United States Patent

[11] 3,602,690

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[22] Filed **Oct. 3, 1968**
Division of Ser. No. 418,434, Dec. 15, 1964, Pat. No. 3,439,590
[45] Patented **Aug. 31, 1971**

[73] Assignee **Maryland Cup Corporation Owing Mills, Md.**

[54] **A QUICK ACTING AIR HEATER**
4 Claims, 16 Drawing Figs.

[52] **U.S. Cl.** ..... **219/373,** 53/33, 93/55.1 R, 156/497, 219/365, 219/374
[51] **Int. Cl.** **H05b 3/02,** F24h 3/06, C09j 5/10
[50] **Field of Search** 219/359, 365–376, 379–382, 302; 53/375, 373, 388, 33, 39; 93/55.1; 156/497

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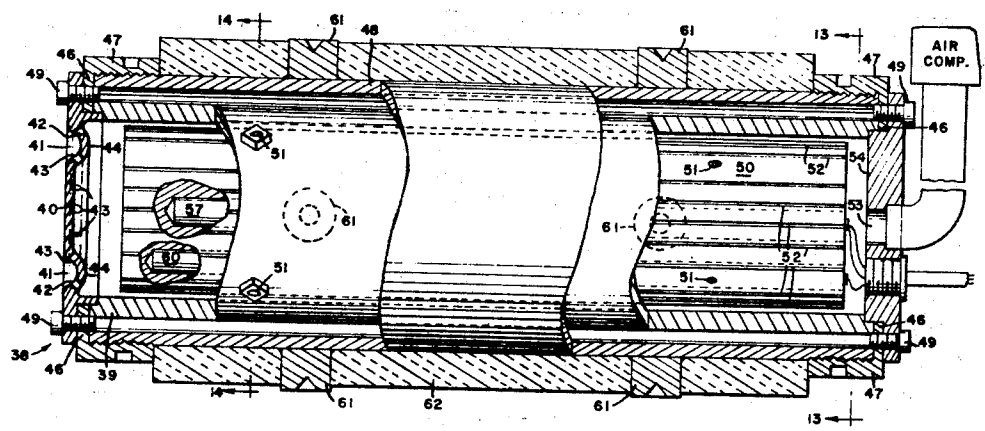
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Primary Examiner—A. Bartis
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ABSTRACT: A quick acting air heater comprises a cylindrical shell and a perforated plate secured to one end of the shell. A solid cylindrical core member is coaxially disposed within the shell, adjustable means being provided for holding it in position relative to the shell. The core member is provided with air passages extending longitudinally and radially inward from its periphery. One or more electrical heaters are embedded in the core displaced from the slots. Means are provided for directing air from a source outside the shell longitudinally through the slots. This provides a highly sensitive heater which is quickly responsive to high temperature requirements. An important feature resides in the fact that no air space exists between the heater and the slots to insulate or retard the flow of heat to the slots.



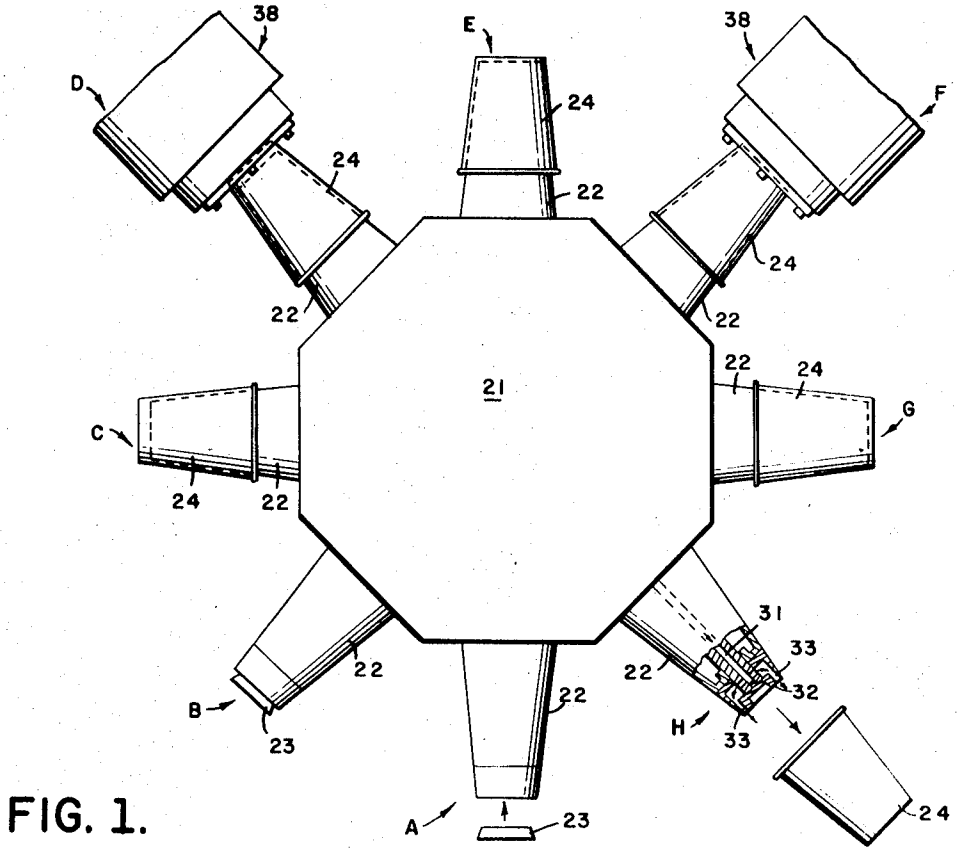


FIG. 1.

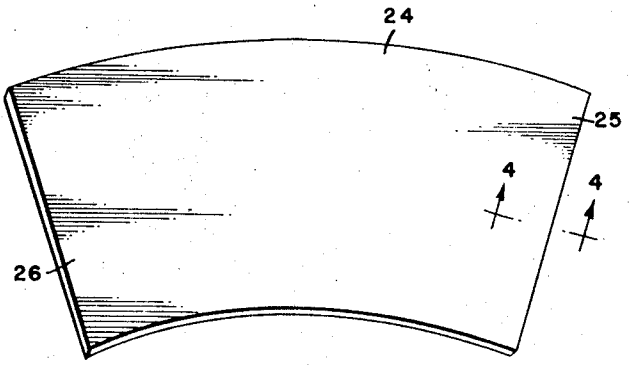


FIG. 2.

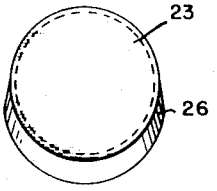


FIG. 3.

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FIG. 14.

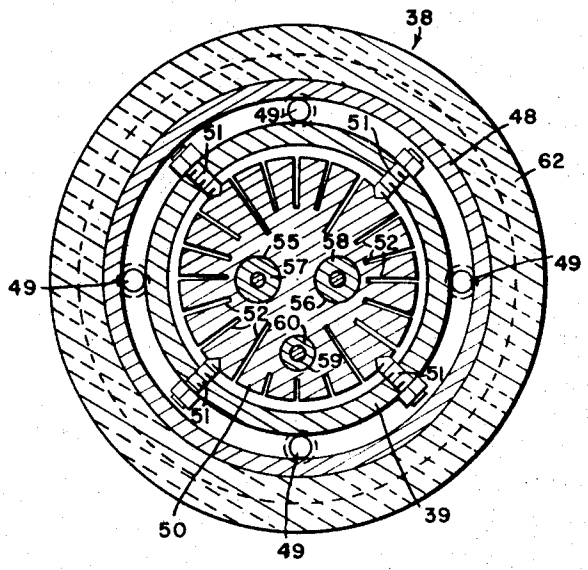


FIG. 4.

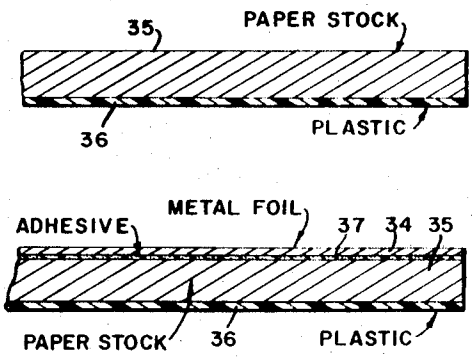


FIG. 5.

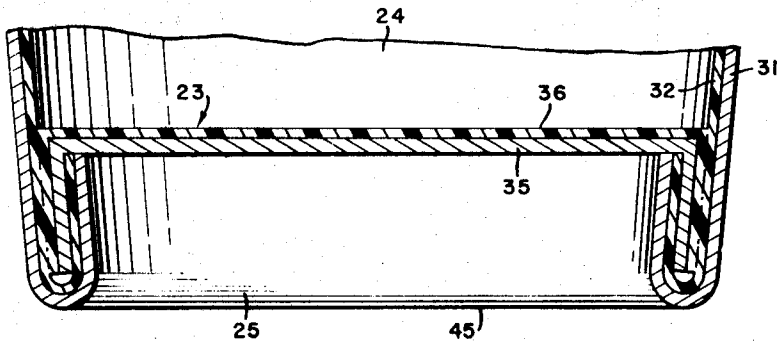


FIG. 15.

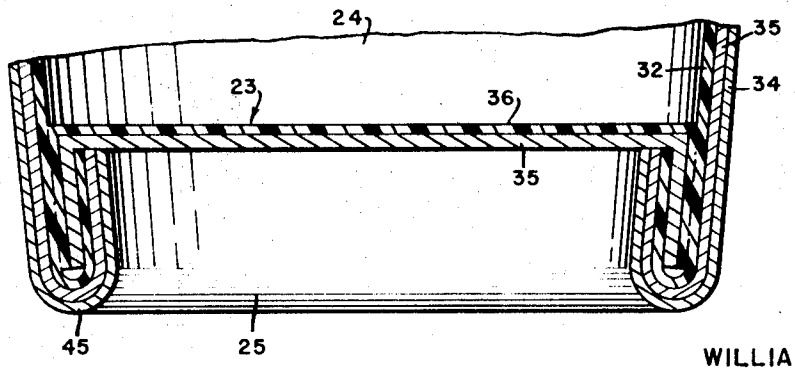


FIG. 16.

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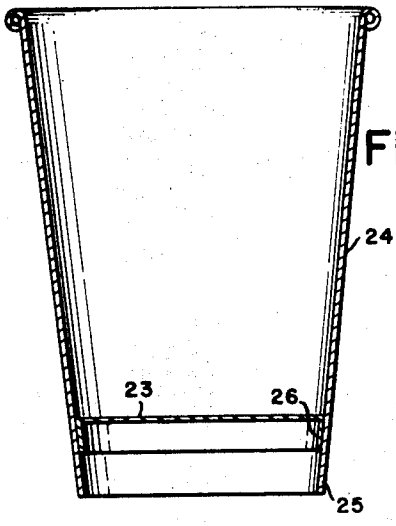


FIG. 6.

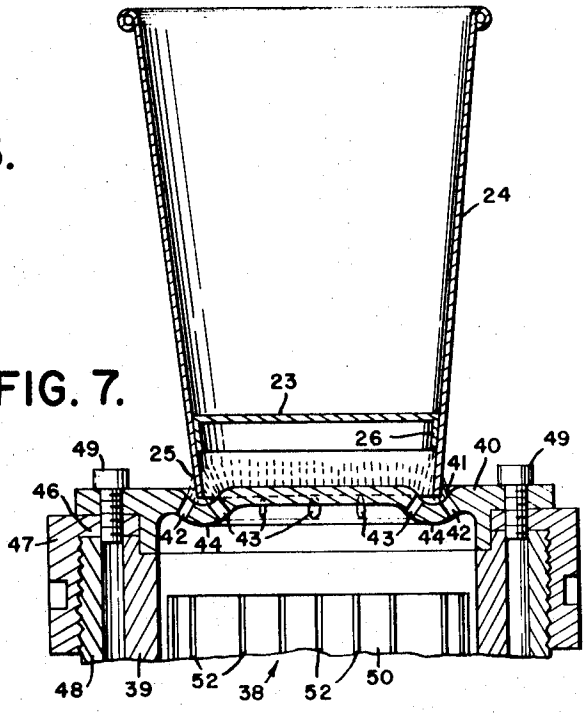


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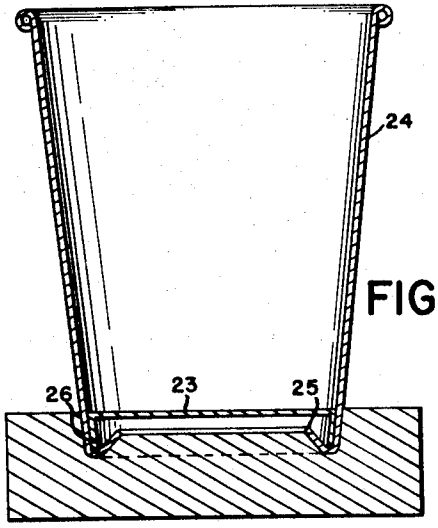


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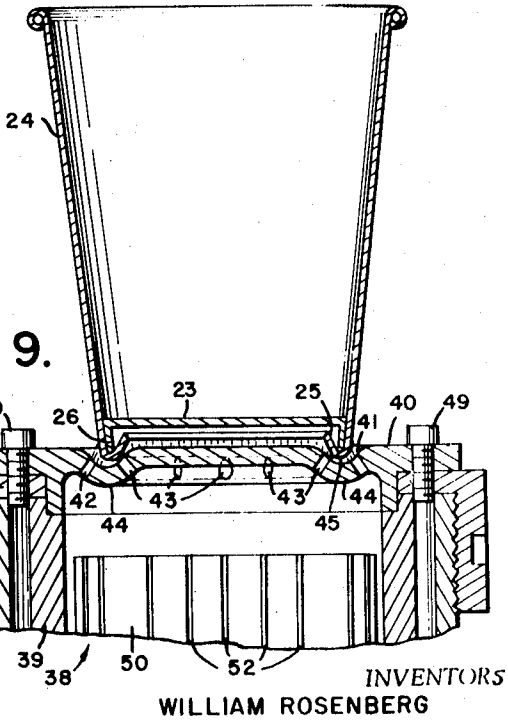


FIG. 9.

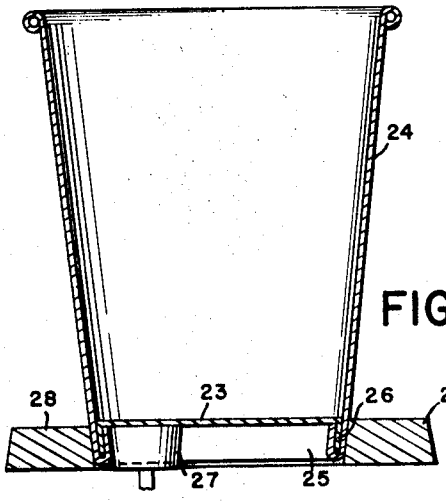


FIG. 10.

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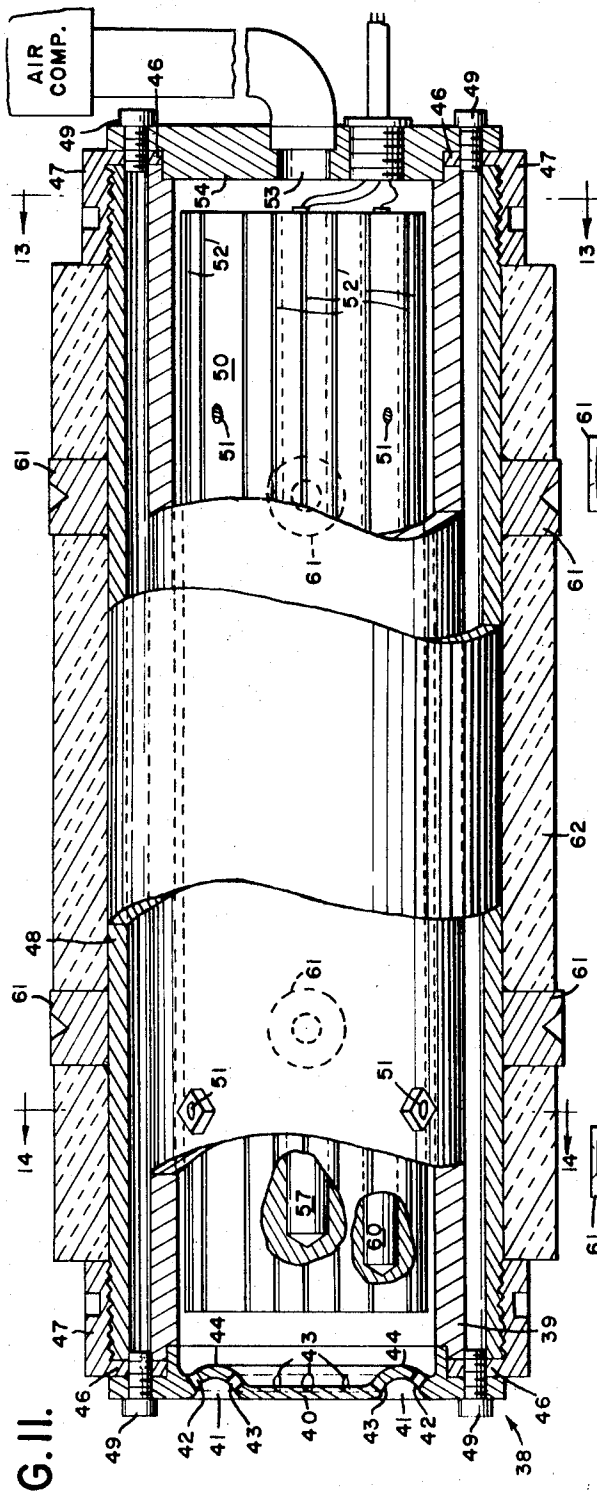


FIG. 11.

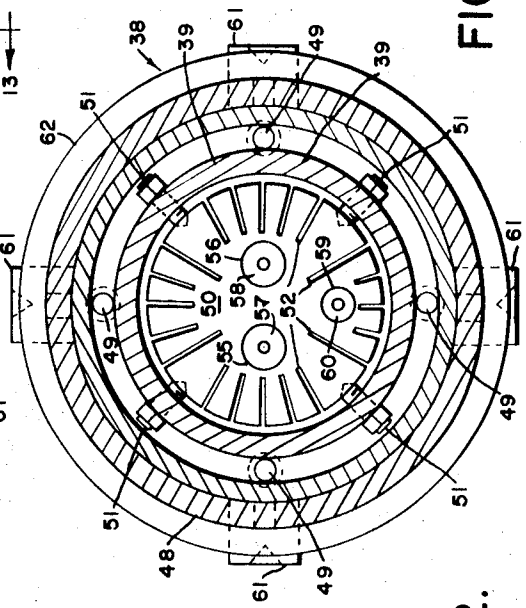


FIG. 13.

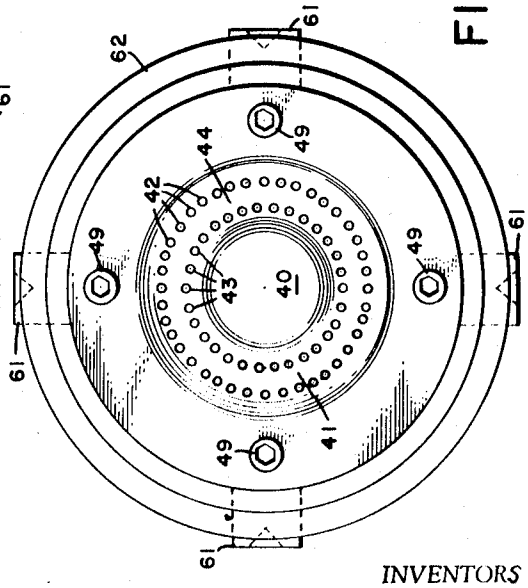


FIG. 12.

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A QUICK ACTING AIR HEATER

This is a division of our application for Pat., Ser. No. 418,434, filed Dec. 15, 1964, now U.S. Pat. No. 3,439,590.

This invention relates to paper cups; and it is more particularly concerned with the manufacture of such cups.

A popular form of paper cup in wide, general use is known in the industry as the "flat bottom" cup. It is made, generally, of a circular bottom wall having a downwardly extending flange and a frustoconical sidewall the bottom of which fits around the flange of the bottom wall. A marginal extension of the sidewall is bent around the flange of the bottom wall and securely fitted to it by a "bottom expander." These two parts, so arranged relative to each other, are glued together, the glue being applied at a convenient step in the assembly of the blanks which form these parts.

In recent years, the industry has developed many improvements in these cups. A significant improvement is the coating of the inside surfaces of the cups with a plastic material to form a barrier against hot liquids, like coffee, and cold liquids to prevent them from coming into contact with and being absorbed by the porous paper. In many instances, these coatings are applied to the cup after their manufacture.

It has been suggested that the plastic coating might be applied to the surface of the blank members before they are assembled and that the paper coating be utilized as the sealing agent in lieu of the conventional glue.

Attempts to carry out this procedure have met with many difficulties. An important difficulty resides in the fact that the plastic material must be heated to the point of tackiness in order for it to be available as a bonding agent. However, in this tacky condition, it is difficult to handle the blanks on the assembly machinery. Slippage necessary to position the blank sections relative to each other is markedly reduced. Also, the surface of the mandrels are exposed to the tacky plastic causing the machinery to become fouled and requiring frequent stoppage and cleaning of the parts affected.

Also, it has been a problem to produce cups of this kind from laminated sheets, such as paper cup stock laminated with aluminum foil, a formidable difficulty being the partial delamination or separation of the plies from each other under the heat required to soften the plastic coating. As a result, partial separation of the plies is encountered.

The general object of the present invention is the provision of an improved method of manufacturing flat bottom cups from plastic-coated blanks.

A specific object of the invention is the provision of such an improved method which is adaptable to commercial automatic cup-making machinery and by means of which the plastic coating does not interfere or adversely affect the operation of the machinery.

Another object of the invention is the provision of such a method which is highly effective and reliable in commercial operations.

A further object of the invention is the provision of such a method which is applicable to the production of cups from laminated sheet material, such as sheets of ordinary paper cup stock laminated with aluminum foil.

These and still further objects, advantages, and features will appear more fully from the following description together with the accompanying drawings. The invention comprises briefly a high sensitivity air heater which is quickly responsive to high temperature requirements, having a cylindrical shell and a perforated plate at one end of the shell. These perforations are preferably in the form of two concentric circles. A cylindrical core of solid material is coaxially disposed within the shell. Means may be provided for adjustably supporting the core coaxially of the shell in spaced relation to the inner wall surface of the shell. The air passages in the core are formed by slots in the core extending longitudinally of the core and radially inward from the periphery. An electrical heater is embedded in the core and means are provided for directing air from an outside source into the shell through the slot passages in the direction of the perforated plate.

In the drawings:

FIG. 1 is a schematic plan view of a rotatable turret forming part of a typical cup-making machine including the radial mandrels with modifications in accordance with this invention and illustrating the series of steps in the formation of the cups.

FIG. 2 is a perspective view of a blank member used in forming the sidewall of the cup.

FIG. 3 is a perspective view of a blank member used in forming the bottom wall of the cup.

FIG. 4 is a cross sectional view along the line 4—4 of FIG. 2.

FIG. 5 is a view similar to FIG. 4 showing a modified form of the blank.

FIG. 6 is a schematic longitudinal cross sectional view of the blank members of FIGS. 3 and 4 at one station in the series of assembly operations apart from the machine as a whole.

FIG. 7 is a schematic longitudinal cross-sectional view of the same blank member in a subsequent step in the method of assembly designated as the initial heating station and showing in section a fragmentary portion of the unit used to direct controlled hot air to the blank members.

FIG. 8 is a longitudinal cross-sectional view of the same blank members in a subsequent step of the method showing diagrammatically the member used to curl the end marginal portion of the wall blank about the flange of the bottom blank.

FIG. 9 is a schematic view of the same blank parts in a subsequent step of the process illustrating the condition at the second heating stage.

FIG. 10 is a longitudinal sectional view showing the relation of the parts at a subsequent step generally referred to in the art as "bottom expansion."

FIG. 11 is a side elevational view of one of the hot air units partly broken away.

FIG. 12 is an end elevational view of the unit of FIG. 11.

FIG. 13 is a sectional view along the line 13—13 of FIG. 11.

FIG. 14 is a cross-sectional view along the line 14—14 of FIG. 11.

FIG. 15 is a longitudinal sectional view on an enlarged scale of a fragmentary portion of a cup made in accordance with this invention by the use of plastic-coated blank members.

FIG. 16 is a view similar to FIG. 15 by the use of blank members plastic-coated on one side and metal foil laminated on the opposite side of the sidewall part.

Referring with more particularity to the drawing, the rotary turret shown in FIG. 1 comprises a conventional hub member 21 having frustoconical mandrels 22 secured thereto and extending radially outwardly therefrom. The turret is conventionally rotated intermittently by means (not shown), whereby the mandrels are successively positioned adjacent stations at which various steps in the process of forming the cups are carried out. The sequence comprises, generally, placing on each mandrel at station A a blank 23 that is to form the bottom section of the cup and then at subsequent station C a blank 24 that is to form the sidewall. The blank 23 is disposed at the outer end of the mandrel and the blank 24 is disposed around the circumference of the mandrel. The ends 25 and 26 of the blank 24 are lapped and secured together on the mandrel at station C by conventional means not shown. At subsequent stations, these blanks are secured together to form the cup which is finally discharged from the mandrel.

In the process of forming cups from ordinary paper stock, the blank 23 forming the bottom of the cup is secured to the sidewall by gluing. When plastic-coated blanks are used, it is possible to dispense with the glue by heating the parts of the blanks to be joined together to the point of tackiness of the plastic coating. One method of accomplishing this is described in U.S. Re Pat. No. 25,302, wherein the blanks are heated to render the plastic tacky and then are moved relative to each other to position the members in proper relation to each other.

A problem is involved in heating the plastic to the point of tackiness. A substantial amount of heat is required and the intervals of rest or dwell times of the mandrels at each station are quite short. Short dwell periods on the order of 0.3 to 0.5 seconds are necessary in order to achieve an economical production capacity.

When the blanks are in their final position, heat is difficult to penetrate the layer of paper, paper being a substantial heat insulator. Consequently, in prior methods, the heat is applied directly to the plastic layer or to both sides of the paper stock where the plastic is to be heated to a point of tackiness in order to achieve the condition of tackiness in the short interval of time available. In accordance with the present invention, controlled heat is applied at two separate stations. At the first or preheating station D, the heat is applied in an amount just sufficient to bring the plastic coating to a condition of impending tackiness. For polyethylene coatings, a temperature of about 750° F. is preferred when a dwell period of about 0.3 to 0.5 seconds is used. The heat is applied through the medium of hot air. At the second heating station F, the temperature is increased and an added quantity of heat is supplied to bring the coating to a condition of tackiness. For polyethylene plastic, a temperature of about 850° F. for the same dwell period has been found satisfactory for this purpose.

Between the station D and the station F, the blank parts **23** and **24** are subjected to a conventional operation known as "curling," whereby an annular marginal portion **27** of the blank **24** is bent around the flange **26** of the blank **23** in preparation of a final forming step known as "bottom expansion." Consequently, as the heating station F is reached, the blank parts are in position for the final forming operation and the heating is provided to effect or to cause the plastic to become tacky. The final forming step takes place at station G and consists of the conventional bottom expansion (see FIG. **10**) whereby the curled portion **25** is pressed into final position. This is diagrammatically illustrated in FIG. **10** by means of an inside roller **27** and an exterior anvil **28**. However, in actual commercial operations, a more elaborate mechanism is used. See U.S. Pat. No. 2,842,033.

At the succeeding station **11**, the completed cup is discharged from the mandrel by directing a blast of air through an axial passageway **31** of the mandrel to a diffuser **32** having openings **33** at the periphery. In passing from the station II to the station A, the mandrel is subjected to a cooling operation by continuing the blast of air to bring its temperature to a point below the softening temperature of the plastic. Unless this were done, the blanks placed on the mandrel at the start of the cycle of operation would have their plastic coating become tacky. Hence, it would be difficult, if not impossible, to manipulate the blank members on the mandrel. Also, the tacky plastic would foul the mandrel and require wasteful stopping of the operation to clean them. The efficiency of the operation from the standpoint of heat flow can be sharply controlled by adjusting the amount of heat extracted at this point so as to prevent the plastic from becoming tacky and subsequently adding only that amount of heat required to supplement the residual heat in the mandrels at the station D.

The use of the preheating station D is especially important in the manufacture of cups from laminated materials, such as paper stock, having a laminated metal foil **34** on one side of the paper stock **35** and the plastic coating **36** on the opposite side (see FIG. **5**). Adhesive materials **37** used to secure the laminates together soften under the temperatures used to soften the plastic coating and may, in fact, be the same material. Consequently, it is important that heat applied to the laminated sheets be such as to avoid separation of these laminates. This is effectively accomplished in accordance with the present invention where the final heating step to soften the coating is not applied until the blanks are in their final relative positions except for the bottom expansion step. The latter step, however, does not adversely affect the laminate bonding but, in fact, increases it under the pressure applied. Hence, the tendency of the laminates to separate is effectively negated and overcome.

The preheating station D and the final heating station F are each equipped with a heater **38**. These heaters at both stations are of substantially the same construction but operated at different temperatures. Each comprises a cylindrical shell **39** of stainless steel or other oxidation-resisting material, adapted to be disposed at the stations in alignment with the mandrels **22** as they come to rest at these stations. The adjacent end of the cylinder is provided with a plate **40** having a circular groove **41**. The groove is provided with two radially spaced circular rows of apertures **42** and **43** on either side of the center **44** of the groove. The center of the groove has substantially the same diameter as the bottom edge **45** of the cup so that the apertures **43** on the inner row are directed toward the inside of the cup while the outer row **42** is directed toward the outside. The plate **40** is secured to an inner flange **46** of retaining rings **47** of an outer cylinder **48** by means of bolts **49**.

On the interior of the cylindrical shell **39**, there is mounted a cylindrical core **50** of a diameter less than the inside diameter of the shell **39** so that it is disposed coaxially therewith in spaced relation to the shell. The core is held in the axial position by means of setscrews **51** passing through the shell and contacting the core.

The core is provided with a series of radial slots **52** that extend longitudinally from one end of the core to the other end through which air to be heated is directed from an air compressor (See FIG. **11**) into the shell through an opening **53** of an end wall **54** at the opposite end of the shell. The core is also provided with a pair of longitudinal bores **55** and **56** in which there are embedded electrical heating elements **57** and **58**, respectively. A third longitudinal bore **59** is provided with a thermocouple **60** for connection to a temperature gauge and regulator (not shown).

The shell **48** is provided with mounting lugs **61** and a sheet of insulation **62** about the outer surface to reduce heat radiation losses.

I claim:

1. An air heater comprising a cylindrical shell, a perforated plate at one end of the shell, a solid cylindrical core member coaxially disposed within said shell, said core member having longitudinal air passages in the form of relatively thin radial slots, an electrical heater embedded in said core displaced from said radial slots, means for directing air from an outside source into the said shell through said passages in the direction of the perforated plate, and adjustable means for supporting the lateral surface of the core in coaxial spaced relation to the inner wall surface of the shell.

2. An air heater as defined by claim **1** in which the perforations of the end plate are arranged in the form of two concentric circles.

3. An air heater as defined by claim **1** in which the end plate contains an annular groove between the two concentric circles to fit the bottom edge of a paper cup.

4. An air heater as defined by claim **1** and means for forcing air into the shell through the passages in the direction of the perforated plate.