HOT AIR SEALING APPARATUS

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Filed: Jan. 30, 1973

Appl. No.: 328,148


Int. Cl. H05b 1/00, B65b 51/20

Field of Search 219/366, 367, 368, 373; 53/375; 165/100; 156/357, 497, 499; 34/96, 155; 251/155, 157/609, 610; 432/225; 93/DIG. 1

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ABSTRACT

A carton sealing apparatus for incorporation in a carton filling and closing line which is characterized by a hot air generator with a discharge nozzle having perforated areas positioned for applying hot air to carton closure panels advanced past the same which panels are supplied with a heat activatable adhesive substance, and associated mechanism for guiding the panels into carton closing position where they are sealed by the adhesive. A bypass arrangement is provided adjacent the nozzle to enable quick discontinuance of the application of the hot air to the adhesive carrying surfaces and equally quick resumption of the application of the hot air without discontinuing the air flow or changing its character.

5 Claims, 12 Drawing Figures
HOT AIR SEALING APPARATUS

This invention relates to packaging and is more particularly concerned with apparatus for sealing carton closure flaps or panels which have been applied thereon an adhesive adapted to be activated by the application of hot air or a similar heat source.

In the packaging of a variety of products a form of carton commonly used comprises a tubular body of paperboard or similar material with end closure panels adapted to overlie each other and to be secured adhesively so as to provide a satisfactory seal for the type of product being packaged. A variety of equipment has been provided for applying a liquid adhesive to the appropriate faces of the flaps and for closing the same while the adhesive is wet or tacky so as to effect a satisfactory seal. In the handling of a number of different products which it is desirable to package in this type of carton the use of a liquid sealing material has been found to have many disadvantages. This has resulted in an effort to employ a preapplied heat activatable sealing material so as to facilitate handling of the cartons while filling with the product and closing of the same.

A coating of sealing material may be placed on the blanks, including the closure panels, and dried during the fabrication of the containers, enabling the cartons to be set up and filled while in a dry condition. In developing equipment for handling cartons having a preapplied, dry, heat activatable adhesive in the flap sealing areas, many problems have been encountered which have been difficult of solution. Consequently, much of the equipment which has been developed for this purpose has not been entirely satisfactory. It is a general object of the present invention to provide heat sealing equipment for carton filling and closing machines which will result in effective sealing of the end closure panels, and which is adapted to be readily incorporated in a relatively high speed packaging line with a minimum of expenditure so as to avoid the need for replacement of much of the equipment heretofore employed in packaging operations where a product is enclosed in a tubular carton having end closure panels.

It is a more specific object of the invention to provide an improved apparatus for closing and sealing the end panels of a carton structure of the type having a tubular body of square or rectangular cross section with hinged panels or flaps for closing the ends thereof on which a heat activatable adhesive has been applied, which apparatus includes a hot air source and an arrangement for directing the hot air onto the adhesive laden closure panels so as to activate the adhesive and effect a seal by laying down the heated panels in overlapping relation.

A still more specific object of the invention is to provide an improved apparatus for sealing carton end panels or closure flaps which is adapted to be incorporated in a packaging line and which is arranged to direct a stream of heated air onto adhesive bearing surfaces of the carton closure panels so as to activate the adhesive preparatory to folding down the panels into overlying seal forming relation.

Another object of the invention is to provide a carton sealing mechanism which includes an improved generator for supplying hot air with a discharge nozzle constructed and arranged so as to direct the hot air onto the side faces of carton end closure members which are guided along the side of the nozzle.

Still another object of the invention is to provide an apparatus for applying heat to the end closure panels of a carton which bear a heat activatable adhesive wherein a nozzle is provided with a hot air supply line which nozzle is positioned for directing the hot air onto adhesive bearing surfaces of the closure panels while they are guided in a path adjacent the nozzle and a means is provided for cutting off the supply of hot air to the nozzle and bypassing the same so as to avoid damage to the carton when there is a stoppage of the machine with the closure panels alongside of the discharge nozzle.

A further object of the invention is to provide in an apparatus of the type described a hot air generator or a hot air supply source with an arrangement for normally directing the hot air through a nozzle and a mechanism for causing the hot air to bypass the nozzle so as to interrupt the application of the hot air to the adhesive laden closure panels.

Still another object of the invention is to provide an apparatus for sealing carton flaps having a heat activatable adhesive thereon which includes a supply source for hot air and a nozzle arranged to direct the hot air onto the carton flaps with a bypass arrangement adjacent the nozzle which enables quick discontinuance of the application of the hot air to the adhesive bearing surface and equally quick resumption of the application of the hot air when desired without discontinuing the flow of the heated air or changing its character.

A still further object of the invention is to provide an apparatus for sealing carton flaps having a heat activatable adhesive thereon which comprises a two step heating arrangement with a separate hot air nozzle for heating each of the side closure flaps, each nozzle being connected to a hot air generator through a bypass valve which is operable to block the flow of the hot air to the nozzle and to open an exhaust port when the advance of the carton carrying conveyor is interrupted.

These and other objects and advantages of the invention will be apparent from a consideration of the heat sealing apparatus which is shown by way of illustration in the accompanying drawings wherein:

FIG. 1 is a plan view, with portions omitted, illustrating a portion of a packaging line with a hot air sealing apparatus which incorporates therein the principal features of the invention;

FIG. 2 is a side elevation showing the apparatus of FIG. 1;

FIG. 3 is a cross section taken on the line 3—3 of FIG. 1;

FIG. 4 is a cross section, to an enlarged scale, taken on the line 4—4 of FIG. 2;

FIG. 5 is a top plan view, to an enlarged scale, of the hot air generating device, with the top cap removed;

FIG. 6 is a partial vertical section, with portions broken away, showing the hot air generating device and the associated nozzle and hot air bypass arrangement;

FIG. 7 is an exploded perspective view showing the details of the nozzle and hot air bypass arrangement at the bottom of the hot air generator;

FIG. 8 is a partial plan view similar to FIG. 1, illustrating a two step hot air sealing apparatus which incorporates a modified hot air generator nozzle and bypass arrangement;

FIG. 9 is a side elevation showing the apparatus of FIG. 8.
FIG. 10 is a cross sectional view, to an enlarged scale, the view being taken generally on the line 10—10 of FIG. 9, with the hot air generator and hot air bypass valve being in vertical section.

FIG. 11 is a view taken on the line 11—11 of FIG. 10; and

FIG. 12 is an elevational view, to an enlarged scale, showing the hot air applying nozzle.

Referring first to FIGS. 1 and 2, there is illustrated a portion of a packaging line suitable for handling cartons which have been filled with a product, such as, for example, laundry detergent, soap powder or any of a variety of other products capable of being packaged in a carton C of the type illustrated. The illustrated carton C (FIGS. 2 and 4) is characterized by a tubular body B, of square or rectangular cross section and having end closure panels or flaps E and F. In the form shown, the closure panels E are hinged to the relatively narrow end wall panels and the closure panels F are hinged to the side wall panels which have a greater width. The carton C is, of course, adapted to be closed by first folding down the smaller end panels or flaps E and then folding down and sealing the larger panels or flaps F which overlap each other.

In the apparatus illustrated the cartons C, each with the bottom end closed and the top closure flaps E and F in upstanding relation, are supported in spaced relation on a traveling conveyor indicated at 10 in FIGS. 1 and 2. The conveyor 10 comprises a horizontally disposed support member 11, which may be a fixed surface over which the cartons slide or a traveling belt support on which the bottom ends of the cartons rest, and a series of pocket-forming members 12 which are mounted in upright, spaced relation on conveyor member 14 which is in turn mounted so as to travel in a vertical plane. The pocket-forming members are of U-shaped cross section and the cartons B are held between the same by a pair of fixed guard rails 16 which maintain the containers in the pockets 17 in an upright position while traveling beneath an end panel or end flap closing wheel 18 and a hot air device 20 for activating the adhesive on the closure panels.

The end panel closing wheel 18, which is of well known construction, is mounted on a cross shaft 18 which is driven in timed relation so as to fold down successively the end closure panels E. The end closure panels E generally have no seal forming coating and serve as dust flaps to protect the product in the carton while the adhesive is activated on the panels F and the latter are folded into top closing relation. The larger side closure panels F in the form of the carton shown are provided on the inside faces with a heat activatable adhesive.

The hot air apparatus 20 for activating the adhesive on the inner faces of the closure panels F comprises an air heater or hot air generator 21 and a nozzle assembly 22 supported in vertically disposed relation by any suitable means, with the nozzle assembly 22 located, as shown in FIGS. 3, 4 and 6, immediately above the path of the top of the carton. The nozzle assembly 22 is positioned at an elevation which brings the bottom portion of the nozzle between the upstanding side flaps F when a carton is advanced beneath the same.

As shown in FIGS. 6 and 7, the nozzle assembly 22 comprises a nozzle head in the form of a generally rectangular box 23 having an imperforate bottom wall 24, a top wall 25 and oppositely disposed side walls 26, 26' with the latter being perforated as indicated at 27 along the bottom margins so as to discharge hot air against the adhesive coated inner faces or surfaces of the carton closure flaps F which are held in upright position by guard or guide plates 28, 28' mounted on the box 23. A bypass valve assembly 30 is interposed between the bottom plate 31 of the heater 21 and the top plate 25 of the nozzle assembly 22.

The bypass valve assembly 30 comprises a rectangular tubular casing 32 set between top and bottom plates 33 and 34, the latter having vertically aligned apertures 35 and 36 which are adapted to be aligned with the aperture 37 in the top plate 25 of the nozzle 22 and the aperture 38 in the bottom plate 31 of the heater 21. A baffle plate 40 is mounted in the casing 31 in a downwardly inclined position which partially obstructs the flow of air through the valve and which co-operates with a gate-forming plate 41. The gate-forming plate 41 is hinged at 42 along the bottom edge of an aperture 43 in the side wall 44 of the casing 32. The aperture 43 forms a passageway to a bypass member 45 which is in the form of an L-shaped conduit with an upstanding leg 46 which is disposed vertically along the outside of the heater 21. Gate member 41 is adapted to swing between the solid line and the dotted line positions shown in FIG. 6. In the solid line position the gate 41 permits the hot air to pass through the valve assembly 30 and into the nozzle 22. In the dotted line position of gate 41 the aperture 43 is opened and the valve 30 is closed so that the hot air is diverted to the exhaust conduit 45 and 46 and discharged into the atmosphere.

The hinge pin at 42 for the gate 41 is journaled in the end walls of the casing 32 and extended for mounting thereon a short radial arm 47 which has a pivotal connection at 48 with the bottom end of a depending link rod 50 which has its top end pivotally connected at 51 to the piston 52 of an air cylinder 53 for operating the gate 41. The air cylinder 53 is operated by an electrically controlled air valve (not shown) in an appropriate electrical circuit (not shown) controlling the movement of the carton carrying conveyor 10. The arrangement provides for exhausting the hot air through the conduit 46 when operation of the conveyor 10 is interrupted so as to avoid overheating the flaps F of a carton which may be stopped at the nozzle 22. The control circuit is arranged so that air is passed through the nozzle 22 when needed to heat the adhesive on the flaps F and the bypass is operated by opening the gate aperture 43 when hot air is not desired, as when operation of the conveyor 10 is interrupted.

The hot air producing device or hot air heater 21, which is cylindrical in the form illustrated, comprises an outer cylinder 60 with the bottom wall 31 and a top cap 61, the latter having a connection through conduit 62 with a suitable air source or supply. An inner cylinder 63 of less axial dimension than the outer cylinder 60 is spaced a substantial distance from the inner face of the outer cylinder member 60 so as to provide an air space or passageway 64 which is divided by the interposition of a further cylinder 65 between the two. The cylinder 65 is mounted on the inner cylinder 63 as shown so that its bottom edge is spaced above the inner face of the bottom wall 31. This permits air flow, as indicated by the arrows in FIG. 6, down along the inside face of the outer cylinder 60 and up between the inner face of the cylinder 65 and the outer face of the cylinder 63, and finally, down within the cylinder 63 and
through the opening 38 in the bottom wall 31. A mounting ring 66 on the top of the intermediate cylinder 65 is spaced above the top edge of the inner cylinder 63 and supports a series of tubular electrical heating units 67 which are disposed in spaced relation so that the air entering the top of the innermost cylinder 63 may circulate through the assembly of heater elements 67 as it is forced down by air pressure and through the bottom opening 38.

Plow members 70 and 71 are provided adjacent the exit end of the nozzle 22 which are arranged to turn down the heated closure flaps F, in the proper sequence, as quickly as possible, while the adhesive is activated by the hot air discharged through the nozzle 22 so as to engage the flaps F in sealing relation. A hold down or pressure applying apparatus 72 is provided to which the cartons pass as they leave the plows 70, 71.

In the use of the apparatus, the end closure flaps or panels E are folded down by the folder device 18 and the side flaps or panels F advance along the sides of the nozzle 22 where the hot air activates the adhesive on both flaps F and the flaps F are laid down in the proper sequence by the folder plows 70 and 71, after which the carton passes beneath the panel hold down device 72. In the event the conveyor travel is interrupted the bypass valve 30 is operated by means of the air cylinder 53 to cut off the flow of hot air to the nozzle housing 23 and to exhaust the air through the conduit 45, 46 so as to avoid overheating the closure panels of a carton which is stopped at the nozzle.

The apparatus is illustrated, in FIGS. 1 and 2, as applied to the sealing of carton flaps on a filled carton. The apparatus may be employed with equal advantage in sealing the bottom closure flaps of an empty carton. In a commercial operation for which the apparatus is especially adapted the cartons are supplied in collapsed or flat condition with the end closure flaps or panels at both top and bottom ends extending in the plane of the side wall panels to which they are connected. The cartons are opened up into tubular form and placed in the pockets of the conveyor with the closure flaps at the top and bottom ends extended. A hot air sealing apparatus is provided with the nozzle 22 disposed below the path of the conveyor and arranged relative to the conveyor so that the side closure flaps at the bottom ends of the cartons pass along the sides of the nozzle and the adhesive thereon is activated by the hot air delivered through the nozzle, after which, the panels are folded into engagement by plows, or other fold down means, so as to close and seal the bottom ends of the cartons which are then filled and finally closed by the apparatus illustrated in FIGS. 1 to 7.

Referring to FIGS. 8 to 12, there is illustrated another form of the hot air sealing apparatus which is incorporated in a carton closing line of the same character as shown in FIGS. 1 and 2, with the sealing apparatus modified and embodying a two step sealing operation. In this form the arrangement illustrated provides for activating the adhesive and folding down the side flaps F in sequence which in some instances is preferred. In this arrangement, the traveling conveyor 110 advances the cartons C in pockets 117 past a folding wheel 118, so as to fold down the end flaps F, and then past successive, in-line hot air sealing devices 120, each of which includes a hot air producing device or generator 121, a hot air bypass valve 130 and an applicator nozzle 122. The nozzles 122 are of identical construction except for being rights and lefts so as to operate on the flaps or panels F and which are on opposite sides of the cartons as they are advanced by the conveyor 110. The hot air generating devices 121 are of identical construction and also the associated bypass valves 130.

The hot air applying nozzle 122, FIGS. 10 to 12, is in the form of a box or a housing with a lower portion 123 through which the hot air is directed onto the closure panel F. This portion 123 of the nozzle has a generally triangular cross sectional shape at the entrance end with a top surface 124 which is inclined, as shown in FIG. 10, approximately 45 degrees, with the bottom apex positioned adjacent the hinge line 125 of the closure panel F which the nozzle is designed to heat. The surface 124 curves downwardly to a very nearly flat plane at the exit end 126 and is perforated as indicated at 127. A curved guide bar 128, supported on a bracket 131, serves to hold the panel F closely adjacent to the nozzle surface 124 as the cartons advance. The upper portion 132 of the housing 122 has a cross section in the form of a funnel for directing the hot air into an entrance passageway 133 connecting the interior of the two nozzle sections 132 and 133. The two nozzle sections may be separable and connected by bolting together mating flanges as shown in FIG. 12.

The hot air bypass valve arrangement 130 comprises a nozzle body member in the form of a block 134, disposed in a horizontal plane at the bottom of the hot air generator 121, which has two side-by-side vertical bores 135 and 136 forming air passageways in which butterfly-type circular valve plates 137 and 138 are positioned for operation, to open and close the passageways. The valve plates 137 and 138 are mounted on an operating support rod 142 which is journaled in the valve body 134 as shown. The valve plates 137 and 138 are mounted on the support rod 142 so that they are in planes offset 90 degrees about the axis of the rod 142 which results in the one passageway being closed and the other being open depending upon the rotation of the support rod 142. The valve body 134 forms the bottom wall of the hot air generator 121 and the nozzle assembly 122 is mounted on the lower face of the valve body 134 and aligned with the bore 135 so that the latter forms an entrance passageway for the hot air into the nozzle portion 132 which is opened and closed by rotation of the valve plate 137. The bore 136 opens at the bottom to the atmosphere and exhausts hot air from the generator 121.

The valve plate support rod 142 is extended at one end and a short radial arm 147 is mounted thereon which has a pivot connection at 148 with the bottom end of a depending link rod 150 which has its top end pivotally connected at 151 to the piston 152 of an air cylinder 153, the latter being mounted by means of bracket 154 on the generator 121. The air cylinder 153 is operated by a solenoid in an appropriate electrical circuit (not shown) controlling the movement of the carton carrying conveyor 110. The bypass is operated when the operation of the conveyor 110 is interrupted so as to avoid overheating the closure panels F of a carton which may be stopped at the nozzle 122.

The hot air generator 121 is cylindrical in form with an outer cylinder 160 having a top plug member 161 and a connection through conduit 162 with a suitable air supply means. An inner cylinder 163 is spaced from
the outer cylinder 160 to provide space for passage of air entering at the top which is divided by an intermediate cylinder 165 mounted as shown on a top ring member 166 which supports a plurality of heating units 167. Air entering at the top travels between the cylinders as indicated by the arrows in FIG. 10 and finally moves downward around the heater units 167 to the valve passageway 135 and into the nozzle 122 when the valve 130 is open. The outer cylinder 121 is bulged out at the bottom at 168 to encompass the bypass passageway 136 in the valve 130.

The operation of the form of the apparatus shown in FIGS. 8 to 12 is much the same as the apparatus in FIGS. 1 to 7 except that the heating of the flaps F is in two stages. The nozzle 122' in FIG. 9 is positioned so as to heat the inside face of the one closure flap F which is immediately folded down by the guide bar 128 so as to pass beneath the nozzle 122 while the other flap F is being heated by the nozzle 122 and folded down by the guide bar 128. A combination folder and hold down roller 170 (FIG. 9) may be provided between the two nozzles 122, 122' and a double roller 171 of the same character may be provided at the leading end of the guide bar 128 for pressing down the flaps F as the carton advances beneath the pressure member 172.

1. In a machine for closing and sealing the end closure flaps of a carton which flaps have a heat activatable adhesive on the surface thereof which is to be sealed, a hot air applying nozzle having a surface with perforations permitting passage of the hot air, said nozzle disposed with the perforated surface in position for directing hot air onto the adhesive bearing surface of a closure flap, means connected to the nozzle for supplying hot air to the nozzle which hot air supplying means comprises an exterior tank forming cylinder having an opening forming an air intake at one end, an inner cylinder of small diameter and shorter length mounted in said exterior cylinder with the side walls spaced from the side walls of the exterior cylinder and with one end closed and spaced from the air intake end of said exterior cylinder so as to permit air to enter said intake opening and pass down between the walls of said cylinders, the other end of said inner cylinder being open and engaging with an end wall of said exterior cylinder, a discharge opening in said end wall of said exterior cylinder which forms a passageway for connecting the interior of said inner cylinder with said nozzle, heating elements in said inner cylinder for heating air passing through said inner cylinder, and an intermediate cylinder having its side walls interposed between the space side walls of said exterior and said inner cylinders and having the side walls at one end terminating a short of the end wall of said exterior cylinder and closed at the other end with an opening forming an air passageway into the closed end of said inner cylinder so as to connect the interior of said intermediate cylinder with the interior of said inner cylinder and a bypass means for controlling the flow of hot air from said inner cylinder to said nozzle which bypass means comprises a valve body mounted on the end of said inner cylinder and having an opening into the nozzle which is aligned with the opening in the bottom end of said inner cylinder and a valve member incorporated in said valve body which is swingably mounted to block the flow of air through said opening into the nozzle while simultaneously opening a port for diverting hot air from said tank into the atmosphere.

2. In a machine as set forth in claim 1 wherein said heating elements comprise a plurality of elongate rod-like electrical resistance elements mounted in an end plate and extending into said inner cylinder.

3. In a machine as set forth in claim 1 wherein said bypass valve has a body forming an opening with openings in oppositely disposed walls forming a normally open passageway for flow of hot air from said inner cylinder into said nozzle, an exhaust port located in a wall of said housing adjoining the opening into said nozzle, a baffle plate in said housing and a hinged plate forming a opening gate member which is located so as to swing between a position to co-operate with said baffle plate in closing the passageway to the nozzle and a position to close said exhaust port and means controlling the swinging movement of said gate member.

4. In a machine as set forth in claim 1 wherein said bypass valve comprises a valve body forming the bottom end wall of said tank forming cylinder and having a pair of parallel bores therein forming air passageways one of which connects said inner cylinder with said nozzle and the other of which forms an air passageway connecting said outer cylinder with said exhaust port and means desirous of one of said passageways while simultaneously opening the other one of said passageways.

5. In a machine for closing and sealing the end closure flaps of a carton which flaps have a heat activatable adhesive on the surface thereof which is to be sealed, a hot air applying nozzle having a surface with perforations permitting passage of the hot air, said nozzle disposed with the perforated surface in position for directing hot air onto the adhesive bearing surface of a closure flap, means connected to the nozzle for supplying hot air to the nozzle which hot air supplying means comprises an exterior tank forming cylinder having an opening forming an air intake at one end, an inner cylinder of small diameter and shorter length mounted in said exterior cylinder with the side walls spaced from the side walls of the exterior cylinder and with one end closed and spaced from the air intake end of said exterior cylinder so as to permit air to enter said intake opening and pass down between the walls of said cylinders, the other end of said inner cylinder being open and engaging with an end wall of said exterior cylinder, a discharge opening in said end wall of said exterior cylinder which forms a passageway for connecting the interior of said inner cylinder with said nozzle, heating elements in said inner cylinder for heating air passing through said inner cylinder, and an intermediate cylinder having its side walls interposed between the space side walls of said exterior and said inner cylinders and having the side walls at one end terminating a short of the end wall of said exterior cylinder and closed at the other end with an opening forming an air passageway into the closed end of said inner cylinder so as to connect the interior of said intermediate cylinder with the interior of said inner cylinder and a bypass means for controlling the flow of hot air between the hot air supplying means and the nozzle which bypass means is located adjacent the nozzle and includes a valve body mounted at the hot air discharge end with a pair of air passages extending therethrough, one of which connects with the interior of said inner cylinder and the other of which connects with an opening in said exterior cylinder and valve gate members operable in said air passageways in said valve body to open one of said passageways while closing the other one of said passageways for interrupting the flow of hot air to the nozzle and simultaneously diverting the hot air to a port for exhausting the hot air to the atmosphere.
CERTIFICATE OF CORRECTION

Patent No. 3,823,306 Dated July 9, 1974

Inventor(s) Robert E. Davis

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In the heading of the patent, after the name of the inventor, the name of the assignee should be inserted

-- FEDERAL PAPER BOARD COMPANY, INC.
Montvale, New Jersey --

Column 7, line 36; "suplying" should be -- supplying --

Signed and sealed this 19th day of November 1974.

(SEAL)
Attest:

McCoy M. Gibson Jr.
Attesting Officer

C. Marshall Dann
Commissioner of Patents
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