June 19, 1962 L. E. LA BOMBARD 3,039,372

CREASING APPARATUS, METHOD AND PRODUCT

Filed June 12, 1958 2 Sheets-Sheet 1

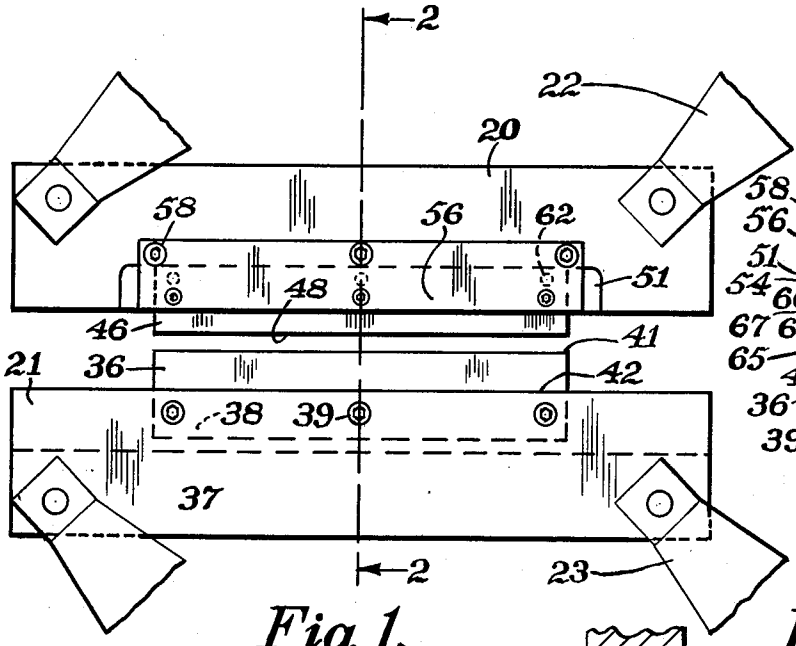

Fig. 1.

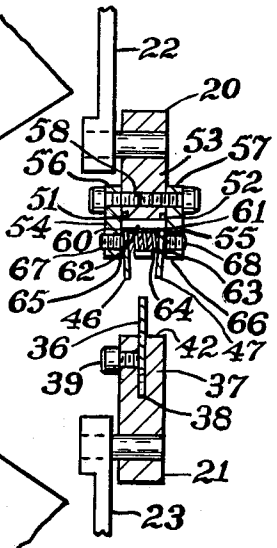

Fig. 2.

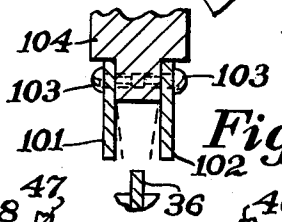

Fig. 2A.

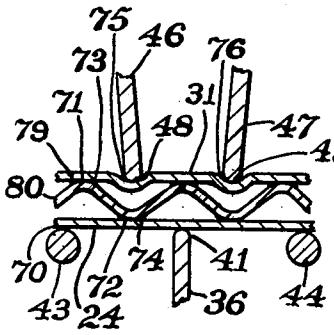

Fig. 3.

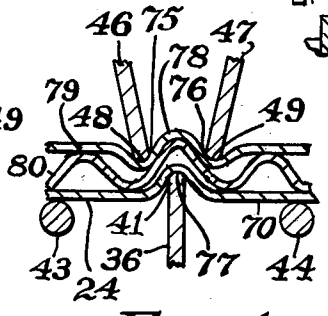

Fig. 4.

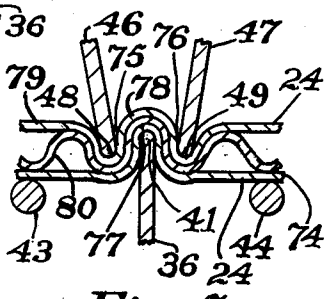

Fig. 5.

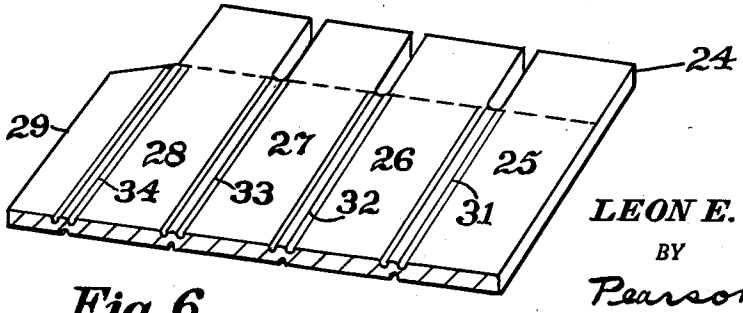

Fig. 6.

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Fig. 7.

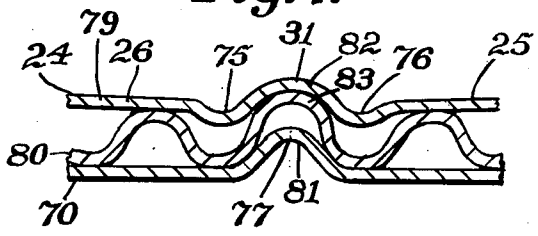


Fig. 11.

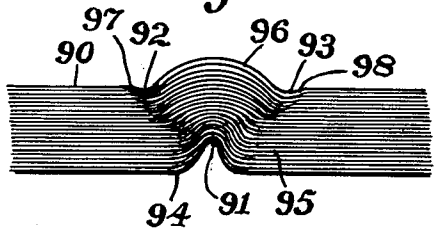


Fig. 8.

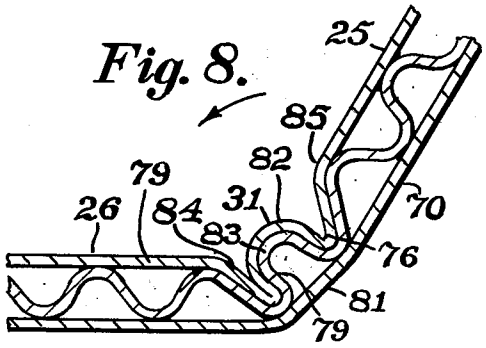
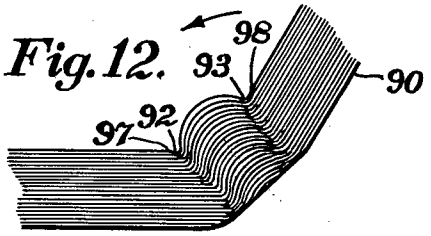


Fig. 12.



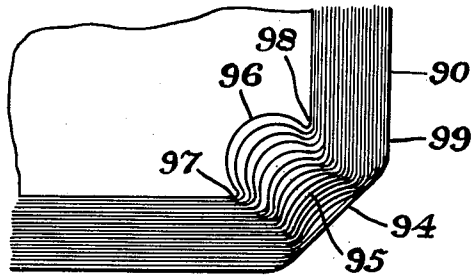


Fig. 9.

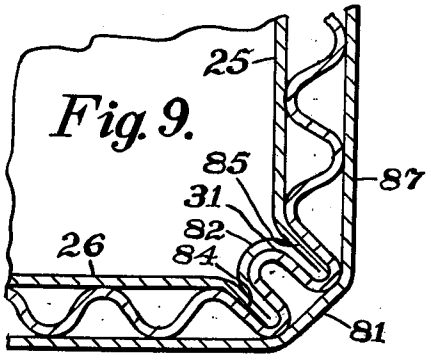


Fig. 13

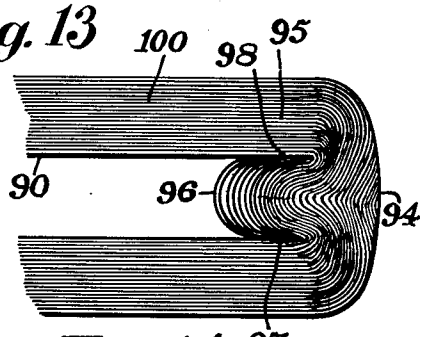


Fig. 14.

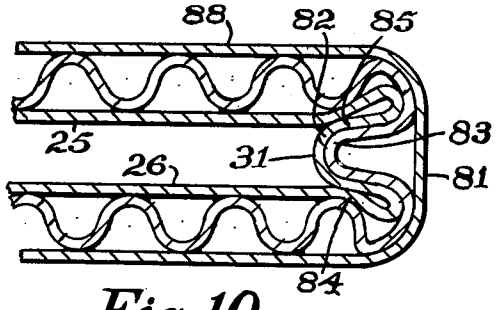


Fig. 10.

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CREASING APPARATUS, METHOD AND PRODUCT

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Filed June 12, 1958, Ser. No. 741,513
9 Claims. (Cl. 93—58.3)

This invention relates to boxes and blanks of paperboard and to an improved creasing apparatus and method for forming the same.

It has long been customary to impress creases in paper material to create foldable box blanks, the creaser dividing the blanks into wall panels, flaps or tabs in cooperation with slits, cut-outs and the like. When the paperboard is relatively thin, such creases can be formed by well known apparatus and the blanks will usually fold accurately on the crease lines at low or high speed. When the paperboard is relatively thick, for example, laminated board or corrugated board, however, ordinary creasing apparatus tends to be less effective and the resulting blanks tend to fold improperly, especially at high speed.

In my copending patent application, Serial No. 709,977 filed January 20, 1958, now Patent No. 2,949,066 granted Aug. 16, 1960, there is disclosed a pair of opposed creaser bars rotating in parallelism and arranged to advance with a blank while firmly impressing a crease therein. The creasing means disclosed therein includes a single blade on one creaser bar and a double blade, of parti-circular cross section on the other creaser bar, the flat faces of the parti-circular blades moving in an arcuate path to pinch crease the paper board against each opposite flat side of the single blade.

In U.S. Patent No. 1,772,785 of August 12, 1930, to Smith, similar apparatus is disclosed in which the creaser bars have a single blade opposed by double blades but the double blades are pivotally mounted and caused to swing on their pivots by the cam action of inclined faces on each side of the single blade. In U.S. Patent No. 2,115,-724 of May 13, 1938, to Knowlton, the double blades are also pivotally mounted and caused to swing on their pivots by leverage and linkage actuated by the approach of the creaser bars toward each other.

Thus, in my said copending application and in the above mentioned patents the double blades are caused to pinch against the single blade by automatic mechanical means and would move inwardly toward the single blade, when the creaser bars approach each other even if there were no paper stock between the bars. Because the double blades press the paper stock against the unyielding flat faces on each opposite side of the single blade in these prior art devices and then wipe across the adjacent face of the stock in a pinching, crushing movement, relatively broad strips of compressed paper stock are formed on each opposite side of the resulting crease. It is my present theory, that while such strips may make the fold line more flexible, and the blank easier to fold my high speed twist belts, they may deform so much of the fold line area that a misaligned fold occasionally occurs.

It is the principal object of this invention to provide creaser bar apparatus in which the movable double blades are moved into pinching engagement with the single blade by and with the paper stock itself and not by any automatic actuating mechanism on the creaser bars or with any crushing effect on the paper stock.

Another object of the invention is to provide a foldable box blank or a box of relatively thick paperboard in which the wall panel fold lines are formed by superposed layers of stretched fibres bounded on each opposite side by shoulders of unstretched fibres and undeformed paper stock.

A further object of the invention is to provide creaser bar mechanism in which a single blade is opposed by pivotable, spring-loaded, double blades adapted to be drawn together by frictional engagement with the stock with no wiping action or crushing effect, of the double blades on the stock.

Still another object of the invention is to provide a box blank of corrugated paperboard with wall panel fold lines so sharply defined as to assure 180° folding of selected panels in exact alignment even under the twisting influence of high speed folder belts.

A still further object of the invention is to provide an improved method for forming a crease in paperboard by stretching the fibres rather than crushing the fibres thereof.

The product of this invention is the subject of my copending divisional patent application, Serial No. 676 filed December 11, 1959, and entitled "Foldable Blank and Carton."

Other objects and advantages of the invention will be apparent from the claims, the description of the drawings and from the drawings in which

FIG. 1 is a side elevation of the creasing mechanism of the invention.

FIG. 2 is a sectional view on line 2—2 of FIG. 1.

FIG. 2A is a view similar to FIG. 2 of a modification.

FIGS. 3, 4 and 5 are enlarged, fragmentary views showing the creasing action of the mechanism of the invention.

FIG. 6 is a perspective view of a box blank in accordance with the invention.

FIG. 7 is a view similar to FIG. 5 of the crease impressed in one type of corrugated paperboard by the mechanism.

FIG. 8 is a view similar to FIG. 7 showing a blank being folded on the compound crease of this invention.

FIG. 9 is a view similar to FIG. 7 of a corner of a box of corrugated paperboard made in accordance with the invention.

FIG. 10 is a view similar to FIG. 7 of a corner of a flat tubular collapsed box of corrugated paperboard made in accordance with the invention.

FIGS. 11, 12, 13 and 14 are views similar to FIGS. 7, 8, 9 and 10 but with the blank and boxes made of laminated paperboard in accordance with the invention.

As shown in FIGS. 1 and 2 the creasing apparatus of the invention includes opposed pairs of creaser bars **20** and **21**, each pair arranged to impress a crease in a sheet or web of paperboard positioned or passing therebetween. The bars **20** and **21** may be mounted on suitable mechanism, forming no part of this invention, for causing the bars to rotate in parallelism toward and away from the material of stock to be creased. For example, the mechanism of the above mentioned Smith and Knowlton patents; or the mechanism described and illustrated in my above mentioned patent application, Serial No. 709,977, filed January 20, 1958, is satisfactory for the purpose, or any other similar apparatus well known in the prior art.

The creaser bars **20** and **21** are mounted to rotate in parallelism on eccentric driving members such as **22** and **23** and are normally spaced apart to admit the paperboard. It will be understood that the paperboard to be creased in the device of this invention is usually relatively thick, resistant to creasing and likely to erase a crease made therein. It may be of corrugated paperboard such as shown in FIGS. 3 to 10 or of paperboard of the pressed or laminated type such as shown in FIGS. 11–14. A typical material is illustrated in FIG. 6 in the form of a simplified box blank **24** of corrugated paperboard in which the closure flaps are not shown. The blank **24** includes the wall panels **25**, **26**, **27** and **28** and

the glue flap 29 and may be formed into a flat, tubular, collapsed box in a manner well known in the trade by fold belts or the like. Unless the fold lines 31, 32, 33 and 34 are well defined in the corrugated material, the blank will resist the folding action of the fold belts and the panels may fold inaccurately. In a collapsed box at least two of the folds, for example on lines 31 and 33, will be at 180° whereby sufficient material must be displaced or crushed along the inside of the fold to keep the outside of the fold from fracturing or tearing.

The creaser bar 21 is provided with a single creasing blade 36 which is preferably of flat elongated material such as metal. The base 37 of blade 36 is detachably fixed in slot 38 of bar 21 by set screws 39 or other suitable means and the blade may be of any desired length depending on the length of the creases desired. The free terminal edge 41 of blade 36 is rounded slightly to avoid cutting the paper stock and the height of the blade above the face 42 of the bar 21 is critical. Contrary to the teachings of the prior art, the face 42 of the bar 21 of this invention performs no camming action and at no time does it exert pressure on the material being creased or on the parts of the opposite creaser bar. As best shown in FIGS. 3–5 the material to be creased is supported adjacent the creaser blades 21 and 22 by the elongated rigid support rods 43 and 44 which are laterally spaced from the creasing area. The blade 36 is adjusted at such height above face 42 as to have a substantially greater effective height than the height of the opposite double blades as best shown in FIG. 2. Thus the crease is impressed with the double blades overlapping the single blade but never crushing the material against a rigid, immovable suface such as the face 42.

The creaser bar 20 is provided with a pair of identical creaser blades 46 and 47, or flat, elongated material such as metal, each having a rounded tip 48 or 49 similar to tip 41. The bar 20 is cut away on each opposite side to form a pair of tapered recesses 51 and 52, separated by the tapered central portion 53, the portion 53 extending between the bases 54 and 55 of the blades 46 and 47. A pair of cover plates 56 and 57 are detachably fixed by bolts such as 58 to each opposite side of the bar 20 as shown. The blades 46 and 47 are perforated at 60 and 61 to receive the pivot pins 62 and the portion 53 is provided with a series of holes such as 63 for coil springs such as 64. The double blades 46 and 47 are coextensive in length with the single blade 36, spaced laterally on each opposite side of blade 36 and of a predetermined height above the faces 65 and 66 of plates 56 and 57 which is substantially less than the corresponding height of blade 36.

A series of set screws such as 67 and 68 are threaded in cover plates 56 and 57 to permit the blades 46 and 47 to be toed in at various angles and to constitute an adjustable stop for controlling the maximum divergence of the blades. The tips 48 and 49 of the double blades are free to be moved inwardly toward each other by the pivoting of the blades on the pins 62 against the opposition of the coil springs 64 which constitute the return means for urging the blades toward their position of maximum divergence. It will be obvious that with no sheet-like material between the blades 36, 46 and 47 the creaser bars 20 and 21 may approach each other with no pinching action whatever on the part of the double blades. The bars are of course so set that they rotate in parallelism without actually touching each other, the point of closest approach being indicated in FIG. 5. The creaser bars 20 and 21 are so mounted as to arrive at creasing position with a substantial space between the face 42 and the opposite faces 65 and 66. Thus the creasing blades may partially overlap to complete a crease without the tips of the blades crushing the fibres of the sheet material against the face of the opposite creaser bar.

In FIGS. 3–5 the operation of the creasing apparatus of this invention is illustrated as applied to forming a crease in corrugated paperboard although it will be understood that the operation is the same with pressed or laminated paperboard. The corrugated material selected for illustration is of the type having an inner liner 79, a fluted section 80 and an outer liner 70 known as "Flute double face" and the upper and lower tips such as 71 and 72 are connected to the liners by an adhesive film such as 73 or 74.

As shown in FIG. 3 the single blade 36 is approaching the space between the double blades 46 and 47 with the corrugated material, for example, the box blank 24, supported on the rods 43 and 44. The creaser bars, being rotatably mounted, are advancing in the direction of advance of the blanks as they approach each other and there may be a plurality of sets of such bars simultaneously forming creases along the fold lines 31, 32, 33 and 34 of the each successive blank 24. It should be noted that the rounded tips 48 and 49 of each blade 46 or 47 first impress a shallow furrow such as at 75 and 76 in the inner liner, or top laminations, of the material and thereby become seated and frictionally adhered in the material. Despite any initial toe-in of the blades 46 and 47, the toe-in is not increased in this first stage of the crease.

As shown in FIG. 4 the continued pressure and approach of the blades 46 and 47 toward the blade 36, increases the depth of the furrows 75 and 76 and creates an opposite furrow 77 in the lower liner, or lower laminations, of the material. The rounded tips 48 and 49 being firmly seated in the furrows 75 and 76 they have created do not slip and wipe across the material but are drawn toward each other, and toward the sides of blade 36 in a pinching action as the double blades pivot inwardly within the recesses 51 and 52. At this point an inwardly projecting ridge 78 is commencing to form between the furrows 75 and 76 and the fibres in the layers, or laminations, between blades 46 and 47 are commencing to be stretched.

In FIG. 5 the final crease is shown with the double blades 46 and 47 overlapping the blade 36 and drawn tightly toward the sides of blade 36 to stretch the fibres in the layers in progressively increasing amounts from bottom to top. The adhesion between the layers of stretched fibres is destroyed in this operation so that the layers or laminations become separated from each other. However, on each opposite side of the crease there has been no stretching of fibres and no destruction of the adhesion of the layers of the material because the double blades are moved only by and with the material being formed into an inwardly projecting ridge therebetween.

Upon release of the material such as blank 24, and separation of the creaser bars 20 and 21 the crease impressed in the material is as shown in FIG. 7 for corrugated board and in FIG. 11 for pressed board. In the corrugated material of FIGS. 6 and 7 the wall panels are divided by the compound creases shown which define the fold lines 31, 32, 33 and 34 and are characterized by a first narrow ridge 81 of stretched fibres in the outer liner 70, created by the furrow 77, a second narrow ridge 82 of stretched fibres in the inner liner 79, ridge 82 overlying, but spaced from ridge 81, the pair of narrow furrows 75 and 76 formed of stretched fibres in inner liner 79, and the narrow ridged portion 83 in the fluted section 80, formed of stretched fibres. Portion 83 is substantially coextensive with the ridges 81 and 82 and located therebetween but any adhesion between the flute tips of section 80 and the liners 79 and 70 has been destroyed by the stretching of the layers over the blade 36. Each compound crease is further characterized by a pair of parallel strips 84 and 85 on each opposite side thereof which I call shoulders and which are uncompressed, unstretched and undeformed by the double blades 46 and 47. Because the compound crease is so bounded, a shoulder such as 84 presents a firm beveled barrier to the ridge 82 and portion 83 as a panel such as 25 is upfolded on line 31 as

shown in FIG. 8. The ridge **81**, on the other hand, gradually flattens into taut condition during the upfolding and cannot twist out of accurate longitudinal alignment as might be the case if the material of beveled shoulder **84** was crushed, deformed or otherwise made too flexible. In practice, a straight line marked along the longitudinal centre line of the furrow **77** remains exactly centred as the furrow is erased and the strip, formed by ridge **81**, becomes taut during a 90° or 180° fold.

When the ridge **82** and portion **83** are barred from further angular movement by the shoulder **84**, the further folding of the panel **25** takes place on the furrow **76** as a pivot zone until the fold is at 90° as shown in FIG. 9. A completed and erected box of rectangular cross section such as indicated at **87** will thus have four corners, each with the compound crease shown in FIG. 9 and each characterized by a pair of beveled undeformed shoulders such as **84** and **85** which retain the original integrity of the material and bound the stretched fibrous layers of the fold line to accurately define the fold.

A flat, tubular, collapsed box of corrugated paperboard such as indicated at **88** will have two alternate fold lines such as **31** and **33** creased as in FIG. 7 and the other two alternate fold lines such as **32** and **34** creased and folded through an angle of 180° as shown in FIG. 10. The ridge **81** is erased and the material thereof is stretched taut on the outside of the 180° fold lines while the ridge **82** and ridged portion **83** are compressed by the opposite beveled shoulders **84** and **85** with identical pressure, thereby maintaining the longitudinal alignment of the fold. The inherent resiliency of the ridged, or bowed, portions **82** and **83** keeps the portion **81** taut and the shoulders **84** and **85** in correct position thus eliminating looseness, excessive flexibility or flabbiness at the fold line and assuring that the panels of the collapsed box **88** are squared-up and tend to remain squared-up.

In FIG. 11 the creasing apparatus of the invention has been applied to laminated, or pressed paperboard **90**, for example, in creating a box blank such as **24** to be formed into boxes such as **87** or **88**. As shown, the single blade **36** has created a furrow **91** in the outer laminations and the double blades **46** and **47** have created a pair of less shallow furrows **92** and **93** in the inner laminations. The board **90** is of course formed of layers of paper and layers of adhesive all bonded into a relatively rigid and uncompressible mass but the blades of this invention are capable of impressing the crease shown in such material under the same pressures as are used for corrugated material.

The resulting compound crease is formed by a plurality of overlying layers of stretched fibres indicated generally at **94**, **95** and **96**, the adhesion between the layers being destroyed and the layers separated from each other. The layers **94**, **95** and **96** are of progressively increased bowed formation and of progressively increased width from the outer layer, or lamination to the inner layer or lamination. The compound crease is bounded by the beveled shoulders **97** and **98** on each opposite side thereof which are similar to shoulders **84** and **85** and are made up of unstretched fibres and unbowed unseparated layers of fibres.

As shown in FIG. 13, the shoulders **97** and **98** maintain the right angular corners of a rectangular box such as **99**, a portion of which is illustrated, in the same manner as indicated in FIG. 9 for corrugated material.

As shown in FIG. 13, the outer layers or laminations **94** are stretched taut and the inner layers **95** and **96** are bowed into a plurality of separated, ridges of stretched fibres which can be compressed by shoulders **97** and **98** when a flat, tubular collapsed box **100** is formed by alternate folds of 180° each.

In addition to the fact that the creaser blades of this invention are unopposed by any other surface and therefore cannot crush the layers of the paper stock, it should be noted that the double blades do not press on the sides of the ridges to force the ridges to bow or buckle to a height above the single blade. Instead the double blades stretch the fibrous ridges over the edge, and along the sides, of the single blade to enable the outer layers or liner to yield without strain or fracture during 180° folding. The resulting compound crease is actually a double hinge connection between adjoining panels, each being capable of 90° of fold along the lines of the pair of furrows formed by the double blades.

The lateral spacing between the tips **48** and **49** of blades **46** and **47** is critical in that it is adjusted by means of the set screws **67** and **68** in accordance with the thickness of the paper stock material. If the material is thin the blades are closely spaced and if the material is thick the blades are widely spaced.

As shown in FIG. 2A the double blades of the invention may be in the form of the pair of blades **101** and **102** of inherently flexible resilient material such as spring metal, each fixed by screws **103** to a creaser bar **104**.

I claim:

1. Creasing apparatus comprising a pair of opposed creaser bars, movable in parallelism toward and away from the path of a sheet to be creased therebetween; a single creaser blade of predetermined height mounted on one creaser bar; a pair of creaser blades, each of less height than said single blade, pivotally mounted on the opposite creaser bar; said pair of blades being pivotable toward each other and toward said single blade by and with a sheet engaged therebetween; means for returning said pair of creaser blades to their original position when disengaged from a sheet and means for moving said creaser bars into creasing position with said blades partially overlapping but without the crushing of the material of said sheet by said blades.

2. Creasing apparatus as specified in claim 1 wherein said single blade and said pair of blades are of thin, uniform cross section and normally substantially in parallelism except for a slight inward toe-in of said pair of blades.

3. Creasing apparatus as specified in claim 1 wherein said single blade and the blades of said pair are each of such height as to be spaced a distance greater than the thickness of a sheet from the face of the opposite bar at the completion of a crease in said sheet.

4. Creasing apparatus as specified in claim 1 wherein said opposite creaser bar includes a portion extending between the bases of said pair of blades, said portion having longitudinally spaced holes extending laterally therethrough and said returning means comprises a plurality of coil springs, each seated in one of said holes and bearing against said pair of blades.

5. In creasing apparatus of the type having a pair of opposed creaser bars rotating in parallelism toward and away from the path of the paper sheets to be creased, the combination of a pair of flat, elongated creaser blades pivotally mounted on one creaser bar, for convergence in a pinching direction, spring means continually urging said pair of blades into maximum divergence position; a single, flat, elongated creaser blade on the opposite creaser bar adapted to support a sheet beetween said pair of blades while the sheet frictionally converges said blades in a pinching direction and faces on said creaser bars opposite the said blades for enabling said blades to overlap in creasing position without crushing the material of a sheet between said blades and the bar faces opposite thereto.

6. Creasing apparatus comprising a pair of opposed creaser bars having opposed faces; means for moving said bars toward a creasing position with said opposed faces spaced apart a predetermined distance; a single, thin creaser blade of uniform thickness mounted on one said bar, the terminal tip of said blade extending to a predetermined height above the face of the bar; a pair of identical, thin, creaser blades of uniform thickness mounted on the other bar of said pair, the terminal tip of each said blade extending to a predetermined height above the face of said other bar and being located at a spaced lateral distance from one of the opposite side faces of said single

bar; the blades of said pair being substantially in parallelism with said single blade and the tips of said pair of blades being movable inwardly toward the side faces of said single bar by, and with, a sheet engaged between said blades; the faces of said bars, opposite the tips of said blades, being so spaced therefrom during and at the completion of, a crease as to insure against crushing of the material of the sheet therebetween.

7. A combination as specified in claim 6 wherein said pair of blades are each of flexible, resilient metal with the bases thereof affixed to said other creaser bar, whereby the tip portions of said blades are bent inwardly during creasing but spring back to normal configuration after creasing.

8. A combination as specified in claim 6 wherein said one creaser bar includes means for adjusting the height of the tip of the single blade thereon and said other creaser bar includes means for adjusting the lateral space between the tips of the pair of blades thereon for accommodating sheets of various thicknesses.

9. The method of creasing paperboard, by means of a single creasing blade mounted opposite to, and operable between, a pair of creasing blades in a creasing area which comprises the steps of supporting said paperboard only at a spaced distance on each opposite side of said creasing area with said single blade opposed only by said double blades in said area; then advancing said single blade and

said pair of blades toward each other, without lateral inward movement of said pair of blades until the tips of said blades have impressed a single shallow furrow in one face, straddled by a pair of shallow furrows in the opposite face, of said paperboard, and then continuing to advance said single blade and said pair of blades toward each other to deepen said furrows until the tip of said single blade overlaps the tip of said double blades within the confines of said paperboard, while permitting said material to draw the tips of said double blades inwardly laterally toward the side faces of said single blade, thereby stretching the fibres in said paperboard around the tips of said blades without crushing said fibres between the tip of any of said blades and an opposite surface.

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