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3,349,502

APPARATUS FOR SHRINKING FILM-WRAPPINGS ON ARTICLES

Filed Aug. 11, 1964

3 Sheets-Sheet 1

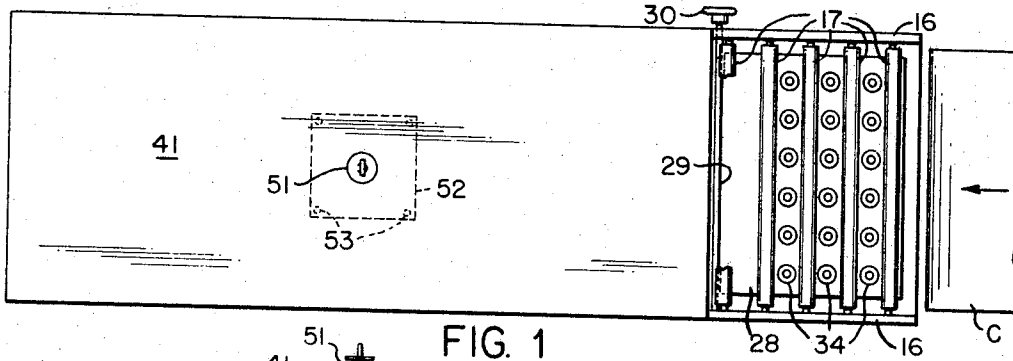


FIG. 1

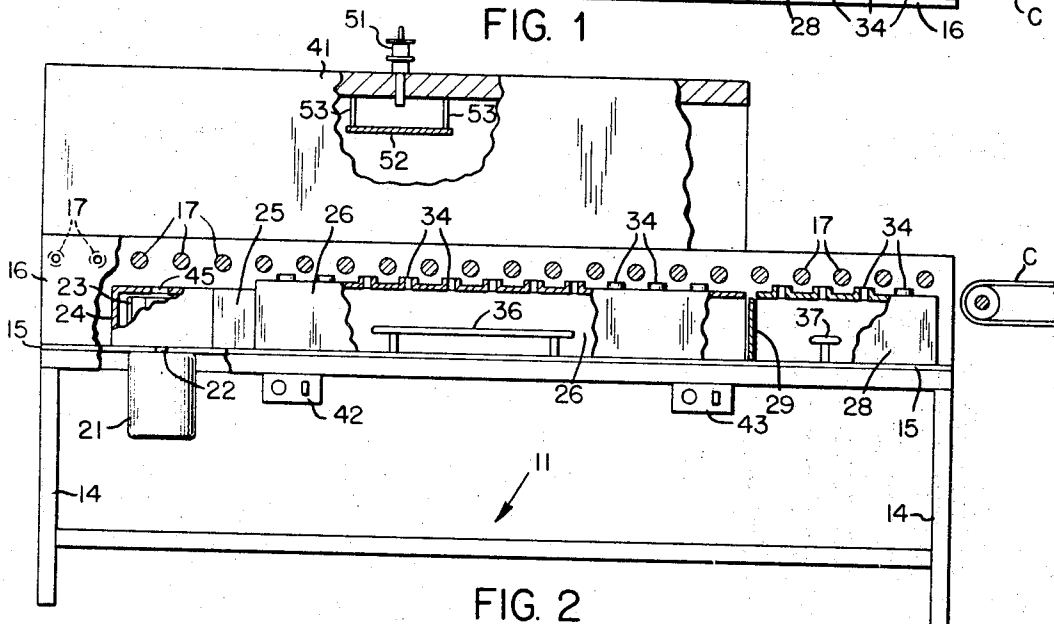


FIG. 2

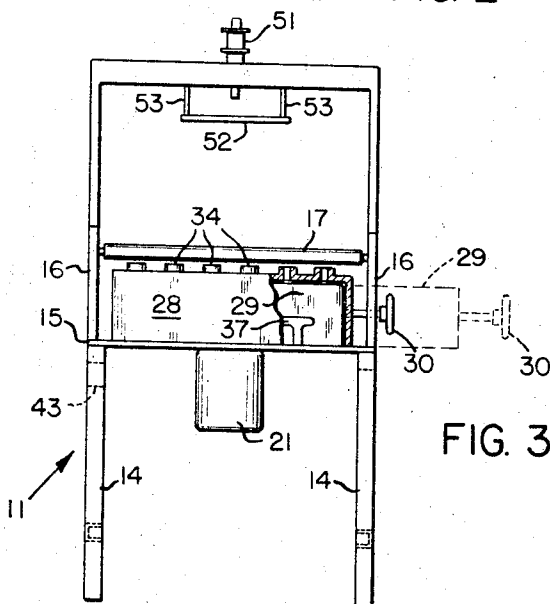


FIG. 3

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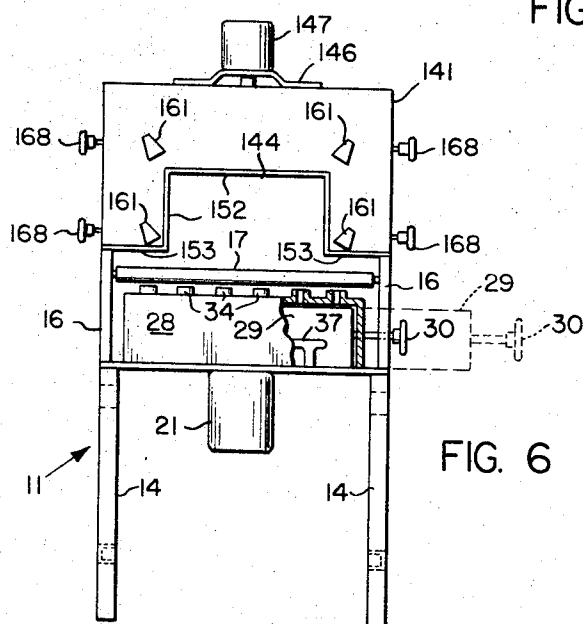
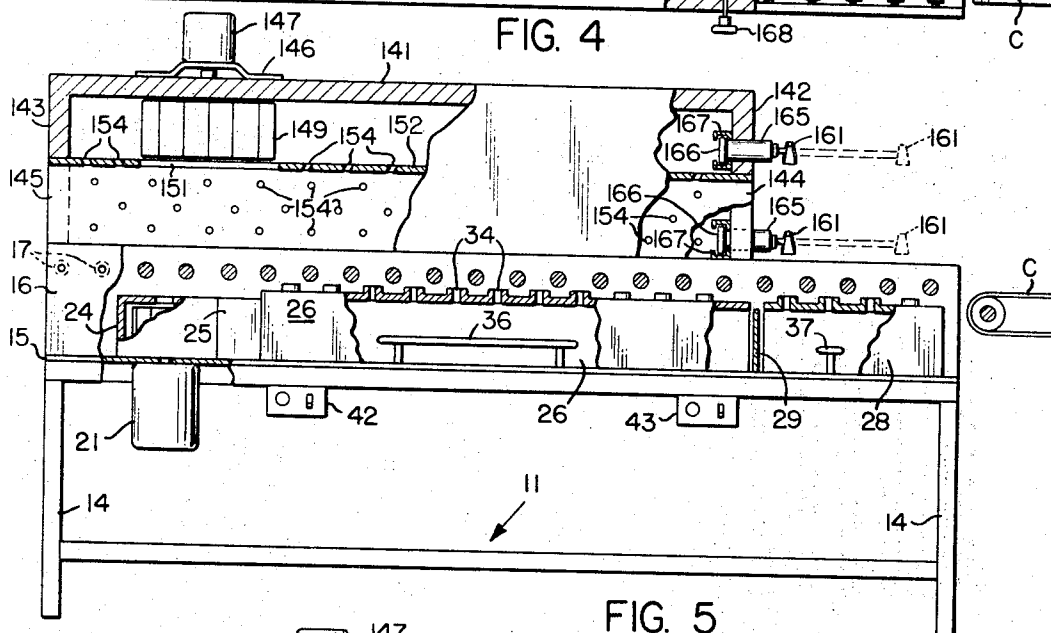
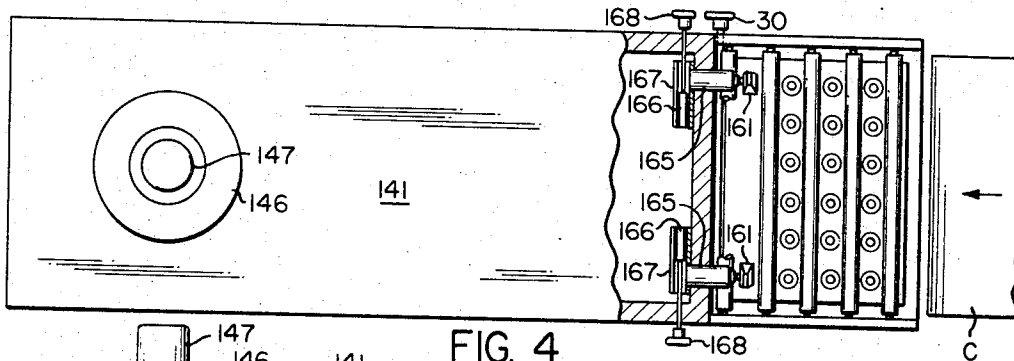
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3 Sheets-Sheet 2



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APPARATUS FOR SHRINKING FILM-WRAPPINGS ON ARTICLES

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3 Sheets-Sheet 3

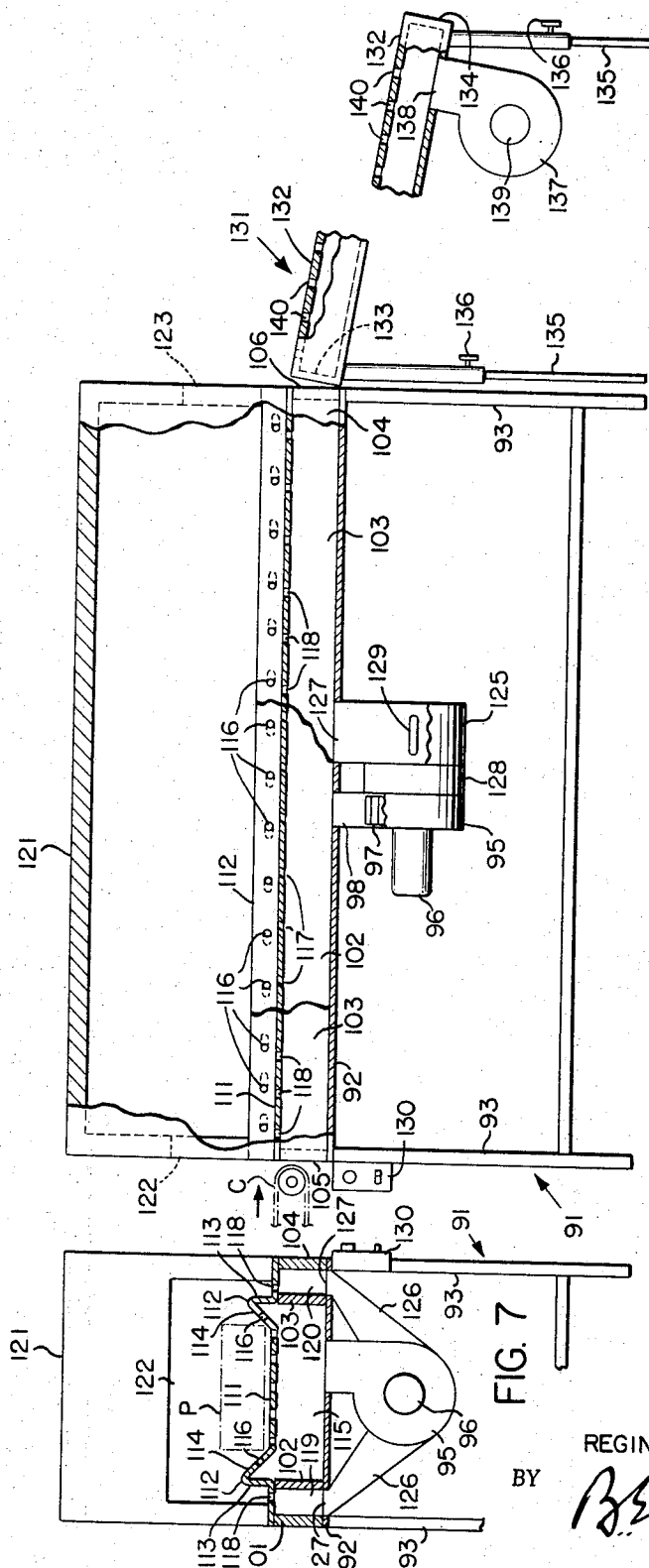


FIG. 8

FIG. 7

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APPARATUS FOR SHRINKING FILM-WRAPPINGS ON ARTICLES

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Filed Aug. 11, 1964, Ser. No. 388,771
7 Claims. (Cl. 34-216)

This invention relates to shrink tunnels for shrinking heat shrinkable plastic wrapping film around various articles such as food, packages containing food, record albums, playing cards, toys, cosmetic aids, etc.

In practice the article is first wrapped and sealed in film; and then it is passed through the shrink tunnel to shrink the film tightly around it. For wrapping and sealing the film about the article, a continuous length of heat-shrinkable film may be folded in half along its length and initially sealed at one end. The article is then inserted between the two layers of film; and may then be passed between cooperating L-shaped jaws of a sealing machine. A heated wire carried by one of the jaws of the machine simultaneously cuts off and seals the film about the package along the open side of the fold and the trailing end of the package. Thereby, the folded film is sealed along one side and both ends of the package.

An alternate method is to use two sheets of film, first joining the sheets along opposite edges to make a sleeve for housing a package, and then using parallel side jaws for sealing opposite ends of the sleeve so that a seam extends around all four sides of a package. A third method is to place a package in a plastic bag of heat shrinkable material, and thereafter to seal the open end of the bag.

When a package wrapped and sealed by any of the above-mentioned methods is subsequently passed through a conventional shrink tunnel, heated air is circulated rapidly about it by a fan or blower and it is immediately exposed to heat on all sides. As a result, wrinkles are likely to be formed in the wrapping at the top of the package; and the seams in the wrapping material, more often than not, are drawn to the top of the package as the film shrinks around the package. The display side of the package and/or the advertising matter thereon is thus made unsightly, detracting from the saleability of the goods.

The possibility of unsightly appearance is increased in the case of a round or disc-shaped package, such as for a pie or pizza, or for a phonograph disc. The sealer leaves the wrapper with four square corners; and when this type wrapper is shrunk onto a round package, the four corners of the sealed wrapping have to be drawn onto the top of the package at least as often as to the bottom, and when they are drawn onto the top, the top of the wrapping is full of wrinkles, and the package presents a very poor appearance indeed.

Certain types of merchandise are packaged by placing the goods in heat-shrinkage plastic sleeves, and passing the package endwise first through the shrink tunnel. As the package enters the shrink tunnel, however, the sleeve tends to shrink rapidly both longitudinally of its axis, as well as radially, so that the open ends of the sleeve are drawn inwardly from the package ends, thereby resulting in undesirable exposure of the merchandise at opposite ends of the package.

Aside from these difficulties, there is the fact that different films require different temperatures and exposure times to properly shrink them onto articles; and if too high a temperature is used, in the interest of saving time, the film tends to burn, particularly at the top of the package where the temperature is highest anyway. Moreover there is the problem of securing uniform shrinkage of the packaging film about an article which

is cold at the places where the film touches it. Thus the film will not shrink uniformly over the places where it touches the cold surface of contents, such as chilled or frozen meat, chicken parts, apples, etc. The air may be heated as high as it can go without burning, and still, the film touching the cold contents will not shrink completely and will leave wrinkles in those places.

A further disadvantage of prior shrink tunnels is that the packages generally are conveyed through the tunnels by positively driven belt conveyors, so that if packages happen to accumulate along a conveyor, the moving belt tends to scuff the plastic package wrappings. Moreover, such conveyor systems are expensive and difficult to maintain.

An object of this invention is to provide heat-shrinking apparatus that in operation will result in greatly improved appearance for packages, particularly those of irregular shape, that are wrapped in heat-shrinkable film.

Another object of this invention is to provide improved heat-shrinking apparatus designed to draw the heat-shrinkable wrapper down to the bottom of a package, so that the top, display or merchandising face of the package will be completely clear and free from unsightly wrinkles or seams.

Another object of this invention is to provide a shrink tunnel which is capable of subjecting heat-shrinkable package wrapping material to selective, localized heating, thereby to permit controlled shrinkage of the wrapping material. To this end, a further object of the invention is to provide heat-shrinking apparatus that will shrink the film down tightly on the top of the package before shrinking it completely onto the other sides of the package.

An additional object of this invention is to provide a shrink tunnel having improved means for conveying packages therethrough.

A further object of this invention is to provide heat-shrinking apparatus of the type described, which will substantially eliminate any scuffing of the film wrapped packages as they are fed through a shrink tunnel.

A still further object of the invention is to provide film-shrinking apparatus which will obviate "burning" of the film. To this end still another object of the invention is to provide heat-shrinking apparatus for shrinking a film covering about a package or article, which will enable the temperature in the shrink tunnel to be reduced as compared with the temperatures ordinarily employed, and which will maintain a humid atmosphere in the tunnel.

Other objects of the invention will be apparent hereinafter from the specification and from the recital of the appended claims, particularly when read in conjunction with the accompanying drawings.

In one embodiment of the invention illustrated herein, an open-top, open-side pre-heat section is provided in front of the shrink tunnel; and the film-wrapped package travels over this pre-heat section before it enters the shrink tunnel. The pre-heat section comprises a plenum chamber having a perforated upper surface over which the package is carried, and from which hot air is emitted upwardly to pre-shrink the film at the bottom of the package.

Hot air under pressure may be directed from the shrink tunnel into the plenum chamber through a duct having a manually operable damper for controlling the volume, and therefore the velocity of the air, which passes into the plenum chamber. An auxiliary heating element and an auxiliary thermostat may also be placed in the plenum chamber further to control the temperature of the air therein.

Since only the bottom of the package is directly exposed to the hot air rising from perforations in the

plenum chamber, the bottom portion of the film wrapping shrinks in the pre-shrinker section of the apparatus much more than do the sides of the wrapping, and still more than does the top because the sides are not directly exposed to the heat, and the top is heated little if at all. Therefore, in the pre-heat section the wrapping is drawn down toward the bottom of the package, taking up the slack on the top and sides before the package enters the shrink tunnel proper. The heat-shrunk package leaving the shrink tunnel presents then the desired clear, unmarred appearance on its top and sides.

In a second embodiment of the invention, a plurality of nozzles are added for directing hot air along the edges of a package. The nozzles are adjustably mounted on the shrink tunnel to project forwardly beyond its entrance so that the jets of hot air from them strike a package before it enters the shrink tunnel. Dampers are provided for shutting off or controlling the flow of hot air from the tunnel to the nozzles. The nozzles are adapted to be employed with or in lieu of the above-described plenum chamber, and are particularly useful for packages wrapped in heat-shrinkable plastic sleeves. The nozzles are positioned to direct hot air onto the sleeves along the sides of a package, adjacent the upper and lower faces thereof, and may be adjusted so that the hot air jets strike the package as it passes over the front end of the plenum chamber or just before it enters into the shrink tunnel. This preheating prevents the sleeves from pulling back off the ends of the package, when the latter enters the heating area of the preheat section or of the tunnel proper.

The invention also includes novel means of conveying packages through the heat shrinking apparatus. More specifically, the heated air, which is used to shrink the plastic wrappers is directed against the packages in such manner as to lift and convey them through the shrink tunnel.

In the drawings:

FIG. 1 is a fragmentary plan view of heat-shrinking apparatus made in accordance with one embodiment of this invention, part of a conveyor roller being broken away;

FIG. 2 is a side elevational view of this apparatus, parts thereof being cut away and shown in section;

FIG. 3 is a front end view of this apparatus with parts thereof cut away and shown in section;

FIG. 4 is a fragmentary plan view of heat-shrinking apparatus made in accordance with a further embodiment of this invention, parts thereof being cut away and shown in section;

FIG. 5 is a side elevational view of this modified apparatus, parts thereof being broken away and shown in section;

FIG. 6 is a front end view of this further embodiment, parts thereof being cut away and shown in section;

FIG. 7 is a rear end elevational view of heat-shrinking apparatus made in accordance with a still further embodiment of this invention, certain of the parts being shown in section; and

FIG. 8 is a fragmentary side elevational view of this last-mentioned apparatus, parts thereof being broken away and shown in section.

Referring now to the drawings by numerals of reference, and first to the embodiment illustrated in FIGS. 1 to 3, 11 denotes the frame or stand on which the apparatus is mounted. This may be of any suitable, conventional construction. The stand shown is table-like in structure comprising rectangular top plate 15 along parallel side edges thereof, and projecting vertically upwardly from this plate in spaced, parallel relation to one another, are a pair of parallel, rigid side plates 16. Rotatably journaled at opposite ends thereof in the plates 16 adjacent the upper edges of these plates, and extending transversely between these plates for rotation about spaced, parallel coplanar horizontal axes, are a plurality

of spaced conveyor rollers 17 for transporting packages from the right to the left as shown in FIGS. 1 and 2.

Secured to and beneath plate 15 adjacent one end thereof is an electric motor 21. The shaft 22 of motor 21 projects through an opening in plate 15 and has secured thereto the blades of a fan 23. Fan 23 is enclosed in a housing 24 which is secured on the plate 15 above the motor 21, and below the conveyor rollers 17. The fan housing 24 communicates through a duct 25 with the rear end of an elongate chamber or housing 26, which extends beneath some of the rollers 17, and part way along the top of plate 15. At its opposite or front end, the housing 26 is open and registers with the open end of an extension thereof which constitutes a plenum chamber 28, which is mounted on plate 15 beneath others of the conveyor rollers 17.

Mounted for sliding movement between main housing 26 and extension 28 is a damper 29 for controlling the flow of air between the housing 26 and the plenum chamber 28. Damper 29 is connected to and operable by a handle 30 located at one side of the frame. Its open and closed positions are shown in FIG. 3 by broken solid lines, respectively.

Mounted in the main housing 26 is a heater 36 (FIG. 2) for heating the air which is delivered by fan 23 through duct 25 into the housing. Mounted in the plenum chamber 28 is another, preshrink heater 37. The tops of the main housing 26 and chamber 28 have nipples 34 in them which are arranged in a plurality of transverse rows parallel to the rollers 17, and which register with the spaces between the rollers. The heated air flows from the chambers 26 and 28 through the nipples 34. It is drawn into fan housing 24 through the opening 45 there-in.

Secured along its lower edges to the upper edges of the two vertically disposed side plates 16 is an elongate, inverted, hood or cover member 41, which is open at front and back and serves to enclose the top and sides of the shrink tunnel.

The heaters 36 and 37 are connected to conventional control units 42 and 43, respectively (FIG. 2), which comprise conventional On-Off switches for the two heaters independently of one another. The fan motor 21 may be connected to the On-Off switch of the unit 42 to be energized with the heater 36, or may be operable independently of the heater by a separate switch.

Mounted in an opening in the top of the hood or tunnel 41 is a conventional humidifier unit 51. Suspended by rods or posts 53 beneath the top of tunnel 41 in registry with the unit 51 is a stainless steel plate 52. The humidifier unit 51 is operative to drip water at a controllable rate onto the plate 52.

In the use of the apparatus shown in FIGS. 1 to 3, the packages, whose wrappings are to be heat-shrunk on them, are delivered by a first conveyor C (FIGS. 1 and 2) onto the conveyor rollers 17 above the pre-shrink chamber 28. Assuming that the fan 23 and the heater coils 36 and 37 are operating, and that the damper 29 is open, air is pumped by the fan into housing 26 where it will be heated by coil 36. Part of this air will pass upwardly out of the housing 26 through its nipples 34, and the remaining part will pass into the chamber 28. There it is heated to a higher temperature by the coil 37, and then passes out nipples 34 into the spaces between the rollers 17 upon which is disposed the incoming package.

Since the chamber 28 is uncovered, only the underside of the package is subjected directly to the blasts of hot air, which emanate from the pre-heater chamber 28. This causes the heat-shrinkable film to shrink tightly over the bottom of the package, and to be drawn down from the top and sides of the package; and the seams, which have previously been formed in the film by the sealing machine, tend to be drawn down beneath the package

also. The top and sides of the package thus remain clear and free of unsightly seams.

From the preheater or preshrinker, the package passes into the shrink tunnel proper. The package is now exposed on all sides to the heated air in the tunnel which emanates from the nipples 34 in the housing 26. The wrapper has already been pretty well preset around the package, however, in the preshrinker section so that there is little chance now of wrinkles being formed in the top or sides of the wrapping. In this section of the apparatus the wrapping film is merely further shrunk onto and drawn firmly about the package.

One of the great advantages of the preheater plenum 28 is that it enables a lower temperature to be used in the shrink tunnel itself than has been used in the past. Thus danger of "burning" the film through too high a shrinking temperature is obviated. Experience has shown, that is the case of the heat-shrinkable wrapping material sold under the tradename of "Reynolon," for instance, the temperature required, where the shrink tunnel is used alone, should be approximately 290° F. However, with a preheater 28, the temperature in the preheater chamber can be 310° to 315° F., without "burning," for the preheater is not enclosed, while the temperature in the shrink tunnel itself may be reduced to from 270° to 275° F. Although the bottom of the package is exposed to a relatively high temperature in the preheater, the time that a package spends over the preheater is so brief that the wrapping material does not tend to become brittle or charred.

Moreover, since the temperature in the tunnel, and hence the temperature of the plate 52, is maintained well above 212° F., the water dripping from unit 51 tends to turn immediately to steam upon hitting plate 52, thereby increasing the humidity of the air in the shrink tunnel. This has the effect of increasing the heat transmission rate; and this permits faster shrinkage, or alternately, use of lower temperatures in the shrink tunnel. It effects shrinkage of the wrapping film even where the film touches a cool surface on the item it surrounds.

The modified apparatus illustrated in FIGS. 4 to 6 is particularly adapted to heat shrink a package which has been wrapped in a heat-shrinkable plastic sleeve. In this embodiment, wherein like numerals are employed to designate elements which are identical to those of the first embodiment (FIGS. 1 to 3) a modified tunnel hood 141 is supported on the side plates 16 above certain of the conveyor rollers 17, in much the same manner as the hood 41. Hood 141, however, includes forward and rear end walls 142 and 143, respectively, which have therethrough identically shaped rectangular openings 144 and 145 (FIGS. 5 and 6) that define the tunnel entrance and exit, respectively. Mounted by a bracket 146 to hood 141 adjacent the rear end of the latter is an electric motor 147, which is adapted to be connected for operation with motor 21. The shaft of the motor 147 projects through the top wall 148 of the hood, and has secured to it a recirculating fan 149 (FIG. 5) of the centrifugal type, which rotates about a vertical axis adjacent the inside face of the hood. The fan 149 registers with a large circular opening 151 formed in the top of an inverted, U-shaped, perforated plate 152, which extends longitudinally through the tunnel, and which is secured at opposite ends thereof to the marginal edges of the tunnel openings 144 and 145, respectively. The plate 152 has therethrough a plurality of apertures 154, and has longitudinally extending flange portions 153 (FIG. 6) which project horizontally outwardly beneath opposite sides of hood 141.

Mounted on the front wall 142 of the tunnel adjacent the tunnel entrance 144 are four, identical, spaced nozzles 161. Each of the nozzles 161 is positioned adjacent one of the four corners of the entrance 144, and is carried by a conventional, telescopic pipe 165, which is secured in the front tunnel wall 142 with its axis extending parallel

to the tunnel length. Each pipe 165 permits its associated nozzle 161 to be shifted manually between a retracted position as shown by solid lines in FIG. 5, and an advanced position as shown in phantom by the broken lines in this figure.

At its inner end each of the pipes 165 communicates with the space between the plate 152 and the hood 141. A slidable damper 166, guided in a bracket 167, associated with each nozzle 161, controls the flow of hot air to the nozzle. The dampers are manipulated by handles 168.

The remainder of this second embodiment is identical to that of the embodiment illustrated in FIGS. 1 to 3, including conveyor rollers 17 for conveying packages across the preshrink chamber 28, and then into the tunnel.

In operation, the fan motors 21 and 147, and the heater 36 are energized. The dampers 166 are adjusted as required. If they are open part of the hot air from between the plate 152 and the tunnel wall flows to each of the nozzles 161. If the preheater 37 is deenergized, and the damper 29 is in its closed position there is no preheating of the package through the agency of the plenum chamber 28. In such case the nozzles 161 are preferably disposed in their retracted positions as shown by solid lines in the drawings, and are tilted angularly about the axes of their respective pipes 165 to direct hot air along the upper and lower side edges of a package as the latter is fed by the conveyor C (FIGS. 4 and 5) into the shrink tunnel. The plastic sleeve surrounding such package is thus preheated at four spaced points about its periphery as the package passes the nozzles 61, thereby producing a predominately radial shrinkage of the sleeve: first about the forward end of the package, then along the upper and lower side edges of the package, and finally about the rear end of the package. This radial preshrinkage of the wrapping sleeve tends to stabilize the sleeve length, and prevents the open ends of the sleeve from being pulled or shrunk back from opposite ends of the package, when all sides of the sleeve are finally subjected to hot air in the shrink tunnel.

If the bottom preshrinker 28 is employed simultaneously with the nozzles 161—i.e., if the damper 29 is in its open position, the nozzles 161 preferably are pulled out to their advanced position as indicated by the broken lines in FIG. 5 so that the advancing package is preheated by the nozzles 161 before passing over the plenum 28. Preferably heater 37 is then energized as well as heater 36.

The dampers 29 and 166, and the thermostats in the units 42 and 43 control, respectively, the velocity and temperature of the air flowing from the preheater chamber 28, and from the nozzles 161. The exposure time and the temperature of the air necessary to produce shrinkage of the wrapping material about a package depends upon the type of wrapping material employed.

Referring now to the modification illustrated in FIGS. 7 and 8, the support or frame 91 is also table-like, and comprises a horizontal plate 92 secured to the upper ends of four, vertical, reinforced legs 93. Secured to the bottom of the plate 92 substantially centrally thereof is a fan housing 95. Secured to and projecting from one face of the housing 95 is a motor 96 having a shaft (not illustrated) which projects into the fan housing 95 and has secured thereto a centrifugal fan 97. The upper end of the housing 95 is open and registers with an opening 98 formed in the plate 92 substantially centrally thereof.

Secured to the top of the plate 92 adjacent opposite sides thereof, respectively, and extending parallel to the longitudinal side edges of the plate 92 between opposite ends thereof are two pairs of laterally spaced beams 101 and 102, and 103 and 104, respectively. Secured to opposite ends of the two pairs of beams 101 to 104, and to the front and rear marginal ends of the plate 92 are end plates 105 and 106, respectively.

Secured to the tops of the beams 101 to 106 in vertically spaced relation with the plate 92 is a further plate 111.

Intermediate its longitudinal side edges the plate 11 is provided with a pair of parallel, longitudinally extending pleats or crimps 112, each of which projects above one of the inner members 102 and 103. Each pleat or crimp 112 comprises a vertically disposed web portion 113 (FIG. 7), which registers with the inside face of one of the beam members 102 and 103, respectively, and a diagonal web portion 114 (FIG. 7), which is inclined downwardly and inwardly from the top of a respective pleat 112 toward the horizontally disposed central section of plate 111.

Each diagonal web portion 114 of the plate 111 has therethrough a plurality of inclined apertures 116, which register with the space 115 (FIG. 7) between the inner beam members 102 and 103. The horizontal central section of the plate 111 between the ribs 112 also has therethrough a plurality of inclined apertures 117, which also register with this space 115. The two horizontal side portions of the plate 111, which overlie the two spaces 119 and 120 between the pairs of beams 101 and 102, and 103 and 104, respectively, have therethrough a plurality of apertures 118, which register with the spaces.

Secured to and seated along its lower edges on the marginal side edges of the plate 111 is an elongate, inverted hood 121. At opposite ends thereof the hood 121 is provided with rectangular openings 122 and 123, respectively, which form an entrance and an exit, respectively, for the packages that are conveyed through the tunnel.

Mounted beneath the plate 92 adjacent the side of the fan housing 95 remote from the motor 96 is a return air plenum 125 (FIG. 8). Plenum 125 comprises a pair of upwardly diverging ducts 126 (FIG. 7), each of which registers at its upper end with one of a pair of openings 127 formed in the plate 92 adjacent opposite sides thereof between the beams 101 and 102, and the beams 103 and 104, respectively. Adjacent its lower end the plenum 125 is connected by a duct 128 with the fan housing 95 and the intake side of the fan 97 mounted therein.

Mounted in conventional manner in the return air plenum 125 is a heater 129. The heater 129 and the motor 96 are adapted to be connected to a control unit 130, which is mounted on one of the vertical legs 93 of the frame adjacent the front of the apparatus. The unit 130 contains a conventional On-Off switch for simultaneously energizing and deenergizing the motor and the heater 129; and a thermostat for controlling the operation of the heater 129, when it is energized through the On-Off switch.

Mounted adjacent to the discharge end of the shrink tunnel is a gravity conveyor 131. Conveyor 131 comprises an elongate, rectangular plenum or sleeve 132. Opposite ends of the plenum 132 are sealed by transverse end walls 133 and 134. Each end of the plenum 132 is supported on a pair of conventional, telescoping legs 135. The length of each telescoping leg 135 is adapted to be adjusted by a manually operable set screw 136. As shown in FIG. 8, the legs 135 are adjusted so that the end of the plenum 132 remote from the shrink tunnel 121 is positioned horizontally below the end of the plenum 132 which is positioned immediately adjacent the exit 123 of the tunnel.

Mounted beneath the end of the plenum 132 remote from the tunnel 121 is a fan housing 137 (FIG. 8). The upper end of the housing 137 is open and registers with an opening 138 in the bottom of the plenum 132. Mounted adjacent the fan housing 142 is an electric motor 139. Motor 139 has a shaft which projects into the housing 137, and has secured thereto a centrifugal fan (not illustrated) for rotation by the motor 139 in the fan housing. When the motor 139 is energized, the fan attached thereto blows cool air, or air at ambient or room temperatures, into the plenum 132, and out of a plurality of holes 140 formed in the upper wall thereof.

The motor 139 may be connected to the control unit 130 to be actuated simultaneously with the motor 96, or

it may be controlled by a separate On-Off switch, not illustrated.

In operation packages are adapted to be conveyed to the tunnel 121 by a conveyor C, part of which is shown by broken lines in FIG. 8. Assuming that the motors 96 and 139 and the heater element 129 are energized, hot air is pumped by the fan 97 into the space 115 and through the openings 116 and 117 in the member 111.

As shown more clearly in FIG. 8, all of the opening 117 in the plate 111 are inclined from the lower face of the plate 111 upwardly and to the right in FIG. 8, or in the direction in which it is desired that the packages (one of which is shown by broken lines at P in FIG. 7) be moved through the tunnel. Also as shown in FIG. 8, the openings 116 in the diagonal web portions 114 of the plate 111 are inclined from the inner to the outer faces of the web portions 114 in the direction in which the packages move through the tunnel 121—i.e., from the left to the right in FIG. 8. Therefore, when a package is in the tunnel, the hot air issuing from the openings 116 and 117 not only effects a shrinking of the plastic material surrounding the package, but also functions as conveying means for moving the package through the tunnel. As it enters the tunnel, each package is lifted slightly upwardly and moved forwardly by the air issuing from the holes 117. It is guided centrally through the tunnel by the hot air which is directed onto opposite sides of a package by the openings 116.

After passing through the tunnel 121, the packages pass onto the upper surface of the downwardly inclined conveyor 131. The openings 140 in the top of the plenum 132 extend at right angles to the top of the plenum. When the fan in housing 137 is operating, then packages, which exit from the tunnel 121, are supported just above the top of the plenum 132 upon a thin cushion of air issuing from the openings 140; and the "floating" packages are thus conveyed by the force of gravity downwardly along the top of the plenum 132. The air issuing from the openings 140 is not heated and therefore also tends to cool the heat-shrinkable film surrounding the packages.

From the foregoing it will be apparent that applicant has provided relatively simple means for preshrinking heat-shrinkable wrapping material around the bottom or ends of a package. By preshrinking a sealed package wrapper along a package bottom, applicant's apparatus prevents the seams from obstructing the advertising or display and prevents any undesirable wrinkling of the wrapping material across the top of the package, when it is passed through the shrink tunnel proper. Similarly, the preshrinking of a plastic wrapping sleeve at opposite ends thereof prevents the sleeve ends from shrinking back off of the package ends, when the latter passes through the shrink tunnel. Moreover, by employing an air conveyor means for transporting the packages instead of positively driven conveyor rollers or the like, the likelihood of damage to the plastic wrapping as a result of collision between packages is substantially reduced.

While the embodiments illustrated in FIGS. 1 to 6 utilize rollers 17 to convey packages across the preshrinker 28 and through the tunnel 41 or 141, it is to be understood that the nipples 34 in the tops of the housings 26 and 28 could be inclined in the direction in which the packages are to be passed through the tunnel—i.e., from the right to the left in FIGS. 2 and 5—in which case the air issuing from nipples 34 could be utilized to assist the movement of packages along the rollers 17, or the latter could be eliminated completely, as in the case of the embodiment shown in FIGS. 7 and 8. Moreover, in lieu of inclining the nipples 34, and the openings 116 and 117 in the direction of the travel of the packages, they could be directed normal to the direction of travel of the packages, and the frames 11 and 91, or the base plates 15 and 92, could be in-

clined to the horizontal intermediate their ends, as in the case of the plenum 132, thereby to utilize gravity to convey the packages on a cushion of air through the tunnels 41, 141 and 121. Also, although not illustrated, it is to be understood that the tunnels 141 and 121 are adapted to have mounted thereon a humidifier unit 151 of the type shown in the embodiment of FIGS. 1 to 3.

While the invention has been described in connection with several specific embodiments thereof, it will be understood, then, that it is capable of further modification, and this application is intended to cover any variations, uses, or adaptations of the invention following, in general, the principles of the invention and including such departures from the present disclosure as come within known or customary practice in the art to which the invention pertains and as may be applied to the essential features hereinbefore set forth, and as fall within the scope of the invention or the limits of the appended claims.

Having thus described my invention, what I claim 20 is:

1. Apparatus for shrinking heat-shrinkable wrapping material about an article, comprising
 - (a) a preheat section completely open at its top and at its sides,
 - (b) a tunnel juxtaposed to said preheat section and closed at its top and both sides but having both ends thereof open, one of said ends adjoining said preheat section,
 - (c) means for conveying a wrapped article along a predetermined path successively over said preheat section and through said tunnel,
 - (d) means positioned in said preheat section for directing a stream of heated air against the bottom of the article to cause the wrapping material to shrink locally about the article, and
 - (e) means in said tunnel for directing a stream of heated air onto all sides of the article.
2. Apparatus for shrinking heat-shrinkable wrapping material about an article, comprising
 - (a) an enclosure,
 - (b) means for circulating heated air in said enclosure,
 - (c) means for conveying the wrapped article through said enclosure,
 - (d) first preheating means for selectively directing heated air onto the underside only of said article, before it is conveyed into said enclosure, and
 - (e) second preheating means including a plurality of nozzles adjustably mounted on the exterior of said enclosure at the entering end thereof,
 - (f) the last-named means including a plurality of manually adjustable dampers interposed between said nozzles and said enclosure for selectively connecting said nozzles to the interior of said enclosure for receiving and directing part of the heated air circulated therein onto the remaining sides of the article before it is conveyed into said enclosure.
3. Apparatus as defined in claim 1, wherein said conveying means comprises
 - (a) a plate over which said article is adapted to pass during its travel,
 - (b) said plate has therethrough a plurality of openings inclined from their lower ends to their upper ends in the direction in which the article is to travel, and
 - (c) means for blowing air from beneath said plate, and through said openings onto said article to move the latter in said direction.
4. Apparatus for shrinking heat-shrinkable wrapping material about packages, comprising
 - (a) a plurality of conveyor rollers,
 - (b) means mounting said rollers for rotation about spaced, parallel, coplanar axes,
 - (c) a first chamber beneath certain of said rollers and having in its upper wall a plurality of apertures

- arranged in spaced, parallel rows which register with the spaces between said certain rollers,
- (d) a second chamber spaced longitudinally from said first chamber and mounted beneath the remainder of said rollers, and having in its upper wall a plurality of apertures arranged in spaced, parallel rows which register with the spaces between said remaining rollers,
 - (e) means for feeding wrapped articles onto said rollers for conveyance thereby successively over said first and second chambers,
 - (f) a tunnel-like housing mounted over said second chamber and having therethrough an opening through which the articles move during their passage over said second chamber, and
 - (g) means for blowing hot air upwardly through said apertures in said first and second chambers during the passage of the articles thereover,
 - (h) the apertures in said first chamber being operative to direct hot air onto one side only of each article before it passes over said second chamber.
5. Apparatus for shrinking heat-shrinkable wrapping material about articles, comprising
 - (a) a pair of spaced heating chambers, each of which has a plurality of apertures in one side thereof,
 - (b) a first heater element in one of said chambers,
 - (c) means for circulating air in said one chamber to be heated by said first element,
 - (d) means including manually operable damper means for selectively interconnecting said chambers to convey part of the heated air in said one chamber into the other chamber,
 - (e) a second heater element in said other chamber for increasing the temperature of the air which enters said other chamber from said one chamber,
 - (f) means for conveying wrapped articles successively past said one side of said chambers and into the path of the heated air issuing from the apertures in said chambers,
 - (g) a hollow housing registering with said one chamber to direct the heated air from said one chamber around the articles as they pass said one chamber,
 - (h) the apertures in said other chamber being operative to direct the air issuing therefrom onto one side only of the articles before they pass into said one chamber, and
 - (i) means including a plurality of nozzles mounted on the exterior of said housing and selectively connectable to said one chamber to receive and direct heated air therefrom onto selected portions of the sides of the articles before they pass into said one chamber.
 6. Apparatus as defined in claim 1, wherein said conveying means comprises
 - (a) a plate over which said article is adapted to pass during its travel,
 - (b) said plate having therethrough a plurality of openings which extend normal to opposite faces of said plate, and being inclined to the horizontal downwardly in the direction the article is to travel,
 - (c) means for blowing air from beneath said plate, and through said openings onto the bottom of the article to lift it off said plate so that it will be conveyed by the force of gravity in said direction.
 7. Apparatus as defined in claim 3, wherein
 - (a) portions of said plate adjacent opposite sides thereof are inclined upwardly and outwardly, and extend in the direction of travel of the article, and
 - (b) said marginal portions have therethrough a plurality of apertures, which are inclined in the direction of travel of the article, and which communicate with said first-named means to receive and direct air therefrom onto opposite sides of an article as it travels through said enclosure.

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