

- [54] **SHRINK TUNNEL FOR PALLETIZED LOADS**
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[51] Int. Cl.**F26b 19/00**
[58] Field of Search**53/30, 184; 34/66, 34/242, 216, 219, 225, 230, 232, 233**

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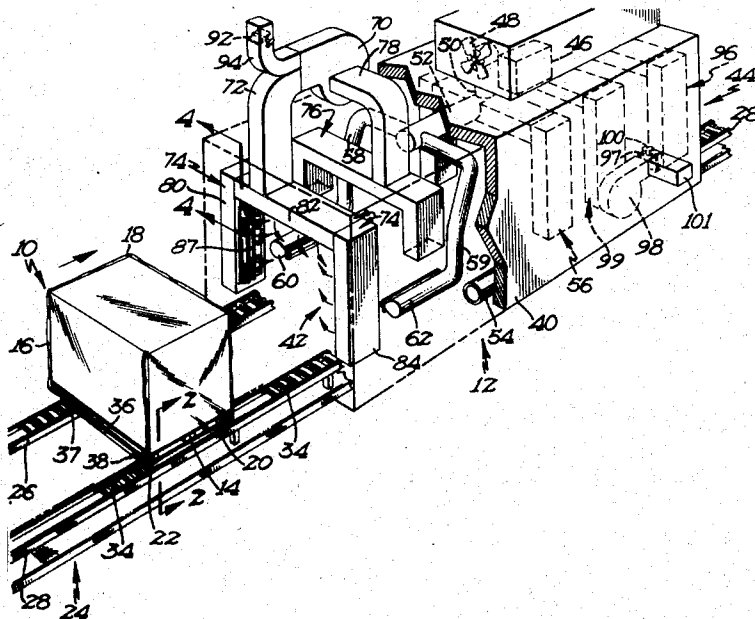
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[57] **ABSTRACT**

A shrink tunnel for shrinking a covering of plastic material onto a palletized load including apparatus for generating a curtain of air at entrance and exit of the tunnel to isolate a shrink zone within the tunnel from an ambient environment and to provide preheating and cooling of the plastic cover at entrance and exit, respectively, as the load moves through the tunnel. The shrink zone has a pair of stationary nozzles near the entrance of the tunnel for directing heated air at the skirt of the plastic covering adjacent the base of the palletized load to shrink the skirt to the pallet. The remainder of the covering is thereafter shrunk onto the load thereby protecting the load from the elements during shipment or storage and binding it to the pallet for convenient shipment.

9 Claims, 5 Drawing Figures



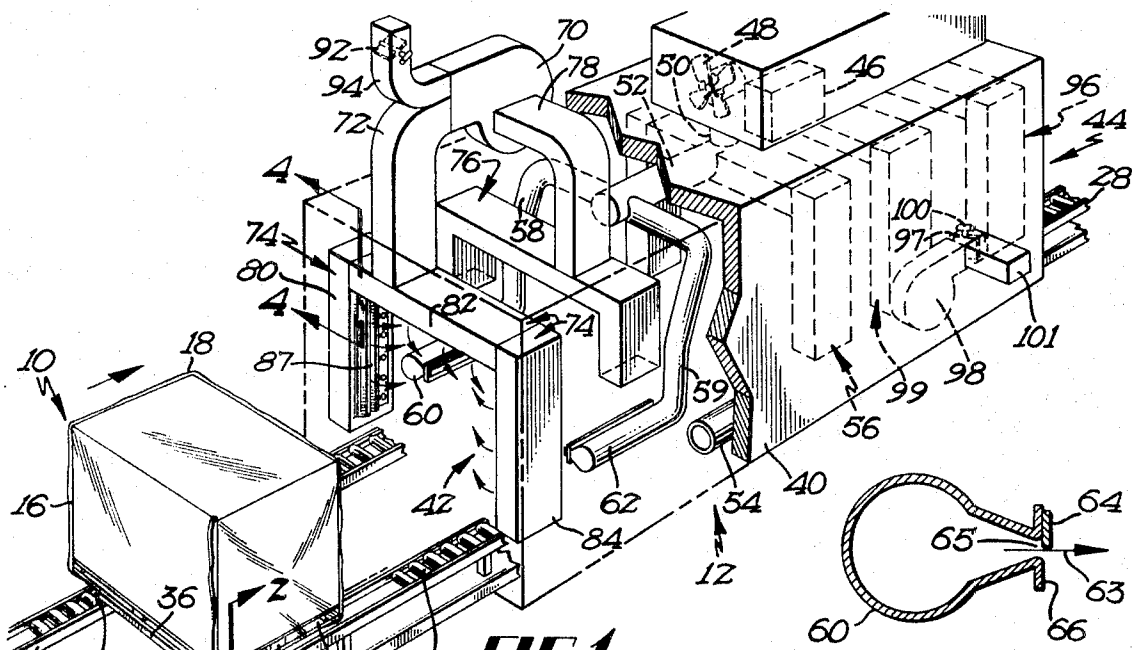


FIG 1

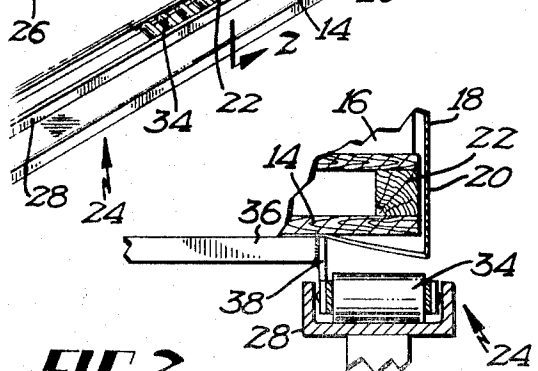


FIG 2

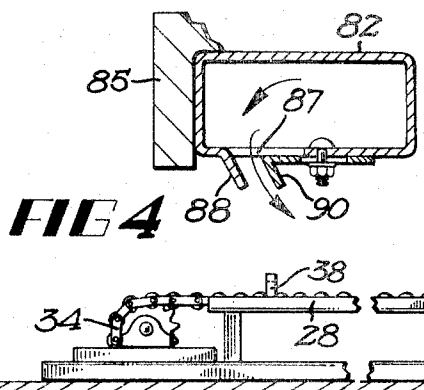


FIG 3

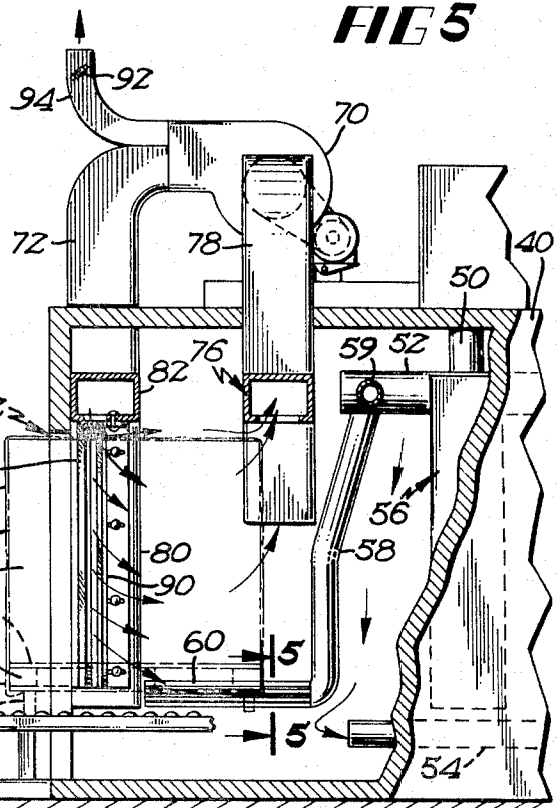


FIG 4

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SHRINK TUNNEL FOR PALLETIZED LOADS

BACKGROUND OF THE INVENTION

Pallets are frequently used by manufactures in shipping their products because pallets provide rigid, reliable platforms on which loads can be stacked and bound. Transporting a loaded pallet is simple, fast, and efficient since fork-lift trucks can easily lift and transfer them from loaded vans or boxcars to their final use area.

Traditionally loads have been bound to pallets by metal straps or cords. Such retainers are adequate to hold the load on the pallet but provide little protection from adverse weather and rough handling during transit or storage. Accordingly, it is desired to provide an apparatus which rapidly binds the load securely to the pallet and provides protection for the load from weather and handling at a minimum of cost.

The present invention comprises a shrink tunnel for palletized loads. A loaded pallet is covered with a wrapper of shrinkable or oriented plastic material and conveyed through the shrink tunnel to shrink the material into a tight fitting relationship with the load and pallet thereby protecting the load and binding it to the pallet.

It is desirable to provide a preheating zone at the shrink tunnel entrance to warm the plastic covering prior to its encountering the high temperature shrink zone. The invention includes apparatus to generate a curtain of preheating air at the tunnel entrance which simultaneously preheats the plastic and isolates the shrink zone from the ambient environment. Additional apparatus can be used to generate a curtain of air at the exit of the tunnel to establish a cooling zone to decrease the temperature of the plastic covering as the load leaves the tunnel and further isolate the shrink zone from the ambient environment.

Before the plastic cover is fully shrunk onto the palletized load, the plastic covering should be shrunk tightly against the pallet itself. If this step is not taken, the plastic covering as a whole shrinks and the skirt of the covering recedes to a level above the pallet making it difficult to thereafter anchor the load to the pallet with the plastic covering. Accordingly, the invention includes apparatus to shrink the plastic covering against the sides of the pallet before shrinking the plastic covering against the load.

SUMMARY OF THE INVENTION

The invention comprises a shrink tunnel for palletized loads which shrinks a plastic covering against the palletized load to provide protection for the load and bind it to the pallet. A loaded pallet with a plastic covering thereover moves along a conveyor through the shrink tunnel which includes a high temperature shrink zone. The tunnel has apparatus for generating a curtain of air at entrance and exit to respectively preheat and cool the plastic covering as the palletized load passes therethrough. In addition the curtain of air acts as an air door to isolate the shrink zone from the ambient environment.

The shrink zone has apparatus for heating and circulating air at a temperature adequate to shrink the plastic material into tight fitting relationship with the load. The apparatus includes a pair of stationary shrink

nozzles near the entrance of the tunnel to shrink the plastic material tightly against the sides of the pallet before the remainder of the plastic material is shrunk tightly against the load. The anchors the plastic material solidly to the pallet and when the final shrinking of the plastic covering occurs thereafter, the load is securely bound to the pallet. The plastic covering provides protection against rough handling and adverse weather.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a pictorial view of the shrink tunnel invention with the outer tunnel wall partially cut away.

FIG. 2 is an enlarged sectional view taken along cutting plane 2—2 of FIG. 1 showing the conveyor system used with the invention.

FIG. 3 is a section side view of the shrink tunnel of FIG. 1 with a palletized load entering the tunnel.

FIG. 4 is an enlarged sectional view of a preheating nozzle taken along cutting plane 4—4 of FIG. 1.

FIG. 5 is an enlarged cross sectional view taken along cutting plane 5—5 of FIG. 3 showing a stationary shrink nozzle.

DESCRIPTION AND OPERATION OF THE INVENTION

FIG. 1 shows a palletized load 10 about to enter a shrink tunnel shown generally at 12. The palletized load 10, consisting of pallet 14 and load 16, has a bag-like wrapper or covering 18 of shrinkable or oriented plastic material pulled downward over the load, the covering being of sufficient length so the skirt 20 of the wrapper covers the sides such as 22, of the pallet 10. The cover 18 may consist of a length of tube stock polyethylene plastic, or other shrinkable plastic like material, which is pulled over the palletized load, the tube stock then being cut and sealed at the top of the load to form a bag-like wrapper. Any loose folds of plastic material can be folded against the load. The covering selected should be sturdy enough to provide protection to the load; polyethylene plastic with a thickness of approximately 5/1000 inch is acceptable.

The palletized load 10 with its wrapper 18 is moved along a conveyor system 24 which defines a path through the shrink tunnel. Referring now to FIGS. 1 and 2 the conveyor has a pair of identical tracks 26 and 28 with roller chain drives 32 and 34. Moving roller chains 32 and 34 have a plurality of cross bars such as 36 attached transversely to the chains at spaced intervals. The cross bars 36 engage the palletized load 10 to carry it along tracks 26 and 28.

Referring now to FIG. 1, the shrink tunnel 12 has a tunnel housing 40 which includes entrance 42 and exit 44. Approximately intermediate between entrance and exit is an apparatus for establishing a shrink zone within the tunnel housing. The shrink zone apparatus includes apparatus for heating and circulating air such as shrink zone heater 46, shrink zone blower 48, ducts 50, 52, 58, and 59, shrink nozzles 60 and 62, shrinking arch 56 and shrink zone air return 54. Heater 46 warms air to a temperature range adequate to shrink the plastic wrapper 18, and blower 48 forces the shrinking air into ducts 50 and 52 leading to shrinking arch 56 and into ducts 58 and 59 terminating at stationary shrink nozzles 60 and 62. The arch 56 and shrink nozzles 60 and

62 release shrinking air to establish a shrinking zone of sufficient volume to shrink the plastic wrapper 18 into a substantially tight fitting relationship with the load. This temperature range varies with the physical and chemical properties of the plastic material used, but for polyethylene with a thickness of 5/1000 inch, it is approximately 300–400°F.

It should be understood that the shown apparatus for heating and circulating the air is but one means for raising the temperature of the shrink zone to a shrinking temperature range and that other means, such as radiant heating, are contemplated as usable with the invention.

The shrink nozzles 60 and 62 are, of course, not the only apparatus which can be used to shrink the skirt of the wrapper against the sides of the pallet. Any means for heating the plastic material adjacent the pallet to a shrinking temperature can be used to anchor the skirt to the pallet.

As the palletized load with a plastic wrapper thereover moves through housing 40 it encounters stationary shrink nozzles 60 and 62 before reaching shrinking arch 56. Shrink nozzles 60 and 62 direct shrinking air against the skirt 20 of the wrapper which overlies the sides of the pallet 14 and shrinks the skirt 20 tightly against the pallet to anchor the wrapper thereto. Thus when palletized load 10 reaches shrinking arch 56, the wrapper is securely anchored to the pallet and as the air from shrinking arch 56 heats the plastic wrapper, it shrinks into a tight fitting relationship with the load, binding it to the pallet.

The cross sectional configuration of a shrink nozzle 60 is shown in FIG. 5. Lips 64 and 66 separated by slotted orifice 65 direct shrinking air outward as shown by arrow 63, lip 64 being moveable to control the quantity of air released in order to adapt the shrink nozzle 60 to plastic materials having various thicknesses. A lesser quantity of heated air is required to shrink a thin plastic covering than is needed for a thicker covering. Nozzles 60 and 62 are elongated to extend longitudinally along the conveyor 24 to provide continued heating of the wrapper skirt 20 to assure shrinkage of the wrapper against the pallet.

Most of the shrinking air expelled from shrinking arch 56 or shrink nozzles 60 and 62 circulates through the shrink zone and enters shrink zone air return duct 54 which extends to the shrink zone heater 46 and blower 48 which repeatedly heat and circulate the air. Referring now to FIG. 3, the air return 54 is located below the level of a pallet passing through the shrink zone. This positioning creates a slight vacuum within the plastic wrapper 18 which minimizes billowing of the wrapper as it passes through the tunnel. As will be further described hereafter a portion of the shrinking air from the shrink zone is accepted by preheating zone air return 76 to aid in establishing preheating zone.

The tunnel entrance 42 is provided with apparatus for generating a combined air door and plastic wrapper preheating zone adjacent the entrance. The generating apparatus is shown in FIG. 1 as including preheating zone blower 70, outlet duct 72 exhaust duct 94, damper 92, preheating arch 74, preheating zone air return 76, and inlet duct 78.

Preheating zone air return 76 accepts both shrinking air from the shrink zone and ambient air entering from

the entrance 42 and combines them to obtain preheating air which has a temperature range lower than that of the shrinking air. This preheating air temperature range may be at approximately 200°–250°F for 5/1000 inch polyethylene plastic. By manipulating damper 92 in exhaust duct 94, a predetermined quantity of air is exhausted from the shrink tunnel, thereby causing an essentially equal quantity of ambient air to enter through entrance 42 and exit 44. Preheating air is obtained by mixing the shrinking air with the ambient air.

Blower 70 delivers the preheating air to the preheating arch 74 which includes a plurality of interconnected preheating nozzles here shown as the three nozzles 80, 82, and 84; naturally, a greater or lesser number of nozzles can be used. Preheating nozzles 80 and 84 have a length substantially equal to the height dimension of the entrance; nozzle 82 has a length substantially equal to the width of the entrance dimension.

FIG. 4 shows the cross sectional configuration of preheating nozzle 82 mounted adjacent wall 85 of the tunnel housing. Each preheating nozzle has a longitudinally disposed slotted orifice 87 extending substantially the length of the nozzle, and lips 88 and 90 adjoining the slotted orifice and separated thereby to direct preheating air across and into the tunnel entrance 42.

Referring again to FIG. 4, the position of lip 90 of nozzle 82 can be varied to control the volume of air expelled from the orifice in order to balance the air flows from nozzles 80, 82, and 84 and generate the curtain of preheating air. Operation of nozzles 80 and 84 is identical to that of nozzle 82. The three preheating nozzles co-operate to generate a curtain of air at the entrance 42 which establishes a preheating zone extending to return 76.

The flow pattern of the air issuing from preheating arch 74 is indicated by flow arrows in FIGS. 1 and 3. The air flow of preheating nozzles 80 and 84 is directed across and into the tunnel entrance; the air flow of nozzle 82 is directed downward and into the entrance. As a load passes through the arch 74 the air from the arch flows along the load and into the return 76 as shown in FIG. 3. Preheating air emitted from preheating arch 74 heats the plastic covering as the load passes through the arch and isolates the shrink zone from the ambient environment outside the entrance 42.

Most air expelled from preheating nozzles 80, 82, and 84 enters tunnel housing 40 and is drawn into preheating zone air return 76 and conveyed by duct 78 to the blower 70. Thus preheating air is circulated and recirculated to generate a curtain of preheating air at the entrance of the tunnel housing.

Referring again to FIG. 1, exit 44 has a cooling zone generated by cooling arch 96 formed from a plurality of cooling nozzles, here shown as three interconnected nozzles identical to preheating nozzles 80, 82, and 84 of preheating arch 74. The cooling arch 96 receives its air supply through duct 97 extending from cooling zone blower 98. A cooling zone air return 99 accepts air emitted from the cooling arch 96 and returns it to the blower 98 for recycling. Thus the cooling arch 96 with its blower 98 generates a curtain of air at the exit which establishes a cooling zone for the plastic wrapper and an air door which isolates the shrink zone from the ambient environment outside the exit. A damper 100 ex-

hausts a predetermined amount of air out duct 101 in order to cause ambient air to enter the exit at a predetermined rate. The mixing of shrink zone air and ambient air permits one to obtain a supply of cooling zone air having a temperature lower than the shrinking air. This cooling zone air may be in the same temperature range as preheating air.

Although the apparatus forming the cooling zone is not shown as identical to that for generating the preheating zone, it should be understood that the same identical structure could have been used.

In operation, a palletized load 10 with a plastic covering 18 thereover is placed on conveyor system 24 which carries it through the shrink tunnel 12. The palletized load enters preheating arch 74 and preheating air emitted from nozzles 80, 82, and 84 preheats the plastic covering 18. As the load passes through entrance 42 the preheating air flows about its periphery, rapidly warming the plastic in preparation for its entering the shrink zone. The nozzles 80, 82 and 84 establish a curtain of air which isolates the shrink zone from the ambient environment. Most air from preheating arch 74 is picked up by air return 76 by recycled.

As the plastic covering encounters stationary shrink nozzles 60 and 62 which as shown in FIG. 1 are disposed in the preheating zone to shrink the skirt 20 onto the pallet while preheating air continues to be applied to upper portions of the cover, shrinking air shrinks the skirt 20 of the plastic cover into a tight fitting relationship with the pallet. This anchors the skirt to the pallet and prevents the plastic covering from shrinking upward and uncovering the lower sides of the load in response to heat from the still to be encountered shrinking arch 56. The remainder of the plastic covering is shrunk into tight fitting relationship with the load as the palletized load moves past the shrinking arch 56. It should be understood that the shrinking arch 56 is not part of the invention and can be replaced by any known equivalent structure.

As palletized load 10 leaves the shrink zone and passes through exit 44 the plastic covering is cooled by air emitted from cooling arch 96 which functions identically to preheating arch 74. The cooling arch 96 reduces the temperature of the plastic wrapper 18 permitting earlier handling thereof, and also isolates the shrink zone from the ambient environment.

While I have described a preferred embodiment of the present invention, it should be understood that various changes, adaptations and modifications may be made therein without departing from the spirit of the invention and the scope of the appended claims.

What is claimed is:

1. A shrink tunnel to shrink a plastic wrapper covering a palletized load into a substantially tight fitting relationship with the palletized load as the load moves along a path through the tunnel comprising:

a tunnel housing including an entrance and exit;

apparatus for establishing a shrink zone within the tunnel housing, the apparatus including means for raising the temperature of the shrink zone to a temperature range adequate to shrink the plastic wrapper into a substantially tight fitting relationship with the palletized load as the load moves along the path through the shrink zone;

apparatus for generating a combined air door and plastic wrapper preheating zone adjacent the housing entrance, said generating apparatus accepting heated air from the shrink zone and unheated ambient air and combining them to obtain preheating air having a temperature range less than that required to shrink the plastic wrapper, said preheating air being conveyed to the entrance to generate a curtain of air directed across and into the entrance to thereby preheat a plastic wrapper entering the tunnel housing and isolate the shrink zone from an ambient environment.

2. The combination according to claim 1 wherein said means for raising the temperature in the shrink zone includes:

apparatus for heating and circulating air, the apparatus heating the air to a predetermined temperature range adequate to shrink the plastic wrapper onto the palletized load and circulating the shrinking air through the housing to establish a shrink zone at a distance from the entrance thereof containing an adequate volume of shrinking air to shrink the plastic wrapper into a substantially tight fitting relationship with the palletized load.

3. The combination according to claim 1 wherein the apparatus for generating a combined air door and plastic wrapper preheating zone further includes:

a preheating zone blower;

a preheating zone air return conveying said preheating air from the tunnel housing to said preheating zone blower;

a plurality of preheating nozzles receiving said preheating air from said preheating zone blower and located about the entrance for emission of said preheating air to generate the curtain of air.

4. The combination according to claim 3 wherein an outlet duct extending from the preheating zone blower to the said nozzles supplies air to the nozzles, said outlet duct having a damper therein adjacent the preheating zone blower to exhaust air from the tunnel housing thereby causing ambient air to enter the housing at a predetermined rate thereby controlling the temperature of said preheating air.

5. The combination according to claim 3 wherein each preheating nozzle has a longitudinally disposed slotted orifice and a pair of lips adjoining the slotted orifice and separated thereby to direct preheating air issuing therefrom across and into the tunnel entrance to generate the curtain of air.

6. The combination according to claim 5 wherein one of the lips of each preheating nozzle is moveable relative to the slotted orifice to controllably obstruct the orifice and thereby vary the volume of air passing through the orifice.

7. The combination according to claim 1 including:

a cooling zone blower;

a cooling zone air return located in the tunnel housing between the shrink zone and the exit conveying air from within the tunnel housing to the cooling zone blower; and

a plurality of cooling nozzles receiving the air from said cooling zone blower, the nozzles located about the exit to expel the air therefrom thereby generating a curtain of air adjacent the exit.

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8. A tunnel to shrink a plastic cover on a palletized load into a tight fitting relationship with the load comprising:

a tunnel housing including an entrance and exit;
a conveyor moving the palletized load through the housing;

means heating and circulating shrinking air inside the housing to establish a shrink zone in spaced relation to the entrance, the temperature of the shrinking air being adequate to shrink the cover into tight fitting relationship with the palletized load as the load moves through the shrink zone;

second means for supplying an independent preheating zone of air immediately adjacent the entrance and having a temperature substantially less than the shrinking zone air;

said heating and circulating means also including a pair of stationary shrink nozzles between the preheating zone and the shrink zone, one nozzle being located on each side of said conveyor adjacent the conveyor and on a vertical level with a pallet moving therealong, the nozzles directing shrinking air

substantially horizontally across the housing and at the sides of the pallet as the load passes through the preheating zone to thereby shrink the skirt of the cover to tightly grip the pallet prior to the load entering the shrink zone wherein the remainder of the cover is shrunk onto the load.

9. The combination according to claim 8 wherein said second means includes a plurality of entrance nozzles arranged to direct preheating air against the top and sides of the palletized load, said second means further including an air return spaced along the tunnel housing from the entrance nozzles so the preheating air flows along and preheats the top and sides of the palletized load, and then enters the air return, the preheating zone extending along the tunnel housing to said air return, the shrink nozzles being disposed in the portion of the tunnel housing containing the preheating zone to shrink the skirt of the cover onto the pallet while preheating air continues to be applied to upper portions of the cover.

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