June 23, 1964 R. L. MARTIN 3,138,075

APPARATUS FOR FOLDING CARTON BLANKS

Filed Feb. 18, 1963 7 Sheets-Sheet 1

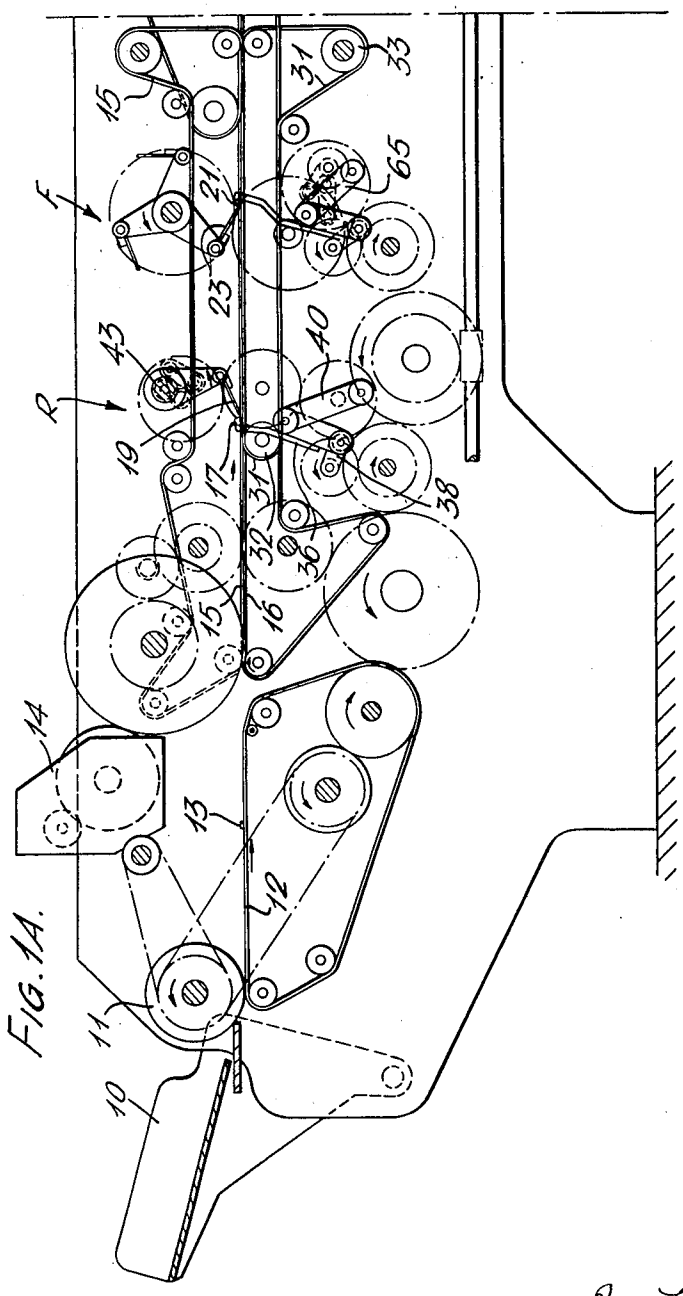

FIG. 1A.

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Filed Feb. 18, 1963 7 Sheets-Sheet 2

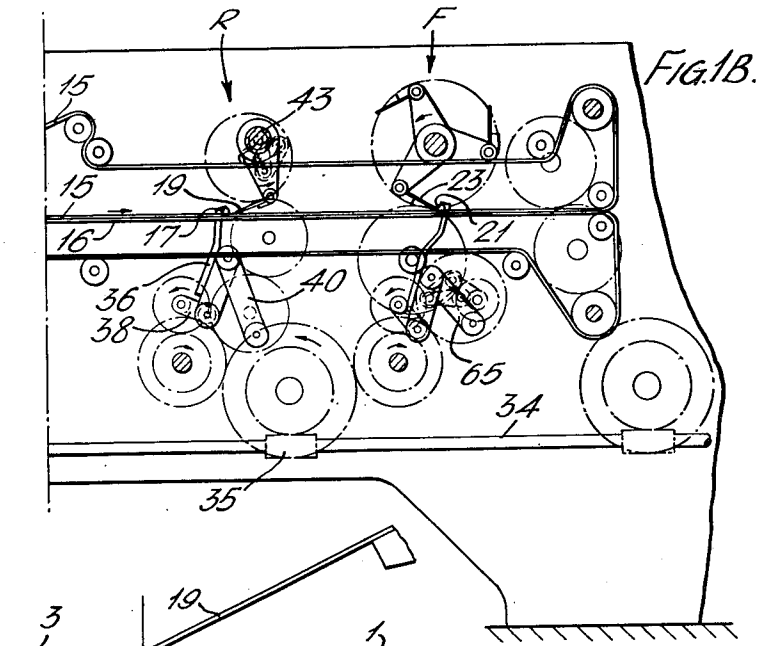
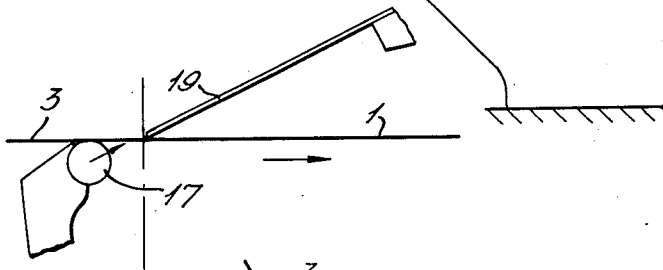


FIG. 1B.



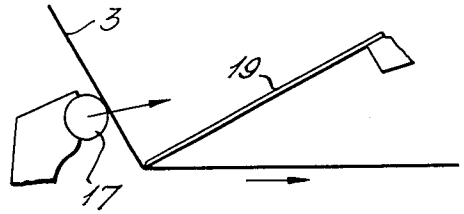
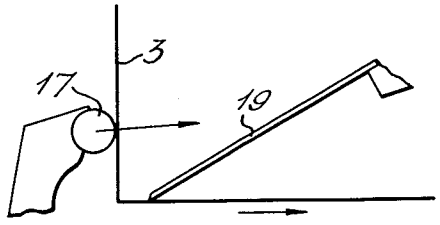


FIG. 3.



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June 23, 1964 R. L. MARTIN 3,138,075

APPARATUS FOR FOLDING CARTON BLANKS

Filed Feb. 18, 1963 7 Sheets-Sheet 3

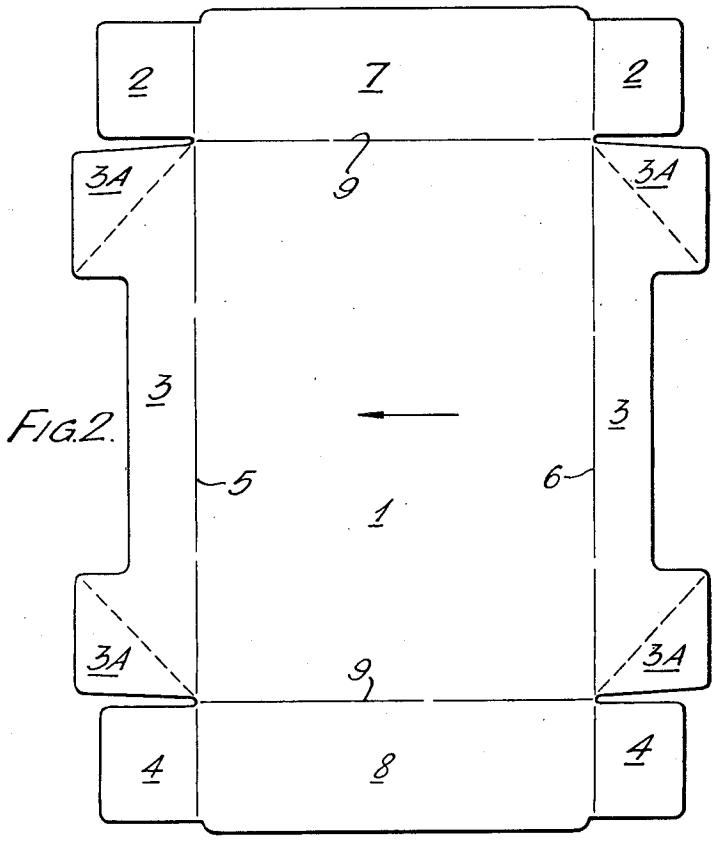

FIG. 2.

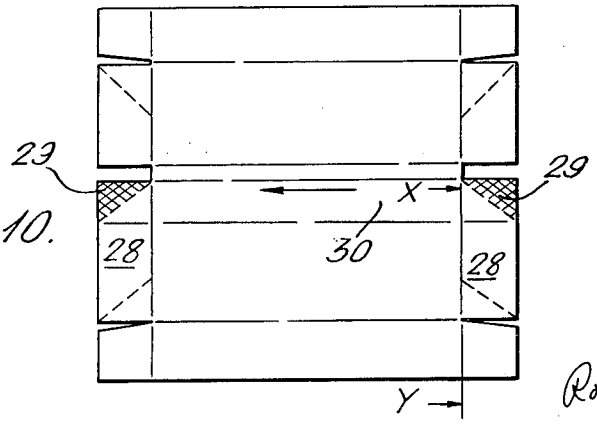

FIG. 10.

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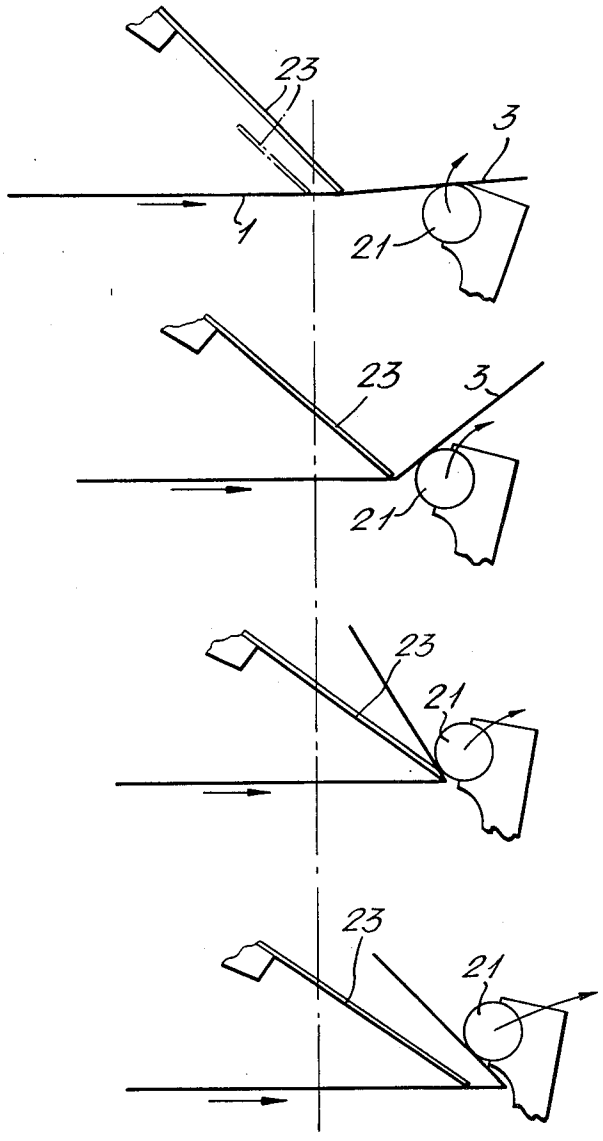
June 23, 1964 R. L. MARTIN 3,138,075

APPARATUS FOR FOLDING CARTON BLANKS

Filed Feb. 18, 1963 7 Sheets-Sheet 4

FIG. 4.



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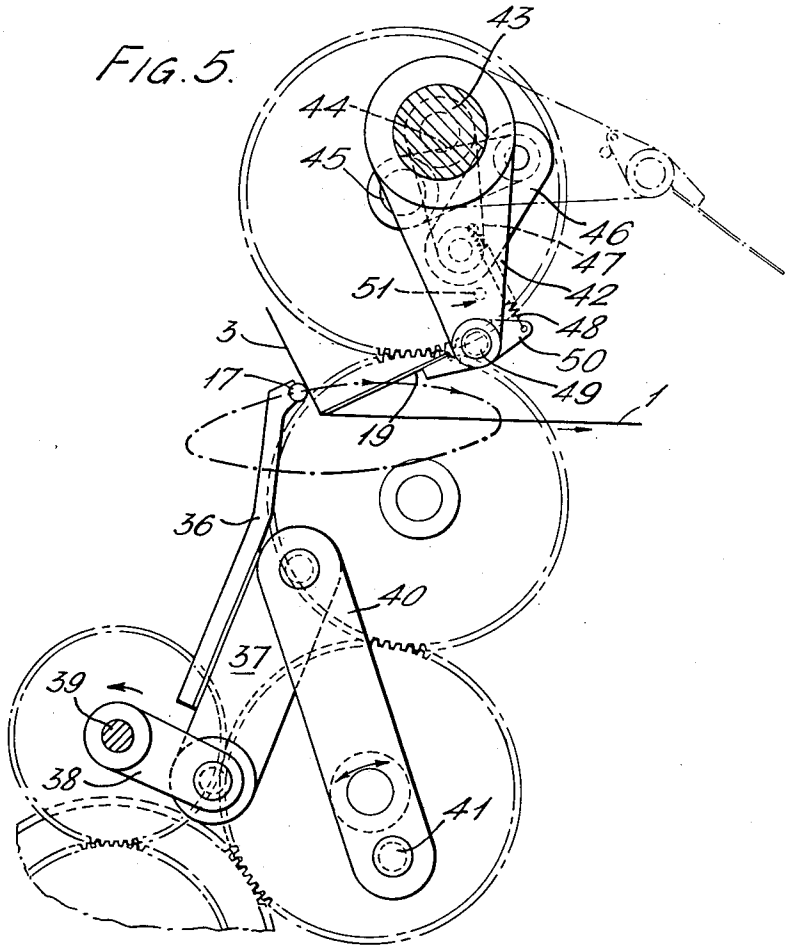
June 23, 1964 R. L. MARTIN 3,138,075

APPARATUS FOR FOLDING CARTON BLANKS

Filed Feb. 18, 1963 7 Sheets-Sheet 5

FIG. 5.



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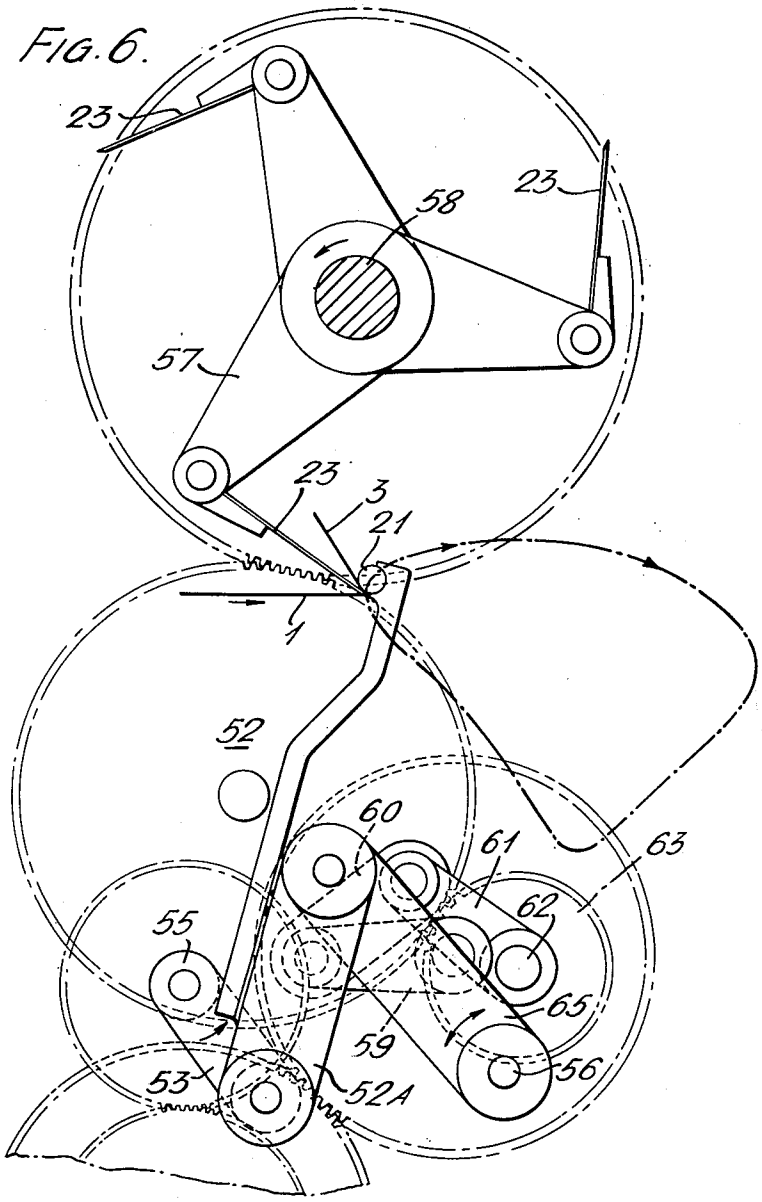
June 23, 1964 R. L. MARTIN 3,138,075

APPARATUS FOR FOLDING CARTON BLANKS

Filed Feb. 18, 1963 7 Sheets-Sheet 6

FIG. 6.



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June 23, 1964 R. L. MARTIN 3,138,075

APPARATUS FOR FOLDING CARTON BLANKS

Filed Feb. 18, 1963 7 Sheets-Sheet 7

FIG. 9.

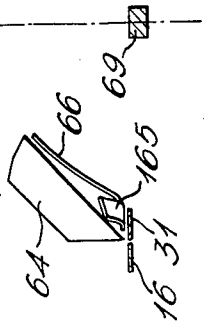


FIG. 7.

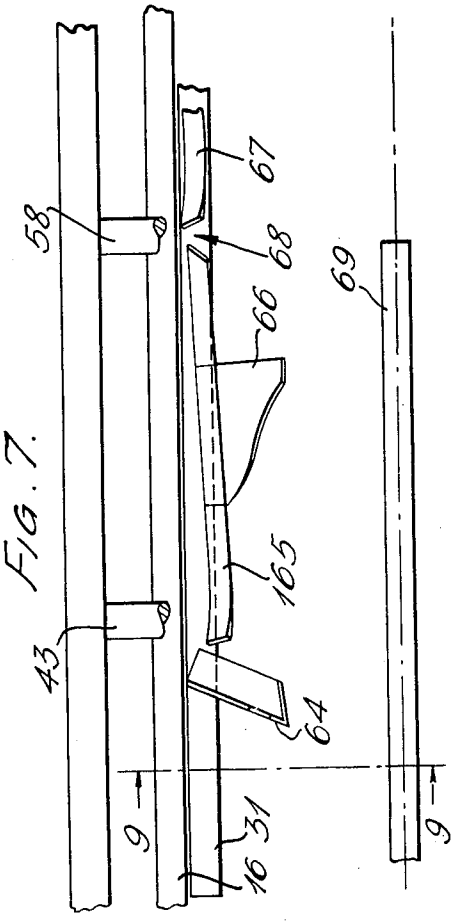
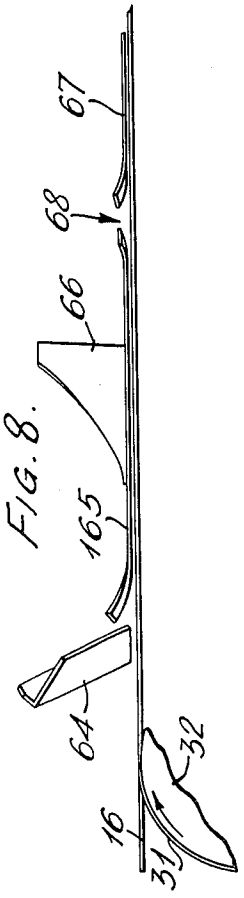


FIG. 8.



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3,138,075

APPARATUS FOR FOLDING CARTON BLANKS

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Claims priority, application Great Britain Feb. 20, 1962
2 Claims. (Cl. 93—49)

This invention concerns apparatus for folding carton blanks in a carton making machine, and more particularly for folding flaps and panels of such blanks.

Folding the flaps of a carton blank is often effected while a blank is moving in a straight path, the blank being so orientated that any flaps to be folded over are folded on a line parallel to the direction of movement. Commonly ploughshare folders are used to rotate a flap through a desired angle about said line but it is also known to fold such a flap against a rigid edge, such as an angle of a metal bar, by rollers and other contrivances. A blank is usually creased on the lines along which it is to be folded.

Such devices are satisfactory for many blanks, particularly if the shape of the flaps is simple but with complex shapes, or where the material is unusually stiff, a flap does not always fold exactly on the desired line. Also if the flap itself presents a cut-out pattern, or if it is one of a series of flaps in line, the folding by such devices is difficult and uncertain. Further, where a blank has a central rectangular panel with flaps extending from all sides of the panel, it is highly desirable that all flaps shall be folded while the blank moves along a single straight path. As will be seen later, folding such a blank, while the blank moves through a straight path, entails folding flaps at the sides which are parallel to the line of movement, by conventional devices but the flaps in question are usually simple rectangular flaps. If for any reason such flaps cannot be satisfactorily folded by conventional devices they can be folded in the manner hereinafter described, in which case the whole operation cannot be conducted while the blank moves through a single straight path.

The invention provides a carton making machine comprising means for moving a flat carton blank along a straight path, said carton blank having a main panel to which flaps are attached and being positioned with respect to said means so that a flap is at each end of the panel, as considered in the direction of movement, and the line on which such a flap is to be folded is at right angles to said direction, a blade having a straight edge about which a flap is folded by angular movement of the flap about said edge, means for positioning said edge on the line about which the flap is to be folded, and means for moving the flap bodily in a rotational movement about said edge so that all parts of the flap execute the same angular movement simultaneously.

Preferably the flap folding is executed while the blank is in continuous movement along the path, in which case the means for positioning the blade edge, and the means for moving the flap by rotation about the edge, are operated by variable-velocity mechanisms so that they execute the necessary movements without interfering with the movement of the blank. Four-bar mechanisms are suitable variable-velocity mechanisms.

Where a carton is to be made up as a collapsed tray, which can be opened when articles are to be packed in the tray, the free corners of each such flap need to be bent through 180°, on a line disposed at 45° to the sides of the flap defining the free corners, to provide triangular portions or ears which lie on the main part of the flap so that, eventually flaps on the other sides of the main panel can be joined to the triangular portions by adhesive, the bending of these triangular portions can be effected by cooperating cam faces, prior to the flap folding operation, but in the specific construction which follows, they are folded by fixed folders, bent to suitable shapes, and such folders constitute part of the invention when the machine is arranged for folding the blank as a stage in the formation of a collapsible tray.

Adhesive applying devices to apply adhesive to selected parts of the blank are provided so that flaps which are folded over can be attached to other parts.

The invention will be more fully described with reference to the accompanying drawings in which:

FIGURES 1A and 1B jointly show an elevation of a machine embodying the invention, the front side of the machine being omitted,

FIGURE 2 is a flat layout of a typical blank which is to be completely folded to make a collapsible tray, certain flaps being joined by adhesive,

FIGURES 3 and 4, are diagrams for explaining the folding of flaps at opposite ends of a carton blank.

FIGURE 5 shows mechanism for folding a rear flap, drawn to a larger scale than the same mechanism shown in FIGURES 1A and 1B,

FIGURE 6 shows mechanism for folding a front flap, drawn to a larger scale than the same mechanism shown in FIGURES 1A and 1B,

FIGURES 7, 8 and 9 are diagrammatic views of fixed folding devices for folding certain triangular ears shown in FIGURE 2,

FIGURE 10 shows another blank.

Referring first to FIGURE 2, the blank has a main panel **1** and at each side in the view are three flaps **2**, **3** and **4**. Creases **5** and **6** are made in the blank and it is on these creases that the flaps **2**, **3** and **4** are to be folded. At the top and bottom of the panel **1** in the view are further flaps **7** and **8** defined by creases **9**. It will also be seen that the free corners of the flaps **3** have creases which form right-angled triangles at said free corners, the triangles being marked A3.

The blank is fed to the machine shown in FIGURES 1A and 1B with the surface which will form the exterior of the tray downwards and as, usually, such surface is printed it will be referred to, for ease of description, as the printed face, and the face which will form the interior of the tray will be termed the upper face. The blank moves in the direction indicated by the arrow on FIGURE 2, so the flaps 2; 3; 4 are at each end of the main panel **1**, as considered in the direction of movement of the blank.

For convenience, the flaps 2; 3; 4 at the left-hand side of the blank in FIGURE 2 will be called front flaps, and those at the right-hand side, rear flaps.

Blanks are fed from a magazine **10**, FIGURE 1A, by a suction feed drum **11**. This rotates in timed relationship with a conveyor **12** having dogs **13** on it which carry blanks along at definitely spaced intervals.

A gluing device is provided at **14** which can apply glue or other adhesive to parts of blanks, as will be described later.

Blanks coming from the conveyor **12** pass between belts **15** and **16** which constitute a further conveyor whereby a blank is carried through flap-folding devices located at positions marked R and F, the device R operating on rear flaps and F on front flaps.

From FIGURES 1A and 1B it will be seen that these flap folding devices are duplicated. The devices at R and F in FIGURE 1A fold the flaps **3** of the blank shown in FIGURE 2, while the devices at R and F in FIGURE 1B fold the flaps **2** and **4** of the blank. These devices in FIGURE 1B are therefore of duplex construction, one part for flap **2** and one for flap **4**, though common oper-

ating mechanism operates both. By splitting the folding operations into two in this way, the machine is more flexible, as the blade **19** can be made of a fixed width to cover a fair range of widths of flap **3** and the duplex devices can be spread apart or closed in to suit the positions of flaps **2** and **4**. The devices and operating mechanism will be described in detail later with reference to the large scale views, FIGURES 5 and 6, but for the present it is sufficient to say that at R a blade **19** is positioned so that its free edge, which is straight, lies on the line about which a rear flap is to be folded, while a bar **17** constitutes means for moving the flap bodily in a rotational movement about said edge so that all parts of the flap execute the same angular movement simultaneously. At F, a blade **23** and bar **21** perform the folding operations on the front flaps.

As in the construction being described, the conveyors **12** and **15** and **16** move continuously, the blades **19** and **23** and bars **17** and **21** have movements imparted to them whereby the desired folding can take place and whereby each blade and associated bar can move clear of the blank when their work is done, to avoid interference with the moving blank.

So that the belt conveyors can preserve the timed relationship, the belts are of the "Trakgrip" type, and to avoid displacement of a blank carried between the belts **15** and **16**, spring pressed rollers (not shown) are provided, to press the belts together, at least at the part where the flap folding operations take place.

The belt **16** extends from end to end of the machine but the belt **15** is in two parts, overlapping one another at the right-hand side of FIGURE 1A. This is because while the blank is being conveyed for folding the flaps **3**, it is gripped by the flaps **2–7** and **4–8**, and when flaps **2** and **4** are to be folded it is gripped by the folded over flaps **3**.

Further belts **31** are provided, one at each side of the machine, to cooperate with certain fixed folders and like devices shown in FIGURES 7, 8 and 9 and described later. These belts turn on pulleys **32** and **33** as the said folders are located in this area.

As the devices at R and F in FIGURE 1B correspond essentially with those at R and F in FIGURE 1A, no further description of them is necessary so far as FIGURE 1B is concerned.

The machine is driven by a mainshaft **34** having worms **35** which drive the various parts by gear trains as shown. The only points worth noting are that the arms carrying the blade **19** make one revolution per carton blank passing, while the arms carrying the blades **23** are in triplicate so that the three-armed member makes one third of a revolution per carton blank. This is because there is not much time for the blade **23** to execute its movements, as the blank is moving away from it and to have to rotate through a complete revolution for each carton would mean a slow moving blade unable to keep up with the blank.

The flap folding operations can be best followed from the diagrams, FIGURES 3 and 4. FIGURE 3 shows the operations on a rear flap, and FIGURE 4 the operations on a front flap.

Referring to FIGURE 3 the vertical chain line is drawn through that crease of a blank, about which the flap is to be folded. The parts are marked **1** and **3** to agree with FIGURE 2. The chain line is drawn as a datum to show that as the blank moves away from the position where it is flat and the blade **19** has just been positioned with its straight edge on the crease, the bar **17** moves up and bends the flap about the blade. As soon as the bend is well defined, the blade begins to accelerate and leave the corner between **1** and **3** and by the time the flap has been bent to 90°, the blade is well away from the corner. It still trails along the panel **1** for a time and later it swings upwards, the movement being shown on FIGURE 5 where the operating mechanism is also shown.

Referring to FIGURE 4, much the same kind of events take place but as the blade **23** is moving with the blank, but is on the interior of the angle formed by folding the flap over towards the panel, the blade is retarded when its work is done. The datum line in this figure is also drawn through the place where the crease is when the blank is flat, the blade **23** then being in the position shown in broken lines.

In both cases the flap is folded through an angle sufficient to define the bending line accurately and sharply before the blade leaves the crease, after which further pressure by the bars **17** or **23** is sufficient to complete the folding operation, to a sufficient extent.

Referring now to FIGURE 5, the track of the bar **17** is shown by a chain line and it will be seen that after the folding is completed, the bar moves down below the path along which the blanks move. Thus by the time the bar is about to pass down beneath said path it has folded the flap to a fairly acute angle with respect to the blank. The bar **17** is carried on an arm **36** fixed to a link **37**. This link is pivoted to a crank **38**, fixed on a shaft **39** rotating at uniform speed. Another link **40** pivoted at **41** is pivoted to the link **37**. There is thus provided a four-bar mechanism, the fourth bar being the distance between the centre of shaft **39** and the pivot **41**.

The cooperating blade **19** is pivoted on the free end of an arm **42**, fixed to a rotatable shaft **43**. A crank **44** fixed to a uniformly rotatable shaft **45** is coupled at its free end by a link **46** to an arm **47** which constitutes a driving crank for the shaft **43**. Thus a four-bar mechanism is provided, the fourth bar being the distance between the centres of the shafts **43** and **45**.

The operative part of the movement of the blade has already been described with reference to FIGURE 3 and, as the blade rises clear of the blank, a spring **48** rotates the blade about its pivot **49** until an arm **50**, carrying the blade, meets a stop **51** and the blade and arm **42** rotate as shown in chain lines.

The bar **21**, FIGURE 6, is fixed to a bar **52** which is fixed to a link **52A**, which is pivoted at one end to a crank **53** fixed to a uniformly rotating shaft **54**. The link **52A** is also pivoted to a link **65** pivoted at **56**. There is thus provided a four-bar mechanism, the fourth bar being the distance between pivot **56** and the centre of shaft **55**.

The bar **21** is caused to move through the path shown in chain lines, and ahead of the blank after the folding is done, and to return to its operative position beneath the blank path. The three-armed member **57** is fixed to a rotatable shaft **58** but this is driven by the gearing shown from a four-bar mechanism arranged below the path of the blank. A uniformly rotating crank **59** is connected by a link **60** to a further crank **61** on a shaft **62** to which is fixed a small gear wheel **63**. This provides another four-bar mechanism, the fourth bar being the distance between the shaft **62** and the crank centre of crank **59**. The small gear **63** drives the three-armed member through the gearing shown with a gear reduction of one to three.

The pitch between the devices R and F is constant and so, as various lengths of blank are dealt with, the radial position of the blades **19** and **23** is adjusted so that the blades meet the blank in the necessary timed relationship. Similarly, the mechanism driving the bars **17** and **21** is re-timed so that these contact the blanks at the proper times.

The invention so far described would serve for any carton folding where it is desired to fold front and rear flaps in the manner described and any further treatment would depend on the nature of the carton being made and how its walls were to be joined to one another. In the present case the blank, FIGURE 2, is for making up into a collapsed tray and for this purpose it is necessary to fold the triangular ears **3A** so that their printed side is pressed down on to the printed side of the flaps **3**. The ear folding is performed by fixed folders shown in FIGURES 7

to 9. In FIGURE 7 only the folders for one side of the blank are shown, as the others are identical and symmetrical about the broken line in the figure, which is the centre of the path along which the blank moves. As the rear flap is beginning to fold and approaching 90° with respect to the main panel, the ear **3A** strikes an angular folder **64** on its corner and the continued movement of the blank and the obstruction by said folder causes the ear on said flap to bend backwards about the crease line shown in FIGURE 2. As the movement continues, the parts folded on the crease line close to a narrow **V** and the folded flap can then run under a strip **165**, which holds it down. The action is supplemented by a plate **66** which is wide enough to hold down the ear and a considerable part of the flap **3**. In FIGURE 9, which is a section on line **9—9**, FIGURE 7, the plate **66** is shown as curving upwards. This is because the ear is still sticking upwards, at its edge remote from strip **165**, which only engages the extreme lower corner of the ear. At this stage the neighbouring part of the main panel is supported by the belt **31** so the folding is effective and the bending of these two ears helps to hold the flap **3**, to which they are attached, close to the main panel. The middle of the panel is supported by a bar **69**.

The ears **3A** on the front flap are folded as the front flap begins to run under a curved strip **67** which is spaced at **68** from the end of strip **165**. At this position, the front flap is being turned up by the bar **21**, as previously explained, and as the ear is held under strip **67**, it begins to bend about the crease into an acute angle so that its printed face approaches the printed face of the flap **3**. With this movement the parts of the flap and ear forming said acute angle project up through the space **68** and as flap **3** in bent more and more and the blank is of course moving, the folded ear goes under strip **67** and is thus confined. As the blank continues to move on, the flaps and ears are held down by strips mounted above the path of the blank, but these are not shown as they obscure the parts referred to.

When the whole blank thus folded has passed beyond the device at F in FIGURE 1B, the folding operations by the devices described are finished and the completion of the operations on the carton may take place on conventional lines. The blank therefore continues on its path and the flaps **2** and **4** have adhesive applied to them by a device exactly like the one shown at **14**. The adhesive is applied to the upper face of the folded flaps **2** and **4**. This face is, in fact, part of the aforesaid printed face but the flaps are of course left uprinted so that they take the adhesive properly. Then the flaps **7** and **8** are folded over by ploughshare folders through 180° and pressed down to cause the flaps **2** and **4** to adhere to the ears **3A**. The product is a collapsed tray which can be opened by pulling up the folded flaps and the whole operations have been conducted while the blank is moving along a straight path.

If, however, the nature of the blank is such that conventional folding devices are not satisfactory for these final folding operations, the blank may be fed through the same sort of folding apparatus as already described, either by having a machine of this kind disposed at right angles to the one described, or by having it in line therewith, with an intermediate device for rotating the partly folded blank through a right angle.

FIGURE 10 shows a blank in which flaps **28** are to be folded over on to the other parts on the line XY and when that has been done the triangular flaps **29** shown

hatched will lie on a panel **30** and are stuck to the panel by adhesive applied to the flaps. The flaps are hatched to indicate adhesive, although it could be put on the panel. This adhesive has to be applied before any folding is done so in this case the gluing device **14** is used, the remaining operations being carried on as before.

What I claim as my invention and desire to secure by Letters Patent is:

1. In a carton-making machine of the kind comprising means for continuously moving along a straight path a flat carton blank having a main panel to which flaps are attached and which is positioned with respect to said means such that front and rear flaps are located at each end of the panel, as considered in the direction of movement, and individual means for folding each flap on a line substantially at right angles to said direction of movement, the improvement in said folding means consisting of a rigid blade having a straight edge about which said flap is folded, means for moving the blade to position said edge on the line about which the flap is to be folded, means for keeping the edge on the line, and means for moving the blade away from the line after said flap has been folded through an angle sufficient to define the bending line accurately and sharptly, a bar for folding said flap, means for moving sid bar in a closed path to engage said flap and move it bodily in a rotational movement about said edge such that all parts of the flap execute the same angular movement simultaneously, said means for moving each blade and bar comprising variable velocity gearing, whereby the blade appertaining to said rear flap is accelerated to a speed greater than that of said blank as said blade is moved away from its line and said blade appertaining to the front flap is decelerated to a speed less than the speed of the blade as said blade is moved away from its line.

2. In a carton-making machine of the kind comprising means for continuously moving along a straight path a series of flat carton blanks each having a main panel to which a flap is attached at the leading end, as considered in the direction of movement, means for folding each flap on a line substantially at right angles to said direction of movement, the improvement in said folding means consisting of a plurality of rigid blades secured equidistant about a rotatable shaft, each of said blades having a straight edge about which a flap is folded, means for rotating said shaft at a rate such that the edges of said blades are successively positioned on a line about which a flap is to be folded and maintained on the line, and for reducing said rate of rotation to move said blade edges away from said lines after each flap has been folded through an angle sufficient to define the bending line accurately and sharply, a bar for folding each flap, means for moving said bar in a closed path to engage each of said flaps and move them bodily in a rotational movement about each of said blade edges such that all parts of each flap execute the same movement simultaneously, said means for rotating said shaft and moving said bar comprising variable velocity gearing.

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