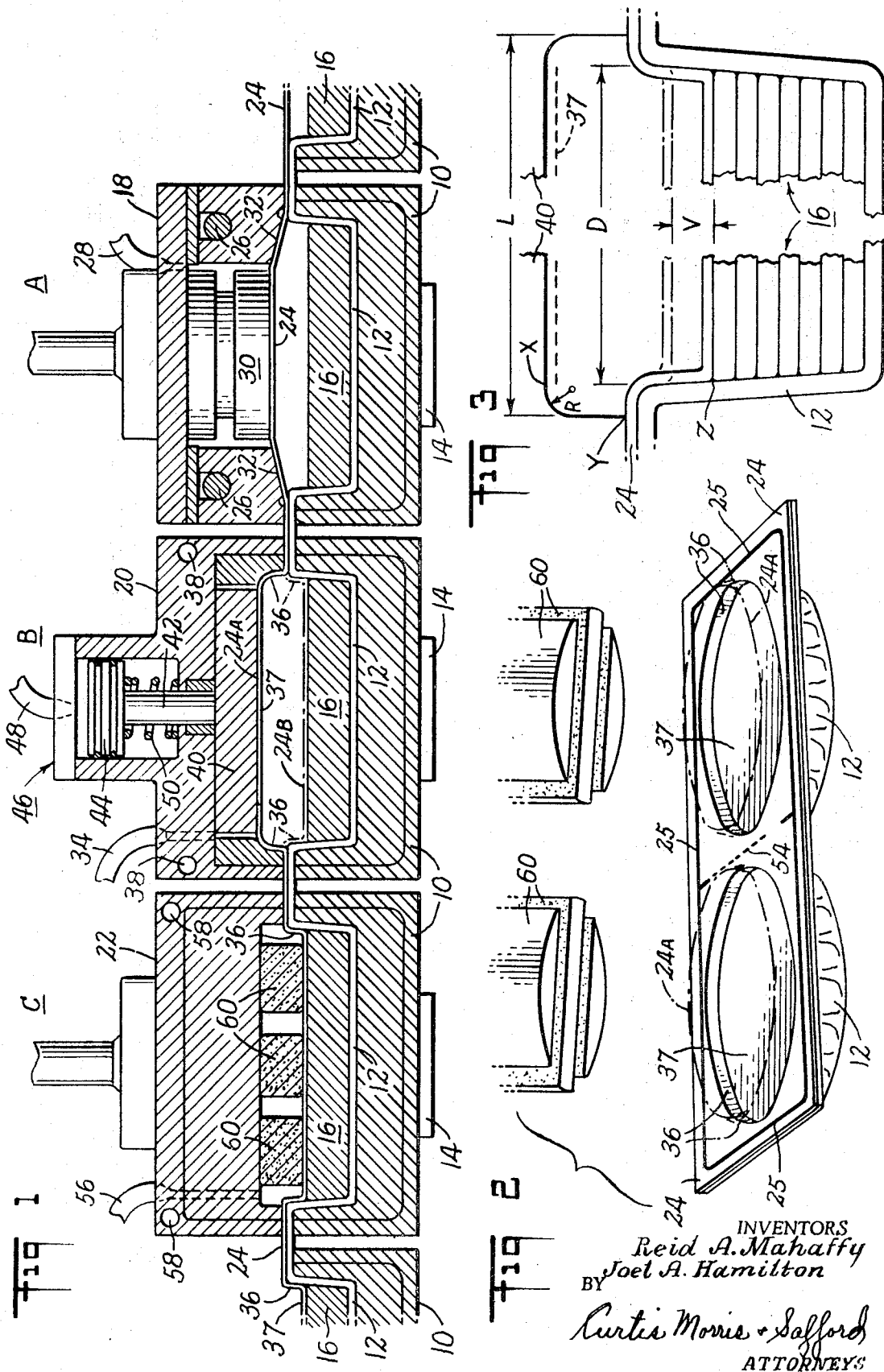
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PACKAGE FORMING METHODS AND APPARATUS

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## PACKAGE FORMING METHODS AND APPARATUS

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Continuation of application Ser. No. 672,146, Oct. 2, 1967, which is a continuation-in-part of application Ser. No. 620,070, Mar. 2, 1967. This application July 30, 1969, Ser. No. 849,248

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41 Claims

### ABSTRACT OF THE DISCLOSURE

Automatic packaging machine for applying a flexible film closure to a semirigid cup-like receptacle and including means for (1) stretching the film at an elevated temperature prior to evacuation of the package, (2) cooling the film while maintained in stretched condition to make the stretched dimension relatively permanent, and (3) evacuating the package with the film closure sealed to the semirigid receptacle, so as to force the film by atmospheric pressure against the packaged articles.

This application is a continuation of Ser. No. 672,146, filed Oct. 2, 1967, now abandoned, which in turn is a continuation-in-part based on parent application Ser. No. 620,070, filed Mar. 2, 1967.

This invention concerns the packaging of articles, such as food products, in containers formed of plastic. More particularly, this invention relates to automatic packaging apparatus and techniques for making improved evacuated or gas-filled packages of the type comprising a semirigid cup with a closure top made of formable plastic sheet stretched down into the cup and tightly pressed against the packaged articles.

In copending application Ser. No. 484,284, filed on Sept. 1, 1965, by R. A. Mahaffy et al., there is disclosed a composite package of the type described above, and a packaging machine to produce such packages. In that machine, the semirigid cups are carried by conventional chain-mounted trays which are indexed intermittently past a series of operating stations. The packages are completed at two successive stations, referred to respectively as the preliminary seal station and the final seal station.

As described in that copending application, in the preliminary seal station the filled cups are covered by a sheet of flexible film which is secured in place by heat-sealing along peripheral flanges. Also at this station the film within the peripheral flanges is heated to prepare it for subsequent stretching. After indexing to the final seal station, the now-assembled package is evacuated and the evacuation opening is closed off by heat-sealing. Upon subsequent venting of the evacuation chamber, the inrush of atmospheric pressure stretches the flexible film down into the semirigid cup to engage and support the packaged articles.

It has been found that improved results can be achieved through use of a modified arrangement to be described hereinbelow. One important advantage of this new arrangement is that the amount of stretching of the flexible film does not vary with changes in the nature (e.g., compressibility, shape) or condition (e.g., temperature) of the packaged articles, so that a machine carrying out the new technique can readily be used with articles having different characteristics and yet provide consistently good results.

In a presently preferred embodiment of this invention, the package sealing and evacuating operations are carried

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out at three successive stations of the machine. At the first station, flexible plastic film is heat-sealed to the peripheral flanges of a semirigid cup containing the product to be packaged, and simultaneously this film is heated interiorly of the seal lines for subsequent stretching. In the next station, the film (while still hot) is stretched upwardly into a relatively deep cavity adapted to form a package closure having a horizontal central face with vertical side walls at the periphery thereof. The film is cooled while held in this stretched condition so as to minimize any creepback of the plastic.

Just before transfer of the package components to the third and final station, the central face of the package closure is pressed down into the semirigid cup to engage the product therein, and the side walls of the closure thereupon flex down along the cup side walls. After transfer to the third station, the package is sealed in an evacuation chamber which exhausts the air from the package through a slit in the flange of the semirigid cup. The slit then is sealed-off to make the container air-tight, and the evacuation chamber is vented to atmosphere.

The preheating of the film in the first station may be directed primarily to the marginal portions interiorly of the preliminary heat-seal lines so that the subsequent stretching in the second station will be limited essentially to these regions. Alternatively the entire film area of the preliminary heat-seal lines may be preheated. In either case, after such preheating the plastic film is stretched in the second station to a substantial extent so as to provide the closure with dimensions at least sufficient to extend down into the semirigid cup to the level where the upper surface of the packaged product ultimately will be after the package has been completed and the product compressed by atmospheric pressure. In certain specific cases, the final dimensions of the stretched side walls of the closure should be sufficient, when appropriate for the particular compressed shape of the product, to form a right angle at the intersection of the upper surface of the product and the side wall of the semirigid cup.

Such prestretching and precooling of the closure in the second station serves to assure that the film dimensions are ample to permit the container closure to be intimately and tightly fitted by atmospheric pressure to the contours of the package product and the semirigid cup. The atmospheric pressure will be transmitted fully to the packaged product, which will provide the sole support for that pressure. Thus, effectively no stresses other than compression will be placed on the container elements, so that there will be no significant distortion of the semirigid cup.

We have found that the completed package generally will be superior if, when the evacuation chamber at the third station is vented, atmospheric pressure is admitted first against the film closure side and then against the semirigid cup side. This sequence tends to aid in producing the desired tight-fitting engagement between the closure film and the packaged product by causing the film to conform to the shape of such product prior to admission of atmospheric pressure to the semirigid cup.

The techniques and apparatus described herein are adapted to produce uniformly consistent results when packaging various articles, particularly including cold compressible articles such as sliced bologna. The prestretching and precooling of the closure is especially advantageous in avoiding distortion of the semirigid cup which might otherwise occur if the heated film simply is stretched for the first time directly down into the filled cup and thereby into contact with a refrigerated product which chills the film before proper stretching can be effected.

Accordingly, it is an object of the invention to provide novel packaging apparatus and techniques for making improved composite packages of the general type described herein. It is a specific object of this invention to provide techniques for making such packages with consistently good characteristics suitable for a variety of packaged articles. Other objects, aspects and advantages of the invention will in part be pointed out, in and in part apparent from, the following description considered together with the accompanying drawings, in which:

FIG. 1 is a vertical section taken longitudinally through a portion of an automatic packaging machine and showing particularly the operating stations where the package-forming steps to be described take place;

FIG. 2 is a perspective view showing a side-by-side package pair as they would appear in the final seal station; and

FIG. 3 is an enlarged view of a cross section of the middle station in FIG. 1.

Referring now to FIG. 1, the apparatus includes a large number of trays 10 (only several of which are shown herein) supported for indexing movement by an endless chain in the manner described in more detail in U.S. Pat. 3,061,984. The trays move from right-to-left and, at a position preceding the stations shown in FIG. 1, are provided with cup-shaped receptacles 12 of relatively thick and rigid material, sometimes referred to in the art as "semirigid" cups. Each tray preferably has two side-by-side package-forming cavities, as described in the above-referenced U.S. Pat. 3,061,984. The cups may be preformed and then inserted into the tray cavities, by any conventional means, but preferably the cups are produced by stretching a sheet of plastic material down into the cavities of the trays in accordance with known forming techniques.

If the cups 12 are to be formed with vacuum, the trays 10 advantageously are provided with vacuum seal elements 14 adapted to engage and slide along a smooth-surfaced elongate vacuum manifold (not shown herein) in accordance with the teachings of U.S. Pat. 3,125,839. The cavities in the trays may have any desired shape consistent with the shape of the packages to be produced. Illustratively, the package cups are shown herein with a circular cross-section (see FIG. 2) particularly adapted for holding products 16 such as a stack of sliced bologna.

Above three successive operating stations A, B and C shown in FIG. 1 are respective sealing dies 18, 20 and 22 the outer walls of which are provided at their lower edges with sealing surfaces adapted to seat down against the peripheral flange surfaces of the trays 10. These sealing dies are integral parts of a single packaging head (not shown) which is vertically-reciprocable at the end of each machine "dwell" period so as to lift the sealing dies up out of contact with the trays during indexing.

At a position just preceding the operating station A, a thin film of flexible and stretchable plastic packaging material 24 is applied over the trays 10, as by means of a conventional lay-down roll (not shown). This film covers the cups 12 including the horizontal side flanges extending around the mouth of each cup. The indexing movement of the trays first draws the film 24 under the initial sealing die 18 at station A and the subsequent vertical downward motion of the die presses the film tightly against the cup flanges along a line extending around the entire periphery of the tray encompassing both side-by-side cup cavities.

The sealing die 18 is provided with conventional electric heater elements 26 which heat the lower sealing surfaces of the die to a relatively high elevated temperature. These sealing surfaces therefore act as heat-sealing bars to heat-seal the film 24 permanently to the cup flanges around the entire periphery of the tray 10, i.e., around both cups, as illustrated by the heat-seal line indicated at 25 in FIG. 2.

Shortly after the sealing die 18 reaches its engaged

position, vacuum is applied to the interior chamber of the sealing die by means of a vacuum line 28. The resulting pressure differential across the surface of the film 24 forces the film up into contact with the horizontal surface of a thermally-insulated (and thus relatively cool) member 30. There are two such members, one for each of the side-by-side packages, and each member is centrally positioned with respect to its corresponding tray cavity.

Surrounding each of the central members 30 and physically isolated therefrom are inclined roof segments 32 against which the film 24 also is forced by the differential pressure created by vacuum line 28. These roof segments are heated to an elevated temperature by the electrical heater elements 26, and serve to transfer heat to the marginal portions of the film surrounding each member 30, i.e., in the border regions interiorly of the seal line 25 around the tray periphery. This transferred heat softens the plastic for the subsequent stretching operation to be described. After sufficient heat has been transferred to the film, the vacuum line 28 is vented and the sealing die moves up to permit the assembled packaged pair (now heat-sealed around the periphery) to be indexed to the next station B.

For some applications, it may be advantageous to arrange the first station A to heat the film 24 throughout the entire central area within the heat-seal lines. To this end, each of the members 30 may be made integral with its surrounding roof segment 32, rather than being thermally insulated therefrom, so that the heat from elements 26 spreads inwardly across the entire upper surface of the chamber. Thus, as will be apparent from the description hereinafter, the subsequent stretching of the film will extend inwardly beyond the border regions immediately adjacent the heat-seal lines. That is, more of the film material will be included in the stretched portions than with the arrangement first described. This can be helpful particularly if the degree of subsequent stretching required is unusually great, since it tends to assure that the stretching does not create localized film areas which are too thin to be physically rugged and durable.

At station B, the next sealing die 20 moves down to engage the already-sealed film 24 around the periphery of the supporting tray 10. Thereafter, the interior chamber of this die is evacuated to a quite low level by a vacuum line 34, and the resulting pressure differential stretches the film 24 up with great force against the roof of the die. This roof defines two cylindrical cavities each having a shape conforming generally to the cylindrical shape of the ultimate package closure.

The plastic film material forced up into the cavities of die 20 is formed into two cylindrical-shaped cap-like elements matching the shape of the die, as illustrated in FIG. 2 by the lines 24A. These cap-like elements are adapted to form package closures 24B when subsequently flexed down (inverted) into the corresponding semirigid cups. In vacuum-forming elements 24A, the film material particularly is stretched in those regions which become the side walls 36 of the closures 24B, i.e., in the border regions previously heated by the inclined roof segments 32.

The stretching of the film in station B is carried to a permanent set dimension beyond the elastic limit of the film, and the stretched film is cooled by its contact with the roof of the chamber so that its dimensions and shape are fixed to approximately the dimensions and shape of the die 20. The central face 37 of the film will not be stretched significantly if the central member 30 in the previous station A is cool, but will be stretched somewhat if that member 30 is heated as previously mentioned. It may be preferred in certain applications, particularly if the central face 37 of the film 24 contains printed indicia, to avoid heating and stretching that portion of the film.

The intermediate sealing die 20 preferably is cooled, as by means of conventional water-cooling conduits 38, to reduce the temperature of the outer die walls and the central roof section 40. Since the film 24 is held by vac-

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uum in its stretched condition against the interior surface of the sealing die during the "dwell" period between machine indexing steps, the side walls 36 of the closure (and the central face 37, if stretched) are chilled in their stretched state. This chilling tends to stabilize the plastic material in its stretched dimension. Thus there is very little "creep-back" of the plastic material when the vacuum in line 34 subsequently is vented.

Referring now to FIG. 3, we have found that with a product such as sliced bologna, superior results are achieved by making the horizontal dimension (width or diameter) of the flat central face 37 at least equal to or slightly in excess of the horizontal dimension D across the top of the product between the side walls of the semi-rigid cup. This allows the film to lie substantially flat across the top of the product when the film is flexed down into its closure position 24B. We also have found it desirable to form the film with a corner radius R, rather than to attempt to make a sharp right-angled bend in that region. The radius R should be of reasonable size, e.g., at least one-tenth of the closure depth.

We also have found it desirable to form the element 24A with an overall horizontal dimension L between the side walls somewhat greater than dimension D across the top of the product in the cup. In this regard, the film length between points X and Y particularly should be sufficient, and preferably more than sufficient, to reach from Y to Z, including the vertical distance V representing the amount by which the packaged product ultimately will be compressed by atmospheric pressure when the package is completed. Such an arrangement tends to assure that the film in the finished packages will have no tensional stresses and may lie in direct contact both with the side walls of the semi-rigid cup and with the top of the product. If the film is not stretched to reach a proper stable dimension, an internal package "void" may be created at the intersection point Z, and the display (bottom) side of the semirigid cup may tend to collapse so as to become undesirably concave under atmospheric pressure.

Immediately after venting of the vacuum in the sealing die 20, and before the next indexing step, the upstanding cap-like elements 24A are flexed down to the final closure position as shown at 24B in FIG. 1. For this purpose, the tral roof sections 40 are arranged as side-by-side plungers (only one of which is shown) secured to the ends of vertical shafts 42 operated by corresponding pistons 44 in conventional air cylinders generally indicated at 46. The interior of each air cylinder is supplied with compressed air through a hose 48 immediately after the sealing die 20 is vented. Downward movement of the plunger forces the stretched film into its final position extending down into the side-by-side cups 12. The compressed air then is vented, and the plungers returned to their upper position by springs 50.

With the formed top in its normal downwardly extending position 24B, the tray 10 is indexed to the final seal station C for evacuation and completion of the packaging. At this station there is provided, in the region immediately beneath the tray 10, conventional means for evacuating both of the side-by-side packages simultaneously. Typically, such evacuation takes place through a slit in the plastic sheet from which the cups are formed. This is illustrated in FIG. 2 by a slit 54 on the horizontal flange portion between the side-by-side cups 12. Normally, slit 54 will be formed before the cup reaches station A. It may also be noted that, when the cup is at stations A and B, air will enter through slit 54 as the spaces above film 24 are evacuated, and will exit through the slit when the film is flexed to its down position 24B in station B.

The evacuation apparatus may include the usual "web-lifter" which is held captive in each tray as described in detail in the above-mentioned U.S. Pat. 3,061,984. During the machine dwell period at the final seal station, this web-lifter is shifted up through the slit 54 to raise the flexible film 24 a sufficient distance to create suitable evacuation

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passages into the interior of both of the side-by-side cups 12. Thereupon, vacuum is drawn through the web-lifter passage, as by means of a vertically-reciprocable gasketed coupler (not shown) which engages the sealing element 14 on the bottom of the tray. The interior chamber of the sealing die 22 also is similarly evacuated at this time by means of a vacuum-line 56, so as to minimize any pressure differential across the film 24 during the evacuation operation.

After evacuation has been completed at station C, the captive web-lifter in the tray 10 drops down away from the slit 54, and the film 24 is heat-sealed to the cups in the region immediately around the slit 54, i.e., in the area joining the side-by-side cups 12, to provide a complete hermetic seal for both of the packages. This hermetic seal extends fully across the film, between the two sides of the preliminary seal line 25, so that each of the two packages is independently sealed from atmosphere.

After the evacuation opening has thus been closed off, the vacuum lines in the final seal station C are vented to atmosphere. Preferably the top line 56 to the sealing die 22 is vented before the vacuum connection to the tray 10 through the bottom seal element 14. The resulting inrush of air into the sealing die chamber forces the central face 37 of each closure tightly and intimately against the top of the corresponding packaged product 16.

As noted hereinabove, the closure side walls 36 (and the central face 37 where appropriate) were previously stretched to a dimension equal to or in excess of that necessary to permit the film to extend, without further stretching, from the horizontal plane of the mouth of the cups 12 down to the top of the product 16 after the latter has been compressed by atmospheric pressure (as indicated in FIG. 3). Thus it will be evident that the closure 24B will engage the product 16 essentially entirely across the cup 12, and will form a right angle at the intersection point Z so as to lie directly against the cup side walls up to the horizontal plane of the cup mouth. Under these circumstances, the film transmits essentially all of the atmospheric force directly to the packaged product without pulling at the sealed margins and thereby distorting the normal configuration of the semirigid cup.

Since venting of the sealing die 22 can most conveniently be effected through a single opening (normally located near the center of the die roof), it is possible for the inrushing air particles to drag the film 24 out of its proper position with the closure 24B extending down symmetrically into the cup 12. To avoid such distortion, the sealing die 22 also may be provided with a series of pressure pads 60, e.g., formed of inert resilient material. These pads are adapted to hold the film down against the packaged product 16 during the "dwell" period between indexing steps. As shown in FIG. 2, the pads may have a generally circular outline, when seen in end-view. The diameter of the circle should be somewhat less than the interior diameter of the cups 12, in order to assure that the film can still be raised sufficiently by the web-lifter (as described hereinabove) to provide an evacuation channel of adequate capacity into the interior of each of the cups.

The sealing die 22 at the final seal station C also may be provided with the usual water cooling conduits 58 if necessary to furnish sufficient heat removal or chilling of the various parts.

Although a specific embodiment of the invention has been set forth in detail, it is desired to emphasize that this is not intended to be exhaustive or necessarily limitative; on the contrary, the showing herein is for the purpose of illustrating the invention and thus to enable others skilled in the art to adapt the invention in such ways as meet the requirements of particular applications, it being understood that various modifications may be made without departing from the scope of the invention as limited by the prior art.

We claim:

1. Apparatus for making evacuated packages of the type having a cup-shaped member of semirigid material and a top closure of formable material, said closure including side walls extending down into the cup-shaped member to a broad central face urged by atmospheric pressure against the packaged product; said apparatus comprising: means for conveying the cup-shaped members past a series of operating stations; means at one of said operating stations for evacuating the assembled packages; closure-forming means at another station preceding said one operating station for producing said top closure with said side walls; said forming means including means to stretch the closure material and to maintain it in stretched condition while the stretch dimension is made substantially permanent without significant tendency of creep-back towards the original dimension; said conveying means including means for transferring the stretched closure from said forming means to said one operating station so as to provide an assembled package at that one station, the evacuation of the assembled package at said one station serving to draw the central face of said closure down towards pressure engagement with the upper surfaces of the packaged product.

2. Apparatus as claimed in claim 1, including means to heat said formable material prior to forming thereof into said closure; said forming means including means to stretch said material while heated to create said side walls; said forming means further including means to cool the closure material while the side walls thereof are held in stretched condition to minimize change of the stretched dimension before transfer to said one station.

3. Apparatus as claimed in claim 2, wherein said forming means includes means to stretch said side walls to a dimension greater than the distance between the mouth of the cup-shaped member and the upper surface of the product to be packaged, whereby to assure full and effective engagement between said central face and said product surface.

4. Packaging apparatus comprising, in combination, means for conveying cup-shaped receptacles past a series of operating stations, said receptacles carrying products to be packaged; means for applying a continuous sheet of formable packaging material over said receptacles; forming means at one of said stations for stretching said sheet opposite the interior marginal regions of the receptacle then at that one station to form a package closure having (1) a central face at least approximately parallel to the mouth of the receptacle, (2) side wall means including said stretched portions extending transversely away from said central face, and (3) flange portions outwardly beyond said stretched portions for sealing the closure to corresponding parts of the receptacle; said forming means including means to make the stretched dimension of the side wall substantially permanent without any significant tendency to creep back towards the original nonstretched dimension; and means at a station subsequent to said one station for evacuating the assembled package comprising said formed closure with its outer flange sealed to the corresponding receptacle.

5. Apparatus as claimed in claim 4, wherein said forming means comprises means to force said sheet away from the corresponding receptacle; and die means positioned above said receptacle to receive and shape said sheet to develop said side walls.

6. Apparatus as claimed in claim 5, including means to heat the sheet material to enhance its stretchability; said forming means including means to cool said die means to assure that the stretched dimension of the sheet material becomes its permanent dimension.

7. Apparatus as claimed in claim 6, wherein said forming means comprises vacuum means operative to maintain said sheet in its stretched condition until sufficiently cool to effectively eliminate significant creep-back of the packaging material.

8. Apparatus as claimed in claim 6, wherein said heating means is located at a station preceding said one station.

9. Apparatus as claimed in claim 8, wherein said heating means applies heat preferentially to the interior marginal region of said sheet adjacent the peripheral seal thereof to the receptacle, whereby to assure that stretching takes place primarily in said marginal regions to form said side walls.

10. Apparatus as claimed in claim 5, including plunger means to invert the closure after formation thereof in said die means, whereby the closure extends down into the receptacle for transfer therewith to the subsequent station for evacuation.

11. Apparatus as claimed in claim 4, including means at said subsequent station for stabilizing said central face in position over the packaged articles when the evacuation vacuum is vented.

12. Apparatus as claimed in claim 11, wherein said stabilizing means comprises pressure pad means adapted to engage the outer surface of said central face.

13. The method of making evacuated packages of the type comprising a relatively rigid cup-shaped receptacle having a closure of formable film including side walls extending down into said receptacle to a central face pressed down against the packaged product; said method comprising the steps of heating the formable packaging film; stretching the film while heated so as to form the side walls of the closure; cooling said film while maintaining said side walls stretched, thereby to minimize creep-back of the stretched material; and evacuating the package including said closure so as to cause said central face to be urged by atmospheric pressure down against the packaged product.

14. The method of claim 13, wherein said film is stretched to an extent such that said side walls have a depth greater than the spacing between the mouth of the receptacle and the exposed surface of the product within the receptacle, thereby to assure good tight-fitting engagement of the closure with said exposed surface without deformation of the receptacle after evacuation.

15. Apparatus as claimed in claim 5, wherein said die means comprises a generally planar section against which said central face is pressed and adjoining side sections against which said side walls are pressed, said die means being formed with a curved inner surface joining said planar section with said side sections and providing a radius of curvature of reasonable size adapted to prevent undue localized stretching and assure adequate permanent dimensions of said side walls.

16. Apparatus as claimed in claim 15, wherein the distance from the periphery of said planar section to the edge of said side section, as measured along the surface of the die means, is at least as great as the distance from said edge of said side section to the product within the receptacle when the latter subsequently is evacuated and exposed to atmospheric pressure.

17. Apparatus as claimed in claim 15, wherein the lateral distance between the side sections of said die means is at least slightly greater than the corresponding lateral distance across the top of the packaged product.

18. Apparatus as claimed in claim 4, including heating means operable prior to the operation of said forming means to heat the regions of said sheet to be stretched by said forming means into said side walls, thereby to soften the packaging material sufficiently to permit ready stretching thereof.

19. Apparatus as claimed in claim 18, wherein said heating is effected by heated surface means operable to contact the packaging material along said side wall regions prior to application of the stretching force.

20. Apparatus as claimed in claim 18, including means to apply heat to said side wall regions at a rate greater than to said central face regions, whereby to ensure preferential stretching of the side wall regions in the subsequent forming action.

21. Packaging apparatus of the type including means for conveying semirigid cup-shaped receptacles past a series of operating stations with said receptacles carrying products to be packaged and means for applying a continuous sheet of formable packaging material over said receptacles; the improvement which comprises the combination of:

heating means at one station to apply heat to said formable material to condition it for subsequent stretching;

forming means at a second station subsequent to said one station, to stretch the heated formable material to create a package closure having (1) a central face at least approximately parallel to the mouth of an associated receptacle, (2) side wall means including at least part of the stretched portions of said formable material and extending generally transversely away from said central face, and (3) flange portions extending outwardly away from the end of said wall means which is remote from said central face, the flange portions being adapted to be sealed to corresponding portions of the associated receptacle; and a package finishing means at a third station subsequent to said second station for evacuating each assembled package comprising the formed enclosure with its flanged portion sealed to said corresponding portion of said associated receptacle.

22. Apparatus as claimed in claim 21, wherein the forming station includes means to cool the stretched packaging material to ensure substantial maintenance of the stretched dimensions when the package is transferred to the finishing station for evacuation.

23. Apparatus as claimed in claim 21, wherein said one station includes means to shift the material away from the associated receptacle and into the proximity of a heated surface, to transfer the desired amount of heat energy thereto.

24. Apparatus as claimed in claim 23, wherein said heated surface comprises marginal members disposed opposite the interior marginal regions of the receptacle to contact the regions of said sheet to be made into the side walls of the closure.

25. Apparatus as claimed in claim 24, including a relatively cool member located interiorly of said marginal members to minimize heat transfer to the regions of said packaging material to become the central base of the closure.

26. Apparatus as claimed in claim 21, wherein said one station further includes means to heatseal the film to the receptacle along a line extending at least part way around the receptacle, to provide a preliminary seal arranged to permit evacuation of the package at said third station.

27. The method of making packages of the type comprising a cup-shaped receptacle of form-retaining material and a top of formable material sealed thereto, said top including outer flange sections integral with interior marginal portions stretched down into the receptacle immediately adjacent the receptacle side walls, said marginal portions being integral with a central face of the top pressed against the packaged product; said method comprising the steps of:

heating a sheet of formable top material to facilitate stretching thereof;

applying a stretching force to the heated material in a first direction which is at least approximately perpendicular to the surface of the sheet so as to stretch part of the material to form said interior marginal portions approximately at right angles with respect to the sheet of heated material and with the central face offset in said first direction with respect to the outer flange sections;

shifting said central face in a reverse direction with respect to said one direction, the shifting movement thereof being sufficient to move the central face through and past said outer flange sections towards

its final position immediately adjacent the packaged product; and

thereafter evacuating the assembled package and hermetically sealing the top to said receptacle.

28. The method of making packages of the type comprising a cup-shaped receptacle of form-retaining material having flanges to which a top of formable material is sealed, said top including outer portions sealed to said flanges and integral with interior portions stretched down into the receptacle to define a central face pressed against the packaged product; said method comprising the steps of (but not necessarily in the order listed):

heating a sheet of formable top material to facilitate stretching thereof;

applying a stretching force to the heated material in a direction which is at least approximately perpendicular to the surface of the sheet to stretch part of the material to form said interior portions with the offset central face, the stretching being carried to an extent sufficient to offset said central face a distance which is greater than the distance between the cup flanges and the upper surfaces of product in the receptacle;

shifting said central face into said receptacle to a position immediately adjacent the packaged product; and evacuating the assembled package and hermetically sealing the top to said receptacle.

29. The method of making packages of the type comprising a cup of form-retaining material having flanges around the mouth thereof, said package including a top of formable material with outer portions sealed to said cup flanges, said outer portions being integral with interior portions stretched down into the cup to a central region pressed against the upper surfaces of the packaged product; said method comprising the steps of (but not necessarily in the order listed):

placing a product in said form-retaining cup;

applying a sheet of formable top material over the cup; heating the top material to facilitate stretching thereof;

applying a stretching force to the heated material in a direction away from the cup to form said interior portions with the central region offset from said outer portions a distance which is greater than the distance between the effective plane of the cup flanges and the surface of the product;

shifting said top central region towards said cup to a position immediately adjacent the packaged product; and

evacuating the assembled package and hermetically sealing the top to said cup.

30. The method of making packages of the type comprising a cup-shaped receptacle of form-retaining material and a top of formable material sealed thereto around the periphery, said top including outer sealing flanges integral with interior portions stretched down into the receptacle immediately adjacent the receptacle side walls to a central face pressed against the packaged product; said method comprising the steps of (but not necessarily in the order listed):

applying a sheet of formable top material over a receptacle of form-retaining material;

securing said top material to the periphery of the receptacle;

applying a stretching force to the top material immediately inboard of said periphery and in a direction away from the receptacle so as to stretch that part of the material to a permanent-set dimension to form said interior portions at least approximately at right angles with respect to said sheet and with the central face offset from the portions secured to said periphery;

shifting said central face towards said receptacle, past said secured portions, to a position adjacent the packaged product; and

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evacuating the package and hermetically sealing the top to said receptacle.

31. The method of making packages of the type comprising a cup-shaped receptacle of form-retaining material and a top of formable material sealed thereto around the periphery, said top including outer sealing portions integral with interior marginal portions stretched down into the receptacle immediately adjacent the receptacle said walls and extending to a central face pressed against the packaged product; said method comprising the steps of:

applying a sheet of formable top material over the receptacle;  
heating the top material to facilitate stretching;  
applying a stretching force to the top material in a direction away from the receptacle so as to stretch part of the material to form said interior marginal portions so that they extend at least approximately at right angles with respect to the sheet of material and with the central face offset from the portions secured to said periphery;  
cooling the top material while maintaining the stretched dimension thereof to reduce substantially any subsequent creep-back of the stretched material;  
shifting said central face towards said receptacle, past said secured portions thereof, to a position adjacent the packaged product; and  
thereafter evacuating the package and hermetically sealing the top to said receptacle.

32. The method of making evacuated packages of the type comprising a cup-shaped receptacle of form-retaining material and a top of formable material sealed thereto around the periphery, said top including outer sealing portions integral with interior portions stretched down into the receptacle to a central face pressed against the packaged product; said method comprising the steps of (but not necessarily in the order listed):

placing a product in the receptacle;  
applying a sheet of formable top material over the receptacle;  
heating the top material to facilitate stretching;  
applying a stretching force to the top material in a direction away from the receptacle so as to stretch part of the material to form said interior portions with the central face offset from the outer sealing portions, the stretching being sufficient to produce an offset greater than the distance between the cup periphery and the upper surface of the product when the product has reached its final dimension (including any compression thereof) after evacuation of the package;  
shifting said central face towards said receptacle, past the packaged product; and  
the packaged product; and  
evacuating the package, providing a hermetic seal of the top to the receptacle, and venting the outside of the completed package to atmospheric pressure.

33. The method of claim 32, including the step of cooling the heated top material while maintaining the stretched condition thereof to reduce substantially any tendency to creep-back to the original material dimensions.

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34. The method of claim 32, wherein said top material is heated by drawing it away from the receptacle to a position adjacent a heating element.

35. The method of claim 32, wherein the top material is heated preferentially in the region immediately adjacent the outer sealing portions.

36. The method of claim 32, wherein the stretching is carried out to provide a horizontal dimension of the central face at least equal to the corresponding dimension across the top of the product.

37. The method of claim 36, wherein the top material is stretched to provide a horizontal dimension greater than the corresponding dimension across the top of the product.

38. Packaging apparatus comprising:

means providing a series of elements adapted to carry cup-shaped receptacles of form-retaining semirigid plastic past a series of operating stations where packaging operations are performed including loading of the product and application of a continuous sheet of plastic packaging material over said receptacles in succession;

first means adjacent the path of movement of said series of elements to heat said sheet of packaging material to an elevated temperature facilitating stretching thereof;

second means adjacent said path of movement for stretching a portion of the heated sheet material away from its associated receptacle to form a closure having side walls and a central face aligned with the mouth of the receptacle; and

third means for mechanically engaging and thereby shifting said stretched sheet material towards its associated receptacle to position the central face of the closure down in the receptacle adjacent the upper surface of the product.

39. Apparatus as claimed in claim 38, wherein said elements comprise support means defining a series of cavities each carrying a receptacle, said second means comprising a head engageable with said support means to present a forming-die recess aligned with the receptacle.

40. Apparatus as claimed in claim 39, wherein said stretching means includes means to develop a vacuum adjacent the outer surface of the packaging material;

said third means including plunger means, operable after the closure has been stretch-formed in said recess, to force the formed top down into the associated receptacle.

41. Apparatus as claimed in claim 39, wherein said head includes means to cool the surface of the recess so as to chill the formed plastic material while it is held in stretched condition.

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TRAVIS S. MCGEHEE, Primary Examiner

U.S. Cl. X.R.

53—30, 112, 184

**UNITED STATES PATENT OFFICE**  
**CERTIFICATE OF CORRECTION**

Patent No. 3,545,163

Dated December 8, 1970

Inventor(s) Reid A. Mahaffy et al.

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 5, line 44, "tral" should read -- central --.  
Column 11, line 53, before "the" insert -- said secured portions thereof, to a position adjacent --; line 54, cancel "the packaged product; and".

Signed and sealed this 13th day of April 1971.

(SEAL)  
Attest:

EDWARD M. FLETCHER, JR.  
Attesting Officer

WILLIAM E. SCHUYLER,  
Commissioner of Patents