May 2, 1961 M. E. ZIMMERER 2,982,073

FOLDING MACHINE

Filed June 23, 1958 4 Sheets-Sheet 1

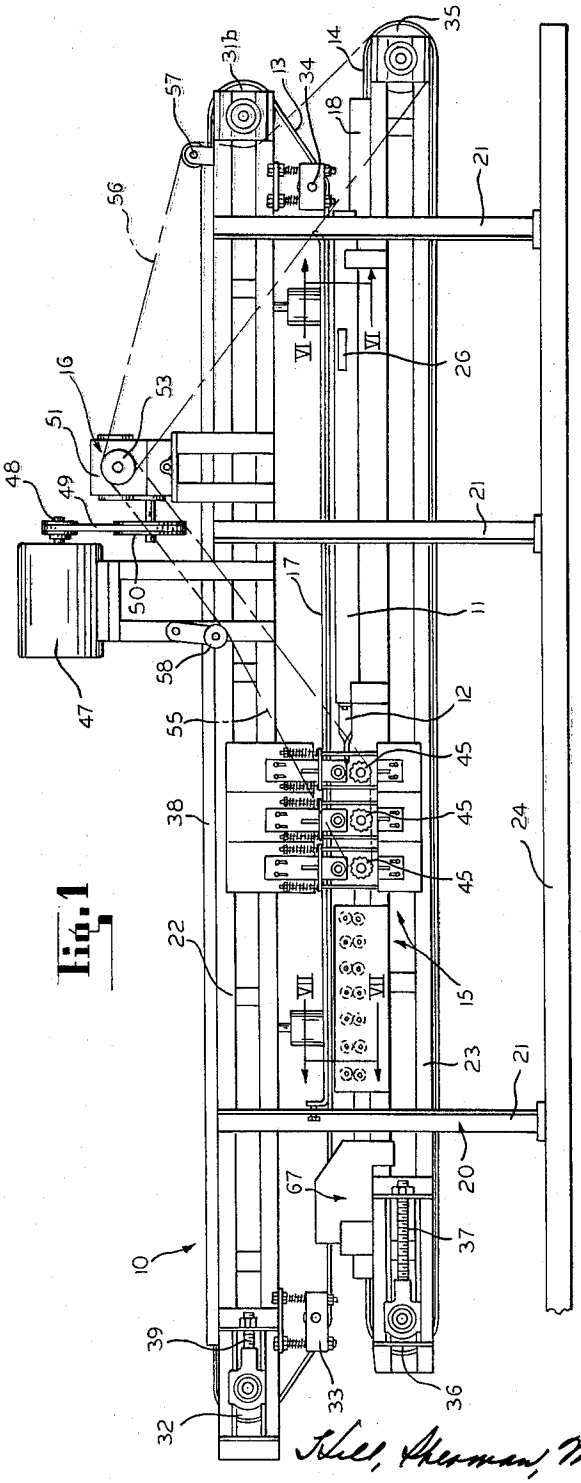

Fig. 1

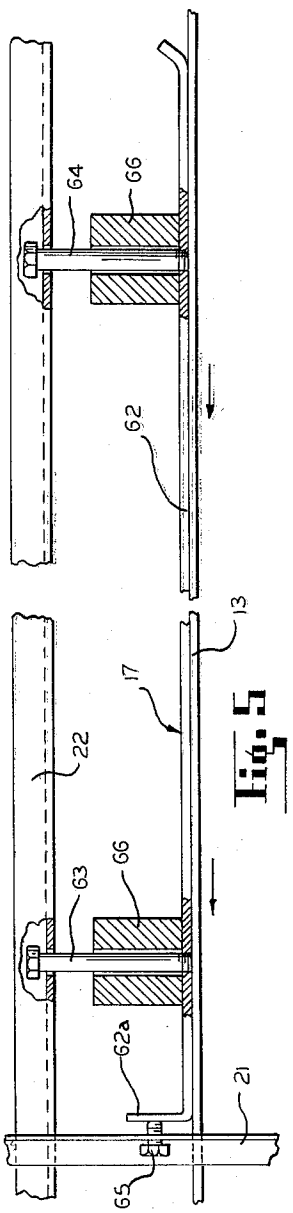

Fig. 5

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FOLDING MACHINE

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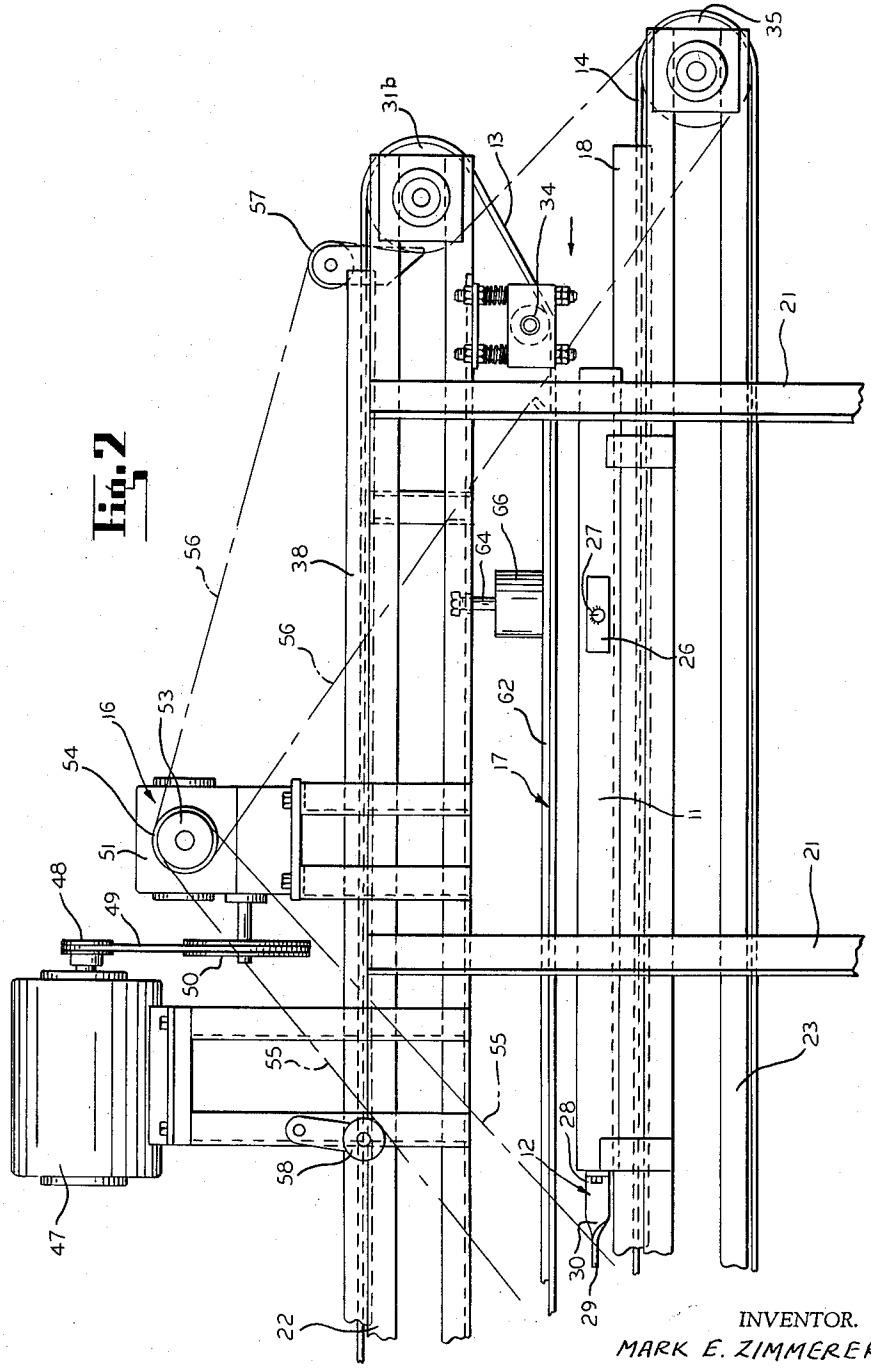
Fig. 2



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FOLDING MACHINE

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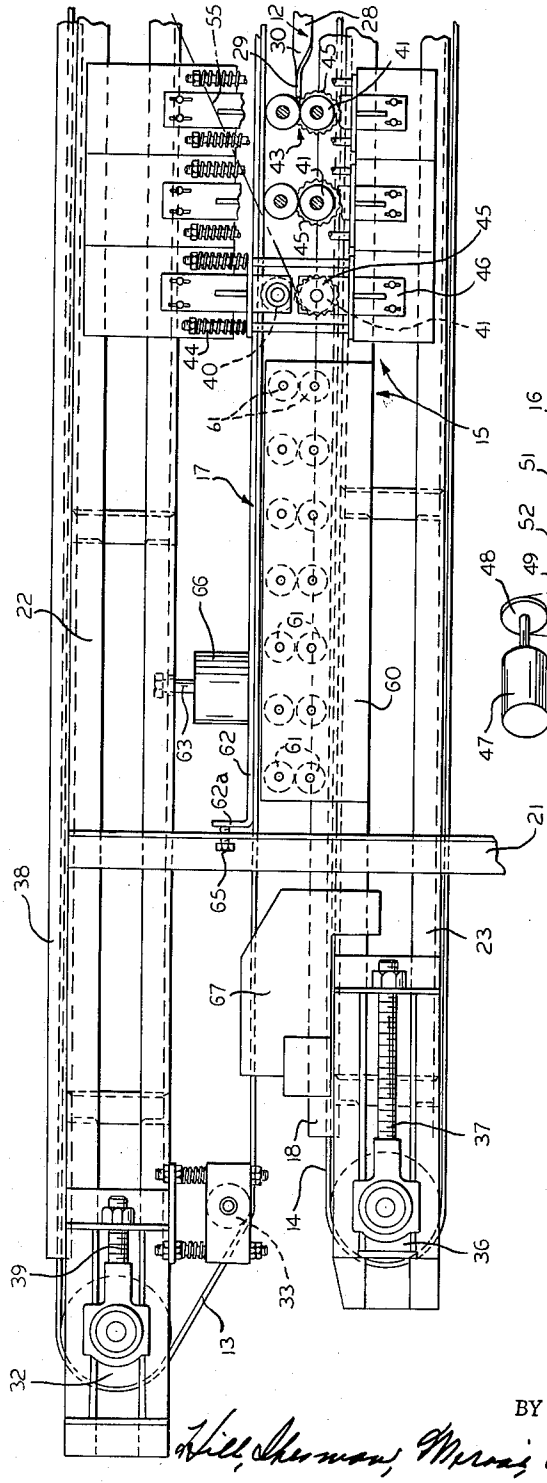

Fig. 7

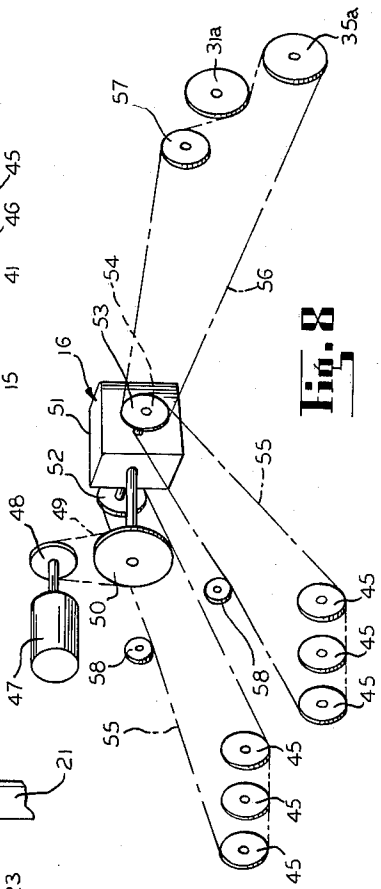

Fig. 8

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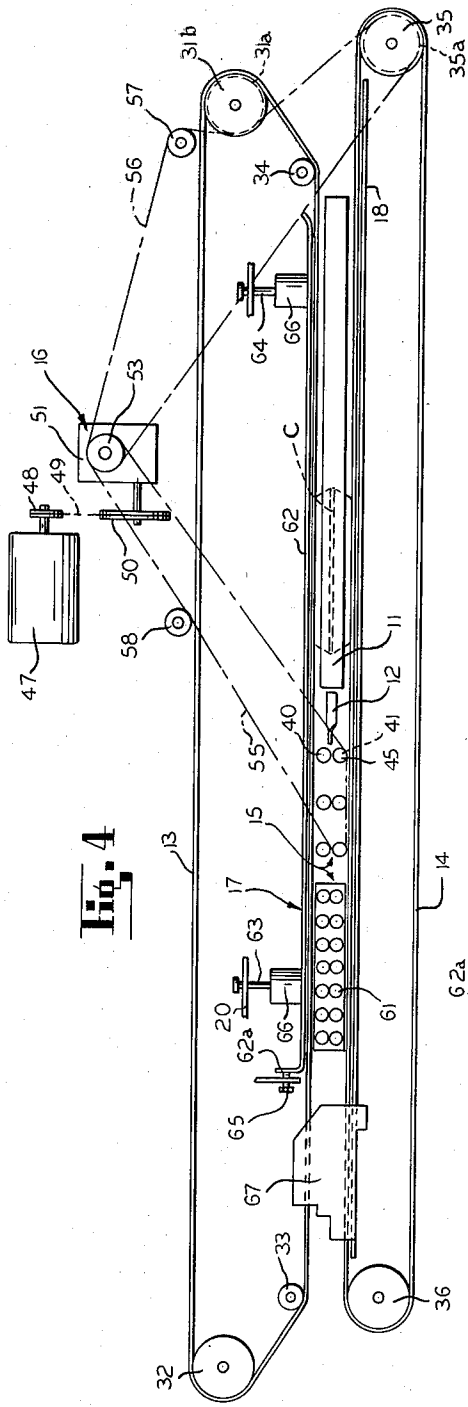

Fig. 4

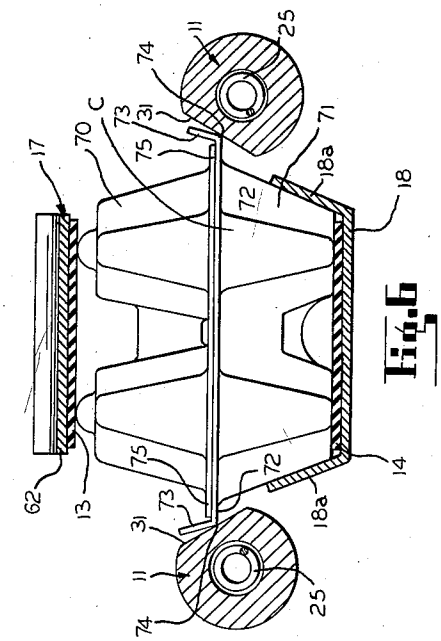

Fig. 6

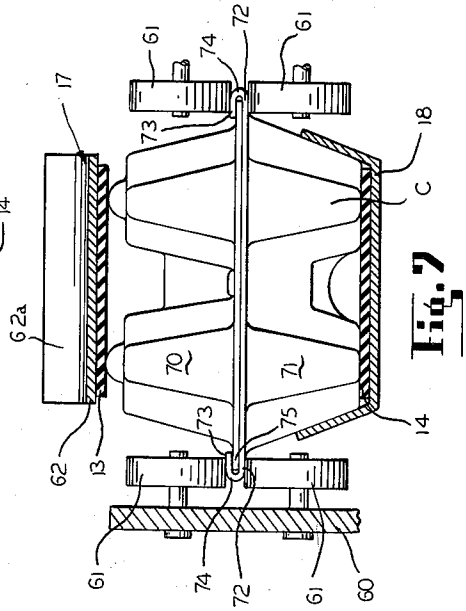

Fig. 7

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United States Patent Office 2,982,073 Patented May 2, 1961

2,982,073

FOLDING MACHINE

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Filed June 23, 1958, Ser. No. 743,731

11 Claims. (Cl. 53—366)

This invention relates generally to folding machines, and more specifically to an improved machine for securing a first rigid thermoplastic flange of a carton about a second rigid carton flange.

Although the principles of the present invention may be included in various folding machines or devices, a particularly useful application is made in a machine which has been adapted to close a thermoplastic egg carton which comprises two separable halves, at least one of which is thermoplastic.

The present invention contemplates the utilization of a means for heating a portion of the thermoplastic to a softening temperature, a means for folding the softened portion about the adjacent part of the carton, together with means for continually moving or translating the carton successively past each of said means.

Accordingly, it is an object of the present invention to provide an improved folding machine, which is adapted to fold rigid thermoplastic by first heating it.

Another object of the present invention is to provide a machine for folding heated thermoplastic wherein the folded portion is held by the machine in a particular manner until the thermoplastic has cooled sufficiently to rigidify.

Yet another object of the present invention is to provide a machine which may be employed to close thermoplastic cartons.

Many other advantages, features and additional objects of the present invention will become manifest to those versed in the art upon making reference to the detailed description and the accompanying sheets of drawings in which a preferred structural embodiment incorporating the principles of the present invention is shown by way of illustrative example.

On the drawings:

Figure 1 is a side elevational view of a folding machine provided in accordance with the principles of the present invention;

Figure 2 is an enlarged elevational view of the right hand portion of Figure 1;

Figure 3 is an enlarged elevational view of the left hand portion of Figure 1;

Figure 4 is a view generally similar to Figure 1, but wherein the supporting elements have been omitted;

Figure 5 in an enlarged view, partly in section, partly in elevation, and partly broken away, of a detail of Figure 1;

Figure 6 is a fragmentary sectional view taken along line VI—VI of Figure 1 showing an egg carton in the machine;

Figure 7 is a sectional view taken along line VII—VII of Figure 1 and showing an egg carton in the machine; and

Figure 8 is a diagrammatic view in perspective of the drive mechanism of Figure 1.

As shown on the drawings:

The principles of this invention are particularly useful when embodied in a folding machine assembly such as illustrated in Figure 1, generally indicated by the numeral **10**. The folding machine assembly **10** includes a straight heating bar **11**, a stationary folding element **12**, a pair of driven conveyor belts **13**, **14**, a series of rolls generally indicated at **15**, a common drive means generally as indicated at **16**, and a pair of rigid back-up members **17** and **18** for the belts **13** and **14** respectively. It will be appreciated that when the machine is used to close the carton at two points, several of these elements may be duplicated to effect simultaneous closing thereof.

The various components of the machine **10** are directly or indirectly supported by a rigid stationary frame **20**. The frame **20** includes a series of legs **21**, the instant embodiment having six such legs arranged in pairs and disposed on the outer sides of the frame **20**. Intermediate the rows of legs, there is disposed an upper bridge work **22** and a lower bridge work **23**, each of which is secured to the various legs as by welding. Each of the upper bridge work **22** and the lower bridge work **23** comprises a suitable number of pieces of channel iron suitably welded together to provide means for attaching the various elements and to provide the necessary strength and rigidity for the machine **10**. The individual legs **21** in this embodiment are shown as being supported on the top of a bench or table **24**. It is to be understood that various brackets or adapters may be provided and secured to the frame **20** and to the various elements of the machine.

The instant machine is provided with two of the heating bars **11**, which are best seen in Figures 2 and 6. The instant bars **11** are about 34 inches in length and comprise cold rolled steel having an original diameter of 1¼ inches. Each of the bars is provided with one or more heating elements **25** which are removably carried within each of the bars **11**. The heating elements **25** are connected in series with a thermostatic control shown schematically at **26**, which control has a knob **27** by which the operating temperature may be selected. The details of the thermostat do not form a part of the instant invention.

Immediately adjacent to the inner end of the heating bar **11**, there is disposed the stationary folding element **12**. The folding element **12** has a first end **28** and a second end **29**. Intermediate these ends, there is a central region **30** which has a contoured surface which is blended with the ends **28** and **29**. In this embodiment, the end **28** is generally blended with a flat surface **31** on each of the heating bars **11**, the central region's contoured surface makes a twist of approximately 135 degrees, and whereby the second end **29** presents a generally horizontal surface.

The conveyor belt **13** is rotatably supported on the upper bridge work **22**. To this end, there is provided a stationary axis pulley **31***b* which is rotatably supported at the entrance end of the machine **10**. There is also provided an adjustable axis pulley **32** disposed at the opposite or discharge end of the machine **10**. The belt **13** is also provided with a pair of spring loaded pulleys **33** and **34** which serve to keep the belt taut at all times.

The conveyor belt **14** is supported by a stationary axis pulley **35** and an adjustable axis pulley **36** in downwardly spaced position immediately beneath the belt **13**. The adjustments **37** for the pulley **36** may be used to achieve the proper tension on the belt **14**, and may also be used as a compensator for various lengths of belt which may be provided. The pulleys **35** and **36** are thus bearingly supported by the lower bridge work **23** of the frame **20**. The upper run of the belt **14** is underlaid by the rigid back-up member **18** so that it cannot sag along the length

thereof. The upper run of the belt **13** is likewise underlaid by a support member **38** which is generally similar to the back-up member **18**. The support member **38** extends beneath the upper run of the belt **13** and outwardly along the edges thereof to define a channel which serves to prevent excessive movement of the belt **13** in a lateral direction. While the spring loaded pulleys **33** and **34** provide a constant tension for the belt **13**, it can be seen that the adjusting mechanism **39** of the variable position pulley **32** not only allows for the various lengths of belt **13** which may be employed, but, since the belt **13** is generally inelastic, the adjustment **39** also serves to control or select the spacing intermediate the lower run of the belt **13** and the upper run of the belt **14**.

As best seen in Figures 3 and 7, the series of rolls **15** includes both spring biased rolls such as **40**, driven rolls such as **41**, and rolls such as **61** which are neither spring biased nor driven. Each of the rolls is disposed adjacent to another roll, with their axes aligned and with the peripheries of the rolls in generally tangent or near-tangent arrangement. Figure 3 shows the rolls which are provided for the instant embodiment on one side of the machine. It is to be understood that a duplicate set of rolls is provided on the opposite side of the machine as shown in Figure 7.

The first pair of rolls is disposed adjacent to the second end **29** of the folding element **12**. This pair of rolls has been indicated by the numeral **43**. In this embodiment, three such pairs of rolls are successively provided. At least the first pair is disposed so close to the folding element **12** that the rolls thereof may engage softened portions of the carton before such portions have rigidified. In order to insure not only mere engagement but a substantial forming or intimate engagement between the portions of the carton, at least one of the rolls is movably supported, such as the roll **40**, and its movable support in turn is biased by a pair of springs **44** which urge the roll **40** positively toward the roll **41**. The free spacing between the rolls **40** and **41** is less than the thickness of that portion of the carton which is to pass therethrough so that the spring forces act indirectly on the carton itself. To insure that the carton does not slip with respect to the belts **13** and **14** when it is to pass between a pair of spring biased rolls, means are provided for positively rotatably driving at least one of the rolls, such as the roll **41**. To this end, a sprocket wheel **45** has been supplied externally of the supporting bracket **46**.

The lower bridge work **23** supports a plate **60** on each side thereof to which is rotatably attached aligned spaced pairs of rolls **61**. Each of the rolls **61** is rotatably mounted in a conventional manner, a given pair of rolls having a gap therebetween which is substantially the same size as is the thickness of the carton portion as it leaves the last of the spring biased rolls **40**. To the extent that any portion of the carton begins to expand or move away from another portion, the rolls **61** serve to preclude such expansion, to restore the flange position, and to hold it in intimate contact with the other flange portion until the thermoplastic of the carton has cooled sufficiently to again become rigid. It will be noted that the rolls **61** are neither directly driven, except by the carton, nor are they biased toward one another. Rather they are disposed in fixed axial relation to each other. It will be appreciated that the number of rolls **61** and the extent of their distribution may be increased or decreased depending upon the speed at which the belts **13** and **14** are moved so as to provide means for holding the overlying portions of the softened flange for whatever duration of time is necessary to insure that complete rigidification has occurred before the flange is released from the rolls.

The common drive means **16** includes a motor **47** adapted as by a pulley **48** and a belt **49** to rotate the input pulley **50** of a speed reducing gear box **51** which has a plurality of output pulleys **52**, **53**, and **54**. The output pulleys **52** and **53** are each connected as by a link chain **55** to a plurality of drive sprockets **45**, each of which is drivably associated with a driven roll **41**. The output pulley **54** of the speed reducer **51** is connected as by a link chain **56** to a pair of sprocket drive wheels **31***a*, **35***a* respectively drivably associated with the conveyor belt pulleys **31***b* and **35**. An adjustably disposed idler **57** supported by the upper bridge work **22** may be utilized to both take up the slack in the chain **56**, and to insure that the chain **56** engages the sprocket wheel **31***a* for a sufficient peripheral extent. An idler **58** may likewise be supported against the chain **55** to keep it taut. Suitable brackets are provided for the motor **47** and the gear box **51** to rigidly support them to the frame **20**.

The rigid back-up member **18** disposed beneath the upper run of the conveyor belt **14** is provided with guide portions **18***a* best seen in Figure 6. The guide portions **18***a* extend along the spaced opposite edges of the back-up member **18**. The guide portions **18***a* extend in a surrounding fashion about the upper run of the belt **14** so as to preclude lateral movement of the belt **14**. In the instant embodiment, the portions **18***a* extend somewhat further than the distance needed for the belt-guiding function so that they also serve to guide the carton C against lateral movement as it passes through the machine **10**. The portions **18***a* serve a further function. As will be presently explained, there is downward force on the top of the carton C. The material from which the carton is made, while it is rigid, is resiliently yieldable, whereby such force tends to cause bulging or spreading of at least the lower portion of the carton C. The portions **18***a* thus closely embrace the lower portion of the carton to also back it up to preclude such spreading or bulging.

The back-up member **17**, as best seen in Figure 5, includes a rigid metal plate **62** which extends lengthwise of the machine **10** to back up the lower run of the belt **13** adjacent to the heating bar **11** and the series of rolls **15**. To allow for minute differences in height of carton passing through the machine, the spring biased pulleys **33** and **34** are capable of yielding against the force of their springs, should the need arise. Likewise, the plate **62** of the back-up member **17** is yieldably mounted so that it too may yield should the need arise. Likewise, it will also yield and follow the lower run of the belt **13** in response to adjustments made at the movable pulley **32**. To this end, in this embodiment, there is provided a pair of guide pins **63**, **64** which are threadably secured to the plate **62** and which extend upwardly through apertures in the upper bridge work **22**. This type of attachment permits the plate **62** to move up and down as required, while any substantial movement in a plane parallel to the lower run of the belt **13** is precluded. Preferably, the pins **63**, **64** comprise headed bolts so that when the belt **13** is removed for maintenance or replacement, the plate **62** is supported. Since the belt **13** moves in the direction of the arrows, there is a tendency for the pins **63**, **64** to be drawn against the edge of the aperture which is closest to the discharge end of the machine. When so drawn, a certain amount of friction may develop between the pin **63** and the edge of the hole. To avoid this type of rubbing, one end **62***a* of the plate **62** is upwardly or angularly directed to define an abutment. A screw **65** is adjustably carried by a portion of the frame **20**, and may be so positioned that when the belt **13** draws the plate **62** with it to engage the abutment **62***a* against the screw **65**, the pins **63**, **64** are substantially centered in their apertures.

The weight of the plate **62** serves to hold the belt **13** against the upper or adjacent surface of the carton. In the instant embodiment, a pair of annular weights **66**, **66** have been disposed respectively about each of the pins **63** and **64** to augment the weight of the plate **62**.

The mass of the plate **62** and the mass of the individual weights **66** each acts to bias the belt **13** toward the other belt **14** and its guide **18**.

The instant embodiment has also been provided with a printing mechanism generally indicated at **67**, the details of which do not form a part of the instant invention. This mechanism is so disposed and arranged that cartons passing through the machine may thereby be provided with suitable indicia, such as date code, trademarks, or other identification.

While the operation of the instant machine has been disclosed in conjunction with a certain egg carton, it is to be understood that the machine may be used to advantage with other cartons as well. The instant carton includes a cover **70** comprising cellulose acetate, and a base **71** comprising polystyrene. Polystyrene has the property that it is rigid at ordinary temperatures, but when its temperature is raised sufficiently, it becomes soft and pliable, its rigidity being reassumed upon cooling.

Accordingly, for this material, the thermostat **26** is set to maintain a temperature at the heating bars in the range of 290–310° F. The base **71** has a flange including longitudinal portions **72**, **73** and a narrow elongated intermediate portion **74**. The cover **70** or upper portion of the carton C is likewise also provided with a rigid flange **75**.

When the lower portion of the carton C has been filled and its upper portion disposed above it, the carton is ready to be closed. In this condition, the filled carton is fed into the entrance end of the machine **10** on the belt **14** and is moved by the belt between the guide portions **18***a* so that the narrow elongated intermediate portions **74** engage the flat heated surfaces **31** of the heater bars **11**. Thus heat is directly transferred to the portion **74** whereby it becomes softened. As the belts **13** and **14** continue to advance the carton C, the flange portions **73** engage the end **28** of the folding element **12** and then engage the contoured surface of the central region **30** whereby the portion becomes folded about a portion of the flange **75** of the cover. As best seen in Figure 7, the portions **73** and **72** thereby sandwich in the portion **75**, in that the portions **72** and **73** overlie one another.

The end **29** of the folding element **12** completes the folding of the flange **73** and holds it in intimate contact with the adjacent surface of the other flange **75**. The end **29** also directs the flanges to be received between the pairs of driven rolls **43** which cooperate to engage the overlying portions to further hold them in intimate contact during cooling and rigidifying of the softened flange.

The temperature of the softened flange, in this example, is somewhat less than the temperatures of the heater bar as it leaves the heater bar, and is typically less than 100° F. when it emerges from the last of the non-driven non-biased rolls **61**.

It is to be understood that if heat were provided to the carton by a means separate from the machine **10**, the remainder of the machine could be used to advantage to close the carton.

While the temperatures and materials given herein are intended to be illustrative, it is to be understood that the portion of the carton to be softened must be heated to a temperature above the lowest softening temperature, and should not be heated to a temperature as high as the lowest burning temperature. The joint thus formed relies on its configuration, rather than on a surface-to-surface fusion of the flanges. The resultant joint thereby may be freely disengaged for access to the contents by merely compressing the sidewalls of the cover **70** together so as to permit the withdrawal of the flange **75** from the U-shaped heat-formed flange of the base **71**. Likewise, reengagement may be obtained by deflection of the cover **70**.

Although various minor modifications might be suggested by those versed in the art, it should be understood that I wish to embody within the scope of the patent warranted hereon all such embodiments as reasonably and properly come within the scope of my contribution to the art.

I claim as my invention:

1. A machine for securing a first rigid thermoplastic flange of a carton about a second rigid carton flange, comprising in combination: a heating bar adapted to engage and to directly heat a narrow elongated intermediate portion of the first flange to a softening temperature; means for folding a portion of the softened first flange to sandwich in the second flange intermediate resulting adjacently overlying portions of the first flange; means for holding the overlying portions of the first flange in intimate contact with the second flange during the cooling and rigidifying of the first flange; and means for continually moving the carton successively past each of said means.

2. A machine for securing a first rigid thermoplastic flange of a carton about a second rigid carton flange, said flanges being spaced from and being disposed between the top and the bottom of the carton, comprising in combination: means for directly heating a narrow elongated intermediate portion of the first flange to a softening temperature; means for folding a portion of the softened first flange to sandwich in the second flange intermediate resulting adjacently overlying portions of the first flange; means for holding the overlying portions of the first flange in intimate contact with the second flange during the cooling and rigidifying of the first flange; and driven means adapted to engage the top and the bottom of the carton for continually moving the carton successively past each of said means.

3. A machine for securing a first rigid thermoplastic flange of a carton about a second rigid carton flange, comprising in combination: means for heating the first flange to a softening temperature; means for folding a portion of the softenend first flange to sandwich in the second flange intermediate resulting adjacently overlying portions of the first flange; means for holding the overlying portions of the first flange in intimate contact with the second flange during the cooling and rigidifying of the first flange; a pair of flexible conveyor belts arranged to engage opposite sides of the carton respectively, for continually moving the carton successively past each of said means; and a rigid back-up member for each of said belts and disposed to oppose movement of said belt in a direction away from the carton, one of said members being yieldably mounted and biased toward the other member.

4. A machine for securing a first rigid thermoplastic flange of a carton about a second rigid carton flange, comprising in combination: means for heating the first flange to a softening temperature; a stationary element having a first end arranged to engage the softened first flange, a central region having a contoured surface blended with said first end to fold a portion of the softened first flange about the second flange, and a second oppositely disposed end having a surface blended with said contoured surface for holding the folded portion against the second flange during initial cooling; and movably driven means adapted to engage opposite sides of the carton for continually moving the carton successively past said heating means and said stationary element.

5. A machine for securing a first rigid thermoplastic flange of a carton about a second rigid carton flange, comprising in combination: means for heating the first flange to a softening temperature; a stationary element having a first end arranged to engage the softened first flange, and a central region having a contoured surface blended with said first end to fold a portion of the softened first flange about the second flange; means for holding the overlying portions of the first flange in intimate

contact with the second flange during the cooling and rigidifying of the first flange, said means including a second oppositely disposed end on said stationary element, said second end having a surface blended with said contoured surface, and a series of adjacently arranged paired rolls engageable with the overlying portions of the first flange; and movably driven means adapted to engage opposite sides of the carton for continually moving the carton successively past said heating means and said stationary element.

6. A machine for securing a first rigid thermoplastic flange of a carton about a second rigid carton flange, comprising in combination: means for heating the first flange to a softening temperature, means for folding a portion of the softened first flange to sandwich in the second flange intermediate resulting adjacently overlying portions of the first flange; means for holding the overlying portions of the first flange in intimate contact with the second flange during the cooling and rigidifying of the first flange, said means including a series of adjacently arranged paired rolls engageable with the overlying portions of the first flange; and driven means adapted to engage opposite sides of the carton for continually moving the carton successively past each of said means.

7. A machine for securing a first rigid thermoplastic flange of a carton about a second rigid carton flange, comprising in combination: means for heating the first flange to a softening temperature; means for folding a portion of the softened first flange to sandwich in the second flange intermediate resulting adjacently overlying portions of the first flange; means for holding the overlying portions of the first flange in intimate contact with the second flange during the cooling and rigidifying of the first flange, said means including a series of adjacently arranged paired rolls engageable with the overlying portions of the first flange, at least one of said pairs of rolls being disposed adjacent to said folding means and having means for positively biasing said rolls against the overlying portions before they have rigidified; and driven means adapted to engage opposite sides of the carton for continually moving the carton successively past each of said means.

8. A machine for securing a first rigid thermoplastic flange of a carton about a second rigid carton flange, comprising in combination: means for heating the first flange to a softening temperature; means for folding a portion of the softened first flange to sandwich in the second flange intermediate resulting adjacently overlying portions of the first flange; and a series of cooperatively arranged pairs of rolls engageable with at least one of said flanges, at least one of said rolls being rotatably driven for continually applying a moving force to cartons engaged thereby.

9. A machine for securing a first rigid thermoplastic flange of a carton about a second rigid carton flange, comprising in combination: means for heating the first flange to a softening temperature; means for folding a portion of the softened first flange to sandwich in the second flange intermediate resulting adjacently overlying portions of the first flange; a pair of driven conveyor belts arranged to engage opposite sides of the carton respectively, for continually moving the carton successively past each of said means; a pair of cooperatively arranged rolls engageable with at least one of said flanges, at least one of said rolls being rotatably driven for aiding said continual movement; and common drive means for simultaneously driving each of said driven belts and said driven roll.

10. A machine for securing a first rigid thermoplastic flange of a carton about a second rigid carton flange, comprising in combination: means for heating the first flange to a softening temperature; means for folding a portion of the softened first flange to sandwich in the second flange intermediate resulting adjacently overlying portions of the first flange; means for holding the overlying portions of the first flange in intimate contact with the second flange during the cooling and rigidifying of the first flange; a pair of flexible conveyor belts arranged to engage opposite sides of the carton respectively, for continually moving the carton successively past each of said means; and a back-up member for one of said belts and disposed to oppose movement of said one belt in a direction away from the other belt, said member having guide portions along spaced edges thereof and extending beyond said one belt to at least partially embrace the edges of the carton to hold it on said one belt.

11. A machine for securing a first rigid thermoplastic flange of a carton about a second rigid carton flange, comprising in combination: a heating bar adapted to engage and to directly heat a narrow elongated intermediate portion of the first flange to a softening temperature, said bar being adapted to be continually maintained at a temperature intermediate the lowest softening and the lowest burning temperatures of the flange; a stationary element having a first end arranged to engage the softened first flange, a central region having a contoured surface blended with said first end to fold a portion of the softened first flange about the second flange, and a second oppositely disposed end having an surface blended with said contoured surface for holding the folded portion against the second flange during cooling; a pair of driven conveyor belts arranged to engage opposite sides of the carton respectively, for continually moving the carton successively past each of said heating bar and folding element; a series of adjacently arranged paired rolls engageable with the overlying portions of the first flange at least one of said pairs of rolls being disposed adjacent to said second end of said folding element and having means for positively biasing said rolls against the overlying portions before they have rigidified, at least one of said rolls being rotatably driven for aiding said continual movement; common drive means for simultaneously driving each of said driven belts and said driven roll; and a rigid back-up member for each of said belts and each respectively disposed to oppose movement of said belt in a direction away from the carton, one of said members being yieldably mounted in biased relation toward the other member against one belt, and said other member having guide portions along spaced edges thereof and extending beyond the other belt to at least partially embrace the edges of the carton to hold it on said other belt.

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