

[54] **APPARATUS FOR HEAT SEALING CARTONS**

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[22] Filed: **Oct. 24, 1969**

[21] Appl. No.: **869,193**

[52] U.S. Cl. **159/497, 53/375, 93/36 MM, 93/44**

[51] Int. Cl. **B31b 1/64**

[58] Field of Search **156/499, 497; 93/44, 49, 36 MM, 93/59 MT; 53/374, 375; 431/158**

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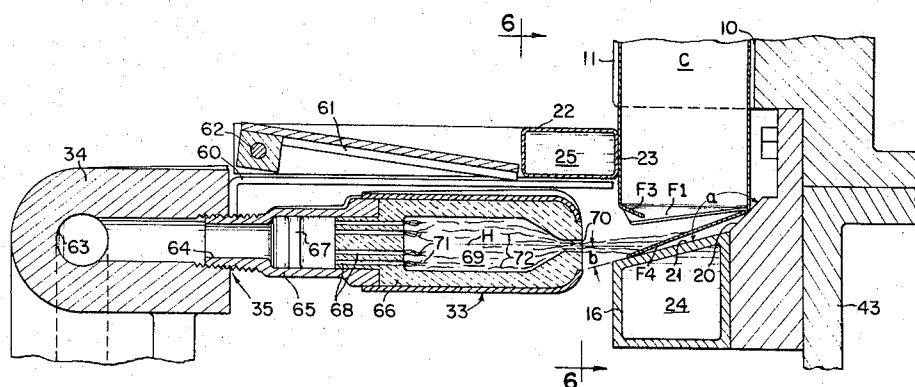
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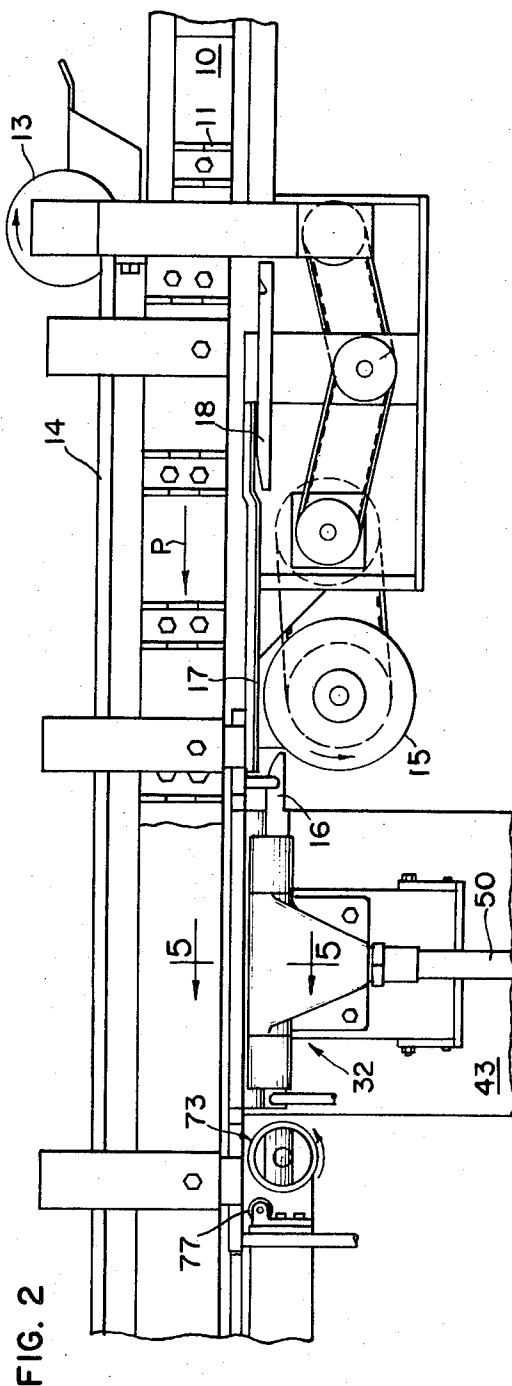
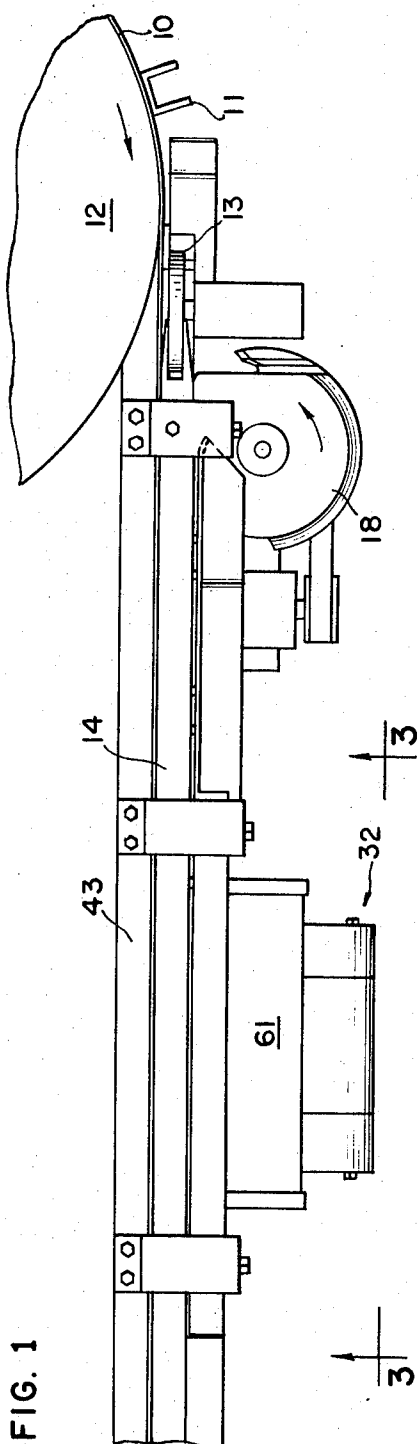
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[57] **ABSTRACT**

An apparatus for heat sealing cartons comprises conveyor means for moving a partially erected carton along a line of flight and folding means for folding polyethylene coated carton closure flaps into superimposed, partially opened relationship. The carton is then moved past a plurality of spaced nozzle means, each comprising a chamber adapted to have a gaseous fuel communicated thereto and ignited therein. Upon combustion of the fuel, a heated fluid is discharged from the chamber, through a nozzle formed on a forward face of the nozzle means and onto the flaps to activate the polyethylene coating for sealing purposes. A driven roller is positioned downstream of the nozzle means to apply a final sealing pressure to the flaps to secure them together.

35 Claims, 15 Drawing Figures





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FIG. 4

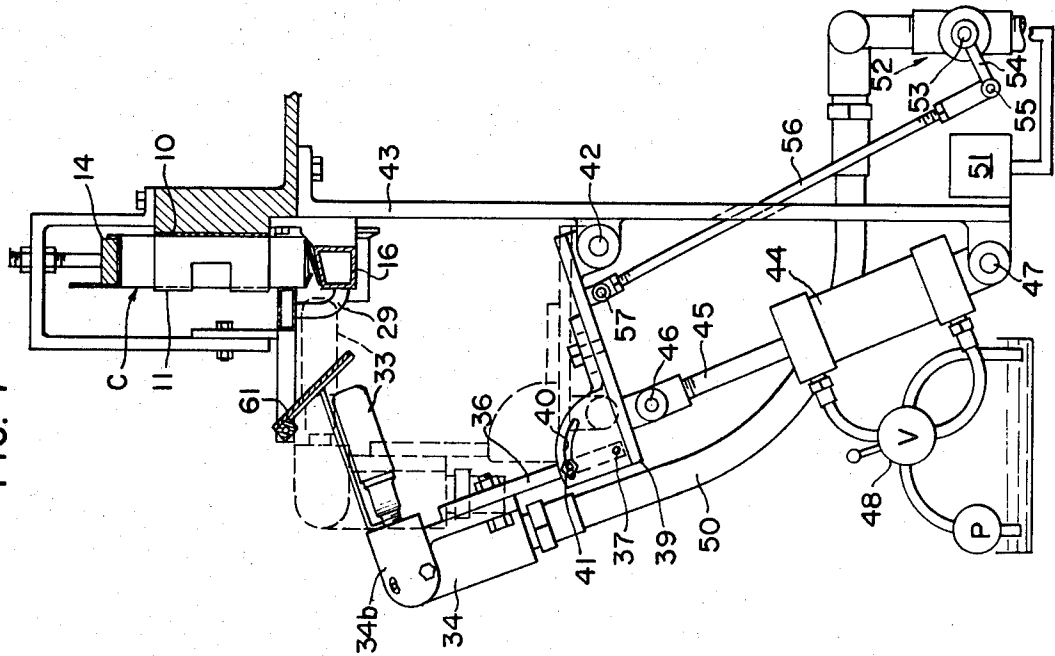
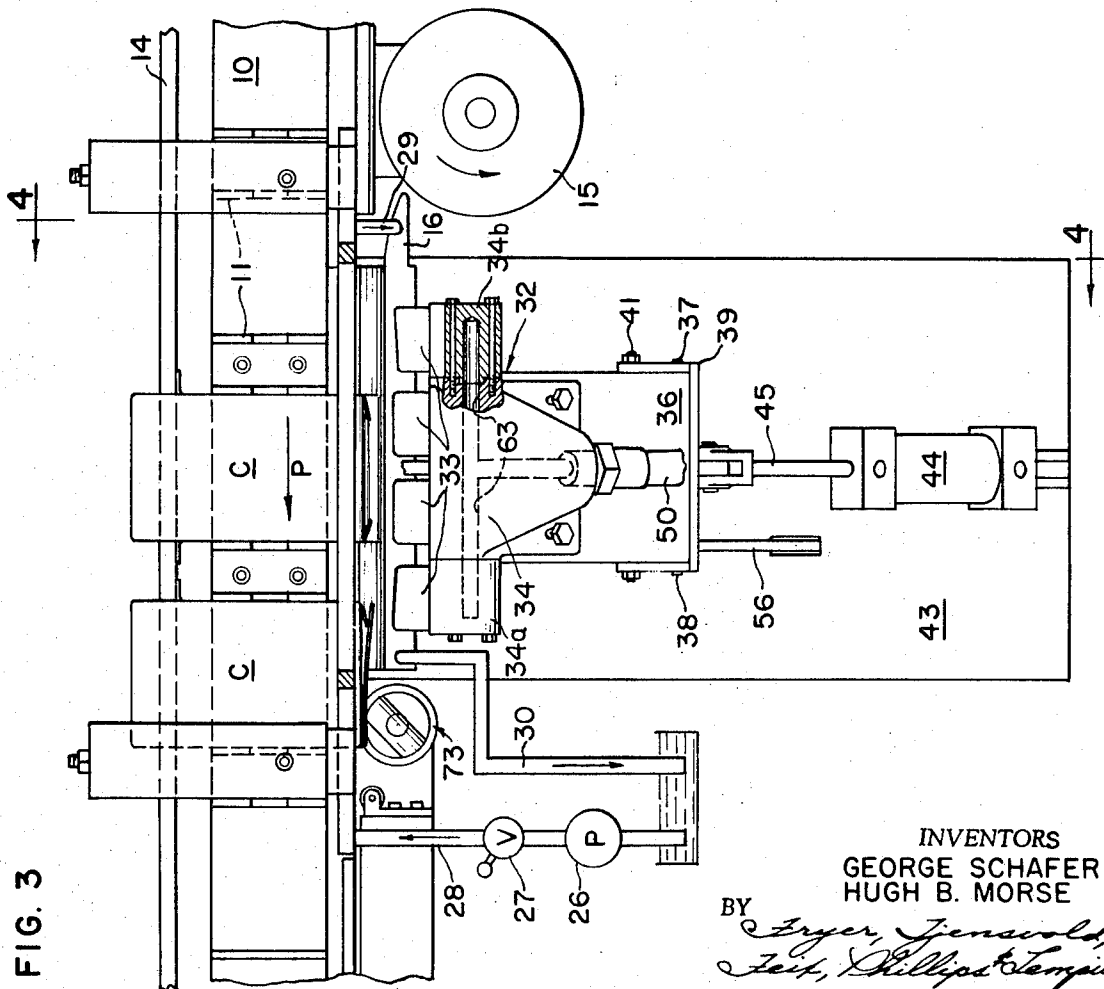
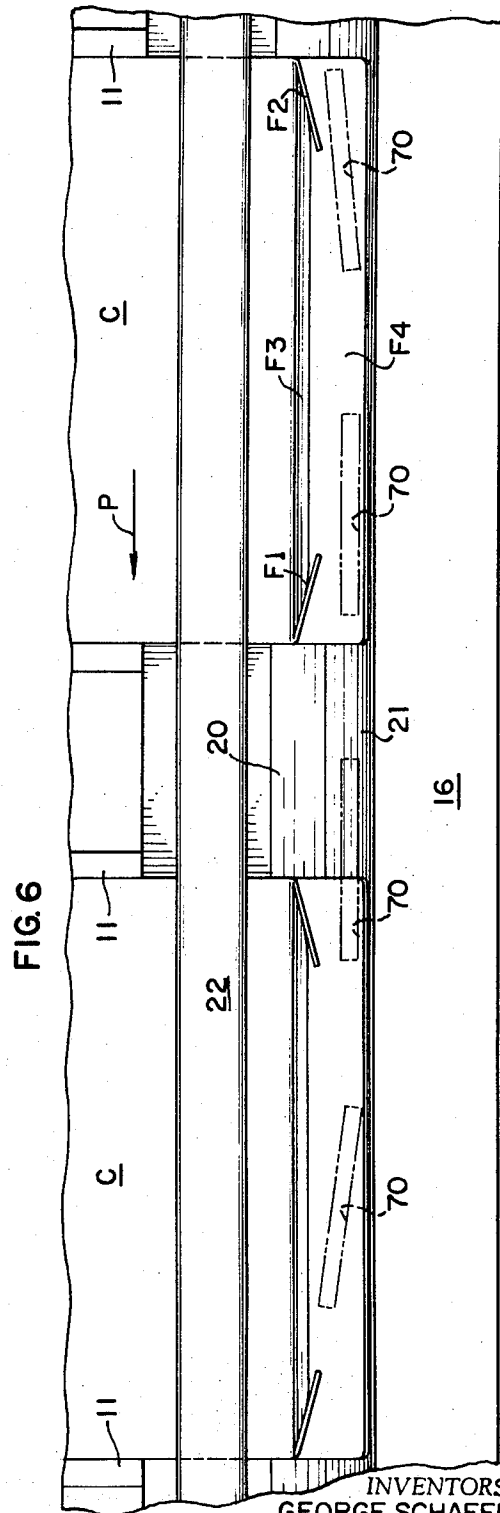
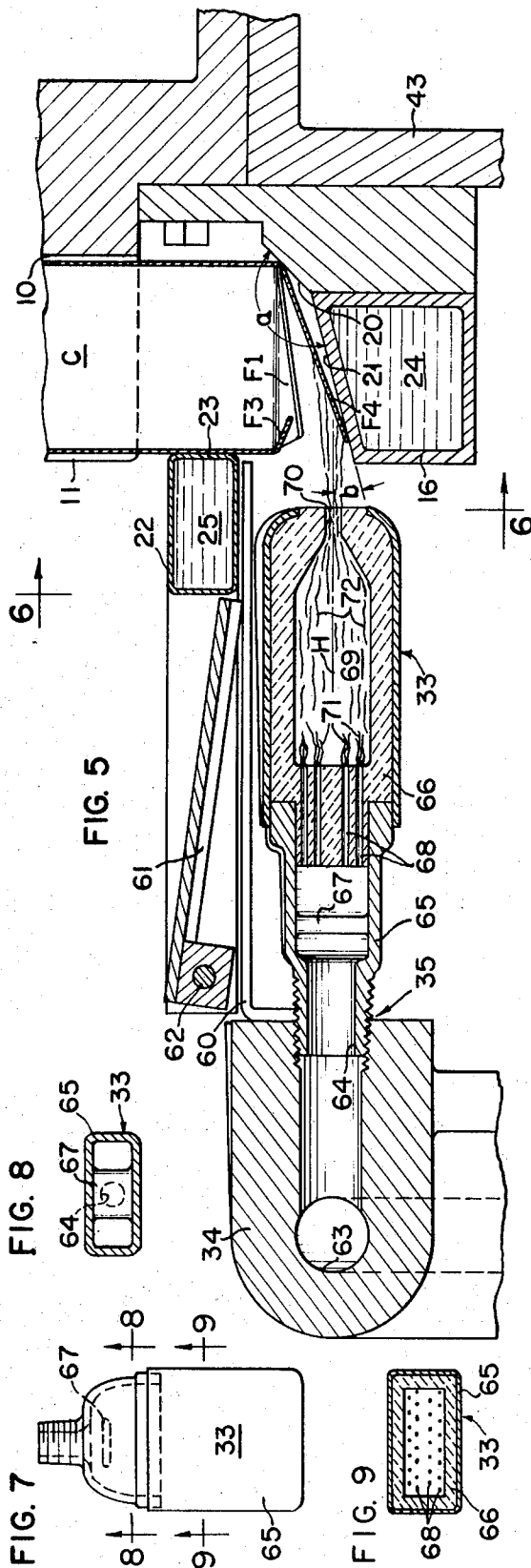


FIG. 3





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FIG. IOA

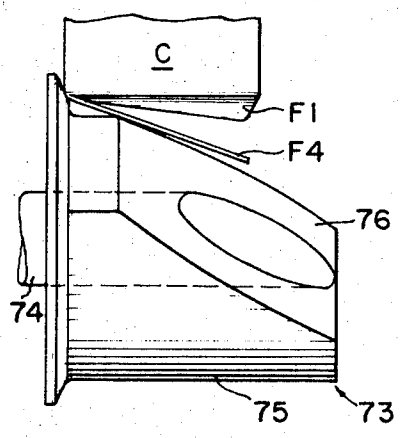


FIG. IIA

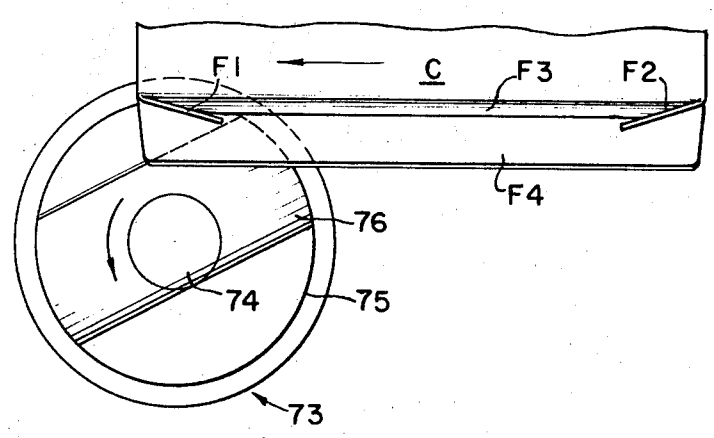


FIG. IOB

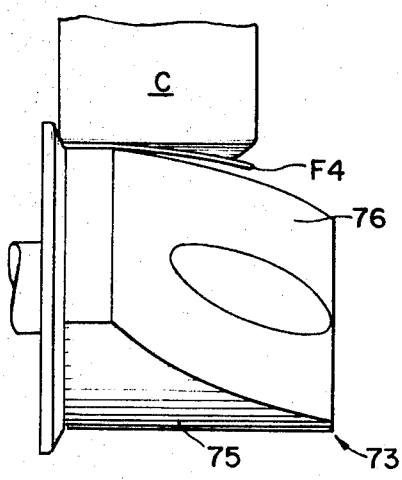


FIG. IIB

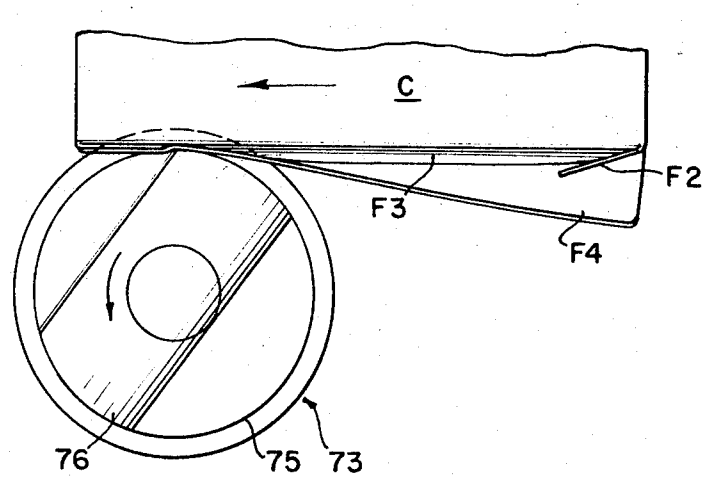


FIG. IOC

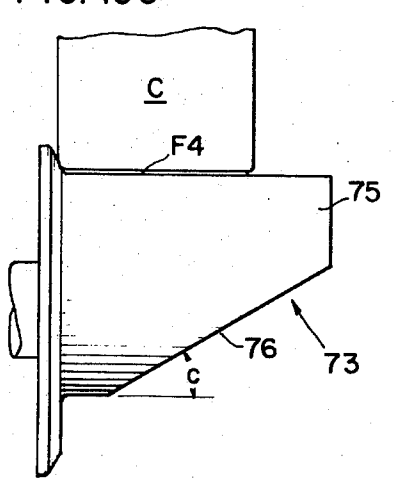
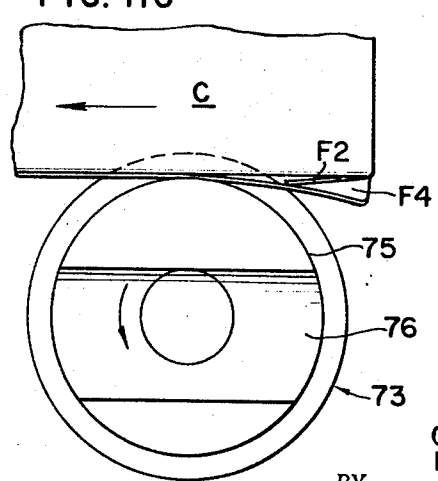


FIG. IIC



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APPARATUS FOR HEAT SEALING CARTONS

Heat sealable adhesives or coating, such as polyethylene, have become quite popular for packaging purposes due to their ability to form a tightly sealed carton end closure. The speed and efficiency by which such packaging desiderata may be effected are largely determined by the type of folding and sealing mechanisms employed in the machine. Many conventional apparatus give rise to racking, scarring and related packaging problems which tend to reduce the efficiency of such apparatus, particularly when packaging speeds are increased appreciably. Consequently, the erected carton's appearance and structural integrity often-times fall below a commercially acceptable level. In addition, such apparatus often-times tend to be unduly complicated, expensive and difficult to service.

An object of this invention is to overcome the above, briefly described problems by providing a noncomplex and readily serviceable apparatus and method for efficiently and economically bonding at least one adhesively treated carton flap to an adjacent carton portion at high packaging speeds. The apparatus comprises at least one nozzle means forming a combustion chamber therein adapted to receive a combustible fuel such as a natural gas-air mixture therein. Upon ignition of the fuel, a heated fluid is discharged through a nozzle of such nozzle means, positioned in juxtaposed relationship to the carton flap, to activate the adhesive thereon. Means may be provided downstream of the nozzle means for applying a final sealing pressure to the carton flap to bond it to the adjacent carton portion, preferably comprising at least one other superimposed carton closure flap.

It will be understood from the following description that the heat sealing teachings of this invention have application to types of packages other than the described carton.

Other objects of this invention will become apparent from the following description and accompanying drawings wherein:

FIG. 1 is a partial top plan view of an apparatus embodying the present invention;

FIG. 2 is a side elevational view of the FIG. 1 apparatus;

FIG. 3 is an enlarged side elevational view taken in the direction of arrows 3—3 in FIG. 1;

FIG. 4 is a cross-sectional view taken in the direction of arrows 4—4 in FIG. 3;

FIG. 5 is an enlarged cross-sectional view taken in the direction of arrows 5—5 in FIG. 2;

FIG. 6 is a sectional view taken in the direction of arrows 6—6 in FIG. 5;

FIG. 7 is a top plan view of a nozzle means or heater employed in the FIG. 1 apparatus;

FIGS. 8 and 9 are cross-sectional views taken in the direction of arrows 8—8 and 9—9, respectively, in FIG. 7;

FIGS. 10A—10C sequentially illustrate a rotary sealing means for applying progressive sealing and bonding pressures to carton end closure flaps; and

FIGS. 11A—11C are side elevational views of FIG. 10A—10C, respectively.

The apparatus illustrated in FIGS. 1 and 2 includes a conveyor means comprising an endless belt 10 having a plurality of spaced lugs 11 secured thereon. Each pair of adjacent lugs are adapted to retain (FIG. 3) and

move each carton C along a horizontal path P, preferably linear, and through the folding and sealing stations of the apparatus. The belt may be guided and driven by rotatably mounted and spaced turrets 12 (one shown) drivingly connected in a conventional manner to a main drive motor (not shown) of the apparatus' integrated drive system.

The folding station may comprise a vertically disposed tucker wheel 13 for folding minor flaps F1' and F2' away from each other and under a stationary hold-down bar 14 to condition the upper portion of the carton for filling purposes. U.S. Pat. No. 3,389,645, assigned to the assignee of this application, describes one type of carton C which may have its top and bottom end closures heat sealed pursuant to teachings of this invention. As shown in FIG. 6, the bottom closure comprises minor flaps F1 and F2 and major flaps F3 and F4. The above-mentioned patent also describes the construction and function of a disc-shaped wobble means or wheel 15 adapted to fold large major flap F4 onto a flap control bar 16 so that it assumes a V-shape in cross-section with respect to the other carton portions.

Prior to the folding of flap F4, flaps F1—F3 are folded into superimposed position and transferred onto a support plate 17 by a horizontally disposed rotary folding means or wheel 18. Wheels 13, 15 and 18 are suitably integrated into the machine's overall drive system to be driven in synchronized relationship with respect to each other. U.S. patent application Ser. No. 735,000, filed on June 6, 1968 by George Schafer et al. for "Apparatus and Method for Forming Cartons," and assigned to the assignee of this application, fully describes the function and construction of a wheel substantially similar to wheel 18.

After bottom closure flaps F1—F4 have been folded into their proper, superimposed positions and moved onto flap control bar 16, they are moved through the sealing station to bond them together. Carton C may comprise a standard one-piece paperboard blank coated on both sides with a suitable laminant plastic coating such as polyethylene, polyvinylidene chloride or other suitable heat sensitive coating which will reactivate (melt) at temperatures approximating 500° F., for example. Also a "heat-seal wax," i.e., a wax coating which has been formulated to accelerate solidification thereof in a short time interval may also be utilized.

Furthermore, the method steps herein taught adapt themselves to the use of a pre-applied thermoplastic adhesive which has been applied during or before the carton blank manufacturing operation. For purposes of these discussions, the above briefly described conventional coatings will be referred to as "heat sealable adhesives" or simply "adhesives." The adhesive chosen for the majority of carton applications under consideration preferably affords the two-fold functions of securing the flaps together and providing a leak-proof sealant at the bonded end closure portions thereof.

Flap control bar 16 (FIG. 5) preferably has intersecting first and second flat surface portions 20 and 21, respectively, formed thereon to be parallel to path P and to define an included obtuse angle α therebetween, preferably selected from the range of from 110° to 170°. The second and first flat surface portions at least partially support and guide a free edge of flap F4 and a corner of the carton whereat the flap is hingedly con-

nected to the carton, respectively. Angle *b*, between flat surface portion 21 and horizontally disposed plane H, is preferably selected from a range from 5° to 30°. In the illustrated embodiment angles *a* and *b* approximate 150° and 15°, respectively, to maintain flap F4 at an angle or V-shape approximating 20° with respect to horizontally disposed plane H.

A stationary positioning bar means 22 is disposed vertically above bar 16 to have a forward surface portion 23 thereof aiding in horizontally positioning carton C in conjunction with diametrically opposed surface portion 20. Coolant receiving passages 24 and 25 are formed in metallic bars 16 and 22, respectively, to circulate a suitable coolant such as cooled water therethrough to function as heat sinks to prevent mar-
ring of the contacted surface portions of the carton during the heat sealing function.

FIG. 3 schematically illustrates a pressurized coolant source comprising a pump 26 which may be suitably driven by the apparatus' drive system to continuously circulate the coolant through an on-off type control valve 27 and into a conduit 28. The conduit communicates with passage 25 of bar 22 to circulate coolant therethrough and to an outlet conduit 29 thereof. The latter conduit in turn communicates with passage 25 which circulates the coolant through bar 16 and to a conduit 30 which returns the coolant to the pressurized coolant source.

A heat sealing means 32 comprises a plurality of identical gas burner type nozzle means or heaters 33 mounted on a forward face of a housing 34 by threaded attachment means or first adjustment means 35. Although four such nozzle means are illustrated, it should be understood that a lesser or greater number thereof may be utilized depending on the particular packaging operation under consideration. Referring to FIGS. 3 and 4, disclosing the heat sealing means in an inoperative or retracted position, the housing is secured to a plate 36 pivotally attached by spaced pivot pins 37 and 38 to a member 39.

A second adjustment means for the heat sealing means comprises an arcuate slot 40 formed in an up-standing plate portion of member 39 and a releasable bolt 41 attached to plate 36. Such second adjustment means may be utilized to selectively adjust the disposition of the center line of heater 33 with respect to horizontally disposed plane H (FIG. 5) and to set the distance separating the nozzle means from carton C.

Member 39 is mounted at its forward end by a pivot pin 42 to a stationary frame 43 of the apparatus. A double acting hydraulic cylinder 44 which may be considered part of the second adjusting means, has its rod end 45 pivotally connected by pin 46 to a lug secured beneath member 39. The cylinder's head end is connected by a pivot pin 47 to frame 43 to selectively pivot member 39 and thus the heat sealing means about pivot pin 42. Conventional control means may include a schematically illustrated three-way valve 48 communicating with a pressurized fluid source (not shown) to selectively communicate such pressurized fluid to either end of the cylinder to effect such selective actuation.

A commercially available natural gas-air mixture may constitute the combustible gaseous fuel communicated to the heat sealing means via a flexible conduit

50. A supply source and control means, schematically illustrated at 51 in FIG. 4, is utilized to pre-mix and communicate the gaseous fuel to the conduit. In one specific application air and natural gas exhibiting pressures of approximating 30 psi and 0.4 psi, respectively, were mixed in control means 51 to exhibit a combined pressure when communicated into the nozzle means of approximately 1.0 psi.

When the heat sealing means is pivoted away from the conveyor means to its illustrated inoperative position, a valve 52 is preferably utilized to at least substantially cut-off the gaseous fuel flow to conduit 50. In a preferred embodiment of this invention it is desirable to continuously maintain combustion in the nozzle means to prevent having to re-ignite them once the machine is set in operation for carton sealing purposes.

The valve may be of the butterfly type, for example, having its gate or shutter (not shown) secured to a pivot pin 53 which in turn is attached to an adjustable rod or link 54. The link is pivotally attached by pin 55 to a rod 56, attached by a pivot pin 57 to a second lug secured beneath member 39. Thus it can be seen that the degree of opening of valve 52 will be automatically controlled in response to actuation of cylinder 34.

A protective plate 60 is secured to housing 34 to overlie the nozzle means to aid in preventing the undue dissipation of heat thereby. When the heat sealing means is maintained in its retracted position a baffle means or plate 61, pivotally mounted by pin 62 to the apparatus' frame, is influenced by gravity to fall onto and past the leading edge of protective plate 60 (FIG. 4). Thus it can be seen that the portion of the baffle plate which extends past plate 60 automatically masks the forward or nozzle ends of the heat sealing means. Conversely, when the heat sealing means is pivoted clockwise about pivot pin 42 to its operative position, baffle plate 61 will slide onto the top surface of plate 60.

Passageways 63 are formed in housing 34 to communicate the gaseous fuel to an inlet passage 64 formed in each of the nozzle means. The nozzle means may be of the type known as Model No. SH-2, manufactured by Selas Corp. of America and is shown in half-scale in FIGS. 7-9. Such nozzle means comprises a metallic housing 65 having a suitable refractory and insulative material 66 formed therein. A vertically disposed baffle 67 is positioned in inlet passage 64 and a plurality of horizontally disposed orifices 68 are formed through the refractory material to communicate the gaseous fuel to a main combustion chamber 69.

A suitable ignition means (not shown) may be inserted through an elongated or slotted nozzle 70, having a cross-sectional area substantially less than that of chamber 69, to ignite the gaseous fuel exiting from orifices 68 to produce flames 71. It should be understood that a plurality of nozzles could be substituted in lieu of single nozzle 70 for certain packaging applications. Due to well-known combustion and convection phenomena, including the expansion of the ignited gas-air mixture, a heated fluid illustrated as streams 72 is discharged from nozzle 70 and directed towards flaps F1-F4. The heated fluid generated in chamber 69 has been found to attain a velocity approximating 2,000 fps during the packaging operation. The heated fluid streams are supplied in sufficient volumes and kept

within predetermined temperature and pressure ranges when discharged from nozzle 70 to activate the adhesive, but to prevent carton distortion or scorching.

The heated fluid streams may be selectively positioned relative to the flaps to impart the heat at critical portions thereof to fully activate the adhesive thereon for sealing purposes. Such adjustment would be effected at least in part by the slot 40 and bolt 41 adjusting means illustrated in FIG. 4. Referring to FIGS. 5 and 6, nozzles 70 of the two intermediate nozzle means may be disposed substantially parallel with respect to horizontal plane H whereas the two outer nozzles may form a small angle (e.g., 10°) with respect to such plane to assure discharge of heat onto all critical surface portions of the carton flaps. The orientation of the outer two slots may be effected by rotating the two outer nozzle means on housing 34 by means of their respective threaded connections 35. It should be understood that various other orientations of the nozzles may be employed depending on the particular packaging application. Also, outboards portions 34a and 34b of housing 34 may be adjustably mounted thereon (FIG. 3) to be selectively rotated about the longitudinal axis of aligned rifle passageway 63.

One unique feature of the present invention is the elimination of the complicated electrical and mechanical hardware, such as blowers, electrical coils, relays, etc., employed in conventional heat sealing apparatus. In addition the cost involved in operating and servicing nozzles 33 is appreciably less than the cost for conventional heat sealers. For example, if one of the nozzles becomes inoperative, it can be expeditiously removed and replaced without involving a lengthy shut-down of the apparatus.

Referring to FIGS. 10A-10C and 11A-11C, folding and at least a portion of the bonding and sealing pressure may be applied to the flaps by means of a cam type roller 73 secured to a horizontally disposed shaft 74. The shaft may be suitably integrated into the apparatus' drive system to have its speed synchronized in relation to the rotation of wheels 13, 15, and 18 and the conveyor means. The outer surface portions of the roller comprise a cylindrical portion 75 intersected by a flat portion 76.

The flat portion facilitates reception of the carton flaps on the roller whereas the cylindrical portion applies a gradual closing pressure thereto in conjunction with hold-down bar 14. Although cylindrical portion 75 is shown as having a constant radius, it should be understood that such cylindrical portion may be formed with a gradually increasing radius (in a clockwise direction in FIG. 11A) to aid in gradually closing the carton flaps. As illustrated in FIG. 10C, flat portion 76 normally forms an angle c with respect to a horizontally disposed plane which may approximate 30°, for example.

A horizontally disposed idler roller 77 (FIG. 2) may be rotatably mounted on the frame of the apparatus, downstream of roller 73, to apply a final sealing pressure to the bottom end closure. The top surface portions of roller 77 are preferably positioned slightly higher vertically (e.g., one-sixteenth in.) than the outer surface portions of cylindrical portion 75 of member 73 to ensure a tight seal. However, it would be understood that the final closing and sealing pressures

could be applied solely by roller 73 or other types of sealing means if so desired.

From the above description it can be seen that the method of this invention essentially comprises the steps of: Positioning nozzle means 33 in close juxtaposed relationship to package portions or flaps F1-F4; communicating a combustible fuel to the nozzle means via conduit 50; igniting the combustible fuel in combustion chamber 69 to create heated fluid 72; and discharging the heated fluid onto the carton flaps via nozzle 70.

As suggested above, this method finds particular application to the bonding of the closure flaps of a one-piece polyethylene-coated carton, but can be applied for the bonding of various other types of package portions. When applied to such cartons, a flap control bar such as bar 16 is preferably employed for holding and maintaining flap F4 in an open position to form a V-shape (FIG. 5) with respect to the other portion of the carton to which it is bonded by means of rollers 73 and 77. Additional steps such as the automatic reduction of the amount of combustible fuel communicated to the nozzle means by valve 52 (FIG. 4) when it is moved away from the carton, are also normally utilized for commercial packaging applications.

We claim:

1. In an apparatus for bonding at least one adhesively treated carton flap to an adjacent carton portion, first means for moving said carton along a path and for folding and maintaining said carton flap in spaced relationship relative to said carton portion and second means for bonding said carton flap and said carton portion together comprising at least one nozzle means normally positioned closely adjacent to said path, said nozzle means comprising a combustion chamber means formed therein adapted to have a combustible fuel communicated thereto to generate a heated fluid therein upon ignition of said fuel solely in said combustion chamber means and at least one nozzle formed in said nozzle means solely at a forward end thereof to communicate with said combustion chamber and positioned in juxtaposed relationship to said path for discharging said heated fluid onto said carton flap to activate the adhesive thereon at a temperature level not exceeding approximately 500°F.

2. The invention of claim 1 wherein said carton portion comprises at least one other carton flap and said first means comprises at least one folding means rotatably mounted in said apparatus for folding said flaps into superimposed relationship.

3. The invention of claim 1 wherein said first means comprises conveyor means for moving said carton along a horizontally disposed linear path.

4. The invention of claim 3 wherein said first means further comprises a metallic flap control bar positioned substantially parallel to said linear path for supporting a free edge of said carton flap thereon.

5. The invention of claim 4 wherein said flap control bar comprises intersecting first and second substantially flat surface portions defining an included angle therebetween selected from the range of from 110° to 170°, said first flat surface portion positioned to at least partially support and guide a corner of said carton thereon whereat said carton flap is hingedly connected to said carton and said second flat surface portion positioned to support and guide the free edge of said carton flap thereon.

6. The invention of claim 5 wherein said second flat surface portion is positioned below a horizontally disposed plane containing said linear path to define an included angle with said plane selected from the range of from 5° to 30°.

7. The invention of claim 4 further comprising means for circulating a coolant through said flap control bar.

8. The invention of claim 4 wherein said first means further comprises a positioning bar means disposed vertically above and in diametric opposition to said flap control bar to have a forward surface portion thereof aid in horizontally positioning said carton.

9. The invention of claim 8 further comprising means for circulating a coolant through said positioning bar means.

10. The invention of claim 1 wherein said second means comprises means for selectively communicating said combustible fuel to said nozzle means, said combustible fuel constituting a gas-air mixture.

11. The invention of claim 3 wherein said second means comprises a plurality of said nozzle means positioned adjacent to said linear path and in substantial parallel relationship therewith.

12. The invention of claim 11 wherein said nozzle means are each mounted in said apparatus by adjustment means for selectively positioning the nozzles thereof relative to said linear path.

13. The invention of claim 12 wherein said nozzle means are mounted in said apparatus to position at least one of said nozzles substantially parallel with respect to said linear path and another one of said nozzles at a small angle relative to said linear path.

14. The invention of claim 1 further comprising adjustment means for selectively moving said nozzle means toward or away from said path.

15. The invention of claim 14 wherein said adjustment means comprises a hydraulic cylinder pivotally mounted in said apparatus and operatively connected to said nozzle means for selectively moving same in response to retraction or extension of said cylinder.

16. The invention of claim 14 wherein said nozzle means is mounted on a housing and wherein said adjustment means adjustably mounts said housing on a member pivotally mounted in said apparatus.

17. The invention of claim 16 further comprising a hydraulic cylinder pivotally mounted in said apparatus and operatively connected to said member for selectively pivoting same.

18. The invention of claim 14 further comprising means for selectively communicating said combustible fuel to said nozzle means, including valve means operatively connected to said adjustment means for automatically regulating the amount of fuel communicated to said nozzle means in response to movement of said nozzle means by said adjustment means.

19. The invention of claim 14 further comprising baffle means mounted in said apparatus for automatically masking said nozzle when said nozzle means is moved away from said path by said adjustment means.

20. The invention of claim 1 wherein said nozzle means comprises a metallic housing having a refractory material formed therein to define said combustion chamber.

21. The invention of claim 20 wherein said nozzle means forms an inlet passage therein communicating with said combustion chamber by means of a plurality of orifices formed through said refractory material.

22. The invention of claim 21 wherein said nozzle comprises a single elongated slot disposed substantially parallel relative to said path, said slot having a cross-sectional area substantially less than a cross-sectional area of said combustion chamber.

23. The invention of claim 22 further comprising a protective plate attached in overlying relationship to said nozzle means to aid in preventing dissipation of heat thereby.

24. The invention of claim 1 wherein said second means further comprises a horizontally disposed roller rotatably mounted in said apparatus for rotation about an axis thereof and positioned downstream of said nozzle means for applying a closing pressure to said carton flap.

25. The invention of claim 24 wherein said roller is rotatably driven and comprises a cylindrical portion for applying said folding pressure and an intersecting flat portion, disposed at an acute angle relative to said axis, for facilitating reception of said carton flap on said roller.

26. The invention of claim 25 wherein the outer periphery of said cylindrical portion has a substantially constant radius and said flat portion normally forms an angle of approximately 30° with respect to said axis.

27. The invention of claim 25 wherein said second means further comprises a second horizontally disposed roller rotatably mounted in said apparatus and positioned downstream of said first-mentioned roller and having its top surface portions positioned slightly higher vertically than the cylindrical portion of said first-mentioned roller.

28. In an apparatus for sealing adhesively treated portions of a package together, the invention comprising nozzle means forming a combustion chamber therein adapted to have a combustible fuel communicated thereto for generating a heated fluid therein upon ignition of said fuel solely in said combustion chamber and at least one nozzle formed in said nozzle means solely at a forward end thereof to communicate with said combustion chamber for discharging said heated fluid onto said package portions to activate the adhesive thereon at a temperature level not exceeding approximately 500°F.

29. The invention of claim 28 further comprising conveyor means for moving said package along a horizontally disposed linear path and a metallic control bar positioned substantially parallel to said path for supporting and guiding at least one of said package portions thereon, the nozzle of said nozzle means being positioned closely adjacent to said control bar.

30. The invention of claim 29 further comprising means for circulating a coolant through said control bar.

31. The invention of claim 28 further comprising means for selectively communicating said combustible fuel to the combustion chamber of said nozzle means, said combustible fuel constituting a gas-air mixture.

32. The invention of claim 29 wherein a plurality of said nozzle means are positioned adjacent to said path.

33. The invention of claim 28 further comprising means for selectively moving said nozzle means relative to said path.

34. The invention of claim 33 further comprising control means for automatically reducing the amount of combustible fuel communicated to the combustion

chamber of said nozzle means when said nozzle means is moved away from said path.

35. The invention of claim 28 wherein said nozzle means comprises a housing having a refractory material formed therein to define said combustion chamber.

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