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Spiegel et al.

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[54] **HEAT SHRINK TUNNEL**

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[21] Appl. No.: **92,623**

[52] **U.S. Cl.** **34/218,** 34/105, 34/232, 34/236, 53/184

[51] **Int. Cl.**.....**F26b 19/00**

[58] **Field of Search** 53/30, 184; 34/160, 227, 229, 34/232, 236, 105

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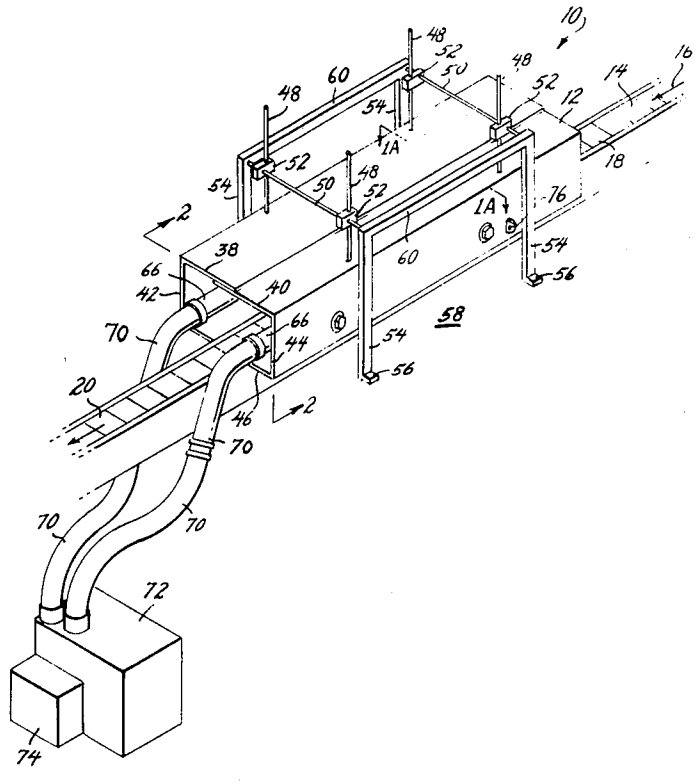
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[57] **ABSTRACT**

A heat shrink tunnel comprising an enclosure, a conveyor to conduct articles through the enclosure from an upstream point to a downstream point, conduit means to deliver hot air to the enclosure, partition means to divide the conduit means into first and second paths, said first path being relatively long as compared with said second path, a source of hot air, means to force the hot air in a generally upstream direction in the two paths of the conduit means, a first slit in the conduit means at an upstream point, communicating with said enclosure to allow hot air in the first path to enter the enclosure in a narrow band and a second slit in the conduit means spaced downstream of the first slit and also communicating with the enclosure to allow hot air to enter the enclosure in a narrow band at a point that is downstream from the first slit whereby the air entering through the second slit and at the downstream location is relatively hot. In many instances the air entering through the first slit at the upstream location is somewhat cooler than the air entering through the second slit, and in such instances the articles being transported by the conveyor are first subjected to a warm zone and then as the articles move downstream are subjected to a hot zone in order to exert a shrinking effect upon a thermoplastic synthetic resin that is wrapped on the articles. Hot spots adjacent the top of the tunnel are avoided since the warm or hot air is admitted to the tunnel in a narrow band that is normally not directed toward the top of the tunnel.

6 Claims, 8 Drawing Figures



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SHEET 1 OF 2

Fig. 1.

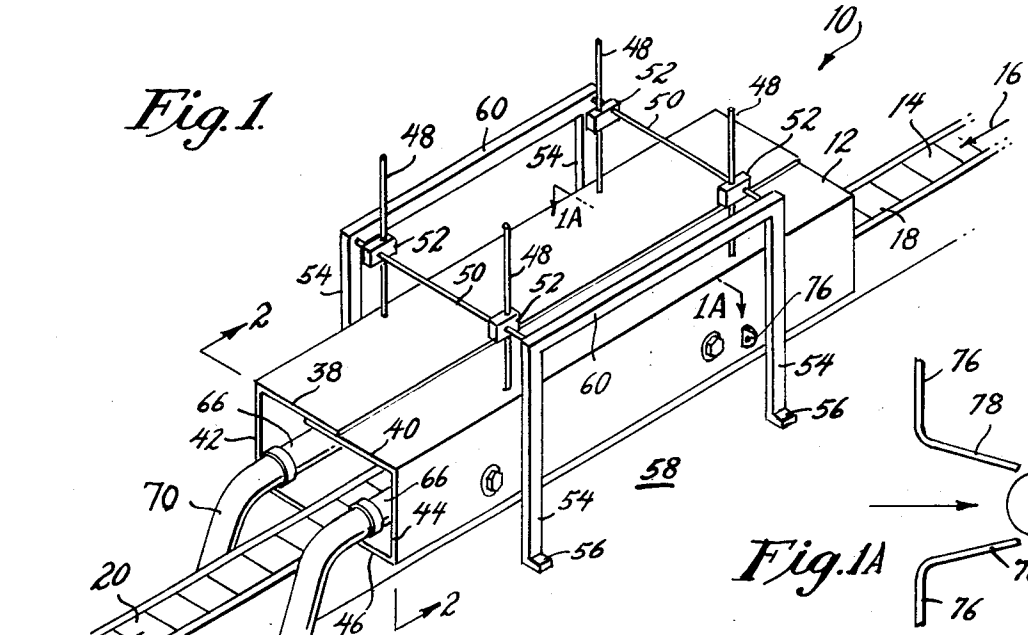


Fig. 1A

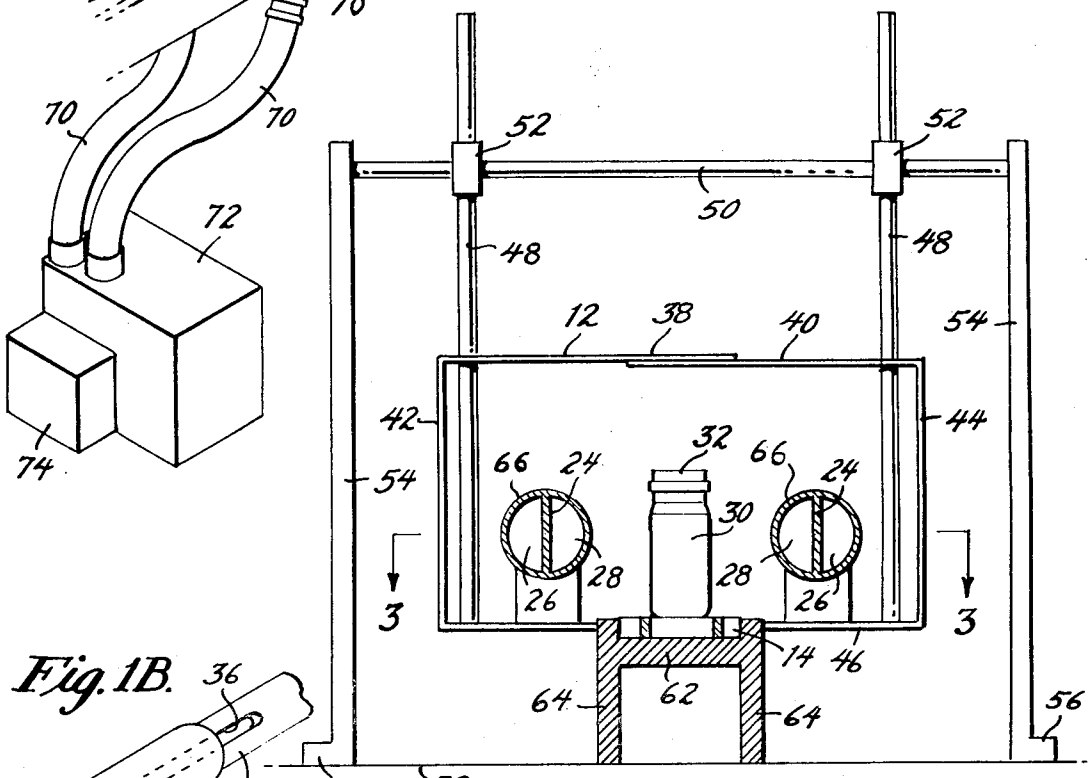


Fig. 1B.

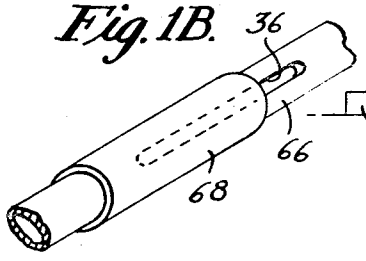


Fig. 2.

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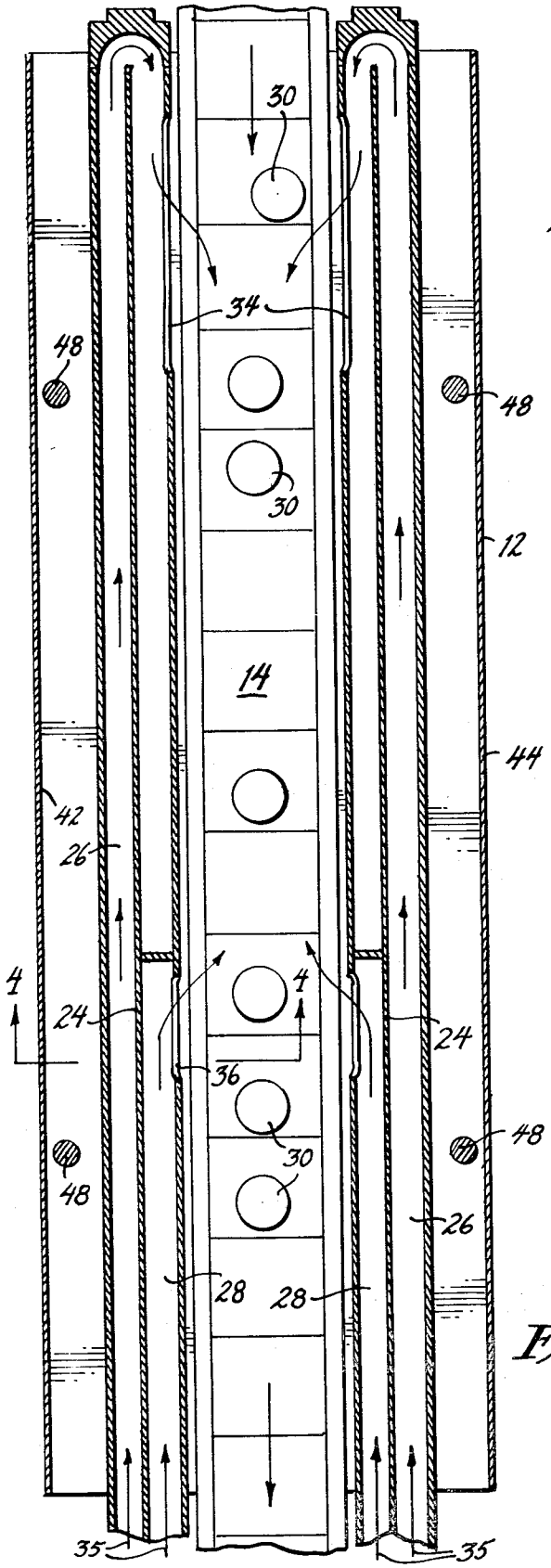


Fig. 3.

Fig. 4.

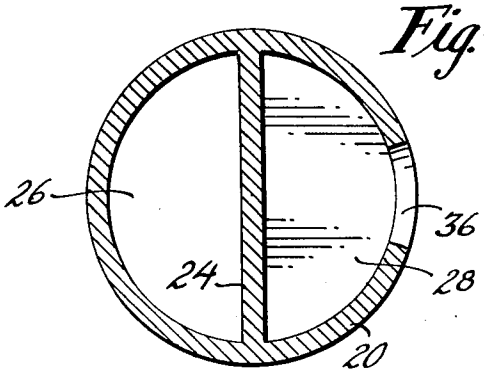


Fig. 5.

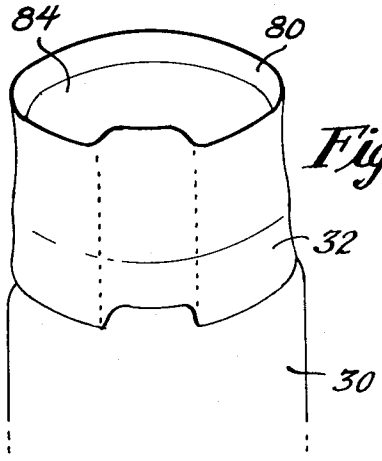
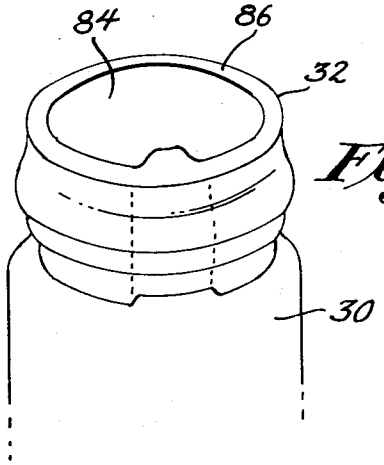


Fig. 6.



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HEAT SHRINK TUNNEL

This invention relates to a heat shrink tunnel and more particularly to a new and improved device to this general class.

It is known to provide a heat shrink tunnel wherein hot air is forced into an enclosure through which articles pass. In subjecting such articles to heat shrink techniques, it is often desirable that the articles first be subjected to a warm zone of air and then be subjected to a hot zone of air. This presents a problem since the hotter zone is located downstream of the warm zone. In the reverse situation, it would be a simple matter just to feed the hot air in at an upstream point and allow it to move downstream with the articles and become somewhat cooler as the articles move downstream. However, in activating heat shrink plastic, it is necessary that the articles first be subjected to a warming action, followed by a hot action in order to fully activate the heat shrink plastic.

The method of sealing the mouth of a receptacle using a heat shrink plastic is disclosed in presently pending application Ser. No. 11,762, filed Mar. 12, 1970, **now U.S. Pat. No.** 3640,417 and entitled "-Method of Sealing the Mouth of a Receptacle". In said application there was provided a closure for a container which permitted, when on display, the customer to look into and smell the product packaged therein, but, nevertheless, prohibited the customer from touching the product directly with the finger. The container is sealed at its mouth portion by a flat, porous top member and has provided at the outer periphery of the container a U-shaped tongue for use in removing the entire closure when the container is to be opened.

The closure of said application Ser. No. 11,762, now U.S. Pat. No. 3,640,417 comprised a heat shrinkable cylindrical portion and there is also a non-heat shrinkable cylindrical portion being secured to the non-heat shrinkable end portion to form a cup. In this way there was minimum shrinkage axially and maximum shrinkage radially when heat is applied.

The disclosure of said application Ser. No. 11,762, now U.S. Pat. No. 3,640,417 is hereby incorporated by reference. It will be seen that the heat shrink tunnel of the present invention provides a very effective piece of apparatus in order to achieve the desirable heat shrink action of said application Ser. No. 11,762, now U.S. Pat. No. 3,640,417.

In view of the foregoing, it is an object of the present invention to provide a heat shrink tunnel wherein there is high velocity and high temperature air flowing in a narrow beam in a general direction upstream and downstream as well as cross-stream, and wherein the air flowed in equal amounts on both sides of the container that is being moved on a conveyor passing through the tunnel.

Yet another object of the present invention is to provide a heat shrink tunnel including means to adjust the narrow beam in a vertical as well as a horizontal direction for the purpose of shrinking one part of the heat shrink band and also to increase or decrease the heat or flow as required.

Still another object of the present invention is to provide a heat shrink tunnel including means to change the length, flow rates, temperature and position of a narrow band of hot air that enters the tunnel at at least one and preferably two spaced points.

In prior devices it was found that the hottest part of the tunnel was located immediately under the roof of the tunnel since hot air rises. However, it should be kept in mind that the hottest part of the tunnel should be adjacent the heat shrink band in order to be most effective in the heat shrink process.

Still another object of the present invention is to provide a heat shrink tunnel which is sufficiently flexible that it can be used in connection with a very wide variety of bottle shapes and sizes, and also heat shrink bands of varying properties.

Yet another object of the present invention is to provide a heat shrink tunnel which at times will provide a warm zone upstream at the point where the conveyor enters the tunnel and also provide a hot zone downstream as the conveyor nears the tunnel exit.

Yet another object of the present is to provide a heat shrink tunnel which is relatively simple in construction, is of low cost, and which is relatively maintenance free.

Still another object of the present invention is to provide a heat shrink tunnel wherein the warm and hot zone can be carefully regulated to obtain a desired temperature gradient that is compatible with the speed of the conveyor and the properties of the plastic that is being subjected to a heat shrink treatment, with the temperature of the air generally increasing as the conveyor moves through the tunnel.

Yet another object of the present invention is to provide a heat shrink tunnel wherein the conveyor moves along an inclination with respect to the tunnel so that the heat shrink treatment is effective initially against the bottom of the heat shrink band, thereby to lock the band at the bottom and prevent upward movement of the band during the remainder of the heat shrink process.

Still another object of the present invention is to provide a heat shrink tunnel that avoids the deficiency of the prior art including an avoidance of subjecting the front of the band to initial heat.

Still another object of the present invention is to provide a heat shrink tunnel that has properties of unobstructed high volume air flow in a narrow band that is easily controllable.

The foregoing as well as other objects of the invention are achieved by providing a heat shrink tunnel which includes an enclosure, a conveyor to conduct articles through the enclosure from an upstream point to a downstream point, conduit means to deliver the hot air to the enclosure, a source of hot air, means to force the hot air upstream through said conduit means, a first slit in the conduit means at an upstream point communicating with the enclosure to allow hot air to enter the enclosure in a narrow band, a second slit in the conduit means at a downstream point from said first slit and communicating with the enclosure to allow hot air to enter the enclosure in a narrow band at the downstream point and means to adjust the location of one or both of said slits as well as the length of said slits in order to direct the narrow bands of hot air for a variety of lengths and positions.

Other objects and many of the attendant advantages of the invention will become more readily apparent by reference to the drawings wherein:

FIG. 1 is a perspective view showing a heat shrink tunnel embodying the present invention;

FIG. 1-A is a sectional view taken along the lines 1-A—1-A of FIG. 1 to show a centering device;

FIG. 1-B is a view of the downstream slit in the conduit means in order to show the adjustability of a sleeve that covers either a greater amount or a lesser amount of the slit and thereby regulates the effective length of the slit;

FIG. 2 is an enlarged sectional view taken along the lines 2—2 of FIG. 1;

FIG. 3 is a sectional view taken along the lines 3—3 of FIG. 2;

FIG. 4 is a sectional view taken along the lines 4—4 of FIG. 3; and

FIGS. 5 and 6 are views of the top portion of a bottle showing the condition of the closure member upon entering the heat shrink tunnel and upon leaving the heat shrink tunnel.

Referring now in greater detail to the various figures of the drawing wherein like reference characters refer to like parts, there is shown at **10** in FIG. 1 a heat shrink tunnel embodying the present invention.

The heat shrink tunnel **10** basically comprises an enclosure **12** through which a conveyor **14** moves in the direction of arrow **16** from upstream point **18** to downstream point **20**. Conduit means **66** are provided in order to deliver hot air to the interior of enclosure **12**. As will be seen, the hot air will be delivered to the enclosure **12** in such a way that the hot air moves generally from an upstream point to a downstream point, but wherein the air increases in temperature as the downstream point is approached.

With reference to FIG. 2 it will be seen that each of the conduit means **66** are divided by partition means **24** in order to create a first path **26** and a second path **28**. As further seen in FIG. 2, the two second paths **28** lie closer to the conveyor **14** whereas the two first paths **26** are positioned outwardly of paths **28**. It will be seen that a bottle **30** carrying a heat shrink closure **32** exits from the enclosure **12**.

With reference to FIG. 3 it will be seen that hot air from a single source enters the first and second paths **26** and **28** in the direction of arrow **35**. The hot air in path **26** moves upstream and finally doubles back upon itself and enters the enclosure **12** through first slit **34**. The hot air in path **28** enters the enclosure **12** through adjustable slits **36**.

From an inspection of FIG. 3 it can be seen that the hot air travels a much longer path in moving through first path **26** as compared with the hot air that moves through much shorter path **28**. Since no special steps are taken to insulate either the conduit means **66** or the enclosure **12**, it follows that there will be considerable heat losses in the longer and somewhat tortuous path **26** as compared with the shorter and more direct path **28**. Thus, the air entering the enclosure **12** through first slit **34** is somewhat cooler than the air entering the enclosure **12** through the second slit **36**. In actual practice it has been found that the hot air being developed in the conduit means **66** may start out with a temperature of 650°. Thus, the hot air entering enclosure **12** through the second slit **36** has a temperature of approximately 625°. However, the hot air travelling in the first path **26** enters the enclosure **12** through first slit **34** at a temperature of about 420° or about 200° cooler than the air entering through the second slit **36**. It has been further determined that the air around the bottle in the area of the first slit **34** takes on a temperature of about 280° whereas the area of second slit **36** has a temperature of about 520°F. Thus, the air around the closure undergoes a temperature rise of more than 200° in travelling in a downstream sense from an area adjacent slit **34** to an area adjacent the second slit **36**.

The details of the enclosure **12** are seen in FIGS. 1 and 2 as including overlapping flaps **38** and **40**, although the enclosure **12** may be made in such a way that there is a butt seam or that the enclosure **12** is simply cut from a one-piece rectangular duct. The enclosure **12** further includes sides **42** and **44** as well as floor **46**.

From FIG. 2 it will be seen that the rods **48** extend through an appropriate opening in enclosure **12** and are fastened to enclosure **12** on the inside. This rod also holds heater tube **66**. The rods **48** are suspended from horizontal rods **50**, with the rods **48** and **50** being joined together with fasteners **52**. The horizontal rods **50** are supported by vertical posts **54** each possessing a toe **56** that engages table top **58**. The posts **54** are joined together with horizontal arms **60**.

With reference to FIG. 2, it will be seen that the conveyor **14** is supported upon a web **62** that extends from support legs **64**.

As shown in FIG. 1-B the second slit **36** is of an adjustable length, with the slit being formed through the wall of tubing **66** that extends upstream from tube **70**. An adjustable sleeve **68** is telescoped upon the tubing or conduit means **66** in order to change the effective length of the second slit **36**.

Furthermore, both tubing **66** and sleeve **68** may be rotated as a unit in order to change the orientation of the slit **36**. Thus, at times it may be desirable that the hot air band eminating from slit **36** be essentially horizontal and at other times it may be desirable that the hot air band be essentially vertical or at some desired position between the horizontal and the vertical. This particular orientation of the slit **36** is easily accomplished by rotation of tubing **66** and sleeve **68**. In some cases it may be desirable that the upstream slit **34** be similarly adjustable, both in length and orientation, and this can be done using the arrangement of FIG. 1-B.

While the invention has been described as including single conduits and partition means **24** in order to establish two conduits, it should be clear that this is not absolutely necessary to the practice of the invention. In some instances it may be desirable to provide two sources of hot air **72**, each of which feeds hot air to a single tube **70**, with one of the tubes **70** being connected to first slit **34** and the other tube **70** being connected to second slit **36**.

It will be seen in FIG. 1 that the conduit **66** is connected by tubing **70** to a source of air **72** including fan **74**. The housing of the fan **74** may have an adjustable opening (not shown) in order to regulate the volume of air being drawn by the fan **74** and forced into the heating system.

With reference to FIG. 1-A it will be seen that the bottles **30** are centered upon the conveyor **14** through the use of a centering device which includes arms **76** that are generally perpendicular to the movement of the conveyor **14**. The arms **76** include inclined flexible tongues **78** that are somewhat converging so that any bottle that is not well centered will be forced gently toward the center line between the tongues **78**. The

arms **76** extend slightly outwardly of the enclosure **12** as seen in FIG. **1**. It is to be noted that the centering device is preferably positioned near the upstream entrance of the enclosure **12**.

With reference to FIG. **5** it will be seen that the closure **32** is initially positioned upon the neck of the bottle **30** in such a way that there is an upstanding rim **80** of shrinkable material or plastic that projects above disc **84** which can be made of metal or a plastic. As the bottle **30** passes through enclosure **12** the closure **32** will be subjected to an ever increasing temperature such that the rim **80** is subjected to a shrinking action so that it eventually is caused to be folded against the disc **84** in a neat fold **86** as shown in FIG. **6**.

In view of all of the foregoing it will be seen that a heat shrink tunnel is provided which effectively provides a warm zone upstream within the enclosure at the point where the conveyor enters the tunnel, but wherein there is also provided a hot zone at the downstream end of the tunnel. As previously noted, the direction of air flow is generally downstream. All of the foregoing is achieved by dividing the conduit means into two paths and wherein the first path is made somewhat longer and tortuous in order to achieve heat losses in the air travelling in the first path. It is to be understood that the air in the first path is then fed into the enclosure at a somewhat upstream point. However, in view of the downstream direction of conveyor movement the air fed into the enclosure will generally be carried downstream along the conveyor. However, the air fed more directly into the enclosure through the second path is subjected to only slight heat loss, and in this way the air fed into the enclosure at the downstream point is considerably hotter. Again, the air entering the enclosure from the downstream slit is carried in a downstream direction by virtue of the downstream movement of the conveyor.

By virtue of all of the foregoing a desired temperature gradient is established within the enclosure that is compatible with the speed of the conveyor and the properties of the plastic that is being subjected to a heat shrink treatment. It is possible to have either the upstream slit or the downstream slit of adjustable length, and in this way a proper heat balance may be established and maintained.

While the source of hot air has been shown as being somewhat removed from the enclosure **12**, it is possible to locate such source at any convenient point, such as directly on top of the frame **60**.

Furthermore, the conveyor **14** need not move in a horizontal plane, but in some instances can move in an inclined plane such that the narrow band of air eminating from the slit **34** will strike the lower portion of heat shrink closure **32** in order to tighten such lower portion prior to the time the upper portions of the heat shrink closure **32** have been shrunk. In this way the entire closure **32** is secured tightly to the neck of a bottle **30** and will not ride up during the heat shrink process.

It should be further noted from FIG. **3** that the narrow bands of hot air entering through the slits **34** and **36** on each side of the enclosure have the effect of subjecting the heat shrink closure **32** to a simultaneous hot air treatment at the front and back, rather than from the sides as was the case in the prior art. This serves to promote a uniform shrinking action, rather than a localized shrinking action that sometimes caused failures.

It follows that the hottest part of the tunnel will generally be in the central part of the tunnel in a vertical sense, rather than at the top of the tunnel as was the case in the prior art. Of course, where desired, it is possible that even the lower portion of the tunnel can be the hottest part of the tunnel provided that the slits **34** and **36** are so rotated that the hot air is directed downwardly.

Without further elaboration, the foregoing will so fully illustrate our invention, that others may, be applying current or future knowledge, readily adapt the same for use under various conditions of service.

What is claimed as the invention is:

1. A heat shrink tunnel comprising an enclosure, a conveyor to conduct articles through the enclosure from an upstream point to a downstream point, conduit means located on each side of said tunnel to deliver hot air to the enclosure, means to force hot air through said conduit means and into said enclosure by way of first and second slits in said conduit means, such that hot air will enter said enclosure in a narrow band, said first and second slits being located on each side of said tunnel in order to provide opposing narrow bands of hot air both at an upstream point and at a downstream point, with such slits being adjustable in both length and orientation, partition means to divide said conduit means into at least first and second paths, said first path being relatively long as compared with said second path whereby air travelling in said first path becomes somewhat cooled and is fed into an upstream slit and relatively hot air in said second path is fed into said downstream slit.

2. The heat shrink tunnel of claim **1** including a centering device positioned adjacent the upstream entrance to said enclosure in order to center articles on said conveyor.

3. The heat shrink tunnel of claim **1** wherein said enclosure is suspended from vertical rods and said conveyor is supported upon a horizontal web.

4. The heat shrink tunnel of claim **1** wherein said second path is blocked upstream of said second slit but in the general area of said second slit.

5. The heat shrink tunnel of claim **1** including means for leading streams of hot air into each end of the conduit means, flowing in opposite directions, each hot air stream flowing through upstream and downstream slits provided in the conduit means and into the enclosure.

6. The heat shrink tunnel of claim **5** wherein the opposing paths of hot air are effectively blocked between the slits and across the full area of the conduit means.

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