SHRINK TUNNEL FOR SHRINKING FILM ON ARTICLES

Filed Nov. 13, 1967

2 Sheets-Sheet 1

INVENTOR
SYDNEY G. F. BELL
SHRINK TUNNEL FOR SHRINKING FILM ON ARTICLES
Sydney George Frederick Bell, Altona, Victoria, Australia, assignor to W. R. Grace & Co., New York, N.Y., a corporation of Connecticut
Filed Nov. 13, 1967, Ser. No. 682,306
Claims priority, application Australia, Nov. 18, 1966, A 14,135/66
Int. Cl. F27h 5/06; E27d 11/02
U.S. Cl. 219—388

ABSTRACT OF THE DISCLOSURE

A shrink tunnel for shrinking film on articles including an inverted U-shaped housing having triple walls forming an inner and an outer air flow duct with air openings for the inner duct distributed over the inner of the triple walls, a port in the intermediate of the triple walls for passage of air from the inner to the outer duct and air inlet means from the outer duct into the bottom part of the tunnel air heating means and air circulating means in the outer air flow duct and conveying means for transporting items through the inverted U-shaped housing.

This invention relates to packaging and is concerned particularly with the production of packages wherein packaged articles or products are supported within an open-topped container and covered by a sheet of heat shrinkable material, the edges of which overlie the rim of the container and are heat shrunk firmly against the walls of the container.

The invention has particular, but not exclusive, application to the production of packages in which a number of articles, for example, cans filled with a product are supported on a close-fitting tray and covered by a wrap of shrinkable plastic film. Such packs, which for the sake of convenience will hereinafter be referred to as "master packs," have a number of advantages over conventional cardboard carton packs. They allow goods to be much more easily displayed since it is simply necessary to break open the plastic film and place the tray containing the articles on a display shelf. Goods supplied in cardboard cartons must be removed from the cartons and then stacked on the shelf for display. Master packs also greatly reduce carton disposal problems.

Master packs are generally produced by stacking the articles to be packed in a tray and forming an open-ended tubular sleeve of heat shrinkable plastic film around the tray and the articles. The partially formed pack is then passed through a heating tunnel which heats the film and causes it to shrink. The ends of the open sleeve must be shrunk considerably so that they will lie flat against the ends of the pack and this requires that the ends of the sleeve be shrunk much more than the top, bottom and sides. Therefore, to manufacture such packs satisfactorily, there should be some provision for accurately controlling the amount of shrinkage over the various parts of the film. Conventional heat shrinking tunnels have not proved satisfactory and it is an object of this invention to provide an improved tunnel whereby the shrinkage of the film can be more accurately controlled.

According to the invention there is provided a heating tunnel comprising a top and two sides arranged in a generally inverted channel-shaped configuration or U-shaped configuration and formed by triple walls defining therebetween an inner air flow duct and an outer air flow duct, air outlet openings for the inner duct distributed over the inner of the triple walls, a port in the intermediate of the triple walls for the passage of air from the inner duct into the outer duct, air inlet means for the outer duct to direct air from the outer duct, inwardly into the bottom part of the tunnel from both sides of the tunnel, air circulating means to draw air through said outlet opening into the inner duct and pass it via the port and the outer duct to said air inlet means, heating means to heat the air passing to the inlet means, and damper means selectively to obstruct and to clear the air outlet openings.

Preferably the air outlet openings are disposed in rows extending longitudinally of the tunnel and the damper means comprises a plurality of damper plates each slidably mounted on said inner wall to cover and uncover the holes of a row by sliding movement thereof.

By using the tunnel of this invention a heat shrinkable thermoplastic film may be desirably shrunk about an article. The article is first enclosed in the film to form a package. This package is passed through a heat shrink zone. Hot air is introduced into a lower portion of the heat shrink zone and forcibly impinged onto the lower portions of opposing sides of the package. A large portion of the hot air is withdrawn from the zone through at least one outlet positioned below the plane passing through the top of the article and above the lower portion of the zone into which the hot air was introduced.

In order that the invention may be more fully explained, one preferred form of shrink tunnel constructed in accordance therewith will now be described in detail with respect to the accompanying drawings in which:

FIG. 1 is a transverse cross-section through the shrink tunnel and a partially formed master pack located there-in;
FIG. 2 is a cross-section on the line 2—2 in FIG. 1;
FIG. 3 is a scrap cross-section of the master pack after heat-shrinking;
FIG. 4 is a scrap cross-section of part of the tunnel corresponding to the view shown in FIG. 1 but to an enlarged scale and illustrating movement of a control flap for an air inlet slot therein;
FIG. 5 is a scrap perspective view of part of the tunnel;
and
FIG. 6 is a perspective view of the resultant master pack after shrinkage.

FIGS. 1 and 2 show a shrink tunnel denoted generally as 11 in which there is disposed a partially formed master pack denoted generally as 12. Tunnel 11 is approximately three feet long and has a thirty inch wide and fifteen inch high tunnel opening 13. It is seen at the bottom and is triple-walled, being comprised of three inverted channel shaped walls 14, 15, 16 of successively decreasing size located one within the other. The space 17 between the outermost wall 14 and the intermediate wall 15 serves as an air delivery duct for supply of heated air into the tunnel an air space 18 between intermediate wall 15 and innermost wall 16 serves as an air return duct via which air is extracted from the tunnel. The tunnel is fitted with an outer casing 22 lined internally with a layer of heat insulating material 23 and is mounted between support frame members 24a and 24b.

A high speed, high pressure air impeller 19 is mounted in the upper part of air supply duct 17 and is driven via a shaft 20 by an electric motor 21 mounted externally of the tunnel. Impeller 19 rotates about a vertical axis and draws air from return duct 18 through a port 26 made directly below it in the intermediate wall 15. Port 26 is fitted with a throat ring 27 to direct the air into the impeller intake and a number of vertically spaced 10 kw. electric heating rods 28 extend in rectangular formations around the impeller.

Impeller 19 rotates at approximately 2800 revolutions per minute and blows air outwardly over heating rods 28 and then downwardly through the vertical legs of air de-
livery duct 17. The heated air is directed inwardly into the tunnel from the bottom ends of duct 17 via four slot inlets 29 arranged to extend longitudinally and extending longitudinally along it. The air issuing from slot inlets 29 in the form of horizontal curtain jets. The lower edge of each slot inlet 29 is defined by a swingable flap 31 which is hinged to the outer tunnel wall 14 at 32 and is actuated by a pivot pin 33 to an adjacent space 34 which passes through an opening in a lug 36 on one of the frame support members 24 and can be moved up and down by rotation of an adjusting nut 37. By rotating the appropriate adjusting nut 37, each flap 31 can be swung to vary the width of its slot inlet 29 from 1/2" down to zero, FIG. 4 shows one slot inlet in a fully opened condition whereas FIG. 1 shows the same slot inlet in a partially closed condition.

The inner wall 16 of tunnel 11 is perforated by holes 38 to allow air to be extracted from the tunnel into return air duct 18. Holes 38 are arranged in eleven longitudinally extending rows which are spaced up the sides and across the roof portion of the wall. The holes of each row are one inch in diameter and are disposed at two inch longitudinal spacing. Each row of holes 38 is provided with a damper strip 39 which overlies the holes of the row and is slidable in a pair of channel guides 41 fastened to the inner face of wall 16. Each damper strip 39 is perforated by a row of one inch diameter holes 42 arranged at two inch longitudinal spacing which, by sliding the damper strip, can be moved into and out of register with the holes 38 of the appropriate row. Thus the holes 38 of each row can be selectively obstructed or cleared by adjustment of the appropriate damper strip. Tunnel 11 is installed so as to straddle part of the upper run of a P.T.F.E. (polytetrafluoroethylene) coated fibre glass conveyor belt 43.

To form a master pack according to the method of this invention an open ended and continuous tubular sleeve of heat shrinkable plastic film is formed around the article to be packaged with the outer ends of the sleeve projecting beyond the article at both open ends. The sleeve enclosed article is passed into a shrink tunnel with the open ends of the sleeve oriented towards the sides of the tunnel. Hot air curtain jets are directed relatively horizontally against the open ends of the sleeve from the lower region of both sides of the tunnel and below the median region of the open ends of the sleeve. A large part of the hot air is withdrawn from the tunnel at a height below the top of the article. The horizontal curtain jets of hot air that are directed against the open ends of the sleeve enter the open ends of the sleeve and balloon the ends of the film out from the article. The balloonend portions of the film are shrunk more rapidly than the other portions of the film. The end portions of the film are thereby shrunk taut and flat about the ends of the article forming a tubular sleeve with smooth constrained ends conforming the article therein.

To form a master pack from a number of cans, the cans 44 are placed in a tightly fitting fibre-board tray 46 and an open ended tube 47 of a heat shrinkable plastic film, for example an irradiated polyethylene film, is formed around the tray and the cans. Tube 47 may be formed by welding means in the case of butyl rubber and tray 46 are bonded by tube 47 and then placed on conveyor belt 43 so that tube 47 is extended transversely of the belt. The partially formed pack is then fed by the conveyor belt towards the heating tunnel. Adjacent the tunnel entry, the conveyor passes over a hot plate/cold plate cooler unit, the partially formed package enters the heating tunnel as shown in FIGS. 1 and 2. The horizontal curtain jets of hot air issuing from slot inlets 29 are located just above conveyor belt 43 and provide maximum hot air impact on the open extended ends of the tube 47. These ends are shrunk considerably so that they shrink flat against the ends of the pack as shown in FIG. 3, leaving an adjustment 48 at each end of the pack surrounded by film which has been greatly thickened at 49 by the extensive shrinking. The curtain jets also act to hold the ends of the film tube "ballooned" out from the pack during shrinking, so preventing the film from folding upon itself which could lead to faulty shrinking.

The amount of shrinking of the film tube 47 can be varied with respect to the shrinkage at the ends by adjusting damper strips 39 and the rate of shrinkage at the ends can be controlled by appropriate adjustment of flaps 31. Thus the volume of hot air directed into the tunnel, and the volume of hot air subsequently passing through the sides and the top of the pack can be controlled to give an optimum distribution of shrinkage to produce an adequately tight package without overstressing the film. The air outlet openings 38 and the air inlet means 29 are positioned relative to another to not only impinge air against the ends of a package passing through the tunnel but to also withdraw air from the large portion of air from the tunnel so directly after its injection into the tunnel that the air cannot rise above the top of the package. A substantial portion of the air outlet openings 38 are below the height of the packages U-shaped housing will accommodate. The resultant master pack is shown in FIG. 6.

Master packs 48 which have been produced by the illustrated apparatus have proved to be very satisfactory. Because of the thickening of the film around openings 48, these openings may be used as finger holes for lifting purposes. The openings also allow the circulation of air between containers 44 to prevent condensation which could damage metal containers. However, it is undesirable that the above described apparatus have been given by way of example only and that the invention is not in any way limited thereto but includes all modifications and adaptations which fall within the spirit and scope of the appended claims.

What is claimed is:

1. A shrink tunnel comprising a generally inverted channel-shaped wall configuration formed by triple walls defining therebetween an inner air flow duct and an outer air flow duct, air outlet openings for the inner duct distributed over the inner of the triple walls, a port in the intermediate of the triple walls for the passage of air from the inner duct into the outer duct, air inlet means for the outer duct to direct air from the outer duct inwardly into the bottom part of the tunnel from both sides of the tunnel, air circulating means within said generally inverted channel-shaped wall configuration through said outer air flow duct to said air inlet means, said air circulating means drawing air through said outlet openings into the inner duct and passing it via the port and the outer duct to said air inlet means, heating means in the path of the air through said outer air flow duct to said air inlet means, said heating means heating air passing to the air inlet means and a conveying means adjacent said air inlet means for transporting items through said generally inverted channel-shaped wall configuration.

2. The shrink tunnel of claim 1 wherein said air inlet means is in the inside bottom portion of the inside wall in both sides of the housing and said air outlet openings are adjacent to and above said air inlet means, and at least a substantial portion of said air outlet openings are below the height of the packages U-shaped housing will accommodate, and said air outlet openings and said air inlet means are positioned relative to one another to...
impinge air against the ends of a package passing through said tunnel and withdraw at least a large part of said air from said tunnel so directly after its injection into the tunnel that a large part of the air will not rise above the top of the package.

3. The shrink tunnel of claim 1 wherein a damper means in air stream engagement with the air outlet openings selectively obstructs and clears said air passage therethrough.

4. The shrink tunnel of claim 1, in which the air outlet openings are disposed in rows extending longitudinally of the tunnel.

5. The shrink tunnel of claim 4 in which the damper means comprises a plurality of elongated damper plates slidably mounted on the inside of the tunnel and covering and uncovering respective rows of the outlet openings by sliding movement thereover.

6. The shrink tunnel of claim 5, in which the longitudinally extending rows of outlets are longitudinal rows of outlet perforations and each damper plate is provided with a plurality of perforations which can be moved into and out of register with said outlet perforations by sliding movement of said damper plate, and a pair of channel guides fastened inside the housing slidably mount each damper plate.

7. The shrink tunnel of claim 1 in which said air outlet means comprise two slot openings, one in each side of the inside wall of said housing and the lower edge of each slot opening is defined by a pivotal flap and adjustment means is provided operable to pivot each of said flaps thereby to vary the effective width of the slot opening.

8. The shrink tunnel of claim 1 wherein the air outlet openings are disposed in rows extending longitudinally of the tunnel, damper means are engaged in air stream engagement with the air outlet openings, the damper means comprising a plurality of damper plates in the form of elongated strips provided with a plurality of perforations which can be moved into and out of register with certain of the air outlet openings, the plates are slidably mounted on the inner wall of the tunnel to cover and uncover the inlet openings by sliding movement thereof; and wherein the air inlet means comprises at least two said slot openings in each side of the tunnel and extending longitudinally of the tunnel, each slot opening is at the bottom of the tunnel and has adjustment means provided to vary the effective width of each slot opening, the adjustment means including a pivotal flap at the lower edge of each slot opening and means operable to pivot the flap thereby to vary the effective width of the slot opening; the air circulating means comprises a centrifugal fan impeller mounted within the outer duct for rotation about a vertical axis and above said port; and the heating means includes an electrical heating element in said outer duct encompassing said impeller.

References Cited

UNITED STATES PATENTS

2,472,293 7/1949 Groven 219—388 X
3,156,812 11/1964 Forman et al. 219—388
3,357,154 12/1967 Shaffer 53—30
3,378,989 4/1968 Denker 53—184
3,389,530 6/1968 Yates 53—30
3,399,506 9/1968 Howe 53—39

VOLODYMYR Y. MAYEWSKY, Primary Examiner

U.S. Cl. X.R.

219—400; 53—39, 184