Oct. 9, 1956 N. ANDERSSON 2,765,716

MATRIX FOR CREASING PAPERBOARD FOR CARTONS

Filed April 12, 1955 3 Sheets-Sheet 1

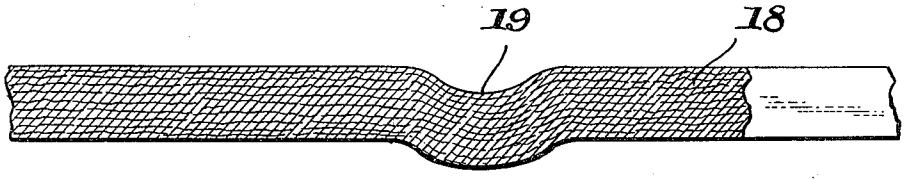


Fig. 1.

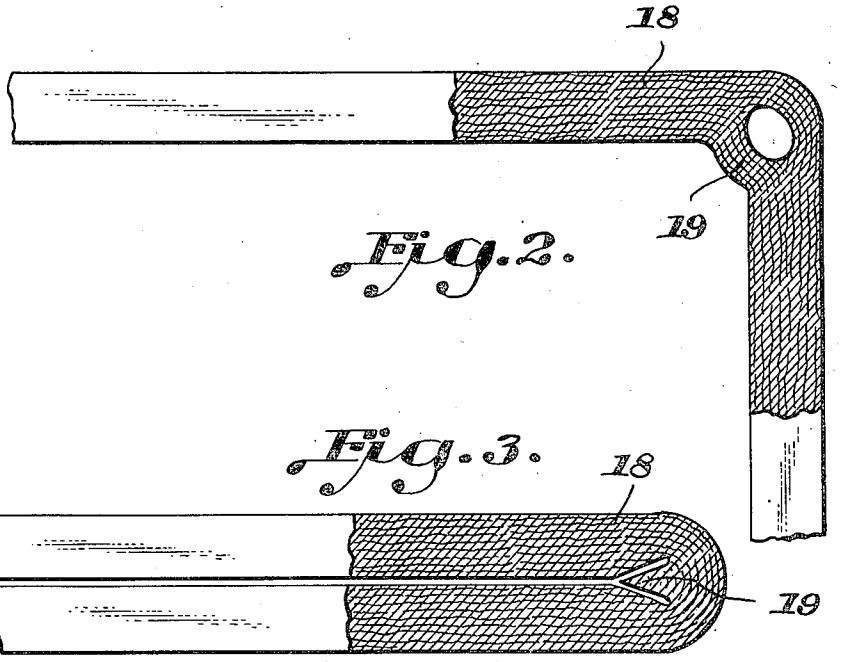


Fig. 2.

Fig. 3.

Fig. 4.

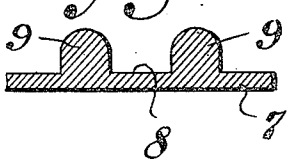
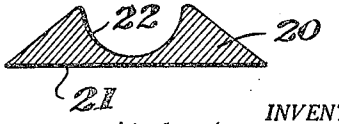


Fig. 5.



INVENTOR.
N. Andersson
BY
Wenderoth, Lind & Ponack
ATTYS.

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MATRIX FOR CREASING PAPERBOARD FOR CARTONS

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Fig. 6.

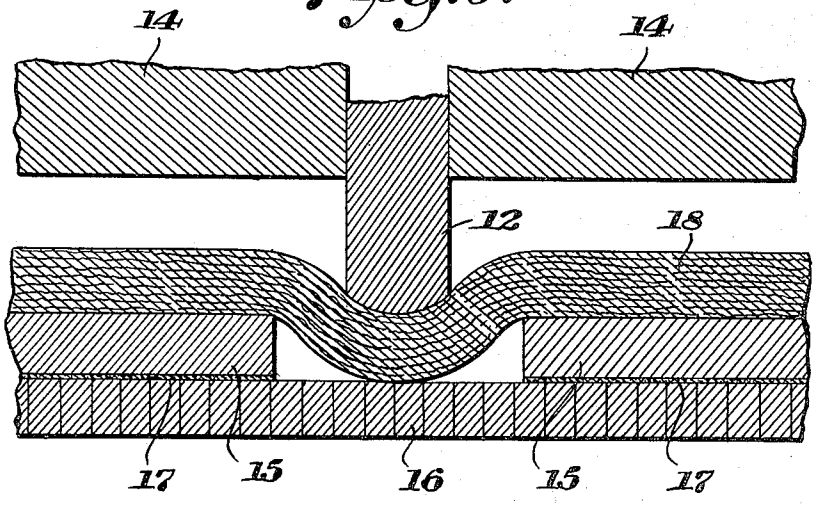
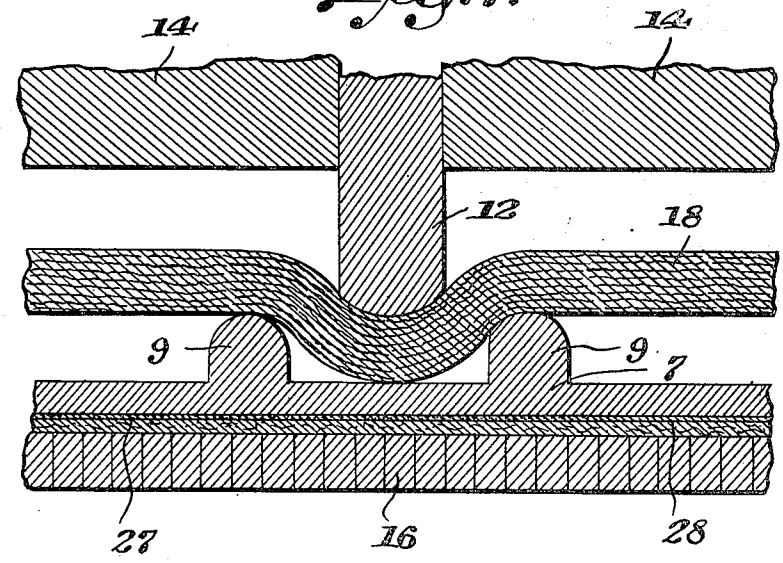


Fig. 7.



INVENTOR.
N. Andersson
BY
Wenderoth, Lind & Ponack
ATTYS

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MATRIX FOR CREASING PAPERBOARD FOR CARTONS

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Fig. 11.

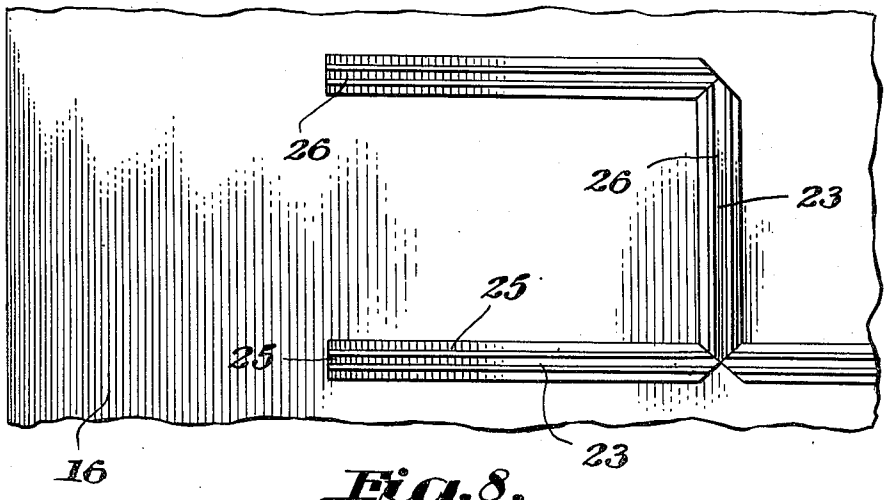
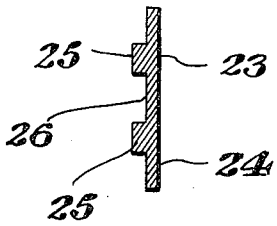


Fig. 8.



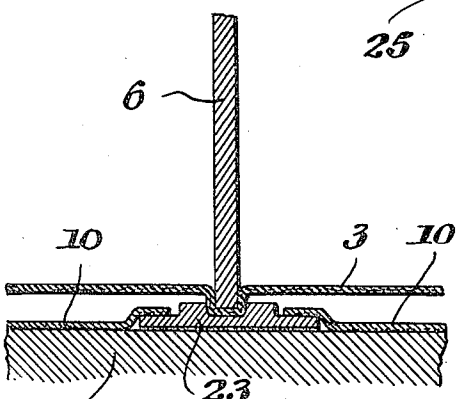


Fig. 9.

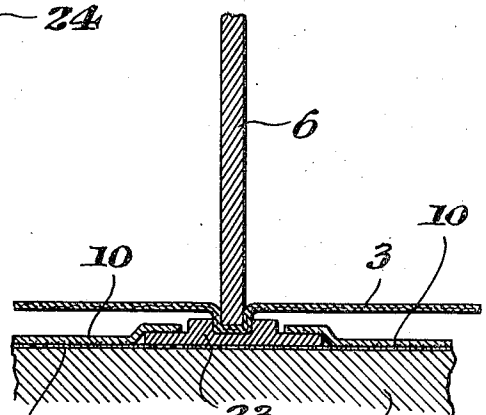


Fig. 10.

INVENTOR.
N. Andersson

BY
Wenderoth, Lind & Ponack
ATTYS.

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MATRIX FOR CREASING PAPERBOARD FOR CARTONS

Nils Andersson, Lund, Sweden

Application April 12, 1955, Serial No. 500,941

4 Claims. (Cl. 93—58)

This application is a continuation-in-part of my application Serial No. 172,824 filed July 10, 1950, now abandoned.

This invention relates to the art of making folding lines, commonly called creases, in cardboard or paperboard and particularly as this art is exercised and applied in the manufacture of folding paper boxes and related paperboard products. A crease, as the word is applied in this instance, may be defined as an embossed or impressed depression in one side of the paperboard with a corresponding raised ridge or welt on the other side forming a line along which the paperboard is structurally weakened and along which the paperboard will fold or bend when pressure is applied. Such creases are the basis of folding paper boxes and determine the lines along which the paperboard will fold thus determining the size and shape of the folded carton.

An object of the present invention is to provide a manufactured material having a structural form specific for the purpose and a method for its application to the creation of a crease or creases in paperboard in the manufacture of folding paper boxes and related paperboard products thereby overcoming many of the disadvantages of prior materials and methods and greatly advancing and improving the art.

The great majority of folding paper boxes and related paperboard products are cut out and creased in one operation on cylinder presses such as the Miehle press, on platen presses such as the Thomson-National, and reciprocating web fed platen presses such as the Mercury press. All of these utilize a flat male die, that is to say a die which lies in the machine against a flat surface, made up of wood or other suitable material which in turn supports metal rules which cut the paperboard and others which impress the creases, all of these rules being held in their desired relative positions as the shape and form to be produced may require. In all cases the desired action, cutting and creasing of the paperboard is accomplished by introducing the paperboard between the die and a steel surface and then bringing the die and steel surface together in such proximity that the cutting rules penetrate and cut through the paperboard and the creasing rules with the cooperation of grooves or channels imposed on the steel surface crease the paperboard in the desired pattern. In the case of cylinder presses the aforementioned steel surface is affixed to the cylinder of the press and is commonly called the jacket; in the case of platen presses it is affixed to one of the platen surfaces or faces and is commonly called the counterplate.

A further object of the invention is to provide a manufactured material of a structural form specific for the purpose of imposing upon the steel surface, jacket or counterplate as the case may be, the grooves or channels which form the female and which in cooperation with the creasing rules of the male die emboss or impress the desired creases into the paperboard. This material together with its method of application and use makes possible considerable savings in time with resultant more efficient use of the expensive equipment thereby forming creases of the most desirable characteristics.

The material and its structural form can be described as follows: A thin strip of homogeneous durable material has indented into one surface a groove or channel of calculated shape and dimensions. This channel or groove runs continuously the length of the strip exactly maintaining its shape and dimensions for its full length. These strips are manufactured from metal, a hard durable plastic such as nylon or such other material as might have the desired characteristics. It may be manufactured by rolling in the case of metal or by extrusion, rolling or molding in the case of plastic or by any other means which proved economical and resulted in a finished strip of the desired structural form. This strip is called a creasing matrix and will be hereinafter referred to by that name.

An object of the invention is to provide a creasing matrix which can be easily utilized on the equipment generally used to cut and crease paperboard without requiring any change or modification of that equipment.

Another object of the invention is to provide a creasing matrix which will have great durability and resistance to wear and stress.

A further object of the invention is to provide creasing matrices whereby the groove or channel shape and dimensions can be selected from empiricial data or tables thus eliminating the need for great manual skill and judgment.

A further object of the invention is to provide creasing matrices in which the groove or channel is constant and uniform in shape and dimensions thus eliminating the variances inherent in prior methods and constructions.

A still further object of the invention is to provide creasing matrices which are readily and easily affixed to the jacket or counterplate and which will reduce the skill required and the non-productive time of the machine.

An additional object of the invention is to provide creasing matrices which will withstand lateral pressure in the groove or channel making possible sharper and better defined creases in the paperboard.

A still further object of the invention is to provide creasing matrices wherein the indented groove or channel shape may be varied to that which is best suited to the purpose of creasing paperboard.

With the above and other objects in view which will become apparent from the detailed description below, some preferred forms of the invention by way of example only, are shown in the drawings in which:

Figure 1 is an enlarged partial cross sectional view of a piece of paperboard into which a folding line or crease has been impressed.

Figure 2 is the same view as Figure 1 after the paperboard has been folded along the crease to approximately 90 degrees.

Figure 3 is the same view as Figure 1 after the paperboard has been folded along the crease to 180 degrees.

Figure 4 is an enlarged cross sectional view of a piece of creasing matrix of one channel shape and dimension.

Figure 5 is an enlarged cross sectional view of a piece of creasing matrix of an alternate channel shape and dimension.

Figure 6 is an enlarged cross sectional view of a crease at the moment of impression using conventional paper or fibre counters.

Figure 7 is an enlarged cross sectional view of a crease at the moment of impression using a creasing matrix of the invention.

Figure 8 is a cross sectional view of another form of creasing matrix.

Figure 9 is a partial cross sectional view illustrating another way for securing a creasing matrix to its support.

Figure 10 is a similar view illustrating still another

way for securing a creasing matrix to its support, and

Figure 11 is a partial plan view illustrating the manner in which creasing matrices may be assembled to form a pattern.

In the various figures similar reference characters indicates like parts.

The advantages of the invention are best set forth by a description of the materials, methods and techniques used prior to the invention; a description of the shortcomings of the prior art both in application and results and a description wherein and by what means the invention overcomes these shortcomings.

The process heretofore followed of preparing the cutting and creasing press to perform the operations desired is the same for either cylinder or platen presses. The die containing the cutting and creasing rules which is designed in such a pattern as to cut out the form of and impress the creases in a folding box, or a number of such boxes, is placed and by mechanical means held against the surface of one of the platens of a platen press or the bed of a cylinder press as the case might be. The subsequent preparation is called "making ready" or the "makeready" and basically is composed of two phases. First a sheet of paper onto which has been attached additional pieces of paper in various areas and spots, thus forming a multiple thickness in those areas or spots, is placed under or behind the jacket or counter sheet, the top or face of the jacket or counter sheet being the surface which will oppose the die in operation. This sheet is called the "spot-up sheet" and is prepared by a trial and error procedure and is for the purpose of causing the jacket or counterplate to come into such proximity with the die when the action takes place that the cutting rules will cut completely through the paperboard.

The second part of the makeready involves affixing upon the top or face of the jacket or counterplate, counters or some means of creasing grooves or channels which in cooperation with the creasing rules will impress the desired creases into the paperboard when the action of the machine takes place. It is this part of the art of making ready the creation of a groove or channel of shape and dimension specific for its purpose and the affixing of this groove or channel in proper location on the top or face of the jacket or counterplate so as to cooperate with the creasing rule in proper manner, that is greatly improved and advanced by the present invention.

Prior to the development of the creasing matrix of the present invention the second part of the makeready was done substantially in the following manner. To the face or top of the jacket or counterplate a sheet of paperboard, pressboard, or fibreboard was adhesively affixed either directly to the surface of the jacket or counterplate or to a sheet of paper previously applied to the surface and affixed to it with adhesive. This sheet was large enough or if put on in pieces were large enough, and so affixed as to cover the surface of the jacket or counterplate in all areas which would come into proximity with the creasing rules of the die. The sheet of paperboard, pressboard, or fibreboard was selected beforehand of a thickness judged proper in relation to the thickness of the paperboard to be creased. A rule of selection generally followed was that this sheet commonly called the "counter" should be approximately the same thickness as the paperboard to be creased.

After the counter sheet was affixed to the jacket or counterplate an action of the press was caused to take place without a sheet of paperboard being introduced between the die and jacket or counterplate and by means of carbon paper, ink or other marking material the creasing rules were caused to print lines upon the counter sheet indicating their relative positions during the action and thus establishing the pattern and location of the grooves or channels to be subsequently cut into the counter sheet.

Using a sharp knife and a straight edge the workman performing the makeready next cut through the counter sheet on each side of the lines printed thereon parallel to such lines and by removing the strip between the cuts thus created a channel or groove which would cooperate with the creasing rule during the action of the press. Great skill and judgement were required in cutting these grooves or channels. For best results they must be exactly and uniformly of the proper width. They must be straight and exactly centered upon and parallel to the lines printed by the creasing rules. In actual practice something far short of perfection was the acceptable standard. Several efforts have been made to devise tools to assist the workman in this exacting task of cutting the counter but none has gained general acceptance and the basic tools have remained the knife and straight edge with the result that the grooves or channels so created have been subject to the shortcomings imposed by human judgement in dealing with measurements and tolerances which are difficult to measure and impossible to see with the naked eye.

An alternate method of creating the grooves or channels was by adhesively affixing strips of the counter material to the jacket or counterplate in such a manner that one side of each of two strips would form a groove or channel. This method has been used to a limited degree but is subject more or less to the same shortcomings as "cut" counters with the additional disadvantage that being subject to considerable lateral stress during the creasing action it is exceedingly difficult to so adhere the strips as to resist this stress and stay in place.

In both the "cut" and "strip" counter methods of creating the grooves or channels the shape has been limited to that of a rectangle with straight sides and bottom and sharp square corners. There is no evidence that this shape is most desirable but to the contrary there is evidence that some other shape would be more desirable, perhaps a circular shape as illustrated in Figure 5.

The "cut" and "strip" counter construction is illustrated in Figure 6 wherein the creasing rule is shown at **12** guided in the die blocks **14**. The counters are shown at **15** and the jacket or counterplate at **16**. The counters **15** are secured by adhesive **17** to the jacket or counterplate **16**. The paperboard being creased is shown at **18**.

It has been the accepted rule that dimensionally the groove or channel should be approximately of a depth equal to the thickness of the paperboard to be creased and the width should be twice this thickness plus the width of the creasing rule. Since paperboard is manufactured and specified as to thickness in increments of .001 inch plus or minus a tolerance of 5% it becomes self-evident that human judgement by itself is not able to attain the desired accuracy.

Among the disadvantages and shortcomings of the process of creasing paperboard by this prior method of cut or strip counters are the following:

1. Great skill and time are required to make ready or create the grooves necessary to make the creases. This is very costly in wages and in non-productive time of the machinery.

2. Grooves are subject to inaccuracies of human judgement in uniform width, straightness, and parallelism both in the continuous length of one particular groove and between separate grooves intended to perform identically.

3. The paperboard, pressboard or fibreboard is subject to wear both by pressure deformation and abrasion and consequently the grooves will not hold their original dimensions. With frequent repair work to keep the grooves in such shape that they perform even acceptably they cannot be made to last for more than 250,000 to 400,000 actions or impressions. This repair work is costly in both wages and non-reproductive time of the machinery.

4. At the time of the action of forming the crease the groove is subject to considerable lateral pressure. This lateral pressure must be borne by the adhesive bond between the counter and the jacket or counterplate. When this adhesive bond fails, as it frequently does, the counter becomes loose and one side of the groove is lost thus destroying it. Because of this inability of the glue bond to withstand the lateral pressure it is not possible to utilize as much of the lateral pressure as might be desired.

5. The shape of the groove created by counters is limited to a rectangular shape with sharp square corners and edges. There is evidence that a different shape of the groove is more desirable and yields better results.

Figure 1 illustrates first the formation of a crease **19** in a paperboard **18** and then in Figure 2 what takes place at the fold line when the paperboard is bent to 90°.

Figure 3 illustrates the formation of the fold line when the paperboard has been folded to 180°.

Figure 4 is a cross sectional view of a creasing matrix **7** which may be constructed from a metal or any hard durable plastic or other material which has the desired characteristics. The matrix **7** has been given the profile shown in Figure 4 by rolling and is provided with a longitudinally extending groove or recess **8** on one side thereof. In Figure 4 the groove **8** is located between two beads or ridges **9** which also extend longitudinally the length of the matrix.

The corresponding matrix is manufactured in long lengths and is cut into any desired short lengths at the place of use.

In Figure 5 a modified construction of the creasing matrix is shown which comprises a strip **20** of triangular form having a base **21** designed to be secured to the jacket or counterplate and a circular groove **22** extending longitudinally of the matrix at substantially the apex of the triangular cross sectional form.

Figure 8 shows also another form of a creasing matrix wherein the strip **23** is flat upon one side **24** while the other side is provided with two spaced beads **25** forming between them a groove **26** which is rectangular in cross section. The construction shown in Figure 8 approximates the forms heretofore used wherein counters **15** are provided as shown in Figure 6.

The creasing matrices such as **7**, **20** and **23** or matrices having any desired form upon one side for the reciprocation of the creasing rule may be directly glued upon the jacket or counterplate **16** as shown in Figure 11 in order to secure the desired crease line pattern and the corresponding matrices may be provided upon the surface opposite that for receiving the creasing rule with a knurled face so as to adhere better when glued.

Additional methods of securing the matrices to the jacket or counterplate **16** are shown in Figures 7, 9 and 10. In Figure 7 the jacket or counterplate has adhesively secured thereto a paper sheet **27** which is preferably of kraft paper and the corresponding matrix **7** is adhesively secured thereto by the adhesive bond **28**.

In Figure 9 a further method of securing the creasing matrix to the jacket or counterplate **16** is shown wherein the matrix is held in place first by being glued to the counterplate **16** and in addition secured by glue tapes **10** extending along the sides thereof. In this figure the paper board being creased is shown at **3** and the creasing rule at **6**.

In Figure 10 a further method of securing the creased matrix to the jacket or counterplate is shown wherein in addition to the securing of the matrix **23** to the paper sheet **27** tapes **10** are provided extending along the sides thereof.

It is to be noted that the creasing matrix and method of application and use are designed to be used on the equipment generally used for cutting and creasing cartons, namely cylinder presses, platen presses and reciprocating platen presses without requiring any changes in these machines or any special additions or modifications of the machine or its basic operation. Since, on all of these generally-used presses, both the cutting and creasing must be performed against a common surface, the jacket or counterplate, the creasing matrix must be thin enough in thickness or vertical dimensions so as not to materially elevate the creasing operation from this common surface. The thickness of the creasing matrix is probably limited to 0.075 inch. The width or lateral dimension must be such as to give relative inflexibility in the length of the matrix and at the same time provide a base by which it can be adhesively affixed to the jacket or counterplate and sufficiently wide to comfortably accommodate the groove idented in the other face or top of the matrix. The width for practical purposes is more than ¼ inch but probably not over ½ inch. This lateral dimension can be varied depending upon the requirements of the groove to be indented and the base necessary for adhesively affixing the matrix to the jacket or counterplate. The creasing matrix is cut at the time of manufacture into lengths convenient for storage and shipment and these pieces are cut into the required lengths just prior to the time of application.

The creasing matrix can be easily manufactured carrying any of several groove shapes and dimensions to fit the various requirements of paperboard thickness, bending quality of the paperboard and kind of crease desired. The user of the creasing matrix will have in stock an assortment of matrices so as to be able to select and use that which has the groove or channel of the shape and size best suited to form the creases as he desires them and will choose the ones which will give the desired resulting creases.

The application and use of the creasing matrix requires no change or modification of the equipment generally used for cutting and creasing nor is any change required in the usual practices of making the die. The makeready is the first step, making the setup for the cutting rules, remains the same as is generally practiced. After the spot-up sheet has been completed and the cutting rules made ready so that they cut through the paperboard as desired, a sheet of paper is adhesively affixed to the jacket or counterplate. This would preferably be a sheet of tough paper such as kraft wrapping paper. The creasing rules of the die are then caused to print upon this sheet of paper lines indicating their relative positions during the action of the machine thus locating the position and pattern in which the creasing matrices are to be affixed.

The creasing matrices are selected with consideration for the paperboard thickness, the rule thickness, and other characteristics of the creases desired. Pieces of the matrix or matrices are cut to lengths corresponding to the length of the creasing rules with which they are to cooperate. The pieces are then adhesively affixed to the sheet of paper on jacket or counterplate using the lines previously printed thereon by the creasing rules to position the pieces of matrix so that they will properly cooperate with the creasing rules so as to form the desired creases when the action of the machine takes place.

The preferred construction of the creasing matrix is a machine-formed metal strip forming a channel of correct size and shape for use as the female die or counter in creasing boxboard. The matrix is accurately and precisely made with a uniformly shaped and calibrated channel. The metal is heat treated in order to secure the best preformance and long life and is supplied in a plurality of channel sizes for various board calipers, rule thicknesses and creasing requirements.

With the matrix as disclosed above, production costs can be lowered because it is simple to apply and quicker and easier than hand cut counters as at present used. Also less skill is required on the part of the pressman. Furthermore, since the channel shape and size is predetermined the human judgement factor heretofore required for securing straightness and uniformity in order to secure high quality creases is eliminated. Also there is

no maintenance required during a run which may go above a million impressions and there is no shellacking or coating required in order to make a run last longer. Furthermore, no taping is required due to the creases becoming too wide and weak as is at present the case.

Since the channels are of the correct and exact size and shape superior creases result. Also, since the channel size and shape is uniform the creases are uniform and there is no variance in the creases from rule to rule or from carton to carton. In addition, there are no tapered creases or crooked creases. Nor are the creases wider at the ends than at the middle or vice versa. The last crease made during a run is exactly similar to the first crease made during such run. The creasing matrix described above is as indestructible as the creasing rule itself.

A detailed method of preparing the makeready with the creasing matrix above described is as follows: The groove or channel width of the matrix is selected with relation to the board caliper and the rule width to be used. In some cases it may be necessary to modify the choice of width in order to meet varying board conditions or characteristics of the crease desired. Very good results have been obtained by using a narrower groove width for forming the with-grain creases.

The matrix is then cut to proper length which is approximately 1/8 to 3/16 inch shorter than the panel size to be creased. The panel size is the center of score to the center of score measure. The matrix should be cut with the grooved side up and if the beads are damaged during such cutting this can be easily remedied by trimming down the ends of each piece.

The side flanges are now beveled so that the corners will be properly joined and the ends of the beads may be rounded off with a small file. Any burrs that may appear on the bottom ends of the pieces should be removed.

The cutting rules are made ready in the normal manner since there is no change in the usual practice with regard thereto. Then a good tough sheet of kraft paper is glued to the jacket or platen. An impression of the creasing rule is now made upon the kraft paper by using a fairly soft paper board between the die and a sheet of carbon paper. After the impression has been made the center of the rule impression should be further marked by using a pencil and straight edge in order to extend the lines beyond the ends of the creasing rules.

The creasing matrix is then glued to the jacket or platen using care in order to see that the center of the groove of each piece is accurately centered on the impression line of the creasing rule.

Furthermore it is very easy to change the matrix if the groove therein is not true with the creasing rule. In such case, it is merely necessary to run a sharp knife along the sides of the matrix, peel it off gently and reglue it as required.

Among the improvements in the art of creasing paperboard and the advantages in the use of the creasing matrices described are the following:

1. The matrix with the groove or channel of proper shape and dimensions for a particular application can be selected from empirical data with due consideration for all the factors involved and having been so selected will be constant and uniform. This reduces the skill and judgement required in previous methods and provides control over the shape and dimension of the groove or channel not possible by human judgement.

2. The shape and dimensions of the groove or channel of the creasing matrix can be controlled in manufacturing to exceedingly close tolerances, thus eliminating the variances inherent in the previous methods.

3. The creasing matrix being made of a durable material such as metal or tough plastic has great resistance to wear, pressure deformation and abrasion. In actual operation the creasing matrices of the present invention have resisted wear for 3,000,000 actions of the machine or impressions without showing any appreciable change in shape or dimensions.

4. In the creasing matrix the groove or channel is indented into the strip and the material surrounding the groove or channel is continuous. This structural form results in a groove or channel which will stand great lateral stress as the sides of the groove are continuous with the base and not dependent upon an adhesive bond as in the prior methods. The ability of the creasing matrix to withstand lateral pressure on the sides of the groove or channel makes possible the formation of better defined creases in the paperboard.

5. In the creasing matrix the shape of the groove or channel is not limited to that of a rectangule but the matrices can readily be manufactured with various shapes which are determined to be most suitable for the particular application.

It is thought that the invention and its advantages will be understood from the foregoing description and it is apparent that various changes may be made in the process, form, construction and arrangement of the parts without departing from the spirit and scope of the invention or sacrificing its material advantages, the forms hereinbefore described and illustrated in the drawings being merely preferred embodiments thereof.

I claim:

1. A creasing matrix, for use in cooperation with a creasing rule to form a crease in paperboard, comprising a longitudinally extending flexible strip of integral construction of durable material having a roughened flat surface on one side by which the matrix can be adhesively attached to a jacket or counterplate and a channel of shape and size specific for the purpose formed in the opposite side of said strip, said strip being relatively thin below 0.075 inch so as to be usable on cylinder or platen presses whereon the creasing operation must be performed against a common surface with the cutting operation and thereby cannot be materially elevated from this surface.

2. A creasing matrix as set forth in claim 1 wherein said strip is of metal.

3. A creasing matrix constructed of durable material for creasing paperboard for cartons comprising a longitudinally extending flexible strip of integral construction having a flat surface and two longitudinally spaced integral beads opposite said flat surface forming a calibrated groove to cooperate with a creasing rule to form a fold line in paperboard, said strip being relatively thin below 0.075 inch and said flat surface being roughened to be adhesively secured to a jacket or counterplate after said strip has been cut to desired length whereby makeready is simplified and quality and quantity of fold lines increased.

4. A creasing matrix as set forth in claim 3 wherein said strip has a cross section of triangular form with said calibrated groove located at the apex thereof and said flat surface at the base thereof.

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