This invention relates to the rapid production of closure seals for containers, including the forming of a shaped cushion pad or sealing member.

It has been proposed and is a practice to form such crown seals with the usual metal shell having a cushion pad therein, made of rubber composition, or of a like elastomer compound. However, when the composition is introduced in the form of a solution or emulsion, for the necessary liquidity of application, rotation of the shell is required for distribution, the composition is not form-maintaining in itself, a lengthy period is required for elimination of the solvent or like vehicle, and the distribution cannot be controlled with assured accuracy, nor can special contours in the sealing area or in the center be attained for maximum sealing efficiency and minimum use of material. Also, curing could only be effected after such solvent was eliminated. On the other hand, when the composition was introduced as a blank, care was required for producing the necessary adhesion in the crown shell and high pressures and temperatures were required for molding. Further, if the blank or disc is cut out from a web, either frame scrap loss or reworking cost is involved; and at least one additional operation is involved in cutting and placing the blank or disc.

When a crown seal is to be used for capping a bottle or other container, the cushion pad serves to conform to the possibly irregular lip of the container, providing a gasket between such lip and the closing face of the metal crown shell itself. The crown seal usually has a further demand upon it, being that of preventing contacts of the contents of the container with the metal at the inner face of the crown shell. These two requirements may be satisfied by materials insoluble and essentially non-permeable to the contents of the container, but in practice such materials do not demand as great a thickness for protection against penetration as is required for providing the necessary sealing gasket for conforming to the container lip. Accordingly, it is preferred in accordance with this invention to provide a crown seal in which the sealing member or cushion pad has a thick outer annular portion for engagement with the container lip, and a thinner central portion to provide the assurance against contact of the contents of the container with the metal of the crown shell.

It has been found that by using compositions formed by dispersing fine particles of a resin such as vinyl resin in a liquid plasticizer, it is feasible to deposit a quantity of such semi-liquid, pasty dispersion in a closure shell, heat the closure shell with the mass therein and thereby partially cure the composition by causing the plasticizer to dissolve portions of the resin particles so that a form-maintaining body is produced, along with causing the plasticizer adjacent the shell to effect adhesion to the lacquer coating so that the mass adheres firmly to the shell; thereafter transferring the shell with the adherent mass therein to a heated platens, and employing a heated punch for shaping the mass to the desired contour while the final volume is essentially the same as the measured original volume. When the partial curing or gelling has been
of the heated platen 30 and heated punch 32 and given the final cure in the oven 40, resulting in the production of a resilient, tough, plasticized resin mass, having an elongation at break, when a specimen is tested for strength, of 150 to 343 per cent, for example, with the usual values being above 250 per cent.

Illustrative of the conditions for the pre-gelling operation is the employment of a hot air oven having a high velocity circulation of air for heating the compound at a temperature of 375° F. for 60 seconds, the time in the oven being from 30 to 60 seconds. For example, a time of 45 seconds at 300° F. is satisfactory with a volume of 200 cubic millimeters.

The temperature and pressure employed for the shaping and final curing depends upon the material of the compound, the degree of curing effected in the oven 30, and upon the shape of the crown shell and the shape to be given the cushion pad. For the crown shell having a one-sixteenth inch radius at top corner, 25 to 75 pounds per square inch pressures are useful with sizes and shapes of cushion pad as illustrated in Fig. 2. Correspondingly, when the top corner radius of the crown shell is three-thousandths of an inch, pressures of 125 to 175 pounds per square inch should be used in forming a plasticized top ring or annulus. Higher pressures can be used, but it is desired to avoid excessive pressures in order to keep machine costs low.

The temperature employed for the molding depends upon the characteristics of the original coating lacquer 5 and the composition for the cushion material. When this lacquer is of vinyl chloride-acetate polymers with the oleoresinous modifier as described above, the temperature can range from 300° F. to 350° F.; when the so-called trimer of vinyl chloride-acetate and maleic anhydride is employed, the temperature may range from 325° F. to 375° F. It is desirable to use temperatures near the maximum, in a production machine, to keep the time and pressure low, for economy.

The time required for molding, following the pre-gelling in the oven, is from 3 to 6 seconds. It will be noted that for economy this time should be kept as short as possible; but no serious deterioration occurs even though the material is held for a far longer time in the heated condition.

The time and temperature are inter-related. For a given characteristic of the product such as the crown shell 25 with its mass 14, coming from the heated zone 20, it is satisfactory to press for 4 seconds at 75 lbs. per square inch and at 375° F., in forming a pad shaped as in Fig. 2 for a crown shell having a one-sixteenth inch top corner radius and using the aforesaid trimer lacquer. The same temperature and time, with 150 lbs. per square inch pressure, is satisfactory with the crown shell having a three-thousandths inch top corner radius.

The temperature employed in the second or final curing stage 40, employing the same type of hot air oven as used for the pre-gelling stage in heated zone 20, can be from 350° F. to 400° F., or in other words, this heating can be carried through at the maximum temperature endurable by the vinyl resin, particularly the portion thereof which is in contact with the crown shell. Temperatures of 350° F. to 400° F. may be employed for a time of 30 to 60 seconds, with the product of the essentially uniform mass of plasticized vinyl resin, with or without the fillers and other components. A satisfactory hot air oven curing condition, for the final curing zone 40, is 380° F. for 30 seconds.

It will be understood that the foregoing disclosure of continuously advancing the crown shells through the process steps is illustrative, and that these shells need not be treated in the heated zone 40 in regular arrangement or order, as they individually have the shaped masses adherent thereto, so that they may be treated in the bulk, with proper provision for the heating of each and every crown cap to the requisite temperature for producing the uniform diffusion of vinyl resin and plasticizer into one another. This time should be provided for each and every shell, and the subjecting of shells to longer times, as pointed out above, is not destructive so long as the selected conditions are proper for a heat-soaking treatment as distinguished from heating through a "come-up" period.

Quantities of the crown shells may be made up in the depositing machine and in the oven 20, and held, for example, at room temperature, over periods of time until they are passed through a separate machine for forming and completing the curing by the action of a pure air oven 32 and a platens 30, although it will be understood that it is presently preferred to accomplish the operations in rapid sequence, to reduce the quantity of heat required.

While the invention has been illustrated by a practice of making crown seals with lacquered metal shells having corrugated skirts of circular outline, and employing the stated materials and conditions, it will be understood that it may be embodied in other forms within the scope of the appended claims.

We claim:
1. The method of forming sealing pads for closure seals, which comprises depositing in a closure shell a quantity of a semi-liquid paste composition consisting of essential components thereof of a normally liquid plasticizer and a finely divided resin which is paste-forming with the plasticizer at a temperature below the fluxing temperature of the resin-plasticizer components, said composition being capable upon being heated at the fluxing temperature of the resin-plasticizer components thereof of forming a permanent rubbery gel, heating the deposited mass until it is non-tacky, pressing a heated forming plunger against the non-tacky mass prior to completed curing thereof and thereby shaping the same into a sealing pad of the desired contour, separating the plunger and mass prior to completed curing thereof, and thereafter maintaining said shaped pad under heat at a fluxing temperature until the said resin-plasticizer components have cohesively fluxed together.
2. The method of forming sealing pads for closure seals, comprising discharging into the closure shell a quantity of a semi-liquid pasty material comprising particles of a resin dispersed in a fluid resin plasticizer, heating the said material in the shell for producing adhesion to the shell and a partial curing by partial dissolution of the resin particles in the plasticizer, and thereafter pressing a heated forming plunger against the partially cured material while the closure shell is on a heated support for shaping the material into a sealing pad, separating the plunger and mass prior to completed curing thereof, and thereafter maintaining said shaped pad at a fluxing temperature until the resin particles have completely
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9. dissolved into the plasticizer and produced an essentially uniform mass adherent to the shell.

3. The method of forming sealing pads for closure seals, comprising discharging into the closure shell a quantity of a semi-liquid pasty material comprising particles of a resin dispersed in a fluid resin plasticizer, heating the said material in the shell for producing adhesion to the shell and a partial dissolution of the resin particles in the plasticizer, thereafter briefly pressing a heated forming plunger against the material while the closure shell is on a heated support for a period of time sufficient to allow the said resin particles to come into intimate contact with the plasticizer and adhere to the shell.

4. The method of making crown seals having therein a shaped and cured cushion pad, which comprises providing a crown shell having an internal lacquer coating exhibiting a vinyl resin at the exposed side thereof, depositing in the crown shell and upon said exposed coating facing thereof a quantity of a mass comprising particles of a vinyl resin dispersed in a fluid vinyl resin plasticizer, heating the mass to a fluxing temperature and until the exposed surface is non-tacky, and thereafter pressing a heated forming surface upon the exposed face of the mass after the same has become non-tacky and prior to complete dissolution of the resin particles into the plasticizer for distributing and shaping the mass in the crown shell, reliving said pressure, and thereafter heating to effect a completed dissolution of the vinyl resin particles into the plasticizer to constitute an essentially uniform mass.

5. The method of making closure seals, which comprises depositing at a temperature of fluxing flow into a closure shell a quantity of resin paste having as dominant gel-forming elements thereof finely divided resin particles suspended in a resin plasticizer which is not an active solvent of the resin at said temperature, partly cured material for shaping the same into a sealing pad of desired contour in contact with and adherent to the shell, separating the plunger and mass prior to completed curing thereof, and thereafter maintaining said shaped pad at a temperature of 300 to 375° F. until the exposed surface of the pad comes to a healing gas and the said resin and plasticizer components have completely fluxed together.

7. The method of making crown seals having therein a shaped and cured cushion pad, which comprises providing a crown shell having an internal lacquer coating, depositing in the crown shell and upon a part of said coating thereof a quantity of a mass comprising particles of a resin dispersed in a fluid plasticizer of the resin, heating the mass, heating the said material in the shell for producing adhesion to the shell and a partial dissolution of the resin particles in the plasticizer, thereafter pressing a heated forming surface upon the partially cured mass in the shell while heating to a temperature of at least 275° F. and thereby distributing and completing adhesion thereof to said lacquer coating, relieving the pressure before the dissolution is completed, and thereafter subjecting the exposed surface of the shaped pad to hot gases and heating the shell for completing the fluxing of the resin particles with the plasticizer to constitute an essentially uniform mass.

8. The method of forming sealing pads for crown seals, comprising discharging into and adjacent the center of an internally lacquered crown shell 100 to 400 cubic millimeters of a semi-liquid pasty material comprising particles of a resin dispersed in a fluid resin plasticizer, heating the said material in the shell for producing adhesion to the shell and a partial dissolution of the resin particles in the plasticizer, thereafter pressing a heated forming plunger against the material while the crown shell is on a heated support for distributing and shaping the material into a sealing pad, separating the plunger and mass prior to completed curing thereof, and thereafter maintaining said shaped pad at a fluxing temperature of 300 to 375° F. until the resin particles have completely dissolved into the plasticizer and the shaped pad adheres for essentially its entire area of contact with the crown shell.

9. The method of forming sealing pads for crown seals, comprising discharging into and adjacent the center of an internally lacquered crown shell 100 to 400 cubic millimeters of a semi-liquid pasty material comprising particles of a resin dispersed in a fluid resin plasticizer, heating the said material in the shell for producing adhesion to the shell and a partial dissolution of the resin particles in the plasticizer, thereafter pressing a heated forming plunger against the material while the crown shell is on a heated support for distributing and shaping the material into a sealing pad, separating the plunger and mass prior to completed curing thereof, and thereafter maintaining said shaped pad at a fluxing temperature of 300 to 375° F. until the resin particles have completely dissolved into the plasticizer and the shaped pad adheres to the crown shell.

10. The method of making closure seals, which comprises depositing at a temperature of fluxing flow into a cold internally-lacquered closure shell a quantity of resin paste having as dominant gel-forming elements thereof finely divided resin particles suspended in a resin plasticizer which is not an active solvent of the resin at said temperature.
of fluid flow of the resin paste and which is an active solvent thereof at a higher and fluxing temperature, heating the said material in the shell for producing adhesion to the shell and a partial dissolution of the resin particles in the plastizer, thereafter pressing a heated forming surface against the heated deposit and thereby distributing and shaping the same, removing the forming surface, and thereafter continuing the heating of the shell and surface and maintaining the deposit at a fluxing temperature until the resin and plastizer have fluxed together and constitute a form-maintaining gel adherent to said shell.

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PRODUCTION OF CLOSURE SEALS BY PARTIALLY CURING
A CUSHION MATERIAL, AND THEREAFTER
SHAPING AND COMPLETING THE CURE
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