

SPECIFICATION

Title of the Invention: Corrugated paperboard box, scoreline forming method for forming scoreline in corrugated paperboard sheet, and scoreline forming device for forming scoreline in corrugated paperboard sheet

TECHNICAL FIELD

[0001]

The present invention relates to a corrugated paperboard box, a scoreline forming method for forming a scoreline in a corrugated paperboard sheet, and a scoreline forming device for forming a scoreline in a corrugated paperboard sheet.

BACKGROUND ART

[0002]

Generally, corrugated paperboard boxes include a peripheral wall formed by bending corrugated paperboard into a tubular shape, and a plurality of flaps integrally connected to one end of the peripheral wall, and are formed with a normal scoreline between the flaps and the peripheral wall such that the flaps can be smoothly bent along the normal scoreline toward the inner surface of the peripheral wall. The corrugated paperboard, of which such a corrugated paperboard box is made, comprises an outer linerboard, an inner linerboard, and a corrugated medium provided between the outer linerboard and the inner linerboard. The normal scoreline between the flaps and the peripheral wall is a groove-shaped scoreline recessed on the side of the inner linerboard (i.e., on the inner side of the box).

[0003]

When products are packed in such a corrugated paperboard box, in order to enable the products to be easily placed into the box, the flaps are bent toward the outer surface of the peripheral wall (i.e., bent in the reverse direction) in some cases. Since the normal scoreline between the flaps and the peripheral wall is a groove-shaped scoreline recessed on the side of the inner linerboard, the flaps can be smoothly bent along the normal scoreline toward the inner surface of the box. However, the flaps are less likely to be bent toward the outer surface of the box. Therefore, it is necessary to hold the flaps by hand, after bending the flaps outwardly, such that the flaps do not elastically return. Also, when completely bending the flaps outwardly such that the flaps do not return, the inner linerboard tends to break along the normal scoreline (i.e., linerboard breakage tends to occur).

[0004]

In order to overcome such problems, the below-identified Patent document 1 proposes a corrugated paperboard box including flaps and a peripheral wall, and formed at the proximal ends (roots) of the flaps with a reverse scoreline extending in parallel to a normal scoreline. The reverse scoreline is a groove-shaped scoreline recessed on the side of the outer linerboard (i.e., on the outer side of the box). If the reverse scoreline is formed, it is possible to smoothly bend the flaps along the reverse scoreline toward the outer surface of the peripheral wall, and thus to easily pack products in the box.

PRIOR ART DOCUMENT(S)

PATENT DOCUMENT(S)

[0005]

Patent document 1: Japanese Unexamined Utility Model
Application Publication No. S60-123317

SUMMARY OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0006]

However, it turned out that if a reverse scoreline as disclosed in Patent 1 is formed in a corrugated paperboard box, when the box is sealed, flaps of the box might not be accurately brought into abutment with each other.

[0007]

Namely, when a normal scoreline recessed on the side of the inner linerboard is formed in the vicinity of a reverse scoreline recessed on the side of the outer linerboard, the thickness of the corrugated paperboard between the normal and reverse scorelines decreases. Therefore, when the flaps are bent outwardly, the corrugated paperboard might not be bent accurately at the center of the reverse scoreline, but might be bent at a position between the normal scoreline and the reverse scoreline. Once the flaps are bent at a position between the normal scoreline and the reverse scoreline, the strength of the portion between the normal and reverse scorelines decreases, so that when the flaps are bent inwardly thereafter, the flaps are not bent accurately at the center of the normal scoreline, but are bent again at a position between the normal scoreline and the reverse scoreline. As a result thereof, after the flaps are bent outwardly, and products are placed into the box, when the flaps are bent inwardly so as to seal the box, a gap might be defined between the distal ends of the flaps.

[0008]

It is an object of the present invention to provide a corrugated paperboard box into which products can be packed easily, and in which flaps can be accurately brought into abutment with each other.

MEANS FOR SOLVING THE PROBLEMS

[0009]

In order to achieve the above object, the present invention provides a corrugated paperboard box made of corrugated paperboard comprising an outer linerboard, an inner linerboard, and a corrugated medium provided between the outer linerboard and the inner linerboard, the corrugated paperboard box comprising: a peripheral wall formed by bending the corrugated paperboard into a tubular shape such that the inner linerboard constitutes an inner surface of the corrugated paperboard box; and flaps integrally connected to one of two ends of the peripheral wall; characterized in that the corrugated paperboard box includes: a groove-shaped normal scoreline formed between the peripheral wall and the flaps, and recessed on a side of the inner linerboard such that the flaps can be bent along the normal scoreline toward an inner surface of the peripheral wall; a groove-shaped reverse scoreline formed at a position spaced apart from the normal scoreline toward the flaps to extend in parallel to the normal scoreline, and recessed on a side of the outer linerboard such that the flaps can be bent along the reverse scoreline toward an outer surface of the peripheral wall; and a shallow scoreline extending in parallel to the reverse scoreline on an opposite side of the reverse scoreline from the normal scoreline, and recessed on the side of the inner linerboard.

[0010]

If the corrugated paperboard box is formed with the shallow scoreline on the opposite side of the reverse scoreline from the normal scoreline, when the flaps are bent toward the outer surface of the peripheral wall, the flaps are not bent at a position between the normal scoreline and the reverse scoreline, and can be bent accurately along the reverse scoreline. Therefore, after the flaps are bent outwardly, and products are placed into the box, when the flaps are bent inwardly so as to seal the box, the flaps are not bent at a position between the normal scoreline and the reverse scoreline. As a result thereof, no gap is defined between the distal ends of two of the flaps.

[0011]

It is preferable that the corrugated paperboard is further formed with a shallow reverse scoreline extending in parallel to the normal scoreline on an opposite side of the normal scoreline from the reverse scoreline, and recessed on the side of the outer linerboard.

[0012]

If the corrugated paperboard box is formed with the shallow reverse scoreline on the opposite side of the normal scoreline from the reverse scoreline, when the flaps are bent toward the inner surface of the peripheral wall, the flaps are not bent at a position between the normal scoreline and the reverse scoreline. Therefore, after the flaps are bent outwardly, and products are placed into the box, when the flaps are bent inwardly so as to seal the box, it is possible to more effectively prevent the flaps from being bent at a position between the normal scoreline and the reverse scoreline.

[0013]

As a scoreline forming method for forming a scoreline in a

corrugated paperboard sheet suitable for manufacturing the above corrugated paperboard box, the present invention provides a scoreline forming method for forming, in a corrugated paperboard sheet comprising an outer linerboard, an inner linerboard, and a corrugated medium provided between the outer linerboard and the inner linerboard, a groove-shaped normal scoreline recessed on a side of the inner linerboard; a groove-shaped reverse scoreline extending in parallel to the normal scoreline, and recessed on a side of the outer linerboard; and a shallow scoreline extending in parallel to the reverse scoreline on an opposite side of the reverse scoreline from the normal scoreline, and recessed on the side of the inner linerboard, the scoreline forming method comprising: providing: a first normal scoreline ring formed, on an outer periphery of the first normal scoreline ring, with a protrusion continuously extending in a circumferential direction, and recesses arranged on two axial sides of the protrusion, respectively; a second normal scoreline ring formed, on an outer periphery of the second normal scoreline ring, with a groove opposed to the protrusion of the first normal scoreline ring, and groove shoulders arranged on two axial sides of the groove, respectively; a first reverse scoreline ring formed, on an outer periphery of the first reverse scoreline ring, with a groove, and groove shoulders arranged on two axial sides of the groove of the first reverse scoreline ring, respectively; and a second reverse scoreline ring formed, on an outer periphery of the second reverse scoreline ring, with a protrusion opposed to the groove of the first reverse scoreline ring, and continuously extending in the circumferential direction, and recesses arranged on two axial sides of the protrusion of the second reverse scoreline ring, respectively; arranging the first normal scoreline ring and the first reverse scoreline ring on the side of the inner linerboard, and the second

normal scoreline ring and the second reverse scoreline ring on the side of the outer linerboard such that the first and second reverse scoreline rings are located on either an upstream or downstream side of the first and second normal scoreline rings, and such that a position of the protrusion of the first normal scoreline ring corresponds to a position of one of the groove shoulders of the first reverse scoreline ring, and a position of the protrusion of the second reverse scoreline ring corresponds to a position of one of the groove shoulders of the second normal scoreline ring; sandwiching the corrugated paperboard sheet between the first and second normal scoreline rings such that the groove-shaped normal scoreline is formed by being sandwiched between the protrusion of the first normal scoreline ring and the groove of the second normal scoreline ring; and sandwiching the corrugated paperboard sheet between the first and second reverse scoreline rings such that the groove-shaped reverse scoreline is formed by being sandwiched between the groove of the first reverse scoreline ring and the protrusion of the second reverse scoreline ring, and the shallow scoreline is formed by being sandwiched between one of the groove shoulders of the first reverse scoreline ring and a corresponding one of the recesses of the second reverse scoreline ring.

[0014]

If this method is used, when the corrugated paperboard sheet is sandwiched between the first and second normal scoreline rings, the portion of the sheet in which the reverse scoreline has been formed or is to be formed is compressed between one of the recesses of the first normal scoreline ring and the corresponding groove shoulder of the second normal scoreline ring, so that this portion is effectively collapsed. Also, when the corrugated paperboard sheet is sandwiched between the first and second

reverse scoreline rings, the portion of the sheet in which the normal scoreline has been formed or is to be formed is compressed between one of the groove shoulders of the first reverse scoreline ring and the corresponding recess of the second reverse scoreline ring, so that this portion is effectively collapsed.

[0015]

Also, by use of the scoreline forming method, when the corrugated paperboard sheet is sandwiched between the first and second normal scoreline rings, a shallow reverse scoreline extending in parallel to the normal scoreline, and recessed on the side of the outer linerboard may be formed in the corrugated paperboard sheet on an opposite side of the normal scoreline from the reverse scoreline, by being sandwiched between one of the recesses of the first normal scoreline ring and a corresponding one of the groove shoulders of the second normal scoreline ring.

[0016]

The scoreline forming method may comprise: arranging, instead of the first and second normal scoreline rings and the first and second reverse scoreline rings, a pair of special scoreline rings on the side of the inner linerboard and on the side of the outer linerboard, respectively; and sandwiching, with the pair of special scoreline rings, the corrugated paperboard sheet such that the groove-shaped normal scoreline, the groove-shaped reverse scoreline, the shallow scoreline, and the shallow reverse scoreline are simultaneously formed in the corrugated paperboard sheet.

[0017]

By using the special scoreline rings, it is possible to accurately control the relative positional relationship of the normal scoreline, the

reverse scoreline, the shallow scoreline and the shallow reverse scoreline, and also to prevent the separation of the outer linerboard and the inner linerboard of the corrugated paperboard sheet from the corrugated medium. [0018]

As a scoreline forming device for forming a scoreline in a corrugated paperboard sheet suitable for manufacturing the above corrugated paperboard box, the present invention provides a scoreline forming device for forming, in a corrugated paperboard sheet comprising an outer linerboard, an inner linerboard, and a corrugated medium provided between the outer linerboard and the inner linerboard, a groove-shaped normal scoreline recessed on a side of the inner linerboard; a groove-shaped reverse scoreline extending in parallel to the normal scoreline, and recessed on a side of the outer linerboard; and a shallow scoreline extending in parallel to the reverse scoreline on an opposite side of the reverse scoreline from the normal scoreline, and recessed on the side of the inner linerboard, the scoreline forming device comprising: a first normal scoreline ring arranged on the side of the inner linerboard, and formed, on an outer periphery of the first normal scoreline ring, with a protrusion continuously extending in a circumferential direction, and recesses arranged on two axial sides of the protrusion, respectively; a second normal scoreline ring arranged on the side of the outer linerboard, and formed, on an outer periphery of the second normal scoreline ring, with a groove opposed to the protrusion of the first normal scoreline ring, and groove shoulders arranged on two axial sides of the groove, respectively; a first reverse scoreline ring arranged on the side of the inner linerboard, and formed, on an outer periphery of the first reverse scoreline ring, with a groove, and groove shoulders arranged on two axial sides of the groove of the first reverse

scoreline ring, respectively; and a second reverse scoreline ring arranged on the side of the outer linerboard, and formed, on an outer periphery of the second reverse scoreline ring, with a protrusion opposed to the groove of the first reverse scoreline ring, and continuously extending in the circumferential direction, and recesses arranged on two axial sides of the protrusion of the second reverse scoreline ring, respectively; wherein the first and second reverse scoreline rings are arranged on either an upstream or downstream side of the first and second normal scoreline rings such that a position of the protrusion of the first normal scoreline ring corresponds to a position of one of the groove shoulders of the first reverse scoreline ring, and a position of the protrusion of the second reverse scoreline ring corresponds to a position of one of the groove shoulders of the second normal scoreline ring, wherein the first and second normal scoreline rings are configured to sandwich the corrugated paperboard sheet between the protrusion of the first normal scoreline ring and the groove of the second normal scoreline ring so as to form the groove-shaped normal scoreline, and wherein the first and second reverse scoreline rings are configured to: sandwich the corrugated paperboard sheet between the groove of the first reverse scoreline ring and the protrusion of the second reverse scoreline ring so as to form the groove-shaped reverse scoreline; and sandwich the corrugated paperboard sheet between one of the groove shoulders of the first reverse scoreline ring and a corresponding one of the recesses of the second reverse scoreline ring so as to form the shallow scoreline.

[0019]

If this device is used, when the corrugated paperboard sheet is sandwiched between the first and second normal scoreline rings, the portion of the sheet in which the reverse scoreline has been formed or is to

be formed is compressed between one of the recesses of the first normal scoreline ring and the corresponding groove shoulder of the second normal scoreline ring, so that this portion is effectively collapsed. Therefore, it is possible to form a reverse scoreline along which the flaps can be bent stably and accurately. Also, when the corrugated paperboard sheet is sandwiched between the first and second reverse scoreline rings, the portion of the sheet in which the normal scoreline has been formed or is to be formed is compressed between one of the groove shoulders of the first reverse scoreline ring and the corresponding recess of the second reverse scoreline ring, so that this portion is effectively collapsed. Therefore, it is possible to form a normal scoreline along which the flaps can be bent stably and accurately.

[0020]

The first and second normal scoreline rings may be configured to sandwich the corrugated paperboard sheet between one of the recesses of the first normal scoreline ring and a corresponding one of the groove shoulders of the second normal scoreline ring so as to form in the corrugated paperboard sheet a shallow reverse scoreline extending in parallel to the normal scoreline on an opposite side of the normal scoreline from the reverse scoreline, and recessed on the side of the outer linerboard.

[0021]

For example, the above scoreline forming device may be provided in a midway portion of a corrugator configured to manufacture the corrugated paperboard sheet. In this case, the first and second normal scoreline rings, and the first and second reverse scoreline rings are provided as a part of a scorer configured to form the normal scoreline in the corrugated paperboard sheet, which continuously extends in a strip shape in a corrugator.

[0022]

For example, the above scoreline forming device may be provided in a cutting machine configured to cut a cut sheet cut off from the corrugated paperboard sheet by the corrugator. In this case, the first and second normal scoreline rings, and the first and second reverse scoreline rings are provided as a part of a cutting machine configured to cut, to a predetermined width size, a cut sheet cut off from the corrugated paperboard sheet.

[0023]

The above scoreline forming device may comprise, instead of the first and second normal scoreline rings and the first and second reverse scoreline rings, a pair of special scoreline rings arranged on the side of the inner linerboard and on the side of the outer linerboard, respectively, and configured to sandwich the corrugated paperboard sheet so as to simultaneously form the groove-shaped normal scoreline, the groove-shaped reverse scoreline, the shallow scoreline, and the shallow reverse scoreline.

[0024]

By using the special scoreline rings, it is possible to accurately control the relative positional relationship of the normal scoreline, the reverse scoreline, the shallow scoreline and the shallow reverse scoreline, and also to prevent the separation of the outer linerboard and the inner linerboard of the corrugated paperboard sheet from the corrugated medium.

EFFECTS OF THE INVENTION

[0025]

Since the corrugated paperboard box according to the present

invention is formed with the groove-shaped reverse scoreline recessed on the side of the outer linerboard such that the flaps can be bent along the reverse scoreline toward the outer surface of the peripheral wall, it is possible to easily pack products into the box. Also, since the corrugated paperboard box is formed with the shallow scoreline on the opposite side of the reverse scoreline from the normal scoreline, when the flaps are bent toward the outer surface of the peripheral wall, the flaps are not bent at a position between the normal scoreline and the reverse scoreline, and can be bent accurately along the reverse scoreline. Therefore, after the flaps are bent outwardly, and products are placed into the box, when the flaps are bent inwardly so as to seal the box, the flaps are not bent at a position between the normal scoreline and the reverse scoreline. As a result thereof, it is possible to accurately bring two of the flaps into abutment with each other.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026]

Fig. 1 is a view of a blank of a corrugated paperboard box according to an embodiment of the present invention, when seen from the side of the outer linerboard (of the blank).

Fig. 2 is an enlarged view illustrating the vicinity of a normal scoreline and a reverse scoreline formed between the top flaps and the side panels of the blank illustrated in Fig. 1.

Fig. 3 is an enlarged sectional view taken along line III-III of Fig. 2.

Fig. 4 is a perspective view of the corrugated paperboard box which has been constructed from the blank of Fig. 1, but of which the top flaps have not been bent yet.

Fig. 5 is a perspective view of the corrugated paperboard box in which the top flaps illustrated in Fig. 4 have been bent toward the outer surface of the peripheral wall (of the box), and in which products have been placed.

Fig. 6 is a perspective view of the corrugated paperboard box, the perspective view illustrating the process of bending the top flaps of Fig. 5 toward the inner surface of the peripheral wall.

Fig. 7 is a perspective view of the corrugated paperboard box which has been sealed by closing the upper end opening of the peripheral wall with the top flaps of Fig. 6.

Fig. 8 is a sectional view taken along line VIII-VIII of Fig. 5.

Fig. 9 is a sectional view taken along line IX-IX of Fig. 6.

Fig. 10 is a sectional view of a corrugator suitable for manufacturing a corrugated paperboard sheet from which the blank of Fig. 1 is formed, the sectional view illustrating the slitter scorer of the corrugator.

Fig. 11 is a partially enlarged sectional view illustrating the axial relative positional relationship of the reverse scoreline rings and the normal scoreline rings illustrated in Fig. 10.

Fig. 12 is a sectional view illustrating a slitter scorer different from the slitter scorer illustrated in Fig. 10.

Fig. 13 is a partially enlarged sectional view illustrating the axial relative positional relationship of, with the reverse scoreline rings and the normal scoreline rings of Fig. 10 reversed such that the normal scoreline rings are arranged on the upstream side of the reverse scoreline rings, the reverse scoreline rings and the normal scoreline rings.

Fig. 14 is a partially enlarged sectional view of the normal scoreline rings used in an experiment.

Fig. 15 is a partially enlarged sectional view schematically illustrating special scoreline rings which are, respectively, a combination of the upper reverse scoreline ring and the upper normal scoreline ring illustrated in Fig. 11, and a combination of the lower reverse scoreline ring and the lower normal scoreline ring illustrated in Fig. 11.

Fig. 16 is a sectional view of a scoreline forming device provided as a part of a cutting machine configured to cut, to a predetermined width size, a cut sheet cut off from the corrugated paperboard sheet.

Fig. 17 is an enlarged sectional view illustrating a comparative example in which the shallow scoreline and the shallow reverse scoreline illustrated in Fig. 3 are not formed, and only the normal scoreline and the reverse scoreline are formed.

BEST MODE FOR CARRYING OUT THE INVENTION

[0027]

Fig. 1 illustrates a blank of a corrugated paperboard box 30 according to the embodiment of the present invention. The blank is made of corrugated paperboard including an outer linerboard 1, an inner linerboard 2, and a corrugated medium 3 provided between the outer linerboard 1 and the inner linerboard 2. The blank includes quadrangular side panels 5, 6, 7 and 8 which are integrally connected one to another through respective scorelines 4 extending in the direction parallel to the corrugations of the corrugated paperboard, and a joint flap 10 integrally connected through a scoreline 9 to the side edge of the side panel 8, located at one end portion of the blank. When the corrugated paperboard box 30 is constructed from the blank, the side panels 5, 6, 7 and 8 constitute the peripheral wall 31 (see Fig. 4) of the corrugated paperboard box 30.

[0028]

The blank of the corrugated paperboard box 30 further includes top flaps 11, 12, 13 and 14 integrally connected to the respective upper edges of the side panels 5, 6, 7 and 8. A normal scoreline 15 is formed between the side panels 5, 6, 7 and 8 and the top flaps 11, 12, 13 and 14 to extend in the direction perpendicular to the corrugations of the corrugated paperboard such that the top flaps 11, 12, 13 and 14 can be bent inwardly along the normal scoreline 15.

[0029]

A reverse scoreline 16 is formed at the proximal end portions (roots) of the top flaps 11, 12, 13 and 14 (i.e., at the end portions thereof close to the normal scoreline 15) such that the top flaps 11, 12, 13 and 14 can be bent outwardly along the reverse scoreline 16. The reverse scoreline 16 extends in parallel to the normal scoreline 15, and thus, in the direction perpendicular to the corrugations of the corrugated paperboard, while spaced apart from the normal scoreline 15 toward the top flaps 11, 12, 13 and 14. The top flaps 11, 12, 13 and 14 are separated from each other by slits 17 formed between the respective adjacent pairs of top flaps 11, 12, 13 and 14, and extending in the direction parallel to the corrugations of the corrugated paperboard.

[0030]

The blank of the box 30 further includes bottom flaps 18, 19, 20 and 21 integrally connected to the respective lower edges of the side panels 5, 6, 7 and 8. A scoreline 22 is formed between the side panels 5, 6, 7 and 8 and the bottom flaps 18, 19, 20 and 21 to extend in the direction perpendicular to the corrugations of the corrugated paperboard such that the bottom flaps 18, 19, 20 and 21 can be bent inwardly. The bottom flaps 18, 19, 20 and 21

are separated from each other by slits 23 formed between the respective adjacent pairs of bottom flaps 18, 19, 20 and 21, and extending in the direction parallel to the corrugations of the corrugated paperboard.

[0031]

As illustrated in Figs. 2 and 3, the normal scoreline 15 is a groove-shaped scoreline recessed on the side of the inner linerboard 2 so that the top flaps 11, 12, 13 and 14 can be bent along the normal scoreline 15 toward the inner linerboard 2. On the other hand, the reverse scoreline 16 is a groove-shaped scoreline recessed on the side of the outer linerboard 1 so that the top flaps 11, 12, 13 and 14 can be bent along the reverse scoreline 16 toward the outer linerboard 1.

[0032]

As illustrated in Fig. 3, a shallow scoreline 24 extends in parallel to the reverse scoreline 16 on the opposite side of the reverse scoreline 16 from the normal scoreline 15. The shallow scoreline 24 is a weakly compressed line recessed on the side of the inner linerboard 2 so as to be shallower than the normal scoreline 15. A shallow reverse scoreline 25 extends in parallel to the normal scoreline 15 on the opposite side of the normal scoreline 15 from the reverse scoreline 16. The shallow reverse scoreline 25 is a weakly compressed line recessed on the side of the outer linerboard 1 so as to be shallower than the reverse scoreline 16.

[0033]

The reverse scoreline 16 is arranged such that the distance between the center of the normal scoreline 15 and the center of the reverse scoreline 16 is 3 mm or more and 7 mm or less. The shallow scoreline 24 is arranged such that the distance between the center of the reverse scoreline 16 and the center of the shallow scoreline 24 is 2 mm or more and 6 mm or less. The

shallow reverse scoreline 25 is arranged such that the distance between the center of the normal scoreline 15 and the center of the shallow reverse scoreline 25 is 2 mm or more and 6 mm or less. The centers of the normal scoreline 15 and the shallow scoreline 24 are each located at the deepest portion of the scoreline 15, 24, as measured from the surface of the inner linerboard 2. The centers of the reverse scoreline 16 and the shallow reverse scoreline 25 are each located at the deepest portion of the reverse scoreline 16, 25, as measured from the surface of the outer linerboard 1.

[0034]

For example, the blank illustrated in Fig. 1 can be formed into the box 30 as described below.

[0035]

As illustrated in Fig. 4, first, the side panels 5, 6, 7 and 8 are bent along the respective scorelines 4 into a tubular shape such that the inner linerboard 2 is inside of the corrugated paperboard box 30, and the joint flap 10, integrally connected to the side panel 8 at one end of the blank, is bonded to the inner surface of the side panel 5 at the other end of the blank so that the side panels 5, 6, 7 and 8 constitute the peripheral wall 31. Second, the bottom flaps 18 and 20, which are integrally connected to the respective lower edges of the side panels 5 and 7, which correspond to or constitute the widthwise surfaces of the box 30, are bent along the scoreline 22 toward the inner surface of the peripheral wall 31, and the bottom flaps 19 and 21, which are integrally connected to the respective lower edges of the side panels 6 and 8, which correspond to or constitute the lengthwise surfaces of the box 30, are bent along the scoreline 22 toward the inner surface of the peripheral wall 31 so that the bottom flaps 18, 19, 20 and 21 constitute a bottom 32 which closes the lower end opening of the peripheral

wall 31. The distance between the normal scoreline 15 and the reverse scoreline 16 is shown exaggeratedly, i.e., shown to be larger than the actual size.

[0036]

In this state, products 33 (see Fig. 5) are packed in the corrugated paperboard box 30. At this time, if the top flaps 11, 12, 13 and 14 extend upright at a higher level than the peripheral wall 31 as illustrated in Fig. 4, the top flaps 11, 12, 13 and 14 will make it difficult, though not impossible, to place the products 33 into the box 30 especially by hand.

[0037]

Therefore, in order to enable products 33 to be easily placed into the corrugated paperboard box 30, the top flaps 11, 12, 13 and 14 are bent toward the outer surface of the peripheral wall 31 (i.e., bent in the reverse direction) as illustrated in Fig. 5. The normal scoreline 15 has the following characteristic: Since the normal scoreline 15 is a groove-shaped scoreline recessed on the side of the inner linerboard 2, the top flaps 11, 12, 13 and 14 can be bent smoothly along the normal scoreline 15 toward the inner linerboard 2, whereas a relatively large force is required to bend the top flaps 11, 12, 13 and 14 along the normal scoreline 15 toward the outer linerboard 1. On the other hand, the reverse scoreline 16 has the following characteristic: Since the reverse scoreline 16 is a groove-shaped scoreline recessed on the side of the inner linerboard 1, the top flaps 11, 12, 13 and 14 can be bent smoothly along the reverse scoreline 16 toward the outer linerboard 1, whereas a relatively large force is required to bend the top flaps 11, 12, 13 and 14 along the reverse scoreline 16 toward the inner linerboard 2. Therefore, when the top flaps 11, 12, 13 and 14 are bent toward the outer surface of the peripheral wall 31, the top flaps 11, 12, 13

and 14 are bent not along the normal scoreline 15 but along the reverse scoreline 16 (see Fig. 8).

[0038]

Though all of the top flaps 11, 12, 13 and 14 are bent toward the outer linerboard 1 in Fig. 5, only any one of the top flaps 11, 12, 13 and 14 (e.g., the one in front of a user packing products in the box) may be bent toward the outer linerboard 1.

[0039]

Thereafter, as illustrated in Figs. 6 and 7, the top flaps 11 and 13 are bent along the normal scoreline 15 toward the inner surface of the peripheral wall 31, and the top flaps 12 and 14 are bent along the normal scoreline 15 toward the inner surface of the peripheral wall 31. When the top flaps 11, 12, 13 and 14 are bent toward the inner surface of the peripheral wall 31 (i.e., bent in the normal direction), due to the above characteristics of the normal scoreline 15 and the reverse scoreline 16, the top flaps 11, 12, 13 and 14 are bent not along the reverse scoreline 16 but along the normal scoreline 15 (see Fig.9). Thereafter, the box is sealed by fixing the top flaps 12 and 14 in position by a fixing means (not shown) such as an adhesive tape, a stapler, or hot-melt adhesive.

[0040]

When the normal scoreline 15, recessed on the side of the inner linerboard 2, is formed in the vicinity of the reverse scoreline 16, recessed on the side of the outer linerboard 1, the thickness of the corrugated paperboard between the normal and reverse scorelines 15 and 16 decreases. Therefore, if only the normal scoreline 15 and the reverse scoreline 16 are formed in corrugated paperboard, and the shallow scoreline 24 and the shallow reverse scoreline 25 are not formed in the corrugated paperboard as

illustrated in Fig.17, when the top flap 11 is bent toward the inner linerboard 1, the corrugated paperboard might not be bent accurately at the center of the reverse scoreline 16, but might be bent at a position between the normal scoreline 15 and the reverse scoreline 16 (e.g., at the position shown by line K in Fig. 17). Once the top flap 11 is bent at a position between the normal scoreline 15 and the reverse scoreline 16, the strength of the portion between the normal and reverse scorelines 15 and 16 decreases, so that when the top flap 11 is bent toward the inner linerboard 2 thereafter, the top flap 11 is not bent accurately at the center of the normal scoreline 15, but bent again at a position between the normal scoreline 15 and the reverse scoreline 16.

[0041]

In contrast thereto, since, as illustrated in Fig. 3, the corrugated paperboard box 30 of this embodiment is formed with the shallow scoreline 24 on the opposite side of the reverse scoreline 16 from the normal scoreline 15, the area between the reverse scoreline 16 and the shallow scoreline 24 is as thin as the area between the normal scoreline 15 and the reverse scoreline 16. Therefore, when the top flaps 11, 12, 13 and 14 are bent toward the outer surface of the peripheral wall 31 as illustrated in Fig. 5, it is possible to prevent the top flaps 11, 12, 13 and 14 from being bent at a position between the normal scoreline 15 and the reverse scoreline 16, and thus to accurately bend the top flaps 11, 12, 13 and 14 along the reverse scoreline 16. Since the corrugated paperboard box 30 is also formed with the shallow reverse scoreline 25 on the opposite side of the normal scoreline 15 from the reverse scoreline 16, the area between the normal scoreline 15 and the shallow reverse scoreline 25 is as thin as the area between the normal scoreline 15 and the reverse scoreline 16. Therefore, when the top

flaps 11, 12, 13 and 14 are bent toward the inner surface of the peripheral wall 31, it is possible to prevent the top flaps 11, 12, 13 and 14 from being bent at a position between the normal scoreline 15 and the reverse scoreline 16, and thus to accurately bend the top flaps 11, 12, 13 and 14 along the normal scoreline 15.

[0042]

Since, as described above, this corrugated paperboard box 30 is formed with a groove-shaped reverse scoreline 16 recessed on the side of the inner linerboard 1 such that the top flaps 11, 12, 13 and 14 can be bent along the reverse scoreline 16 toward the outer surface of the peripheral wall 31, it is possible to easily pack products 33 in the box. Since this corrugated paperboard box 30 is also formed with the shallow scoreline 24 on the opposite side of the reverse scoreline 16 from the normal scoreline 15, when the top flaps 11, 12, 13 and 14 are bent toward the outer surface of the peripheral wall 31, it is possible to prevent the top flaps 11, 12, 13 and 14 from being bent at a position between the normal scoreline 15 and the reverse scoreline 16, and thus to accurately bend the top flaps 11, 12, 13 and 14 along the reverse scoreline 16. Therefore, after the top flaps 11, 12, 13 and 14 are bent outwardly, and products 33 are placed into the box, when the top flaps 11, 12, 13 and 14 are bent inwardly so as to seal the box, it is possible to prevent the top flaps 11, 12, 13 and 14 from being bent at a position between the normal scoreline 15 and the reverse scoreline 16, so that no gap is defined between the distal edges of the top flaps 12 and 14. Therefore, it is possible to accurately bring the top flaps 12 and 14 into abutment with each other.

[0043]

Since this corrugated paperboard box 30 is also formed with the

shallow reverse scoreline 25 on the opposite side of the normal scoreline 15 from the reverse scoreline 16, when the top flaps 11, 12, 13 and 14 are bent toward the inner surface of the peripheral wall 31, it is possible to prevent the top flaps 11, 12, 13 and 14 from being bent at a position between the normal scoreline 15 and the reverse scoreline 16. Therefore, after the top flaps 11, 12, 13 and 14 are bent outwardly, and products 33 are placed into the box, when the top flaps 11, 12, 13 and 14 are bent inwardly so as to seal the box, it is possible to more effectively prevent the top flaps 11, 12, 13 and 14 from being bent at a position between the normal scoreline 15 and the reverse scoreline 16.

[0044]

A corrugator is now described which is suitable for manufacturing a corrugated paperboard sheet from which the corrugated paperboard box 30 of the above embodiment is formed. The corrugator includes, from the upstream side toward the downstream side, a single facer (not shown), a double facer (not shown), a slitter scorer 40 (see Fig. 10), and a cut-off device (not shown). The single facer is a device configured to corrugate a corrugating medium into a corrugated medium 3, and bond an inner linerboard 2 to the corrugated medium 3 so as to form a single-faced corrugated paperboard sheet. The double facer is a device configured to bond an outer linerboard 1 to the single-faced corrugated paperboard sheet fed/conveyed from the single facer so as to form a strip-shaped double-faced corrugated paperboard sheet continuously extending in the conveying direction (direction in which the paperboard sheet is conveyed) (this double-faced corrugated paperboard sheet is hereinafter referred to as the "corrugated paperboard sheet"). The cut-off device is configured to cut the corrugated paperboard sheet in the direction orthogonal to the conveying

direction into individual sheets. In the corrugator, the corrugated paperboard sheet is conveyed with the outer linerboard 1 positioned under the inner linerboard 2.

[0045]

As illustrated in Fig. 10, the slitter scorer 40 includes a scorer 41 and a slitter 42. The scorer 41 includes a rotary shaft 51 arranged over the corrugated paperboard sheet 43, a rotary shaft 52 arranged under the corrugated paperboard sheet 43, a normal scoreline ring 53 fixed to the upper rotary shaft 51, and a normal scoreline ring 54 fixed to the lower rotary shaft 52. The scorer 41 is configured to sandwich the corrugated paperboard sheet 43 between the upper normal scoreline ring 53 and the lower normal scoreline ring 54.

[0046]

As illustrated in Fig. 11, the upper normal scoreline ring 53 is formed on its outer periphery with a protrusion 55 continuously extending circumferentially over the entire circumference of the ring 53, and recesses 56 arranged on the respective axial sides of the protrusion 55. The lower normal scoreline ring 54 is formed on its outer periphery with a groove 57 opposed to the protrusion 55 of the upper ring 53, and groove shoulders 58 arranged on the respective axial sides of the groove 57. The scorer 41 sandwiches the corrugated paperboard sheet 43 between the protrusion 55 of the upper normal scoreline ring 53 and the groove 57 of the lower normal scoreline ring 54, thereby forming in the corrugated paperboard sheet 43 a normal scoreline 15 (see Fig. 3) recessed on the upper side of the paperboard sheet 43 (i.e., on the side of the inner linerboard 2).

[0047]

As illustrated in Fig. 10, the scorer 41 further includes a reverse

scoreline forming device 44. The reverse scoreline forming device 44 includes a rotary shaft 61 arranged over the corrugated paperboard sheet 43, a rotary shaft 62 arranged under the corrugated paperboard sheet 43, a reverse scoreline ring 63 fixed to the upper rotary shaft 61, and a reverse scoreline ring 64 fixed to the lower rotary shaft 62. The reverse scoreline forming device 44 is configured to sandwich, on the upstream side of the normal scoreline rings 53 and 54, the corrugated paperboard sheet 43 between the upper reverse scoreline ring 63 and the lower reverse scoreline ring 64.

[0048]

As illustrated in Fig. 11, the lower reverse scoreline ring 64 is formed on its outer periphery with a protrusion 65 continuously extending circumferentially over the entire circumference of the ring 64, and recesses 66 arranged on the respective axial sides of the protrusion 65. The upper reverse scoreline ring 63 is formed on its outer periphery with a groove 67 opposed to the protrusion 65 of the lower scoreline ring 64, and groove shoulders 68 arranged on the respective axial sides of the groove 67. The reverse scoreline forming device 44 sandwiches the corrugated paperboard sheet 43 between the groove 67 of the upper reverse scoreline ring 63 and the protrusion 65 of the lower reverse scoreline ring 64, thereby forming in the corrugated paperboard sheet 43 a reverse scoreline 16 (see Fig. 3) recessed on the lower side of the paperboard sheet 43 (i.e., on the side of the outer linerboard 1).

[0049]

The upper and lower normal scoreline rings 53 and 54, and the upper and lower reverse scoreline rings 63 and 64 are arranged such that the position of the protrusion 55 of the upper normal scoreline ring 53

corresponds to that of one of the groove shoulders 68 of the upper reverse scoreline ring 63, and such that the position of the protrusion 65 of the lower reverse scoreline ring 64 corresponds to that of one of the groove shoulders 58 of the lower normal scoreline ring 54. In particular, the rings 53, 54, 63 and 64 are arranged such that when the corrugated paperboard sheet 43 passes between the reverse scoreline rings 63 and 64, and then passes between the normal scoreline rings 53 and 54, the portion of the corrugated paperboard sheet 43 that has passed along the one groove shoulder 68 of the reverse scoreline ring 63 passes along the protrusion 55 of the normal scoreline ring 53, and the portion of the corrugated paperboard sheet 43 that has passed along the protrusion 65 of the reverse scoreline ring 64 passes along the one groove shoulder 58 of the normal scoreline ring 54.

[0050]

The sizes of the gaps between the groove shoulders 68 of the upper reverse scoreline ring 63 and the respective recesses 66 of the lower reverse scoreline ring 64 are determined such that the shallow scoreline 24 (see Fig. 3) is formed by sandwiching the corrugated paperboard sheet 43 between the groove shoulders 68 of the upper reverse scoreline ring 63 and the recesses 66 of the lower reverse scoreline ring 64. The sizes of the gaps between the recesses 56 of the upper normal scoreline ring 53 and the respective groove shoulders 58 of the lower normal scoreline ring 54 are determined such that the shallow reverse scoreline 25 (see Fig. 3) is formed by sandwiching the corrugated paperboard sheet 43 between the recesses 56 of the upper normal scoreline ring 53 and the groove shoulders 58 of the lower normal scoreline ring 54.

[0051]

The normal scoreline rings 53 and 54, and the reverse scoreline rings 63 and 64 are arranged to satisfy the following formula:

$$1/2a - 1/2c \leq x \leq 1/2a + b + 1/2c$$

, where "x" is the amount by which the center of the protrusion 55 of the normal scoreline ring 53 is axially displaced from the center of the protrusion 65 of the reverse scoreline ring 64, "a" is the width of the groove 57 of the normal scoreline ring 54, "b" is the width of the groove shoulders 58 of the normal scoreline ring 54, and "c" is the width of the protrusion 65 of the reverse scoreline ring 64.

[0052]

As illustrated in Fig. 10, the reverse scoreline forming device 44 further includes a driving device 45 configured to move up and down the upper reverse scoreline ring 63. The driving device 45 moves up the upper reverse scoreline ring 63 when no reverse scoreline 16 needs to be formed in the corrugated paperboard sheet 43, and moves down the upper reverse scoreline ring 63 when the reverse scoreline 16 needs to be formed in the corrugated paperboard sheet 43.

[0053]

The slitter 42 includes a rotary shaft 71 arranged over the corrugated paperboard sheet 43, a rotary shaft 72 arranged under the corrugated paperboard sheet 43, a knife receiver 73 fixed to the upper rotary shaft 71, and a slitter knife 74 fixed to the lower rotary shaft 72. The slitter knife 74 is a rotary blade formed on its outer periphery with a cutting edge continuous circumferentially over the entire circumference of the slitter knife 74, and configured to slit the corrugated paperboard sheet 43 from the lower side of the sheet 43 (i.e., from the side of the outer linerboard 1), and cut the corrugated paperboard sheet 43 along the

conveying direction (i.e., along the direction perpendicular to the corrugations of the sheet 43).

[0054]

The slitter scorer 40 includes a frame 80 supporting the upper rotary shafts 51 and 71 and the lower rotary shafts 52 and 72, a base member 81 fixed to the floor F, and linear guides 82 provided between the frame 80 and the base member 81. The linear guides 82 support the frame 80 such that the frame 80 is movable in the horizontal direction orthogonal to the direction in which the corrugated paperboard sheet 43 is conveyed. The slitter scorer 40 further includes a frame moving device 83 mounted to the frame 80, and configured such that if, while passing through the slitter scorer 40, the corrugated paperboard sheet 43 is displaced in the direction orthogonal to the direction in which the corrugated paperboard sheet 43 is conveyed, the frame 80 is moved by the frame moving device 83 to follow the displacement of the corrugated paperboard sheet 43.

[0055]

The reverse scoreline forming device 44 includes an auxiliary frame 84 supporting the upper rotary shaft 61 and the lower rotary shaft 62, a base member 85 fixed to the floor F, and linear guides 86 provided between the auxiliary frame 84 and the base member 85. The linear guides 86 support the auxiliary frame 84 such that the auxiliary frame 84 is movable in the horizontal direction orthogonal to the direction in which the corrugated paperboard sheet 43 is conveyed. The reverse scoreline forming device 44 further includes a coupling bracket 87 which is mounted to the auxiliary frame 84, and through which the auxiliary frame 84 and the frame 80 of the slitter scorer 40 are coupled together. Since the auxiliary frame 84 and the frame 80 are coupled together through the coupling

bracket 87, when the frame moving device 83 moves the frame 80 of the slitter scorer 40, the auxiliary frame 84 is also moved together with the frame 80.

[0056]

When this corrugator is used to manufacture the corrugated paperboard sheet 43, the upper and lower reverse scoreline rings 63 and 64 form the reverse scoreline 16 in the corrugated paperboard sheet 43 by sandwiching the corrugated paperboard sheet 43 between the groove 67 of the upper reverse scoreline ring 63 and the protrusion 65 of the lower reverse scoreline ring 64, and simultaneously form the shallow scoreline 24 therein by sandwiching the corrugated paperboard sheet 43 between one of the groove shoulders 68 of the upper reverse scoreline ring 63 and the corresponding recess 66 of the lower reverse scoreline ring 64. Thereafter, the upper and lower normal scoreline rings 53 and 54 form the normal scoreline 15 in the corrugated paperboard sheet 43 by sandwiching the corrugated paperboard sheet 43 between the protrusion 55 of the upper normal scoreline ring 53 and the groove 57 of the lower normal scoreline ring 54, and simultaneously form the shallow reverse scoreline 25 therein by sandwiching the corrugated paperboard sheet 43 between one of the recesses 56 of the upper normal scoreline ring 53 and the corresponding groove shoulder 58 of the lower normal scoreline ring 54. In this way, the normal scoreline 15, the reverse scoreline 16, the shallow scoreline 24, and the shallow reverse scoreline 25 are formed in the corrugated paperboard sheet 43.

[0057]

By use of the above corrugator to manufacture the corrugated paperboard sheet 43, when the corrugated paperboard sheet 43 is

sandwiched between the upper normal scoreline ring 53 and the lower normal scoreline ring 54, the portion of the sheet 43 in which the reverse scoreline 16 has been formed is compressed between one of the recesses 56 of the upper normal scoreline ring 53 and the corresponding groove shoulder 58 of the lower normal scoreline ring 54, so that this portion is effectively collapsed. Therefore, it is possible to form a reverse scoreline 16 along which the top flaps can be bent stably and accurately. Also, when the corrugated paperboard sheet 43 is sandwiched between the upper reverse scoreline ring 63 and the lower reverse scoreline ring 64, the portion of the sheet 43 in which the normal scoreline 15 is to be formed is compressed between one of the groove shoulders 68 of the upper reverse scoreline ring 63 and the corresponding recess 66 of the lower reverse scoreline ring 64, so that this portion is effectively collapsed. Therefore, it is possible to form a normal scoreline 15 along which the top flaps can be bent stably and accurately.

[0058]

By forming the auxiliary frame 84 of the reverse scoreline forming device 44 separately from the frame 80 of the slitter scorer 40 as in the above embodiment, it is possible to use an existing slitter scorer as the slitter scorer 40 by modifying the existing slitter scorer such that the reverse scoreline forming device 44 can be introduced into the corrugator. On the other hand, if a new slitter scorer is used as the slitter scorer 40, as illustrated in Fig. 12, the reverse scoreline forming device 44 may be provided in the frame 80 of the slitter scorer 40 as a device integral with the slitter scorer 40.

[0059]

While the reverse scoreline rings 63 and 64 are arranged on the

upstream side of the normal scoreline rings 53 and 54 in the above embodiment, the reverse scoreline rings 63 and 64 may be arranged on the downstream side of the normal scoreline rings 53 and 54 as illustrated in Fig. 13. Specifically, for example, the reverse scoreline forming device 44 illustrated in Fig. 10 may be arranged on the downstream side of the slitter scorer 40. Alternatively, in the slitter scorer 40 of Fig. 12, the position of the reverse scoreline rings 63 and 64 and the position of the normal scoreline rings 53 and 54 may be reversed.

[0060]

While, in the above embodiment, the normal scoreline 15 and the shallow reverse scoreline 25 are formed by the upper and lower normal scoreline rings 53 and 54 which are provided separately from the upper and lower reverse scoreline rings 63 and 64 by which the reverse scoreline 16 and the shallow scoreline 24 are formed in the corrugated paperboard sheet 43, as illustrated in Fig. 15, an upper special scoreline ring 88 and an lower special scoreline ring 89 may be used to simultaneously form the normal scoreline 15, the reverse scoreline 16, the shallow scoreline 24 and the shallow reverse scoreline 25 illustrated in Fig. 3 by sandwiching the corrugated paperboard sheet 43 between the upper and lower special scoreline rings 88 and 89.

[0061]

As illustrated in Fig. 15, the upper special scoreline ring 88 is formed on its outer periphery with a recess 56, a protrusion 55, a groove 67, and a groove shoulder 68 which are aligned in the axial direction, and which correspond, respectively, to one recess of the recesses 56 and the protrusion 55 of the upper normal scoreline ring 53, and the groove 67 and one of the groove shoulders 68 of the upper reverse scoreline ring 63. The

lower special scoreline ring 89 is formed on its outer periphery with a groove shoulder 58, a groove 57, a protrusion 65, and a recess 66 which are aligned in the axial direction, and which correspond, respectively, to one groove shoulder of the groove shoulders 58 and the groove 57 of the lower normal scoreline ring 54, and the protrusion 65 and one of the recesses 66 of the lower reverse scoreline ring 64.

[0062]

The upper and lower special scoreline rings 88 and 89 form the shallow reverse scoreline 25 (see Fig. 3) by sandwiching the corrugated paperboard sheet 43 between the recess 56 of the upper special scoreline ring 88 and the groove shoulder 58 of the lower special scoreline ring 89, form the normal scoreline 15 (see Fig. 3) by sandwiching the corrugated paperboard sheet 43 between the protrusion 55 of the upper special scoreline ring 88 and the groove 57 of the lower special scoreline ring 89, form the reverse scoreline 16 (see Fig. 3) by sandwiching the corrugated paperboard sheet 43 between the groove 67 of the upper special scoreline ring 88 and the protrusion 65 of the lower special scoreline ring 89, and form the shallow scoreline 24 (see Fig. 3) by sandwiching the corrugated paperboard sheet 43 between the groove shoulder 68 of the upper special scoreline ring 88 and the recess 66 of the lower special scoreline ring 89.

[0063]

The height h_1 from the smallest diameter portion of the groove 67 of the upper special scoreline ring 88 to the largest diameter portion of the groove shoulder 68 of the upper special scoreline ring 88 is set to be smaller than the height h_2 from the smallest diameter portion of the groove 67 of the upper special scoreline ring 88 to the largest diameter portion of the protrusion 55 of the upper special scoreline ring 88. The height h_3 from the

smallest diameter portion of the groove 57 of the lower special scoreline ring 89 to the largest diameter portion of the groove shoulder 58 of the lower special scoreline ring 89 is set to be smaller than the height h_4 from the smallest diameter portion of the groove 57 of the lower special scoreline ring 89 to the largest diameter portion of the protrusion 65 of the lower special scoreline ring 89.

[0064]

Also, the height h_1 is set to be equal to the height h_3 , while the height h_2 is set to be equal to the height h_4 .

[0065]

By using the upper and lower special scoreline rings 88 and 89 to simultaneously form the normal scoreline 15, the reverse scoreline 16, the shallow scoreline 24 and the shallow reverse scoreline 25, it is possible to accurately control the relative positional relationship of these scorelines 15, 16, 24 and 25, and also to prevent the separation of the outer linerboard 1 and the inner linerboard 2 of the corrugated paperboard sheet 43 from the corrugated medium 3.

[0066]

Specifically, when, as illustrated in Fig.11, the reverse scoreline 16 and the shallow scoreline 24 are formed in the corrugated paperboard sheet 43 by the upper and lower reverse scoreline rings 63 and 64, and the normal scoreline 15 and the shallow reverse scoreline 25 are formed therein by the upper and lower normal scoreline rings 53 and 54, arranged on the upstream or downstream side of the upper and lower reverse scoreline rings 63 and 64, if the corrugated paperboard sheet 43 moves while snaking, the normal scoreline 15 and the shallow reverse scoreline 25 illustrated in Fig. 3 might be displaced with respect to the reverse scoreline 16 and the

shallow scoreline 24. In contrast thereto, when the normal scoreline 15, the reverse scoreline 16, the shallow scoreline 24, and the shallow reverse scoreline 25 are simultaneously formed by the upper and lower special scoreline rings 88 and 89 illustrated in Fig. 15, even if the corrugated paperboard sheet 43 moves while snaking, the normal scoreline 15 and the shallow reverse scoreline 25 illustrated in Fig. 3 are not displaced with respect to the reverse scoreline 16 and the shallow scoreline 24. Therefore, it is possible to accurately control the relative positional relationship of these scorelines 15, 16, 24 and 25.

[0067]

Also, when, as illustrated in Fig. 11, the reverse scoreline 16 and the shallow scoreline 24 are formed in the corrugated paperboard sheet 43 by the upper and lower reverse scoreline rings 63 and 64, and the normal scoreline 15 and the shallow reverse scoreline 25 are formed therein by the upper and lower normal scoreline rings 53 and 54, which are provided separately from the upper and lower reverse scoreline rings 63 and 64, and which are arranged on the upstream or downstream side of the upper and lower reverse scoreline rings 63 and 64, the corrugated paperboard sheet 43 is sandwiched twice, i.e., sandwiched between the upper and lower reverse scoreline rings 63 and 64, and between the upper and lower normal scoreline rings 53 and 54. Therefore, due to the shearing force applied at this time between the corrugated medium 3 and the outer linerboard 1 of the corrugated paperboard sheet 43 and/or between the corrugated medium 3 and the inner linerboard 2, the outer linerboard 1 and/or the inner linerboard 2 might be separated from the corrugated medium 3. In contrast thereto, when the normal scoreline 15, the reverse scoreline 16, the shallow scoreline 24 and the shallow reverse scoreline 25 are simultaneously

formed by the upper and lower special scoreline rings 88 and 89 illustrated in Fig. 15, the corrugated paperboard sheet 43 is sandwiched only once, i.e., only between the upper and lower special scoreline rings 88 and 89. Therefore, it is possible to prevent the separation of the outer linerboard 1 and the inner linerboard 2 of the corrugated paperboard sheet 43 from the corrugated medium 3.

[0068]

While the scoreline forming device described in the above embodiment is provided as a part of the scorer 41, which is configured to form the normal scoreline 15 in the corrugated paperboard sheet 43, which continuously extends in a strip shape in the corrugator, the scoreline forming device illustrated in Fig. 16 may be used instead, which is provided as a part of a cutting machine configured to cut sheets cut off from the corrugated paperboard sheet 43 by the corrugator, to a predetermined width (the sheets cut off from the corrugated paperboard sheet 43 are hereinafter simply referred to as "cut sheets 43" or "cut corrugated paperboard sheets 43").

[0069]

The scoreline forming device of Fig. 16 is, for example, a device provided by modifying a cutting machine configured to cut a cut corrugated paperboard sheet 43 to a predetermined width size. As for the elements corresponding to those of the scoreline forming device illustrated in Fig. 10, the same reference numerals as used in the scoreline forming device of Fig. 10 are used below, and their description is omitted.

[0070]

The scoreline forming device of Fig. 16 includes a sheet feed table 91 provided on the upstream side of the reverse scoreline rings 63 and 64 to

support a cut corrugated paperboard sheet 43, and a sheet discharge table 92 provided on the downstream side of the slitter knife 74 and the knife receiver 73.

[0071]

It is now described how this scoreline forming device is used. First, when a cut corrugated paperboard sheet 43 supported by the sheet feed table 91 is fed to the downstream side, and sandwiched between the upper reverse scoreline ring 63 and the lower reverse scoreline ring 64, the reverse scoreline rings 63 and 64 form the reverse scoreline 16 by sandwiching the cut sheet 43 between the groove 67 of the upper reverse scoreline ring 63 and the protrusion 65 of the lower reverse scoreline ring 64, and simultaneously form the shallow scoreline 24 by sandwiching the cut sheet 43 between one of the groove shoulders 68 of the upper reverse scoreline ring 63 and the corresponding recess 66 of the lower reverse scoreline ring 64. Thereafter, when the cut corrugated paperboard sheet 43 is sandwiched between the upper normal scoreline ring 53 and the lower normal scoreline ring 54, the normal scoreline rings 53 and 54 form the normal scoreline 15 by sandwiching the cut sheet 43 between the protrusion 55 of the upper normal scoreline ring 53 and the groove 57 of the lower normal scoreline ring 54, and simultaneously form the shallow reverse scoreline 25 by sandwiching the cut sheet 43 between one of the recesses 56 of the upper normal scoreline ring 53 and the corresponding groove shoulder 58 of the lower normal scoreline ring 54. In this way, the normal scoreline 15, the reverse scoreline 16, the shallow scoreline 24, and the shallow reverse scoreline 25 are formed in the cut corrugated paperboard sheet 43. Thereafter, the cut corrugated paperboard sheet 43 is cut to a predetermined width size by the slitter knife 74, and discharged to the

sheet discharge table 92.

[0072]

While, in the above embodiment, the normal scoreline 15 and the shallow reverse scoreline 25 are formed by the upper and lower normal scoreline rings 53 and 54, and the reverse scoreline 16 and the shallow scoreline 24 are formed by the upper and lower reverse scoreline rings 63 and 64, the reverse scoreline 16 and the shallow scoreline 24 may be formed by a platen die cutter (not shown) including a flat plate-shaped wood pattern, after the normal scoreline 15 and the shallow reverse scoreline 25 are formed by the upper and lower normal scoreline rings 53 and 54.

[0073]

Corrugated paperboard sheets 43 were manufactured by varying the axial relative position between the normal scoreline rings 53 and 54 and the reverse scoreline rings 63 and 64, and an experiment was performed to bend the corrugated paperboard sheets 43. The normal scoreline rings 53 and 54 used in this experiment have the sectional shape illustrated in Fig. 14, and the dimensions shown below. The reverse scoreline rings 63 and 64 used in this experiment comprise an upper reverse scoreline ring having the same shape and dimensions as the lower normal scoreline ring 54, and a lower reverse scoreline ring having the same shape and dimensions as the upper normal scoreline ring 53.

[0074]

[Table 1]

a	b	c	d	e	f	g	h	x _{min}	x _{max}
7.3	2.4	2.4	5.3	4.1	1.6	4.2	1.4	2.5	7.3

(mm)

[0075]

In Table 1, “X_{min}” and “X_{max}” are values defined by the following formulas:

$$X_{\min} = 1/2a - 1/2c$$

$$X_{\max} = 1/2a + b + 1/2c$$

[0076]

[Table 2]

Material	Normal scoreline GAP	Reverse scoreline GAP	X	
			5mm	8mm
K210×S160×K210 (CF)	0.8mm	0.8mm	○	×
	1.2mm	1.2mm	○	○
	1.6mm	1.6mm	○	×

[0077]

In Table 2, “Normal scoreline GAP” is the gap size between the protrusion 55 of the normal scoreline ring 53 and the groove 57 of the normal scoreline ring 54; “Reverse scoreline GAP” is the gap size between the protrusion 65 of the reverse scoreline ring 64 and the groove 67 of the reverse scoreline ring 63; “x” is the amount by which the center of the protrusion 55 of the normal scoreline ring 53 is axially displaced from the center of the protrusion 65 of the reverse scoreline ring 64; “○” means that the corrugated paperboard sheet 43 was bent accurately along the normal scoreline 15 and the reverse scoreline 16; and “X” means that the corrugated paperboard sheet 43 was not bent accurately along the normal scoreline 15 or the reverse scoreline 16.

[0078]

The above experimental result shows that when the normal scoreline rings 53 and 54 and the reverse scoreline rings 63 and 64 are arranged to satisfy the formula “ $1/2a - 1/2c \leq x \leq 1/2a + b + 1/2c$ ”, it is possible to form normal and reverse scorelines 15 and 16 along which the corrugated

paperboard sheet 43 can be bent accurately.

[0079]

While the above embodiment exemplifies a corrugated paperboard box of which the top flaps 11, 12, 13 and 14 have the same length (generally known as an "A" type corrugated paperboard box), the present invention can be also applied to a different type of corrugated paperboard box (such as a "B" type corrugated paperboard box which includes a top flap large enough such that the upper end opening of the peripheral wall is closed by the top flap alone, and in which an insertion piece integrally connected to the distal end of the top flap is inserted in the inner side of the peripheral wall 31 so as to form the lid of the box.)

[0080]

While the above embodiment exemplifies a corrugated paperboard box including a quadrangular peripheral wall 31, the present invention can be also applied to a corrugated paperboard box including a peripheral wall having a shape other than a quadrangular shape, for example, a corrugated paperboard box including an octagonal peripheral wall (formed by cutting the four corners of the quadrangular peripheral wall). The present invention can be also applied to a corrugated paperboard box which includes top flaps at the upper end of the peripheral wall, but which includes no bottom flaps at the lower end of the peripheral wall (known as "semi A" type corrugated paperboard box), or to a two-piece box comprising a semi-A type corrugated paperboard box, and a tray covered by the semi-A type corrugated paperboard box.

Description of Reference Numerals

[0081]

1: outer linerboard
2: inner linerboard
3: corrugated medium
11, 12, 13, 14: top flap
15: normal scoreline
16: reverse scoreline
24: shallow scoreline
25: shallow reverse scoreline
30: corrugated paperboard box
31: peripheral wall
41: scorer
43: corrugated paperboard sheet
53: normal scoreline ring, or first normal scoreline ring
54: normal scoreline ring, or second normal scoreline ring
55: protrusion
56: recess
57: groove
58: groove shoulder
63: reverse scoreline ring, or first reverse scoreline ring
64: reverse scoreline ring, or second reverse scoreline ring
65: protrusion
66: recess
67: groove
68: groove shoulder
88, 89: special scoreline ring

CLAIMS

1. A corrugated paperboard box made of corrugated paperboard comprising an outer linerboard (1), an inner linerboard (2), and a corrugated medium (3) provided between the outer linerboard (1) and the inner linerboard (2),

the corrugated paperboard box comprising:

a peripheral wall (31) formed by bending the corrugated paperboard into a tubular shape such that the inner linerboard (2) constitutes an inner surface of the corrugated paperboard box; and

flaps (11, 12, 13 and 14) integrally connected to one of two ends of the peripheral wall (31);

characterized in that the corrugated paperboard box includes:

a groove-shaped normal scoreline (15) formed between the peripheral wall (31) and the flaps (11, 12, 13 and 14), and recessed on a side of the inner linerboard (2) such that the flaps (11, 12, 13 and 14) can be bent along the normal scoreline (15) toward an inner surface of the peripheral wall (31);

a groove-shaped reverse scoreline (16) formed at a position spaced apart from the normal scoreline (15) toward the flaps (11, 12, 13 and 14) to extend in parallel to the normal scoreline (15), and recessed on a side of the outer linerboard (1) such that the flaps (11, 12, 13 and 14) can be bent along the reverse scoreline (16) toward an outer surface of the peripheral wall (31); and

a shallow scoreline (24) extending in parallel to the reverse scoreline (16) on an opposite side of the reverse scoreline (16) from the normal scoreline (15), and recessed on the side of the inner linerboard (2).

2. The corrugated paperboard box according to claim 1, further formed with a shallow reverse scoreline (25) extending in parallel to the normal scoreline (15) on an opposite side of the normal scoreline (15) from the reverse scoreline (16), and recessed on the side of the outer linerboard (1).

3. A scoreline forming method for forming, in a corrugated paperboard sheet (43) comprising an outer linerboard (1), an inner linerboard (2), and a corrugated medium (3) provided between the outer linerboard (1) and the inner linerboard (2), (a) a groove-shaped normal scoreline (15) recessed on a side of the inner linerboard (2); (b) a groove-shaped reverse scoreline (16) extending in parallel to the normal scoreline (15), and recessed on a side of the outer linerboard (1); and (c) a shallow scoreline (24) extending in parallel to the reverse scoreline (16) on an opposite side of the reverse scoreline (16) from the normal scoreline (15), and recessed on the side of the inner linerboard (2),

the scoreline forming method comprising:

providing: a first normal scoreline ring (53) formed, on an outer periphery of the first normal scoreline ring (53), with a protrusion (55) continuously extending in a circumferential direction, and recesses (56) arranged on two axial sides of the protrusion (55), respectively;

a second normal scoreline ring (54) formed, on an outer periphery of the second normal scoreline ring (54), with a groove (57) opposed to the protrusion (55) of the first normal scoreline ring (53), and groove shoulders (58) arranged on two axial sides of the groove (57), respectively;

a first reverse scoreline ring (63) formed, on an outer periphery of

the first reverse scoreline ring (63), with a groove (67), and groove shoulders (68) arranged on two axial sides of the groove (67) of the first reverse scoreline ring (63), respectively; and

a second reverse scoreline ring (64) formed, on an outer periphery of the second reverse scoreline ring (64), with a protrusion (65) opposed to the groove (67) of the first reverse scoreline ring (63), and continuously extending in the circumferential direction, and recesses (66) arranged on two axial sides of the protrusion (65) of the second reverse scoreline ring (64), respectively;

arranging the first normal scoreline ring (53) and the first reverse scoreline ring (63) on the side of the inner linerboard (2), and the second normal scoreline ring (54) and the second reverse scoreline ring (64) on the side of the outer linerboard (1) such that the first and second reverse scoreline rings (63 and 64) are located on either an upstream or downstream side of the first and second normal scoreline rings (53 and 54), and such that a position of the protrusion (55) of the first normal scoreline ring (53) corresponds to a position of one of the groove shoulders (68) of the first reverse scoreline ring (63), and a position of the protrusion (65) of the second reverse scoreline ring (64) corresponds to a position of one of the groove shoulders (58) of the second normal scoreline ring (54);

sandwiching the corrugated paperboard sheet (43) between the first and second normal scoreline rings (53 and 54) such that the groove-shaped normal scoreline (15) is formed by being sandwiched between the protrusion (55) of the first normal scoreline ring (53) and the groove (57) of the second normal scoreline ring (54); and

sandwiching the corrugated paperboard sheet (43) between the first and second reverse scoreline rings (63 and 64) such that the groove-shaped

reverse scoreline (16) is formed by being sandwiched between the groove (67) of the first reverse scoreline ring (63) and the protrusion (65) of the second reverse scoreline ring (64), and the shallow scoreline (24) is formed by being sandwiched between one of the groove shoulders (68) of the first reverse scoreline ring (63) and a corresponding one of the recesses (66) of the second reverse scoreline ring (64).

4. The scoreline forming method according to claim 3, wherein when the corrugated paperboard sheet is sandwiched between the first and second normal scoreline rings (53 and 54), a shallow reverse scoreline (25) extending in parallel to the normal scoreline (15), and recessed on the side of the outer linerboard (1) is formed in the corrugated paperboard sheet (43) on an opposite side of the normal scoreline (15) from the reverse scoreline (16), by being sandwiched between one of the recesses (56) of the first normal scoreline ring (53) and a corresponding one of the groove shoulders (58) of the second normal scoreline ring (54).

5. A scoreline forming method for forming, in a corrugated paperboard sheet (43) comprising an outer linerboard (1), an inner linerboard (2), and a corrugated medium (3) provided between the outer linerboard (1) and the inner linerboard (2), (a) a groove-shaped normal scoreline (15) recessed on a side of the inner linerboard (2); (b) a groove-shaped reverse scoreline (16) extending in parallel to the normal scoreline (15), and recessed on a side of the outer linerboard (1); (c) a shallow scoreline (24) extending in parallel to the reverse scoreline (16) on an opposite side of the reverse scoreline (16) from the normal scoreline (15), and recessed on the side of the inner linerboard (2); and (d) a shallow

reverse scoreline (25) extending in parallel to the normal scoreline (15) on an opposite side of the normal scoreline (15) from the reverse scoreline (16), and recessed on the side of the outer linerboard (1),

the scoreline forming method comprising:

arranging a pair of special scoreline rings (88 and 89) on the side of the inner linerboard (2) and on the side of the outer linerboard (1), respectively; and

sandwiching, with the pair of special scoreline rings (88 and 89), the corrugated paperboard sheet (43) such that the groove-shaped normal scoreline (15), the groove-shaped reverse scoreline (16), the shallow scoreline (24), and the shallow reverse scoreline (25) are simultaneously formed in the corrugated paperboard sheet (43).

6. A scoreline forming device for forming, in a corrugated paperboard sheet (43) comprising an outer linerboard (1), an inner linerboard (2), and a corrugated medium (3) provided between the outer linerboard (1) and the inner linerboard (2), (a) a groove-shaped normal scoreline (15) recessed on a side of the inner linerboard (2); (b) a groove-shaped reverse scoreline (16) extending in parallel to the normal scoreline (15), and recessed on a side of the outer linerboard (1); and (c) a shallow scoreline (24) extending in parallel to the reverse scoreline (16) on an opposite side of the reverse scoreline (16) from the normal scoreline (15), and recessed on the side of the inner linerboard (2),

the scoreline forming device comprising:

a first normal scoreline ring (53) arranged on the side of the inner linerboard (2), and formed, on an outer periphery of the first normal scoreline ring (53), with a protrusion (55) continuously extending in a

circumferential direction, and recesses (56) arranged on two axial sides of the protrusion (55), respectively;

a second normal scoreline ring (54) arranged on the side of the outer linerboard (1), and formed, on an outer periphery of the second normal scoreline ring (54), with a groove (57) opposed to the protrusion (55) of the first normal scoreline ring (53), and groove shoulders (58) arranged on two axial sides of the groove (57), respectively;

a first reverse scoreline ring (63) arranged on the side of the inner linerboard (2), and formed, on an outer periphery of the first reverse scoreline ring (63), with a groove (67), and groove shoulders (68) arranged on two axial sides of the groove (67) of the first reverse scoreline ring (63), respectively; and

a second reverse scoreline ring (64) arranged on the side of the outer linerboard (1), and formed, on an outer periphery of the second reverse scoreline ring (64), with a protrusion (65) opposed to the groove (67) of the first reverse scoreline ring (63), and continuously extending in the circumferential direction, and recesses (66) arranged on two axial sides of the protrusion (65) of the second reverse scoreline ring (64), respectively;

wherein the first and second reverse scoreline rings (63 and 64) are arranged on either an upstream or downstream side of the first and second normal scoreline rings (53 and 54) such that a position of the protrusion (55) of the first normal scoreline ring (53) corresponds to a position of one of the groove shoulders (68) of the first reverse scoreline ring (63), and a position of the protrusion (65) of the second reverse scoreline ring (64) corresponds to a position of one of the groove shoulders (58) of the second normal scoreline ring (54),

wherein the first and second normal scoreline rings (53 and 54) are

configured to sandwich the corrugated paperboard sheet (43) between the protrusion (55) of the first normal scoreline ring (53) and the groove (57) of the second normal scoreline ring (54) so as to form the groove-shaped normal scoreline (15), and

wherein the first and second reverse scoreline rings (63 and 64) are configured to:

sandwich the corrugated paperboard sheet (43) between the groove (67) of the first reverse scoreline ring (63) and the protrusion (65) of the second reverse scoreline ring (64) so as to form the groove-shaped reverse scoreline (16); and

sandwich the corrugated paperboard sheet (43) between one of the groove shoulders (68) of the first reverse scoreline ring (63) and a corresponding one of the recesses (66) of the second reverse scoreline ring (64) so as to form the shallow scoreline (24).

7. The scoreline forming device according to claim 6, wherein the first and second normal scoreline rings (53 and 54) are configured to sandwich the corrugated paperboard sheet (43) between one of the recesses (56) of the first normal scoreline ring (53) and a corresponding one of the groove shoulders (58) of the second normal scoreline ring (54) so as to form in the corrugated paperboard sheet (43) a shallow reverse scoreline (25) extending in parallel to the normal scoreline (15) on an opposite side of the normal scoreline (15) from the reverse scoreline (16), and recessed on the side of the outer linerboard (1).

8. The scoreline forming device according to claim 6 or 7, wherein the first and second normal scoreline rings (53 and 54), and the first and

second reverse scoreline rings (63 and 64) are provided as a part of a scorer (41) configured to form the normal scoreline (15) in the corrugated paperboard sheet (43), which continuously extends in a strip shape in a corrugator.

9. The scoreline forming device according to claim 6 or 7, wherein the first and second normal scoreline rings (53 and 54), and the first and second reverse scoreline rings (63 and 64) are provided as a part of a cutting machine configured to cut, to a predetermined width size, a cut sheet cut off from the corrugated paperboard sheet (43).

10. A scoreline forming device for forming, in a corrugated paperboard sheet (43) comprising an outer linerboard (1), an inner linerboard (2), and a corrugated medium (3) provided between the outer linerboard (1) and the inner linerboard (2), (a) a groove-shaped normal scoreline (15) recessed on a side of the inner linerboard (2); (b) a groove-shaped reverse scoreline (16) extending in parallel to the normal scoreline (15), and recessed on a side of the outer linerboard (1); (c) a shallow scoreline (24) extending in parallel to the reverse scoreline (16) on an opposite side of the reverse scoreline (16) from the normal scoreline (15), and recessed on the side of the inner linerboard (2); and (d) a shallow reverse scoreline (25) extending in parallel to the normal scoreline (15) on an opposite side of the normal scoreline (15) from the reverse scoreline (16), and recessed on the side of the outer linerboard (1)

the scoreline forming device comprising a pair of special scoreline rings (88 and 89) arranged on the side of the inner linerboard (2) and on the side of the outer linerboard (1), respectively, and configured to sandwich the

corrugated paperboard sheet (43) so as to simultaneously form the groove-shaped normal scoreline (15), the groove-shaped reverse scoreline (16), the shallow scoreline (24), and the shallow reverse scoreline (25).