Dec. 25, 1945. W. C. JOHNSON ET AL 2,391,708

CARTON CLOSING DEVICE

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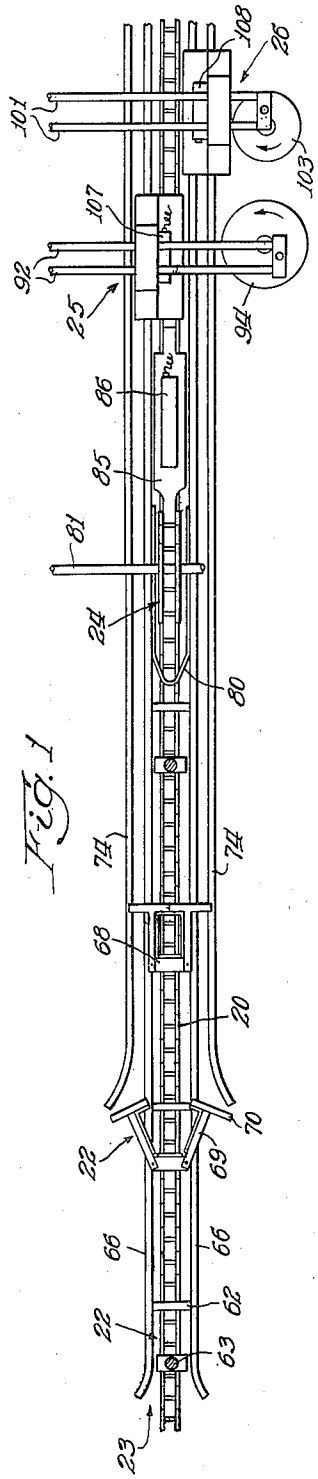

Fig. 1

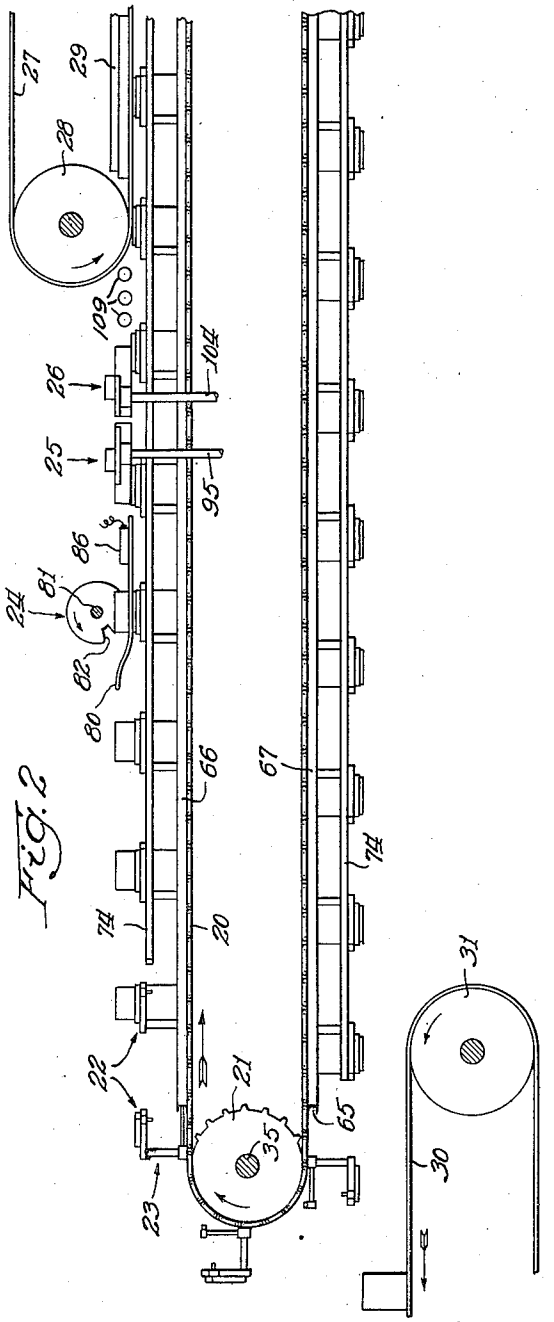

Fig. 2

Inventors:
Warren C. Johnson
Douglas Kirk
By: C. H. Seeley.
Atty.

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Fig. 3

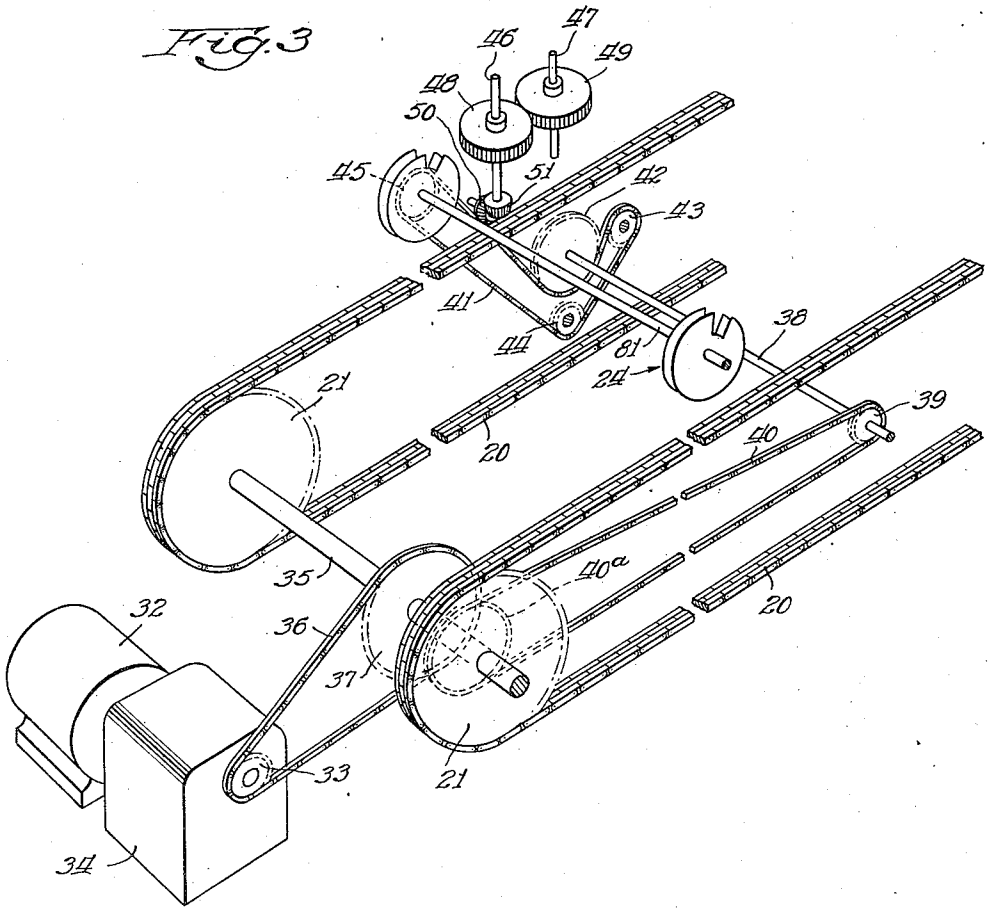

Fig. 14

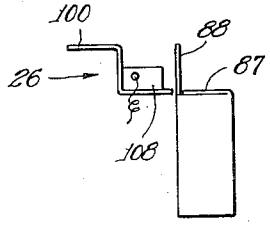

Fig. 15

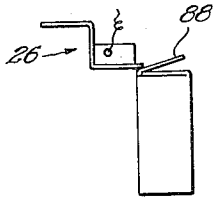

Fig. 16

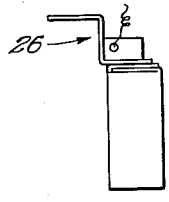

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Fig. 4

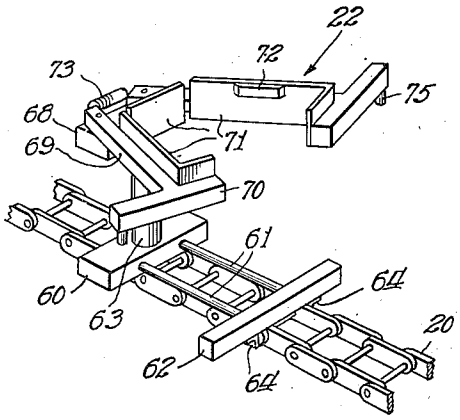


Fig. 5

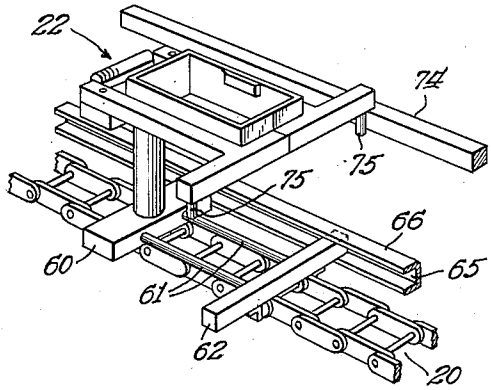


Fig. 8

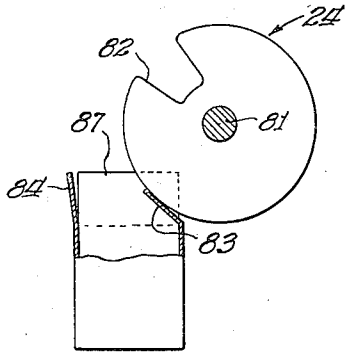


Fig. 9

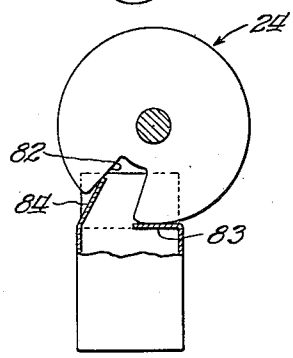


Fig. 10

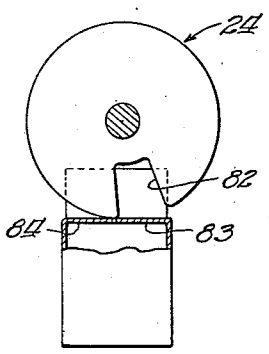


Fig. 11

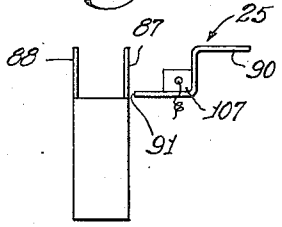


Fig. 12

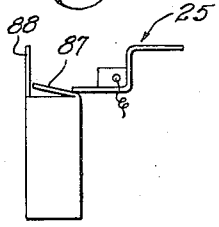
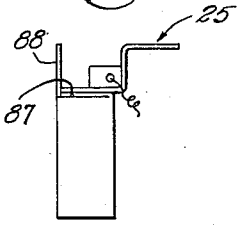


Fig. 13



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Douglas Kirk
By: C. H. Seeley.
Atty.

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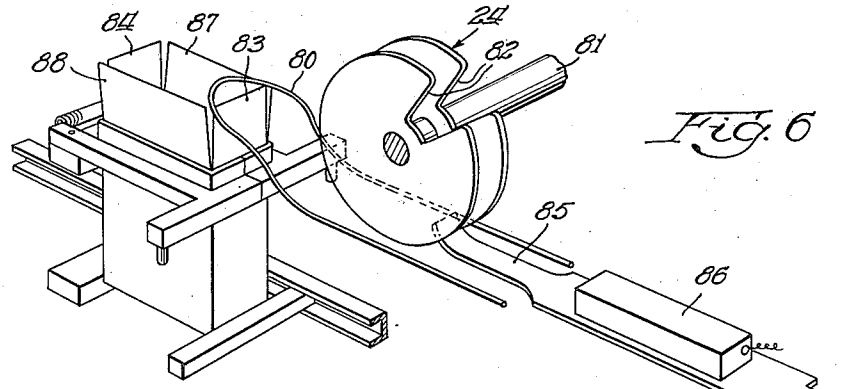

Fig. 6

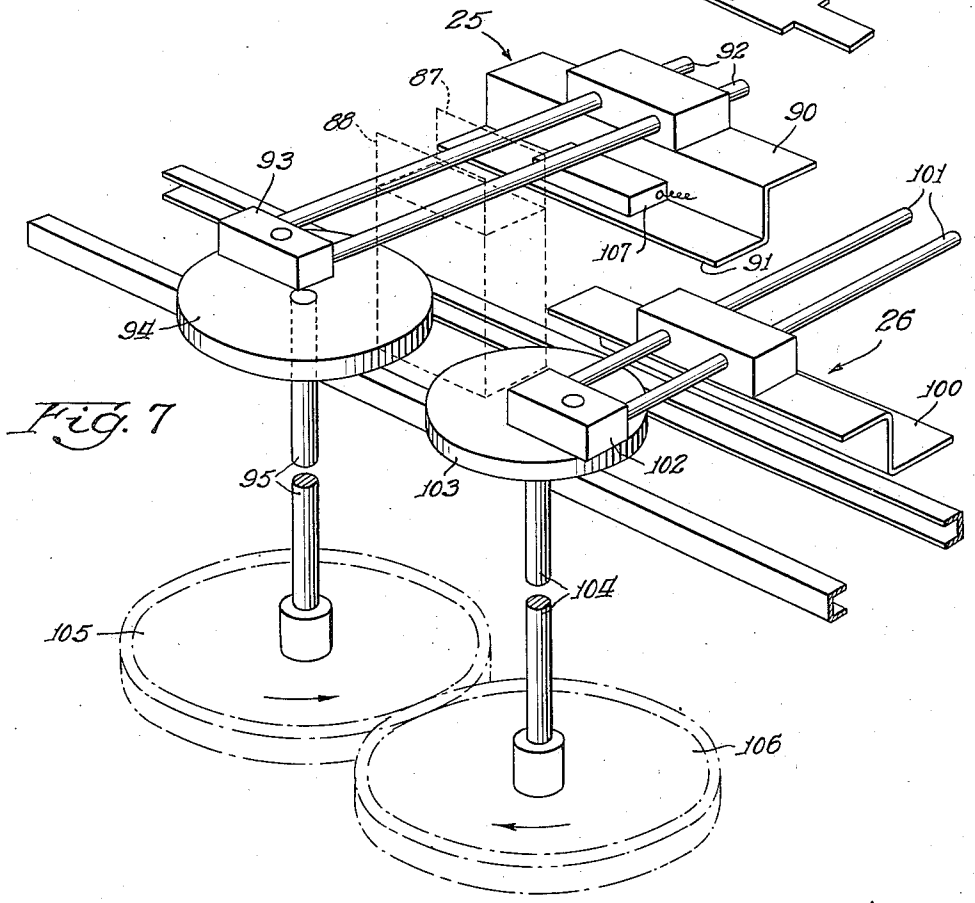

Fig. 7

Inventors:
Warren C. Johnson
Douglas Kirk
By: C. H. Seeley
Atty.

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UNITED STATES PATENT OFFICE

2,391,708

CARTON CLOSING DEVICE

Warren C. Johnson, Cedar Rapids, Iowa, and Douglas Kirk, Chicago, Ill., assignors, by mesne assignments, to Quaker Oats Company

Application June 26, 1943, Serial No. 492,350

4 Claims. (Cl. 93—6)

This invention relates to apparatus for sealing containers and more particularly to continuous automatic machines especially adapted to receive paperboard cartons which have been filled with a desired product and to effect closing and sealing of the top flaps thereof.

While a number of types of machines for this purpose, generally referred to as "top-sealing machines," are available and many others have been proposed, they are generally not adapted to be used in connection with a packaging process involving heat-sealing of the top carton flaps, or they are characterized by relatively slow intermittent motion with attendant wear of the working parts. The machine of the present invention is so arranged that it is simple in construction, and fast and smooth in operation, and it is peculiarly adapted for heat-sealing the top flaps of filled cartons, although some of the novel features thereof are equally adapted to be used on sealing machines employing an ordinary adhesive to seal the cartons.

It is an object of the invention to provide a simple type of continuous top-sealing machine which is especially adapted to close and heat-seal the top flaps of cartons which have been coated with a thermoplastic material. Another object is to provide a top-sealing machine in which heat-sealing of the top closure is effected in such a way as to insure the production of sealed cartons in which the top seal is free from undesirable pinholes, cracks or the like. A further object is to provide novel and efficient means for folding the flaps of cartons into closed position. Further objects, advantages and uses of the invention will be apparent from the following detailed description of a presently preferred embodiment thereof, which should be read in conjunction with the drawings forming a part of this specification.

In the drawings:

Fig. 1 is a partial plan view of one of the duplicate carton-sealing lines with which a sealing machine according to the invention is equipped, illustrating particularly the operation of the carton pockets and the flap-folding devices;

Fig. 2 is a simplified view in elevation of one end of the sealing machine of Fig. 1 showing the relationship of the various parts;

Fig. 3 shows in perspective the driving mechanisms which actuate the various devices incorporated in that end of the machine illustrated in Fig. 2;

Fig. 4 shows in perspective one of the carton pockets with its jaw members open for the reception of a carton;

Fig. 5 shows the carton pocket of Fig. 4 in closed position;

Fig. 6 is an enlarged perspective view of the first carton flap-folding mechanism;

Fig. 7 is an enlarged perspective view of the second of the flap-folding mechanisms;

Figs. 8, 9 and 10 represent diagrammatically three successive stages in the folding of the end wall flap;

Figs. 11, 12 and 13 represent diagrammatically three successive stages in the folding of one of the side wall flaps; and

Figs. 14, 15 and 16 represent diagrammatically three successive stages in the folding of the overlying side wall flap.

The particular embodiment of the invention illustrated in the drawings is in connection with a top-sealing machine provided with two separate carton-sealing lines which are identical in construction and operation, but for the sake of brevity and simplicity, only one of these lines will be completely described. Furthermore, it will be observed that the drawings have been simplified by omitting much of the supporting structure and operational devices, since such structure and devices are not essential to an understanding of the present invention and could be supplied readily by one skilled in the art.

Referring first to Fig. 2, an endless chain 20 is arranged to travel over a sprocket 21 and a similar sprocket not shown, so that its upper reach moves from left to right, and it is provided at regularly spaced intervals with a series of carton pockets generally designated at 22. While each of these arrangements will be described in detail below, Fig. 2 indicates the relative positions of the carton supply point 23, the end wall flap-folding discs 24, the side wall folding devices 25 and 26, the endless belt 27 traveling over pulley 28 and a similar belt not shown and through which heat is transmitted to the carton tops from heating element 29, and the carton removal arrangement which comprises belt 30 traveling on pulley 31 and another pulley which is not shown.

It is believed that the operation of these parts can be explained more simply if the driving mechanism which actuates them and which have been largely omitted from Fig. 2 is first described, and reference is, therefore, made to Fig. 3. Due to the fact that all of the movements of the various parts except belt 30 must be synchronized, they are all driven from a single prime mover, which is illustrated by way of example as electric motor 32 and which drives sprocket 33 through the speed-reducing unit 34. Sprocket 33 in turn

drives shaft 35 by means of chain 36 and sprocket 37, thus causing uniform continuous motion of the chains 20 which travel on sprockets 21 mounted on shaft 35. Belts 27 are arranged to travel in the same direction as and at substantially the same linear velocity as belts 20 by any suitable means not shown, and they are directly above belts 20 so that they are in contact with the tops of the cartons in the carton pockets 22.

The flap-folding mechanism 24, 25 and 26 are all driven from shaft 38 which rotates at a speed bearing a definite ratio to that of shaft 35 since it is coupled thereto by means of sprocket 39, chain 40 and sprocket 40a. The rotation of end wall flap-folding discs 24 is accomplished by means of chain 41 running over sprockets 42, 43, 44 and 45 and the relative sizes of the various sprockets involved is chosen in this case so that discs 24 make two complete revolutions during the time required for chain 20 to travel a distance equal to the spacing between equivalent parts of adjacent carton pockets 22. The reason for this will be discussed more fully when the folding operation is described. The side wall flap folders 25 and 26 are actuated by two vertical shafts 46 and 47 upon which are mounted the cooperating gears 48 and 49, so that they turn at an equal rate but in opposite directions, shaft 46 being in turn driven from shaft 38 by means of the cooperating bevel gears 50 and 51. It will be understood that another pair of side wall flap folders are similarly arranged and driven from the other end of shaft 38.

The carton supply means used forms no part of the present invention, and any suitable arrangement can be employed to insert a series of cartons into the open carton pockets 22 as they pass the point designated at 23 in Fig. 2. Obviously the entrance or supply mechanism should be synchronized with belts 20 and may conveniently be driven from shaft 35.

Referring now to Figs. 4 and 5, each of the carton pockets 22 consists of a base bar 60 extending across chain 20 and rigidly secured to one of the links thereof, as by welding, a pair of rigid rods 61 extending forwardly therefrom, terminating in a cross bar 62 and an upright post 63 mounted on bar 60 carrying mechanism for receiving and gripping a carton near its upper edge. Rods 61 and cross bar 62 constitute the structure upon which the carton rests and bar 62 has a pair of lugs 64 on its lower surface spaced apart so as to receive a portion of chain 20 between them. While lugs 64 are not secured to chain 20 they serve the purpose of preventing lateral movement of the forward portion of carton pocket 22 when chain 20 is traveling in a straight line and thus enhancing the stability of carton pocket 22 when folding operations are performed on the carton therein. Bar 62 is substantially longer than bar 60 so that it may enter the grooves 65 in guides 66 as shown in Figs. 1, 5 and 6. From Fig. 2, it will be observed that guides 66 extend adjacent chain 20 along upper reach of chain 20, and that there is a similar pair of guides 67 extending along the lower reach of chain 20 thereby preventing any sagging of the latter and keeping the carton pockets 22 moving always in a straight line.

Referring again to Figs. 4 and 5, the carton-gripping machanism comprises a cross bar 68 upon which are swingably mounted a pair of arms 69 having inwardly extending portions 70 at their ends. Arms 69 together constitute a pair of jaws of such dimensions as to enclose the particular carton to be handled, and they, as well as bar 68, have secured to their inner surfaces a number of small plates 71 extending above the upper surface of arms 69 to a point just below the top edges of the cartons to be enclosed thereby. Furthermore, these plates are of such thickness that when the jaws are closed as shown in Fig. 5, they will form a continuous collar which grips the carton firmly on all sides and holds it square. Furthermore, those plates 71 coming in contact with the carton side walls are provided with portions 72 in their upper central section which project slightly inwardly to cause a slight inward bending of the carton walls sufficient to prevent the flaps on the carton end walls from passing below the horizontal plane when they are folded. Also, it will be noted that members 68, 69 and 70 constitute a shelf which is capable of receiving such small amounts of excess thermoplastic material as may be forced from the flap surfaces during the sealing operation to be described, so that this excess material does not remain on the cartons and render them unsightly, nor does it drip on the various parts of the machine indiscriminately. Arms 69 are normally urged in the open position shown in Fig. 4 by means of coil spring 73, but as soon as the pocket 22 has traveled past the carton entrance point, the arms are moved to closed position by the action of cams 74 acting on rollers 75 mounted on the lower outer end of arms 69. This is best illustrated in Figs. 1 and 5. As shown in Fig. 2, cam elements 74 extend along the machine substantially parallel to both the upper and lower reaches of chain 20 and also as the latter passes around the sprocket not shown, so that each carton is firmly held in the carton pocket while the flap-folding, heating and cooling operations are being performed and then returns toward the entrance end of the machine in upside-down position. Just before each pocket passes upwardly around sprocket 21, the cams 74 flare outwardly, thus causing arms 69 to assume an open position so that the carton contained therein slides downwardly and rests upside down upon belt 30 for removal from the machine.

In order that the various features of the invention may be completely understood, the operation of the embodiment thereof shown in the drawings will be described with respect to a typical carton passing through it, and the details of such of these features as have not already been mentioned will be given in connection with this description. In this example, the cartons are conventional tubular cartons of rectangular cross-section, which have been bottom-sealed and filled with the desired product, and which have a top flap on each of the side walls coated with a thermoplastic composition, these flaps being adapted to be overlapped to form a top closure.

In starting up the machine, motor 32 and consequently all of the parts driven thereby are placed in operation, so that a series of carton pockets 22 in open position approach the carton entrance point 23. Here a carton is placed in each pocket in succession, preferably by synchronized automatic equipment which forms no part of the present invention and is, therefore, not shown. Almost immediately rollers 75 come in contact with cams 74 so that the arms 69 are swung to closed position and the carton is closely held in upright position by the plates 71.

The carton thus held continues its travel until the side wall flaps, that is, those which lie parallel to the direction of motion come in contact

with guide rods 80. These rods are best shown in Fig. 6 and serve merely to displace the side wall flaps slightly outwardly for a short time so that the other pair of flaps, herein called end wall flaps, may be folded without possible interference from the side wall flaps. The end wall flap-folding mechanism is very simple and consists merely in a pair of discs 24 which are mounted on shaft 81 and rotated by means of sprocket 43 as previously described. Discs 24 are arranged so that at their lowest point their peripheries are substantially in the same plane as the top edges of the approaching cartons and they are spaced apart a distance such that they come in contact with the approaching end wall flaps near their side edges. Each of the discs 24 is provided with a cut-away portion or notch 82 in register with each other and the motion of discs 24 and chain 20 are so synchronized that the notches 82 face upwardly when discs 24 first come in contact with the leading end wall flap 83. Fig. 8 shows diagrammatically the relative positions of the carton and discs 24 shortly after the folding of flap 83 has begun, and it will be noted that this flap is smoothly and easily folded by progressing beneath discs 24. As the movement of chain 20 and discs 24 continues, notch 82 moves around and contacts the upper and outer edge of the trailing end wall flap 84, somewhat as shown in Fig. 9, so that finally flap 84 is folded into the same plane as flap 83, as illustrated in Fig. 10. It is necessary, in order to achieve the result just described, that the circumferential speed of discs 24 be greater than the linear velocity of the carton and in this case the parts are so synchronized that discs 24 make two revolutions while chain 20 is moving a distance equal to that between the corresponding parts of adjacent carton pockets. In other words, notches 82 operate on a trailing carton flap during every other revolution of discs 24. The advantages of this form of folding device are obvious since it is simple and smooth in operation and involves no reciprocating parts whatever.

Returning again to Fig. 6, a hold-down bar 85 is provided which retains flaps 83 and 84 in their folded condition until the side wall flaps can be folded over upon them and this hold-down bar 85 is heated by means of an electrical heating unit 86 for the purpose of pre-heating the folded flaps and softening the thermoplastic material thereon, which removes any beads or other irregularities in the material and aids substantially in making the final heat-sealing operation effective. This pre-heating step is especially effective because of the fact that flaps 83 and 84 are prevented from entering the carton itself by the slight depression of the carton walls previously described so that they are necessarily held in good contact with the heated hold-down bar 85.

The carton in the advancing carton pocket is then acted upon by the side wall flap-folding devices 25 and 26 which act successively to fold the side wall flaps designated 87 and 88 in that order. As shown in Fig. 7, flap folder 25 includes a member 90 which is arranged to present a straight edge 91 to flap 87 along a line just above the top score line of its associated side wall and so to fold flap 87 into contact with flaps 83 and 84, as illustrated diagrammatically in Figs. 11, 12 and 13. This folding, however, is not done by moving the folding member 90 in a direction perpendicular to edge 91, but by causing it to follow a circular path such that edge 91 travels with, as well as toward and away from, the carton. This rotary motion is achieved by mounting the folding member 90 upon a pair of rods 92, which in turn are supported at one end by a block 93 mounted on an eccentric pivot on the upper surface of horizontal disc 94. Disc 94 is arranged to rotate about vertical shaft 95 and the other ends of rods 92 are similarly mounted on a similar disc not shown, adapted to rotate upon shaft 46 (Fig. 3). Since shaft 46, as has already been shown, rotates in a counterclockwise direction, shaft 95 will do likewise and the folding member 90 will travel in a circular translational manner. Also, this motion is synchronized with the motion of chain 20 so that edge 91 is caused to approach and to move with the carton just as the carton pocket is in the proper position with respect to it.

Folding device 26 similarly includes a member 100 mounted on rods 101 which in turn are supported by block 102 on disc 103, and the latter rotates with shaft 104. Shafts 95 and 104 rotate at the same rate and in opposite directions because of the intermeshing gears 105 and 106, and also because rods 101 are similarly supported at their other ends upon a corresponding disc mounted on shaft 47. In this case, of course, folding member 100 approaches the carton from the other side, but it acts in the same manner as shown in Figs. 14, 15 and 16. In the position of the parts shown in Fig. 6, folding device 26 is about to commence the folding of flap 87. These devices give efficient and positive folding action, due to the straight line action of the folding edges and they are also exceptionally smooth in operation because of the circular motion used. The folding members 90 and 100 are also provided with electrical heating units 107 and 108, which serve to prevent the accumulation of thermoplastic material upon them and also to preheat flaps 87 and 88 so as to prevent cooling of the thermoplastic materials on flaps 83 and 84 which have already been softened as described.

The carton in the advancing carton pocket is then ready for the heat-sealing operation, and so passes under the lower reach of belt 27, which holds the top flaps in their closed position. During the transition period these top flaps are kept closed by means of a series of rollers 109 which bear upon the uppermost of them. In the particular application of the invention being described, the top flaps are coated with a thermoplastic material and in order to heat-seal them, it is necessary to apply heat and pressure in a downward direction upon substantially the entire carton top so that this material may soften and flow so as to seal all of the cracks and crevices between and adjacent the flaps. It is, therefore, necessary that belt 27 should be heated in some way and in the present instance, belt 27 is of a material having a high heat conductivity through which passes from the electrical heating unit 29 to the top surface of the carton, and the length of belt 27 and heating unit 29 is such that the desired amount of heat is transmitted to the carton tops. In the presently preferred form of the invention, belt 27 is an endless steel belt and it is slightly wider than the cartons being sealed so that the heat is transmitted as evenly as possible to the carton. Heating unit 29 is also slightly wider than the carton and it has a smooth lower surface upon which belt 27 slides easily and with little friction, even though that surface is adjusted vertically so that it exerts a definite and substantial pressure upon the cartons traveling thereunder.

Upon leaving belt 27, the carton moves forward and comes in contact with any suitable type of cooling unit so that the top flaps are cooled while being held in closed position. While it would be possible to allow the cartons to cool while holding the top flaps closed by any suitable arrangement, this would result in an exceptionally and undesirably long top-sealing line, so that it is much preferred to cool the thermoplastic material at the top of the carton more quickly, such as by a cooled belt similar to belt 27.

Since cam tracks 74 extend throughout most of the lower reach of the belt 20, the cartons remain in their carton pockets 22 and return substantially the entire length of the machine toward the entrance end but they are, of course, in upside down position. At a point just short of sprocket 21, cam tracks 74 flare outwardly so that arms 69 swing outwardly under the influence of spring 73 and the completely sealed carton is released therefrom. Belt 30 is arranged to travel somewhat below the cartons as they are released and slide downwardly from the various carton pockets in succession and serves to carry them in the same direction from the machine. Belt 30 and pulley 31 over which it travels, are not necessarily synchronized with chain 20, although they may be, but in this instance they are separately driven at a somewhat higher linear velocity so that the released cartons will be sure to clear pockets 22 before the latter start their upward travel around sprocket 21. One of the great advantages of this carton outlet arrangement is its simplicity, but another is the complete absence of reciprocating or timed motions which may get out of order.

It will be seen from the above that a carton sealing machine, in accordance with the invention, has been described which has many novel features and which is more advantageous than the devices of the prior art for many purposes and especially for heat-sealing cartons whose closure flaps have been coated with a thermoplastic material. Obviously many modifications may be made by those skilled in the art in the light of the above disclosure, but such modifications are intended to be within the scope of the present invention.

While the invention has been described in connection with a specific embodiment thereof, it is not desired to be limited thereto, but only by the scope of the following claims.

We claim:

1. A machine for folding the flaps on the side walls of a series of tubular cartons of rectangular cross section to form end closures therefor comprising conveyor means adapted to carry said series of cartons with said flaps extending therefrom substantially in the planes of said side walls continuously and at regularly spaced intervals in a predetermined path, continuously rotating means along said path and synchronized with said conveyor for folding those of said flaps in leading and trailing position into substantially the same plane, and a pair of flap-folding members synchronized with said conveyor and traveling continuously in circular translational motion for folding the other two of said flaps consecutively into overlapping relation to said leading and trailing flaps.

2. A machine according to claim 1 wherein each of said flap-folding members is supported upon an elongated member each end of which is non-axially mounted upon a disc member, and means for rotating the disc members associated with one of said elongated members in one direction and for rotating the disc members associated with the other of said elongated members in the opposite direction.

3. In a machine for folding the top flaps of tubular cartons of rectangular cross-section to form top closures therefor including a conveyor for carrying a series of said cartons at regularly spaced intervals in a predetermined direction with said flaps extending substantially vertically upwardly from the side walls thereof, and means for folding said flaps while said conveyor is in motion, the improved apparatus for folding that pair of flaps on the side walls parallel to said direction which comprises a pair of flap-folding members, each of said members being supported for circular translational movement upon an elongated member each end of which is similarly and non-axially mounted on a disc member adapted to rotate about a vertical axis, said flap-folding members being adapted to present edge portions parallel to said direction to the flaps of said pair along a plane just above the score line defining the top edges of said cartons and being on opposite sides of said conveyor and spaced therealong, and means synchronized with said conveyor for rotating said disc members associated with different elongated members in opposite directions, whereby said edge portions travel in the direction of said conveyor while in contact with said flaps and said flaps are folded consecutively into overlapping relation.

4. Apparatus according to claim 3 including means for heating said flap-folding members.

WARREN C. JOHNSON.
DOUGLAS KIRK.