

[54] **METHOD AND APPARATUS FOR
HEAT-SEALING PAPERBOARD PACKAGE
CLOSURE FLAPS**

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[21] Appl. No.: **273,945**

Related U.S. Application Data

[63] Continuation of Ser. No. 101,126, Dec. 23, 1970,
abandoned, which is a continuation-in-part of Ser.
No. 696,794, Jan. 10, 1968, abandoned.

[52] U.S. Cl. 53/47, 53/375, 53/388

[51] Int. Cl. B65b 7/20

[58] Field of Search. 53/47, 375, 388

[56] **References Cited**

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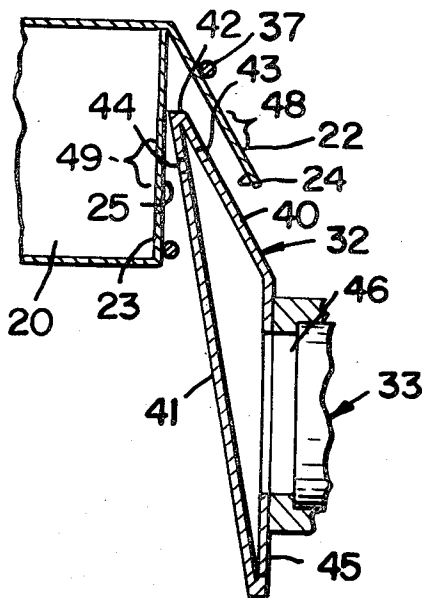
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Primary Examiner—Travis S. McGehee
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[57] **ABSTRACT**

Method and apparatus for heat-sealing paperboard package closure flaps having a heat sealable coating. While the package moves, two flaps are brought into proximity along two planes diverging at an acute angle, and upon the facing flap surfaces, are impinged one or more high-volume, low-velocity streams of very hot air, each along a controlled narrow area to heat one or more critical strips of each flap above the heat-sealing temperature. Immediately thereafter, the flaps are forced together and held together while they are cooled, until the lowering of the temperature results in completion of the seal.

19 Claims, 16 Drawing Figures



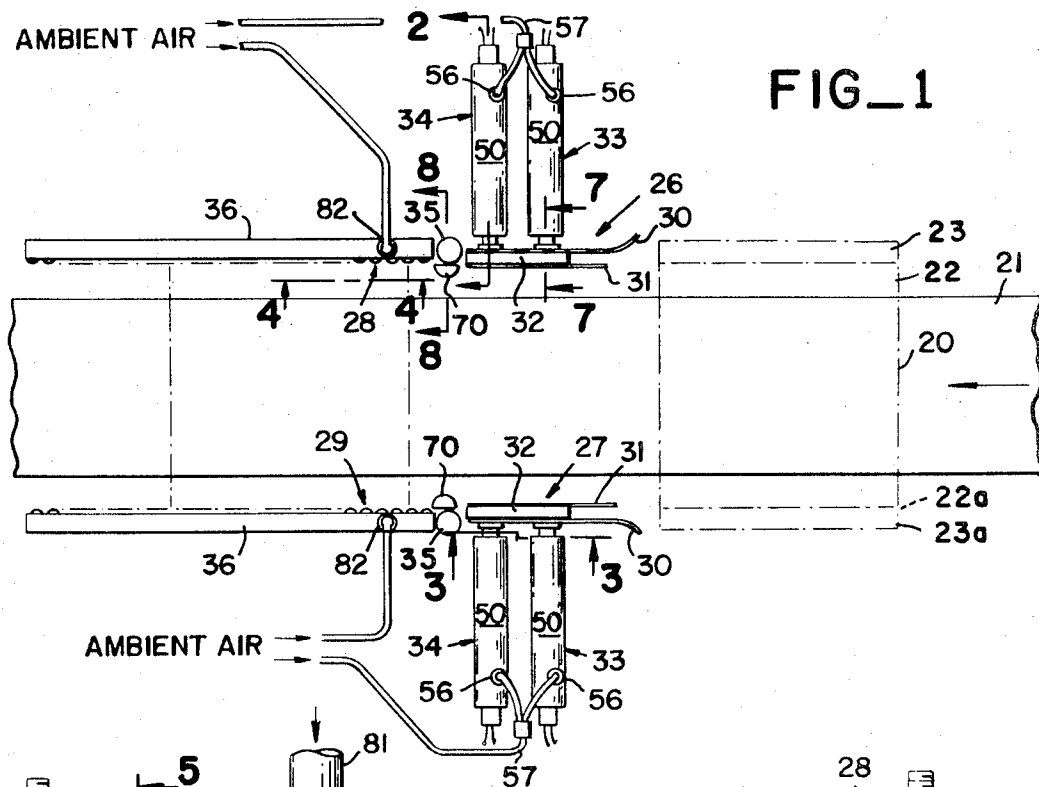


FIG_1

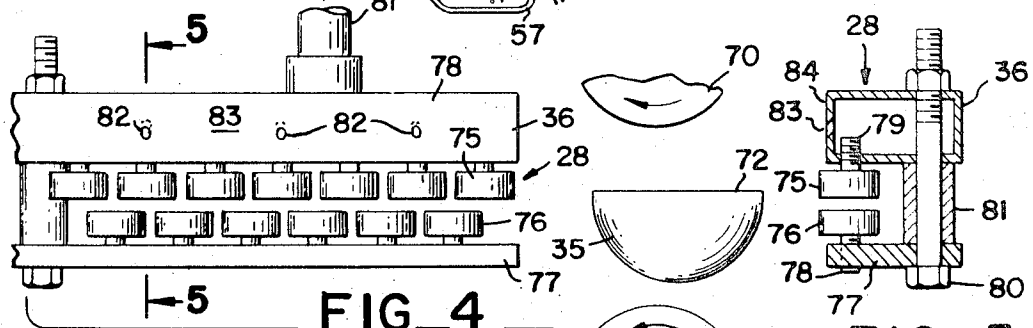


FIG_4

FIG_5

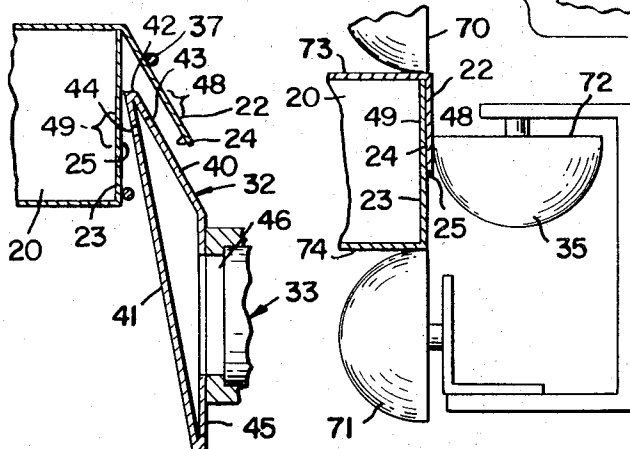


FIG_7

FIG_8

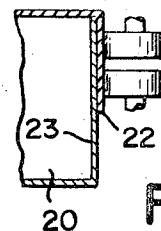


FIG_6

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FIG_2

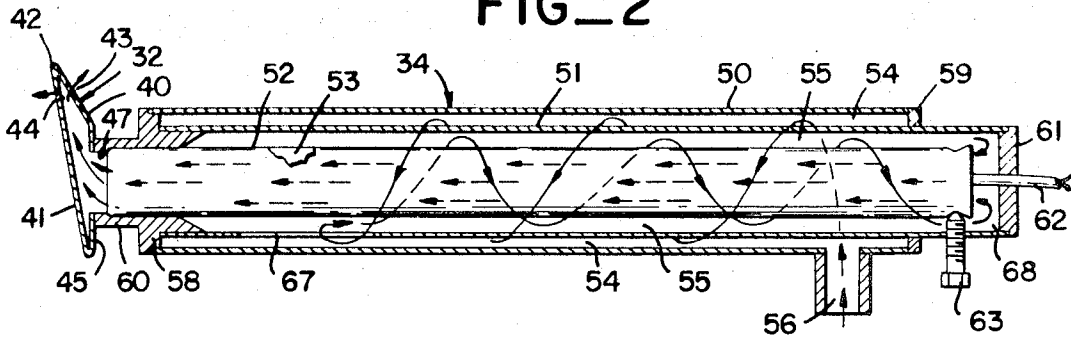


FIG_3

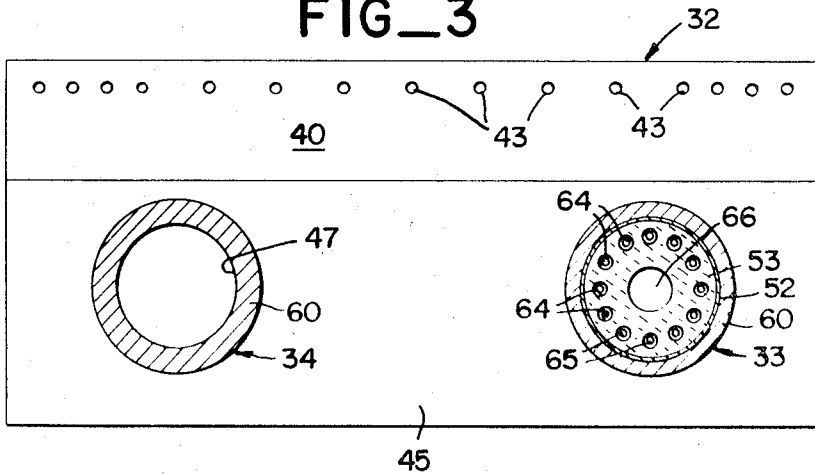


FIG_9

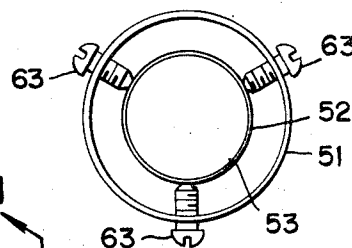


FIG_10

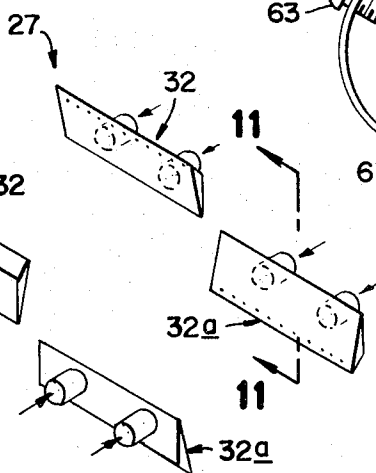
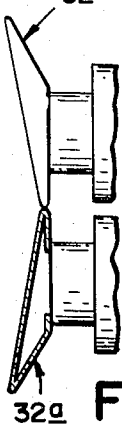


FIG_11



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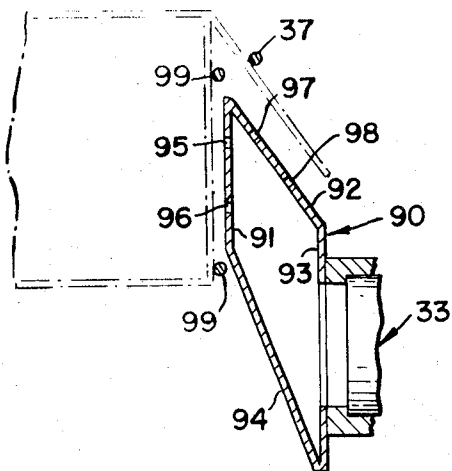


FIG_12

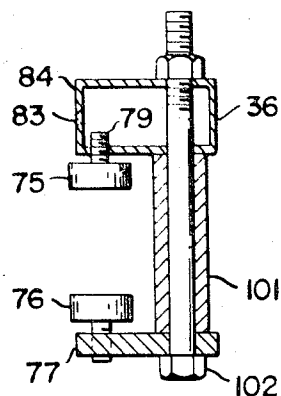


FIG_13

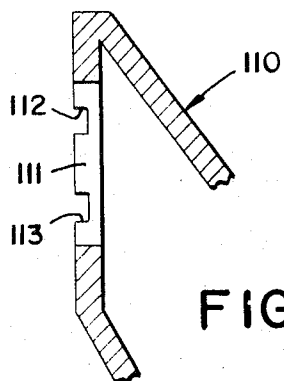


FIG_16

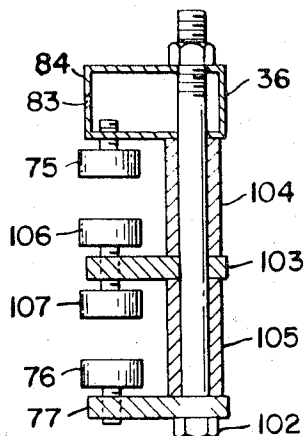


FIG_14

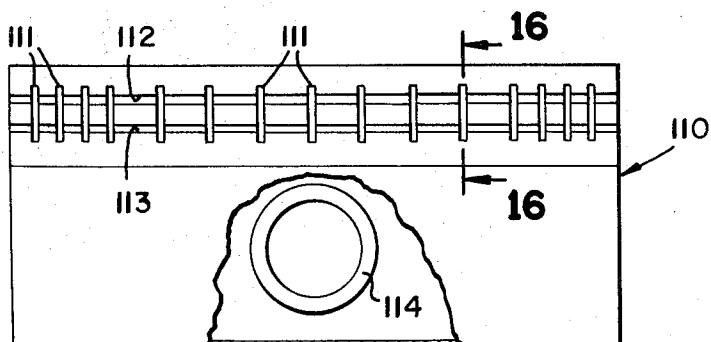


FIG_15

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METHOD AND APPARATUS FOR HEAT-SEALING PAPERBOARD PACKAGE CLOSURE FLAPS

This is a continuation of application Ser. No. 101,126, filed Dec. 23, 1970, now abandoned which in turn is a continuation-in-part of application Ser. No. 696,794, filed Jan. 10, 1968 also abandoned.

This invention relates to improvements in method and apparatus for heat-sealing paperboard packages and the like. It also relates to some subcombinations, including a novel heating apparatus, a novel manifold for emitting hot air against a pair of package flaps that are to be sealed together, and a novel closure means.

Paperboard packages often have their flaps provided with heat-sealable (usually thermoplastic) coatings which are heated, and then the package is closed and sealed by forcing the heated flaps together and holding them together until the heat sealable material is cooled sufficiently to provide a tight seal. Heretofore, there have been difficulties in accomplishing this heat-sealing operation efficiently without damaging the carton or marring its outside surface coating, and, as a result, apparatus for accomplishing it automatically has tended to be very expensive. Also, when packaging frozen goods, it has often been difficult to employ heat sealing without damaging the goods themselves by subjecting them to too much heat. Further, prior-art apparatus is not readily adjustable to changes in types of coatings or to speed changes in packaging machinery. A feature of the present invention is that relatively simple apparatus — costing only about one-tenth or one-twentieth as much as comparable prior-art apparatus — can do the job efficiently and well, without any damage to the frozen contents inside the package or to the package itself, and can do so in a very simple and foolproof manner. Installation costs and maintenance costs are much lower, too, and changes in coating types or in the speed of the packaging machinery are readily made.

Some of the better prior-art systems have required special air driers for drying the air before it is heated, because moist air damages their heater elements, and they have required a supplemental air-compressor system in addition to the normal compressed air system of the packaging plant. The present invention operates without any special driers and uses normal plant compressed air. No supplemental system is needed. In fact, my new system uses much less air than do the prior-art systems.

An important feature of the invention is the provision of a manifold and heater system in which heated air at high temperature is evenly distributed at low-velocity and high-volume over a relatively short distance to quickly heat the plastic coating on the flaps to the temperature at which it becomes tacky or otherwise heat sealable. The present invention does this in a single manifold without necessarily having separate compartments in the manifold. An even flow of air throughout the manifold is provided by spacing the discharge holes to balance the naturally uneven input to those holes. At the holes, the manifold is independently positioned away from the flaps to enable flow of air. Also, by using separately controlled multiple heaters the system (with or without a partition in the manifold) can be used to provide a different temperature at one end or one portion of the manifold than at another end or portion thereof for quick adaptability to various coating types and machine speeds.

The heater housings of the invention prewarm and predry ambient air without any supplemental warmers or driers being required, and they provide a swirl-type of air flow through the double jacket in the first two of the three passes through the heater, thereby getting the greatest efficiency in air heating. Also, less heat is lost between the heater's discharge into the manifold and the manifold discharge than is lost in conventional apparatus, partly because the outlet from the heater elements is large and located quite close to the manifold's discharge openings and partly because of the low velocity of the heated air, a major feature of this system. As a result, the device uses less wattage than conventional systems and wastes less heat.

In this invention no insulation of any kind is needed over or around the heater housings, yet their outer walls are actually barely warm to the touch, although extremely hot air (typically 1000°F. to 1200°F) is sent from the heaters into the manifolds. It is the only system in use today without insulation.

Another feature of the invention is that the air stream flow from the manifolds is designed to contact the flaps only where it is needed and not over their full surfaces. The low velocity of the air stream helps here. The flaps do not touch the manifold while they are being heated, and when they are being cooled, they do not require back-up pressure.

This invention employs much less air than conventional systems and uses it efficiently at the flaps and at low velocity; so it does not inflate the packages, as do many prior-art systems, and as a result, there is no time and space wasted in waiting for packages to deflate before packing them in cases. Also, no temperature correction of the product is necessary and there is no product deterioration.

Another feature of the invention is its mechanical closure. Closing of the outer major flaps is achieved within about one inch from the discharge edge of the manifold, and all of the holding needed to assure completion of the seal takes up only about two feet, even for quite rapidly moving packages, i.e., up to 150 feet per minute. No support is needed, even when sealing polyethylene to polyethylene. Package distortion is eliminated by special apparatus. The type of compression employed in the holding section eliminates the requirement of any kind of refrigerant; instead, free running rollers do the compression while an air stream of ambient air is directed against the carton flaps and rollers. This system can also be used in connection with folder-glueers of a heat-sealing type in a manufacturing converting plant.

To summarize the invention briefly, the apparatus includes a hot air manifold having two surfaces meeting at a sharp acute angle, each such surface having at least one row of openings along it for emitting the heated air. These openings are positioned away from the flaps, so that the air can move away. A novel air heater connected to the manifold comprises a long slim cylindrical ceramic heater with a plurality of circumferentially spaced long air passages, an inner shell surrounding and against the outer wall of the ceramic heater. Around the inner shell and spaced from it to provide a passage is an intermediate shell, and an outer housing surrounds the intermediate shell and is spaced from it to provide a passage; this outer housing has a tangential air inlet. Hence, the air gets three passages through the heater. The ends of the intermediate shell and outer

housing are closed, while the ceramic heater is connected directly to the manifold at one end and is spaced at its other end from the closed end of the intermediate shell. The intermediate shell has aperture means at the end opposite the inlet, so that air entering the tangential inlet is swirled between the outer housing and the intermediate shell for its first passage, then goes through the aperture in the intermediate shell and is swirled around the inner shell in its second passage, goes through the heating passages in the ceramic heater for its third passage, and then enters the manifold through a large outlet. At the manifold the outlet holes are so spaced that the air flow is longitudinally even, and the area of the air flow is balanced to the area of the inlet so that no excess pressure is generated by the expansion of heated air and so that the outlet holes supply the air at the same low velocity as that of the entering air.

Suitable plows, completely independent of the manifold but adjustable relative to it, push the flaps to the proper position relative to the manifold. The positioning of the flaps independent of any guides on the manifold makes this system different from other heretofore known and eliminates dependency on any such manifold-mounted guides to position the flaps. This system enables adjustability to accommodate various coatings, carton velocities, and air temperatures without changing any of the parts. There are no fixed guide bars nor any other inflexible positioning pieces. Thus, the heated flaps are forced against each other, preferably by a set of three free-running rollers, which assure proper positioning of the flaps, along with squareness of the carton and proper dimensioning. The flaps are then held together by one or more rows of cylindrical rollers while cooling air is directed down at the flaps, between the rollers.

Other objects and advantages of the invention will appear from the following description of some preferred embodiments.

In the drawings:

FIG. 1 is a fragmentary top plan view of a package closure system of this invention, including a conveyor system along which paperboard cartons (which may contain frozen food or any other contents) are moved through the flap-heating and heat-sealing stages, which embody the principles of the invention.

FIG. 2 is an enlarged view in section taken along the line 2—2 in FIG. 1.

FIG. 3 is an enlarged view in section taken along the line 3—3 in FIG. 1.

FIG. 4 is an enlarged view in side elevation taken along the line 4—4 in FIG. 1.

FIG. 5 is a view in section taken along the line 5—5 in FIG. 4.

FIG. 6 is a view of a portion of FIG. 5, shown with holding rollers bearing against the outer major carton flaps to hold it closed against the inner major flap, during cooling and congealing of the heat-sealing coating.

FIG. 7 is an enlarged view in elevation and in section taken along the line 7—7 in FIG. 1 showing the air heating of the coating on the outer major and inner major flaps by a manifold of this invention.

FIG. 8 is an enlarged view taken in section along the line 8—8 in FIG. 1, showing closure of the heated flaps of FIG. 7.

FIG. 9 is a view taken along the line 9—9 in FIG. 2, showing the structure of the air heater.

FIG. 10 is a view in perspective of a double manifold unit of the invention, used for closure of wide flap systems with overlap.

FIG. 11 is a fragmentary view in section taken along the line 11—11 in FIG. 10.

FIG. 12 is a fragmentary view in section of a modified form of manifold also embodying the principles of the invention, employing a somewhat different shape and two double rows of discharge openings.

FIG. 13 is a view similar to FIG. 5 of closing rollers for use with the manifold of FIG. 12.

FIG. 14 is a similar view of another form of closure device for bearing on four areas of the closure flaps.

FIG. 15 is a front elevational view of another modified form of manifold having slots and flow-enabling recesses, with a portion cut away to show the rear wall.

FIG. 16 is an enlarged fragmentary view in section taken along the line 16—16 in FIG. 15.

As shown in FIG. 1, 1, a paperboard carton 20 is moved along a conveyor 21. The carton 20 has outer major flaps 22 and 22a and inner major flaps 23 and 23a. These flaps 22, 22a and 23, 23a are to be closed against each other and sealed. At least one of the flaps 22 and 23 has been coated on one of the two facing surfaces 24 and 25 (FIG. 7) with a suitable thermoplastic or other material enabling heat sealing. Often both flaps are so coated. For example only, a frozen food product, such as a pie, may have been placed inside the carton 20, and the operation is to be conducted without in any way overheating that frozen food product or marring the outer surface of the carton. On each side of the package, the closure is to be accomplished simultaneously, in order to maintain alignment of the carton 20, so that there are duplicate apparatus, one on each side of the conveyor 21, comprising identical flap-heating units 26 and 27 and identical flap-closing units 28 and 29.

A narrow plow 30 precedes each heating unit 26 and 27 and bends the inner major flap 23 up to perpendicular position at the end of the carton 20, and a rod plow 31 then bends the outer major flap 22 over to a suitable acute angle, as shown in FIG. 7, as the carton 20 approaches the heating unit 26 or 27.

The plows 30 and 31 immediately precede and continue alongside of a manifold 32 and are made so that they correctly position the flaps 22 and 23 but are not themselves subject to heat build-up when no carton is running through the machine; they stay cool while the machine runs empty. The manifold 32 is a very important element of each heating unit 26, 27 of the invention, and each manifold 32 is provided with at least one or more heaters; in the embodiment shown in the drawings there are a pair of such heaters 33 and 34. The manifold 32 emits very hot (e.g., 1000° to 1200°F.) air at high volume and at low velocity; this air heats the plastic coating of certain narrow areas on the flaps 22 and 23 above the temperature where the coating becomes tacky, and then the outer major flap 22 is closed against the inner major flap 23 by a closing roller 35 or a plow and is held closed against it under pressure by the closure system 28 or 29, while cool air is blown against the carton 20 and flaps 22 and 23 from a cool-air manifold 36. All these will be now discussed in more detail.

In the form of the invention shown in FIGS. 1—11 each hot-air manifold 32 is provided with two walls 40 and 41 meeting at a vertex 42 of a sharp acute angle.

This makes it possible to bring the flap 22 close to the flap 23 at the manifold 32. Each wall 40 and 41 is provided at suitable locations with a row of discharge openings 43 and 44 at different distances from the vertex 42 and not opposite each other, to assure correct overlap of the heated areas in the flaps. As shown in FIGS. 2 and 7, the heated air through the openings 43 and 44 is directed against the flaps 22 and 23, the inner major flap 23 being perpendicular to its main carton walls, while the outer major flap 22 is at an acute angle, as set by the plow 31 and held in position, as by a rod 37, the resistance of the flap 22 to folding keeps it against the rod 37 without any spacing member having to be between the flaps 22 and 23. The manifold 32 may be generally triangular in cross section, as shown in FIGS. 2 and 7, with a third generally vertical wall 45 provided with one or more openings 46 and 47 to receive the output from the heater units 33 and 34; in this instance two heater units 33 and 34 are shown, but there may be only one heater or there may be more than two. The length of the manifold 32 depends partly on the number of heaters and partly on the speed of the conveyor. For packaging closure it may be about 3 to 8 inches long, typically, but may be longer; for providing a manufacturer's joint at very high speeds, it may be a couple of feet long, e.g., 16 to 48 inches long for a speed of 1200 feet per minute.

As shown in FIG. 3, the openings 43 leading from the manifold 32 are spaced apart, not evenly but in a pattern which gives an even distribution of the discharge air, and the openings 44 are similarly spaced, so that the container flaps 22 and 23 are properly heated within a very short travel, a few inches travel only. As shown in FIG. 7, the manifold walls 40 and 41 are spaced from and lie at an angle to the flap surfaces 24 and 25 which they are to heat, thereby spacing the manifold from the flap surface 25 in the vicinity of the openings 44, to enable flow of air, and only a small area 48, 49 of each flap surface 24, 25 is heated. The total area of the openings 43 and 44 is made sufficient to give high-volume, low-velocity air flow, so that the hot air impinges against the flap surfaces 43, 44 to heat them without causing high velocity in toward the vertex 42 and sending air into the inside of the package being closed. Also, the openings 43 and 44 are not spaced the same distance from the vertex 42 but are instead spaced to impinge with flaps at areas 48 and 49 that lie at the same distance from where the flaps 23 and 24 meet; this means that the openings 43 lie closer to the vertex 42 than do the openings 44, and it means that very narrow areas 48 and 49 can be heated and the heat confined to them, since they will mate accurately.

As shown especially in FIGS. 2, 3, and 9, each heater unit 33 or 34 comprises an outer metal housing 50, an intermediate metal shell 51, and a ceramic heater 52 with a close-fitting metal inner shell 53 around the outer circumference of the heater 52. The housing 50, intermediate shell 51, and inner shell 52 are all cylindrical tubes and are radially spaced from each other to provide cylindrical annular passages 54 and 55 on each side of the intermediate shell 51. The outer housing 50 is provided with an inlet 56 leading generally tangentially into it adjacent the end distant from the manifold 32, to induce swirling of the air around the intermediate shell 51. A suitable air supply tube 57 supplies ambient air under low pressure to the inlet 56. A pair of end closure members 58 and 59 connect the outer

housing 50 to the intermediate shell 51, the member 58 closer to the manifold 32 being also used to provide spacing, not only between the intermediate shell 51 and housing 50 but also between the intermediate shell 51 and the inner shell 52 and also a connection fitting 60 to the manifold opening 46 or 47. The intermediate shell 51 is thus fully supported at both ends, to maintain accurate spacing and prevent movement during operation, and it is provided with an outer end closure member 61 through which may extend an electrical power line 62 for the heater 53. The ceramic member 53 and its outer sheath, the shell 52, is held and spaced away from the intermediate shell 51 by the member 58 and by spacing and supporting screws 63. Thus, there is an outer swirl passage 54 between the housing 50 and the shell 51, an inner swirl passage 55 between the shell 51 and the shell 52, and there is a plurality of straight-flow passages 64, each containing a helical heater element 65, running through the ceramic heater 53. The heating elements 65 extend the length of the ceramic body 53, and provide intense air heating for the air passing through the passages 64, which are the only airflow passages through the heater 53. What appears to be a cylindrical passage 66 is blocked intentionally and merely serves to lessen the amount of ceramic body.

As a result of this structure, air enters tangentially through the inlet 56 and swirls around in the first passage 54, going toward the manifold 32. Near the end wall 58 closest to the manifold 32 it passes through a slot or other aperture or apertures 67 in the shell 51 and then swirls back inside the second passage 55 to the opposite end 61 most distance from the manifold 32. Then it turns in and goes by the space 68 in through the plurality of third passages 64 and from there directly into the manifold 32 through the opening 47, which is the full size of the heater 53, so that there is no restriction between the heater 53 and the manifold 32 but rather an enlargement there. In the manifold 32 it goes up and goes out the two series of discharge openings 43 and 44 impinging upon the thermoplastic coated flaps 22 and 23 as shown in FIG. 7. The accumulated total of the areas of the openings 43 and 44 in the manifold 32 is about 110% of the accumulated open cross-sectional area of the passages 64 through the heater 53. This enables a rise in ambient air temperature to about 1000°F. to 1150°F. to take place without increasing the velocity of the heated air. The purpose is to send a volume of hot air at low velocity through the openings 43 and 44 and against the areas 48 and 49, rather than to send high-velocity air through them with resultant forcing of the air to unwanted places and and unwanted rapidity in the cooling of the air. The velocity of the air issuing from the openings 43 and 44 is actually lower than that going into the inlet 56. It has been found that this system heats the flaps 22 and 23 quite rapidly to a temperature enabling their closing. Therefore, such a manifold 32 need only be a few inches long. Most of the housing 50 is merely warm to the touch, though the air inside is rapidly dried and heated and may emerge from the heater 33, 34 at temperatures up to 1000°-1200°F., for example.

Right beyond the end of the manifold 32 are the closing rollers, which preferably comprise a pair of hemispherical rollers 70 and 71 contacting the opposite faces of the carton 20, as shown in FIGS. 4 and 8, and the hemispherical roller 35, which engages the outer major flap 22 and closes it against the inner major flap

23. While the hemispherical shape is preferred, it is not essential in all cases. The low-friction roller 35 is mounted with its flat portion 72 parallel to the main walls of the carton 20 and perpendicular to the flap 23. The other rollers 70 and 71 are mounted perpendicular to this roller 35 and engage the walls 73 and 74 of the carton 20, retaining the carton's shape and squareness while the flap 22 is pushed against the flap 23; these rollers 70 and 71 serve no other purpose than the prevention of distortion of the carton from friction of the closing roller 35; they, thus, insure that the edge of the flap 22 seals parallel to the score line of the flap 23.

Just beyond the closing rollers 35, 70, and 71 are the hold-down roller systems 28 and 29, each of which in the illustrated embodiment comprises two staggered rows of cylindrical rollers 75 and 76 and mounted to be free running and to engage the carton 20 as the carton 20 is moved along them by the conveyor 21. They provide sufficient pressure for retaining the closure without putting so much pressure that it becomes difficult to move the carton 20. They do not seal the carton; they retain the flaps in their closed position while they cool and seal themselves. These rollers 75 and 76 are adjustably mounted, as shown in FIG. 5, between a lower plate 77, which holds the shaft 78 for the lower roller 76, and an upper manifold 36 which holds the shaft 79 for the upper roller 75, the plate 77, the manifold 36 and plate 77 being held together by a bolt 80 and spaced apart by a spacer 81 which may be changed to give different spacing. The manifold 36 has an inlet 82 for a supply of cold air, which can be simply ambient atmospheric air, and is provided with a series of discharge openings 83 in a face 84, which are made to point down against the carton 20 at approximately the level where the horizontal faces meet the convex faces of the roller 70 and 71. By this means, the carton flaps 22 and 23 are rapidly cooled, and in only about two feet the carton can be released from the rollers 75 and 76, and it will remain tightly closed without any additional pressure being necessary.

As shown in FIGS. 10 and 11, the system may be applied as well to a system having two outer flaps which overlap by using a staggered pair of manifolds 32 and 32a each with their heaters. First one outer flap is sealed and then the other.

FIG. 12 shows a modified form of manifold 90 with a rhomboidal shape, having a vertical wall 91 meeting an inclined upper wall 92, a rear vertical wall 93 and a lower inclined wall 94. This shape is often desirable, and for purposes of example is shown with two rows of discharge openings on each of the two upper walls — openings 95 and 96 in the wall 91 and openings 97 and 98 in the wall 92. There could, of course, be single matched rows of openings or more than two rows per wall. The rows are, of course, matched to cause the impinged surfaces to meet when the flaps are closed. Two rows of openings enable more sealing area and sealing strength than does one row. Double rows are not generally practical with the manifold 32, for the divergency between rows would render the two rows different in the temperatures they impart. The rhomboidal shape does enable this, and positive spacing may be obtained by rods 99 and 37, that enable air flow, which are not mounted on the manifold but beside it, to enable free adjustment relative to the manifold.

With double rows of discharge openings, as in FIG. 12, the holding assemblies 28 and 29 are preferably

modified as shown in FIG. 13 to replace the bolt 80 and spacer 81 with a longer bolt 100 and a large spacer 101.

With even wider flaps and more rows of sealing plastic, the structure of FIG. 14 may be used, with a bolt 102 and a bar 103 inserted between two spacers 104 and 105 and supporting on shafts additional rollers 106 and 107. Many other modifications are possible.

The manifold may be varied in many ways. A manifold 110 is shown in FIGS. 15 and 16. It may have the rhomboidal shape of the manifold 90 but has vertical slits 111 instead of double rows of openings to heat a wide band on the flaps. This wider hot-air path gives a broader seal that is feasible with drilled holes. By way of illustration, there are also shown two recesses or slots 112 and 113 that intersect the slits 111. With these, the manifold 110 can be quite close to the flaps to be heated, even touching them and still the slots 112 and 113 let the hot air flow freely in a direction which prevents heating of undesired flap areas. Horizontal slots may be used in staggered formations, and various other opening patterns may be used. A single heater may be attached to the single fitting 114 of the manifold 110.

To those skilled in the art to which this invention relates, many changes in construction and widely differing embodiments and applications of the invention will suggest themselves without departing from the spirit and scope of the invention. The disclosures and the description herein are purely illustrative and are not intended to be in any sense limiting.

I claim:

1. Heat sealing apparatus for closure of paperboard package flaps having heat-sealable coatings, including in combination:
 - a hot air manifold having two surfaces meeting and terminating at a sharp acute angle, each surface having at least one row of openings therealong for sending hot air against two flap surfaces facings and on opposite sides of said manifold,
 - at least one air heater connected to said manifold for supplying hot air thereto, each heater comprising an outer metal tubular housing having first and second closed ends and a tangential air inlet near said first closed end, an intermediate tubular metal shell inside and spaced from said outer housing except at said closed ends and supported at said closed ends to keep the spacing constant and having near said second closed end tangential aperture means and closed at both its ends, and a ceramic heater body having an inner shell on its outer surface lying inside and spaced from said intermediate shell, said ceramic heater body having a plurality of lengthwise passages each with a heating element inside said passages leading through an outlet larger than the total cross-sectional area of said lengthwise passages into said manifold at one end and said body stopping short of the closed end of said intermediate shell at the other end, whereby air enters said tangential inlet, swirls around in a passage between said housing and said intermediate shell, flows through said aperture means, swirls toward the other end in a passage between said intermediate and inner shells and then flows back through said lengthwise passages and into said manifold at relatively low velocity and issues from said manifold openings at relatively low velocity, said mani-

fold openings having a total area greater than the cross-sectional area of said lengthwise passages, means for supplying air under pressure to said inlet of said air heater,

means for moving said package relative to said manifold,

means for guiding said flaps as said package is moved, to space said flaps properly from said manifold,

means for forcing said flaps against each other, and means for holding them against each other until the heated coating congeals and seals them together.

2. The heat sealing apparatus of claim 1 wherein said manifold openings are substantially identical in size and are spaced apart at varying distances to obtain substantially the same flow rate through each.

3. The heat sealing apparatus of claim 1 wherein said rows of manifold openings are spaced from the vertex of said sharp acute angle at different distances, being spaced so that each row on one surface corresponds to a row on the other surface and lies at the same distance relative to the box flaps, so that when the flaps are brought together their heated areas directly overlies each other.

4. The apparatus of claim 1 wherein said manifold is unpartitioned and has a plurality of said heaters spaced apart from each other along said manifold to augment the flow and keep it even.

5. The apparatus of claim 1, wherein said manifold has a shape that is generally triangular in cross section, with a vertical rear wall connecting the wall providing said two surfaces and having the air heater connected generally horizontally to said rear wall.

6. The apparatus of claim 1 wherein said manifold has a shape that is generally rhomboidal, with a vertical rear wall, a vertical front wall providing one of said two surfaces and the other walls inclined, the heater lying generally horizontally and leading into said rear wall.

7. The apparatus of claim 1 wherein said means for guiding said flaps lies solely outside said flaps, and outside said manifold, only said manifold lying between said flaps, said means for guiding acting against the natural tendency of said flaps to move apart from each other, said means for guiding being adjustable relative to said manifold for changing their relative spacing.

8. The apparatus of claim 1 wherein said means for forcing said flaps against each other comprises a free running roller engaging an outer flap at a locus spaced from where said outer flap joins the package, and moving said outer flap against an inner flap, and a pair of free running rollers each engaging package walls adjacent said flaps for maintaining package shape.

9. The apparatus of claim 8 wherein said rollers are hemispherical in shape with the pair of rollers mounted in a plane perpendicular to the plane of the other said roller.

10. The apparatus of claim 1 wherein said means for holding comprises at least one row of cylindrical rollers for engaging a said flap and means for sending ambient air against the package adjacent said flaps.

11. Heat-sealing apparatus for closure of paperboard package flaps having heat-sealable coatings, including in combination:

a hot air manifold having two surfaces meeting at a sharp acute angle and terminating at the vertex of said angle, each surface having at least one row or openings therealong for sending hot air against two

flap surfaces facing and on opposite sides of said manifold,

at least one air heater connected to said manifold for supplying hot air thereto and comprising an outer metal tubular housing having first and second closed ends and tangential air inlet means near one said end, an electrical heater inside said housing and having electrical heating elements therein and passages for air to pass through while contacting said heating elements, and baffle means separating said heater and housing to provide at least two passages between them and having means near one end enabling flow from one passage to the other, said heater passages leading into said manifold at one end at a large opening tending to decrease rather than to increase the air velocity there, whereby air enters said inlet means, swirls around in a passage, between said housing and said baffle means, flows into a second passage, swirls toward the other end, and eventually flows through said passages into said manifold, said manifold openings having a greater total area than the total cross-sectional area of said heater passages, so that the heated air issues at low velocity from said manifold opening,

means for supplying air to said air inlet means, means for moving said package relative to said manifold,

means for spacing said flaps properly from said manifold as said package is moved, and

means for closing said flaps against each other and holding them against each other until the heated coating cogeals and seals them together.

12. Heat-sealing apparatus for closure of paperboard package flaps having heat-sealable coatings, including in combination:

a hot air manifold having two surfaces meeting and terminating at a sharp acute angle, each surface having at least one row of openings therealong for sending hot air at low velocity and large volume against two flap surfaces facing and on opposite sides of said manifold,

at least one air heater having air passage means therethrough and connected to said manifold for supplying hot air thereto, the total area of said manifold openings being substantially larger than the total cross-sectional area of said air passage means of said heater so as to emit air at lower velocity than that of the air through said heater, and means for spacing said flaps properly from said manifold as said package is moved relative to said manifold, and

means for closing said flaps against each other and holding them against each other until the heated coating congeals and seals them together.

13. The apparatus of claim 12 wherein said means for closing said flaps against each other comprises a free running roller engaging an outer flap at a locus spaced from the edge where the outer flap joins the package, and moving said outer flap against an inner flap and a pair of free running rollers each engaging package walls adjacent said flaps for maintaining package shape.

14. The apparatus of claim 13 wherein said rollers are hemispherical in shape with the pair of rollers mounted in a plane perpendicular to the plane of the other said roller.

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15. The apparatus of claim 12 having means for holding said flaps against each other until the heat-sealable coating congeals, said means for holding comprising at least one row of cylindrical rollers for engaging a said flap and means for sending ambient air against the package adjacent said flaps.

16. A method for heat-sealing two pieces of paper-board, at least one of which has been coated with heat-sealable coating, comprising

moving the two pieces at the same velocity,
bringing the two moving pieces into proximity generally opposite each other,

heating a controlled narrow area of each piece by air only, by impinging on each moving piece a high-volume stream of low-velocity hot air along said controlled narrow area, while limiting the air impingement and heating to a small fraction of the total width of each said piece, thereby intensively heating a critical strip of the surface of each piece above the sealing temperature for said coating,
immediately thereafter forcing the two moving pieces together with their heated strip surfaces against each other, to close them into sealing position, and holding them together under pressure as they move until they cool below the sealing temperature of the coating, said pieces being brought into proximity along two planes that diverge from a vertex at a sharp acute angle, said strips being spaced the same distance from said vertex, the pressure to hold the pieces together being applied as a gentle rolling pressure at many separated points while sending ambient air against said pieces in between said separated points, to cool said pieces.

17. A method for heat-sealing two flaps of a paper-board carton, at least one of which has been coated with heat-sealable coating, comprising

bringing the flaps into proximity along two planes diverging from a vertex at a sharp acute angle,
heating a controlled narrow area of each flap as the sole heating of said flaps by impinging on each flat a high-volume, low-velocity, strip-shaped stream of very hot air along said controlled narrow area spaced the same distance from said vertex, while limiting at all times the air impingement and heating to a small fraction of the length and total distance from said vertex to the outer edge of the flap, thereby heating a critical strip of each flap above

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the temperature making said coating tacky, immediately thereafter forcing the two flaps together, to close them into sealing position, and holding them together under pressure until they cool below the congealing temperature of the coating, the holding step being accomplished by constantly applying rolling pressure at a series of separated points while applying ambient cooling air to cool the flaps, in between said points.

18. A method for heat sealing two pieces of paper-board, at least one of which has been coated with heat sealable coating, comprising

bringing the two pieces into proximity generally opposite each other,

simultaneously moving the pieces relative to a duct means positioned therebetween, maintaining at least one of the pieces spaced from and out of contact with said duct means,

heating a portion of each of said surfaces solely by heated gas successively impinging hot gas from said duct means at low velocity but of a volume and temperature to raise the coating above the sealable temperature onto small fractional and equal areas of said surfaces during their movement relative to the duct means, said areas lying along a narrow strip constituting a small fraction of the width of each piece,

forcing the pieces together with their heated strip surfaces against each other to close them into sealing position immediately after the areas along said strip have been heated, and while they are moving past a station, applying pressure at said station against successive mutually exclusive small fractional areas of the pieces, and while moving holding them under pressure on a line substantially normal to their direction of movement while directing cooling air against said pieces until they cool below the sealing temperature of the coating.

19. The method of claim 18 wherein the pieces are the flaps of a carton which extend from opposite walls thereof,

and the step of bringing the two pieces together comprises folding the flaps into proximity along two planes diverging from a vertex at a sharp angle to provide inner and outer flaps which tend to unfold.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,777,448 Dated December 11, 1973

Inventor(s) William J. Howe

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

Column 4, line 19, cancel "1,", second occurrence. Column 9, line 67, "one row or" should read -- one row of --.

Signed and sealed this 17th day of September 1974.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents