June 16, 1959 K. W. BRITT 2,890,540

PAPER NAPKIN

Original Filed May 18, 1954 2 Sheets-Sheet 1

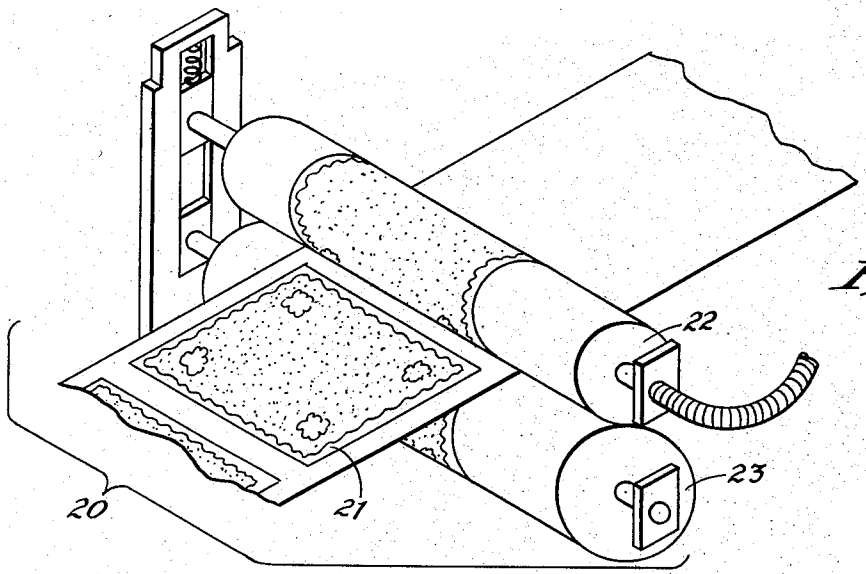

Fig. 1.

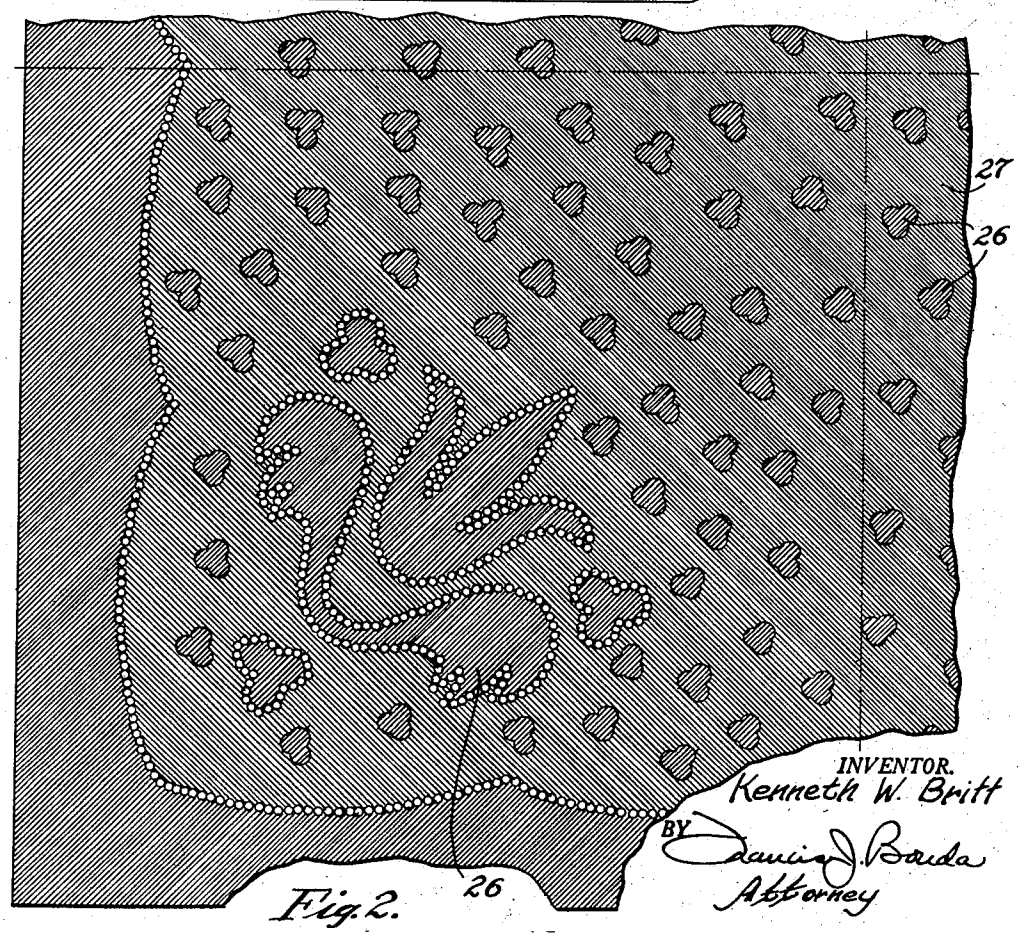

Fig. 2.

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PAPER NAPKIN

Original Filed May 18, 1954 2 Sheets-Sheet 2

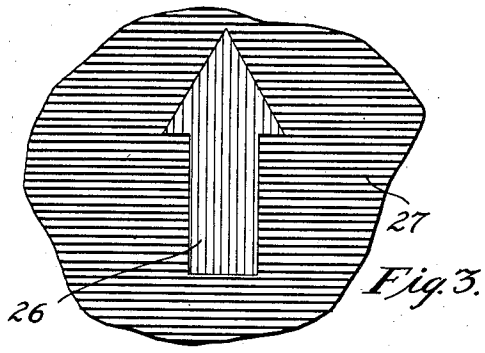
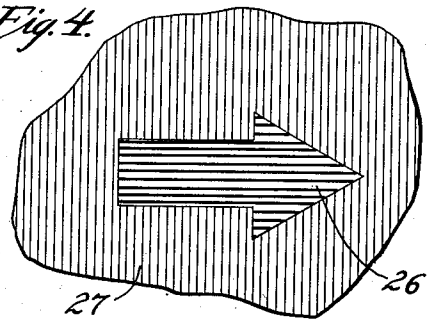


Fig. 3.

Fig. 4.



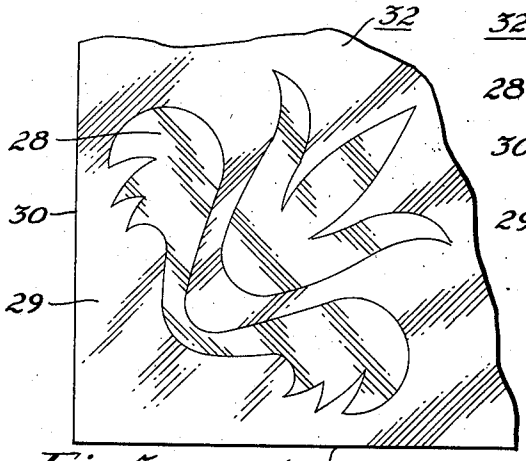


Fig. 5.

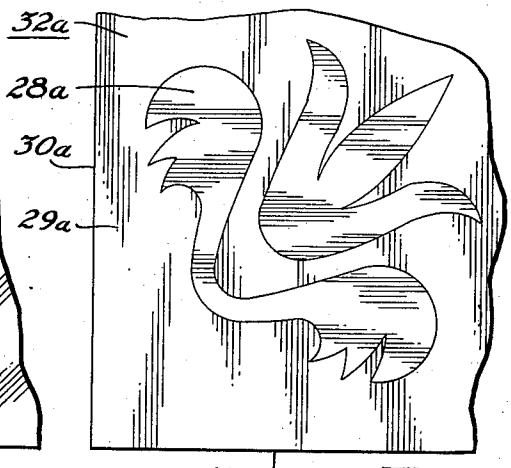


Fig. 6.

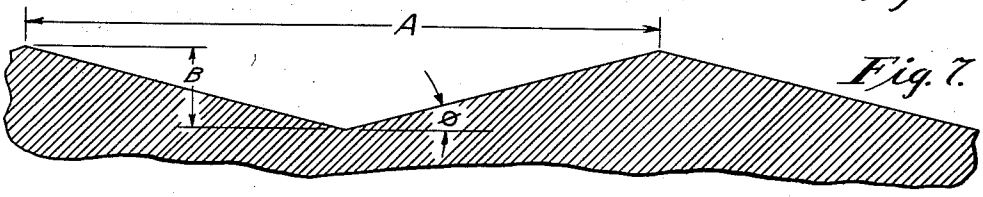


Fig. 7.

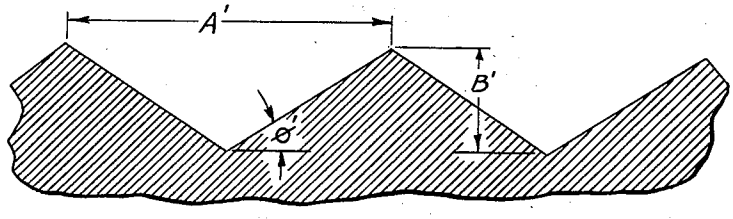


Fig. 8.

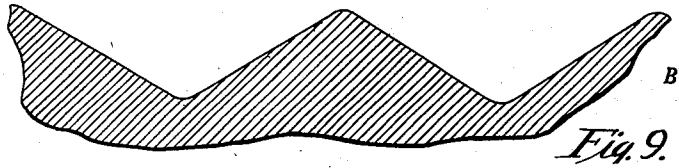


Fig. 9.

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United States Patent Office

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PAPER NAPKIN

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Continuation of application Serial No. 430,523, May 18, 1954. This application October 18, 1955, Serial No. 541,126

5 Claims. (Cl. 41—24)

This application is a continuing application and discloses and claims only subject matter disclosed in copending application Serial No. 430,523, filed May 18, 1954, now abandoned.

The present invention relates to embossed paper and specifically to paper napkins embossed with a distinctive design as well as to the method of manufacturing the distinctive embossed paper napkins of the present invention.

Embossing of paper to produce a design thereon has long been known in the art and is usually accomplished by passing one or more (sometimes as many as six) superimposed webs of paper simultaneously between a pair of opposed rolls, one of which may be of metal and engraved with the design desired to be impressed on the paper. The other roll is generally resilient and usually made of rubber or paper. The resilient roll is urged against the engraved metal roll and the pattern of the engraved metal roll is either "run into" the paper roll or the resilient roll conforms to the design engraved on the metal roll as the two are run together.

Usually a set of gears or other interconnecting means causes the two rolls to rotate in synchronism.

The paper webs (when embossed according to prior practices) are usually at room temperature and are relatively dry.

However, embossed paper has certain disadvantages when manufactured according to prior practices, some of which are lack of definition of the design, lack of sharpness of the impression, weakness or rupturing of the paper, wrinkling or disfiguration of the paper and others.

With the foregoing in mind one object of the present invention is to provide an improved embossed paper napkin of distinctive and unique appearance.

Another object of the present invention is to produce a paper napkin having a damask pattern or a pattern which simulates damask cloth.

Another object of the present invention is to provide embossed paper with a design including fine lines, each of which is clear and distinct in the finished product.

Another object of the present invention is to provide a method for producing the improved paper of the present invention.

Another object of the present invention is to provide an engraved embossing roll to produce embossed paper having a damask finish or simulating damask cloth.

A further object is to provide a paper napkin having a surface which affords a unique and pleasant sensation when handled.

An additional object is to provide a means for securing together the webs of a multi-ply paper napkin.

Another object is to reduce surface linting in a paper napkin manufactured from soft paper.

Another object is to provide a paper napkin which simulates starched damask linen cloth.

Other objects will be apparent by reference to the appended specification, claims and drawings.

For the purpose of illustrating the invention, there are shown in the accompanying drawings forms thereof which are at present preferred, although it is to be understood that the various instrumentalities of which the invention consists can be variously arranged and organized and that the invention is not limited to the precise arrangements and organizations of the instrumentalities as herein shown and described.

In the drawings wherein like reference characters indicate like parts:

Figure 1 is a perspective view of a pair of embossing rolls used to practice the process and produce the product of the present invention.

Figure 2 is a fragmentary plan view of one-quarter of a napkin manufactured according to the present invention.

Figure 3 is an enlarged fragmentary plan view of a portion of a piece of paper having the distinctive embossing of the present invention.

Figure 4 is a view similar to Figure 3 but turned 90° so that the contrast reflectance which produces the damask effect may be observed.

Figure 5 is an enlarged fragmentary plan view of one embodiment of the napkin of the present invention.

Figure 6 is an enlarged fragmentary plan view of another embodiment of the napkin of the present invention.

Figure 7 is a greatly-enlarged cross-sectional view illustrating the surface of a napkin embossing roll engraved 20 lines per inch with each groove .006" deep.

Figure 8 is a greatly-enlarged cross-sectional view similar to Figure 7 but with the roll engraved 40 lines per inch to a depth of .008".

Figure 9 is a view similar to Figure 8 but with the crests and valleys of the grooves slightly rounded.

In the present invention a pair of embossing rolls **20** is used to produce a design on a web **21** of paper passed between the rolls **22** and **23** of the pair of rolls **20**. The web **21** may be single-ply or multi-ply, but preferably is not more than a two-ply web. The roll **22** may be made of steel or any other suitable material engraved with the design which is desired to be impressed on the paper web **21**. A pressure roll **23** is generally made of resilient material such as rubber or paper and is urged toward the engraved roll **22** whereupon the rolls are run together, under pressure, so that the design on the roll **22** will be impressed on the roll **23**.

The roll **22** and the roll **23** are suitably interconnected so that they rotate in synchronism.

The roll **22** preferably is a heated roll and may be maintained at a predetermined temperature by suitable controls such as by regulating the steam pressure in the rolls through a suitable valve (not shown). The heat source may be connected to the roll **22** through suitable journals and bearings.

Inasmuch as temperature changes of the roll **22** cause expansion and contraction thereof and effectively change the diameter of the roll **22**, it is desirable that the roll **23** be resilient so that its matching surfaces will correspond to the design of the engraved roll **22** even though changes in the temperature cause expansion or contraction of the metal roll. Moreover, the use of a resilient roll with an engraved metal roll causes less cutting or tearing of the paper than when two metal rolls are used, even though no heat is applied to the rolls.

Although many types of paper may be successfully employed in the following the teachings of the present invention, the data hereinafter referred to relates to napkins formed from soft creped facial-type tissue made on a paper machine having a Yankee Drier and made from 100% bleached chemical wood pulp and having a ream weight of approximately 10.4 to 11.6 per ply (22# for a two-ply web).

It is preferred that the paper web **21** be maintained within a predetermined range of moisture content and it has been found most satisfactory to control the moisture content during manufacture thereof on the paper machine rather than during the finishing operation. However, addition of approximately 1% moisture can be effected through the use of steam jets to add moisture to the sheet while the web is traveling from a parent roll (not shown) to the pair of embossing rolls **20**.

As will be more fully explained hereinafter, the moisture content (or, conversely, the percent of dryness of the paper) is maintained within a predetermined range to produce the desired results and this range has been found to be between a minimum of 6% and a maximum of 12% and preferably between 8% and 11% moisture (89% to 92% dry).

Although hundreds of designs have been engraved into embossing rolls and have been used to produce embossed paper napkins in the past, none of these designs has shown the distinctive appearance and quality of the damask-type paper napkins of the present invention.

In the present disclosure reference will be made to a damask paper napkin and for the purpose of definition, as herein used, a damask paper napkin or damask-type paper napkin is considered to be one which simulates damask cloth and which is distinguished, in appearance, by having high sheen and pleasing surface feel of starched linen napkins and by having its surface covered with a multitude of straight, narrow, shallow grooves closely spaced in any one area, with adjacent areas having the grooves extending in a direction transverse to the grooves in the first areas. When viewed at an angle the light is reflected from the grooves of certain areas and not from the grooves of other areas so that portions of the surface of the paper appear light and other portions appear dark, and upon turning the sheet of paper 90° the areas which at first were light become dark and the dark areas become light because the first areas now have the light absorbed by the grooves and the second areas have the light reflected therefrom. This contrast in reflectance of light gives the appearance of damask cloth and, moreover, this damask-like pattern is apparent on both sides of the paper as a result of the full embossing of the design into the paper. Moreover, because of the technique of the process of the present invention the damask surface has the high sheen and pleasing surface feel referred to above without appreciable loss of strength or absorbency and, in addition, has a smooth surface which prevents surface linting, and thus has the "feel" as well as the appearance of a damask napkin.

The high reflectance contrast and the exceptionally high strength of the paper are the result of unique engraving of the surface combined with controlled conditions during the embossing operation to produce areas of maximum reflectance contrast with minimum loss of strength or weakening of the paper.

It may be noted here that the brightness of the paper is not increased by the process of the present invention (the brightness of the unembossed paper being substantially the same as the brightness of the paper embossed according to the present invention) but the paper is "worked" in a unique fashion to provide areas of reflectance contrast so that some areas reflect more light to the observer's eye than do other areas, and hence some areas look darker than others, as in a piece of damask cloth.

Inasmuch as reflectance contrast and strength are dependent upon the angle of the engraved groove as well as the depth of the groove, as well as upon certain physical factors of the so-engraved surface (i.e., whether the crests and valleys between the reflecting surfaces of the grooves are sharp or rounded) the method of engraving is an important part of the present invention.

In Figure 2 there is illustrated a section of a napkin produced by the present invention showing areas **26** which have the engraved lines extending in one direction and background areas **27** wherein the engraved lines extend in the opposite direction (i.e., at a 90° angle to the grooves in first areas) so as to produce areas of reflectance contrast on the surface of the napkin.

Figures 3 and 4 illustrate the reflectance contrast referred to above. In Figure 3 the background **27** appears dark because light falling on the grooves in that area is not reflected to the observer, while light falling on the grooves in the area of the pattern **26** is reflected toward the observer and the area appears to be light-colored. When the paper is turned (in its plane) through an angle of approximately 90° or when the angle of incidence of the light falling on the paper is changed, then the pattern-areas **26** become darker and the background-areas **27** become lighter, as illustrated in Figure 4.

Figures 5 and 6 illustrate other characteristics of the pattern or the embossing which have been noted in the processing or manufacturing of the napkin having the distinct design of the present invention. In Figure 5 the areas **28** are engraved with lines extending transversely to the lines of areas **29** but in each of the areas **28** and **29** the lines extend at an angle of 45° to the border edges **30** and **31** of the napkin **32**. This angular relation between the border edges and the groove-direction has been found to be satisfactory in the napkin of the present invention but it is also believed to be desirable to have the sum total of the areas **28** equal the sum total of the areas **29**, so that the paper will not have a tendency to be drawn to one side or the other by the rolls during its passage therebetween because of the gear-like effect of the rolls upon the paper.

The pattern illustrated in Figure 6 is illustrative of a design wherein the grooves in the areas **28*a*** extend at a right angle to the grooves in the areas **29*a***, but where the grooves in areas **28*a*** and **29*a*** extend parallel to one or the other of the edges **30*a*** or **31*a*** of the napkin **32*a*** whereby to minimize skewing or slipping of the paper between the rolls.

It is to be understood that the grooves in adjacent areas preferrably extend at 90° to each other to achieve maximum reflectance contrast, but, if desired, the grooves in adjacent areas may extend at angles other than 90°.

It has been discovered if the paper to be embossed is exceptionally dry that no amount of heat or pressure could satisfactorily impress the pattern of the present invention on the paper web. Moreover, if the paper is too damp, the pattern, though impressed into the surface will soon be lost because the paper will straighten out after it has passed through the embossing rolls and reflectance contrast will be slight.

It has been found that the preferred temperature, moisture and pressure are not simple relationships and that to produce the damask paper napkin of the present invention the paper must be maintained within a critical range of moisture content, and that no amount of subtraction or addition of heat in the roll **22** would produce the desired end result if the moisture content varied appreciably from the range herein set forth. This range is between 6 and 13% and preferably is between 8% to 11%.

However, the temperature range is not as critical as the moisture content but is related to the speed of the passage of the web **21** between the rolls **22** and **23**, to the number of plys of paper in the web **21**, and also to the ream weight of the paper. That is to say, the faster the paper moves between the rolls and/or the greater the number of paper-plys in the web, and/or the greater the ream weight of the paper, the hotter the rolls must be. This is generally called the "pounds-per-minute throughput" of paper passing between the rolls **22** and **23**.

It has also been found necessary to control the width (number of lines per inch) and the depth of the parallel grooves in the areas **28** and **29**. The reflectance contrast from the various surfaces is dependent on the angle and the depth of the grooves in the areas. The wider the

grooves for any given depth, the lower will be the reflectance contrast because the paper will assume a flatter condition over its entire surface. This is illustrated in Figures 7 and 8. The shallow grooves of the paper illustrated in Figure 7 provide less reflectance contrast than do the grooves of the paper shown in Figure 8. The reflectance contrast is a function of the tangent of angle θ; the greater the tangent the higher will be the reflectance. A low tangent will mean either a very flat or a very sharp angle, each of which is undesirable. Flat angles provide for little or no contrast in reflectance by reflecting much light equally in all areas; sharp angles trap the light in all areas equally and hence provide for little or no contrast.

In addition, the strain or weakening of the paper is dependent on the width and depth of the grooves. The deeper the grooves for any given pitch, the greater will be the strain upon the paper and the weaker the paper will be because the pressure roll will be forcing the paper deeper into a groove of restricted mouth area and there will be a greater tendency to rupture the fibers and hence weaken the paper. This is also illustrated in Figures 7 and 8. In Figure 7 the mouth dimension A is great and the depth B slight. The extension of the paper from the dimension A to a dimension which covers the surface of the groove (from crest down to valley and up to crest) is not sufficient to weaken the paper. However, in Figure 8 a greater percentage extension is necessary because A1 is less than A and B1 is greater than B, and hence a greater strain is placed on the paper.

It is believed to be desirable to create a radius at the crest and at the bottom of the grooves on the embossing roll so that a sharp, cutting edge will be eliminated. However, the radius of this rounded portion should be limited so that the lines of definition between the parallel grooves will not be lost.

Figure 7 illustrates a pattern having 20 lines per inch, each groove being .006" deep. The reflectance contrast factor (length of one side of the groove $\times$ number of grooves per inch $\times$ tangent θ) is low, being only 124. However, the strain factor (increase in length of A divided by A) is also low, being 3.2%.

Figure 8 illustrates a pattern having 40 lines per inch, each groove being .008" deep and here the reflectance contrast factor is high (380) and the strain factor is also increased (18.4%). Nevertheless, a pattern of 40 and 8 is preferred, for it provides an optimum balance between reflectance contrast and strain and also provides a more refined appearance. See the following table:

Grooves per inch	Depth of Groove	Reflectance Contrast Factor (per inch)	Strain Factor (percent)
Sharp corners:			
20	.006	124	3.2
20	.012	266	10.8
40	.006	268	11.2
40	.007	321.2	14.4
40	.008	380	18.4
40	.012	668	38.7
60	.006	444	23.3
Rounded corners:			
40	.012	516	18

The desirability of having rounded corners is illustrated by comparison of a pattern of 40 lines per inch at a depth of .012 inch—one pattern having sharp corners, the other having rounded corners. In rolls having sharp line of definition between grooves there is a strain factor of 38.7% and a reflectance factor of 668 while rolls with rounded edges between grooves have a strain factor of 18% and a reflectance factor 516.

The temperature of the engraved metal roll while rotating has been found to be optimum at approximately 280° F. At temperatures below this, the roll is too cool for high speed operation.

If the paper is run at conditions where it is drier than 92%, the pattern will not be formed properly in the paper because it will not conform properly to the configurations of the engraved roll, but if the paper is wetter than 89% dry (11% moisture), good embossing is evident immediately upon discharge of the rolls but later handling and storing of the paper produces wrinkling and causes elimination of the embossed pattern.

High speed operation is desirable from an economic standpoint and the heretofore mentioned temperature of 280° F. permits the web 21 to be run through the rolls at speeds of 500 feet per minute. Operations at 150° F. would be possible if the speed were reduced to the range of approximately 50 feet per minute.

Although a single pattern or design is illustrated (as in Figure 2) it is to be understood that any pattern or figure may be used, subject only to the forming of the surface of adjacent areas in the manner set forth above.

The border portion of the napkin may be grooved in both directions (not illustrated) so that a minimum of "buckling" takes place, but it has been found satisfactory to have the border grooved in only one direction so that the reflectance contrast appears in the border zone as well as in the patterned body-area (as illustrated in Figure 2).

The process described herein also welds or binds the two plys of the sheet together and is superior to previous bonding methods insofar as the selected moisture content and temperatures range in combination with the unique surface pattern supplant any adhesive, and effective bonding is achieved at the same time that the new and novel pattern is provided.

The present invention may be embodied in other specific forms without departing from the spirit or essential attributes thereof, and it is therefore desired that the present embodiments be considered in all respects as illustrative and not restrictive, reference being had to the appended claims rather than to the foregoing description to indicate the scope of the invention.

Having thus described the invention, what is claimed is:

1. The process of forming thin, soft, absorbent creped paper of facial tissue type of provide a surface having contrasting light reflectance characteristics simulating the appearance of fine damask linen which comprises molding and compacting a multi-ply sheet of said paper, by passing said sheet between two rolls, after each ply thereof has passed completely through the drying section of a paper machine, one of which rolls is a metal die roll having on its surface a background area formed by a plurality of small, narrow, closely adjacent, parallel V-shaped grooves and having at least one design element area formed on the background area and the other of which rolls is a mating roll whose surface at least during the passage of the paper between the said rolls conforms to the pattern on the aforesaid metal die roll, the basis weight of each ply being between about 9 and about 15 pounds per ream of 2,880 square feet, and maintaining the moisture content of the sheet just prior to the passage of said sheet between said rolls between about 8% and about 11% and maintaining the surface of at least one of said rolls at a temperature between about 150° F. and about 400° F., the speed of passage of said sheet between said rolls being at least about 50 feet per minute, whereby to heat said moisture-containing sheet during its passage between said rolls to reproduce and set in said sheet a clearly defined pattern corresponding to the pattern on said die roll.

2. The process of forming thin, soft, absorbent creped paper of facial tissue type of provide a surface having contrasting light reflectance characteristics simulating the appearance of fine damask linen which comprises molding and compacting a multi-ply sheet of said paper by passing said sheet between two rolls at a speed of about 500 feet per minute, after each ply thereof has passed completely through the drying section of a paper machine, one of which rolls is a metal die roll having on its surface a background area formed by a plurality of small, narrow,

closely adjacent, parallel V-shaped grooves and having at least one design element area formed on the background area and the other of which rolls is a mating roll whose surface at least during the passage of the paper between the said rolls conforms to the pattern on the aforesaid metal die roll, and maintaining the moisture content of the sheet just prior to the passage of said sheet between said rolls at about 9% and maintaining the surface of at least one of said rolls at a temperature of about 280° F. to heat said moisture-containing sheet during its passage between said rolls to reproduce and set in said sheet a clearly defined pattern corresponding to the pattern on said die roll.

3. The process of forming thin, soft, absorbent paper to provide a surface having contrasting light reflectance characteristics simulating the appearance of fine damask linen which comprises molding and compacting a sheet of said paper, consisting of at least one ply, by passing said sheet between two rolls, after each ply thereof has passed completely through the drying section of a paper machine, one of which rolls is a metal die roll having on its surface a background area formed by a plurality of small, narrow, closely adjacent, parallel V-shaped grooves and having at least one design element area formed on the background area and the other of which rolls is a mating roll whose surface at least during the passage of the paper between the said rolls conforms to the pattern on the aforesaid metal die roll, and maintaining the moisture content of the sheet just prior to the passage of said sheet between said rolls between about 6% and about 13% and maintaining the surface of at least one of said rolls at a temperature between about 150° F. and about 400° F., the speed of passage of said sheet between said rolls being at least about 50 feet per minute and related with the temperature of said roll so that generally higher temperatures are employed with the highest speeds and generally lower temperatures with the lowest speeds, to heat said moisture-containing sheet during its passage between said rolls to reproduce and set in said sheet a clearly defined pattern corresponding to the pattern on said die roll.

4. The process of forming thin, soft, absorbent creped paper of facial tissue type of provide a surface having contrasting light reflectance characteristics simulating the appearance of fine damask linen which comprises molding and compacting a sheet of said paper, consisting of at least one ply, by passing said sheet between two rolls, after each ply thereof has passed completely through the drying section of a paper machine, one of which rolls is a metal die roll having on its surface a background area formed by a plurality of small, narrow, closely adjacent, parallel V-shaped grooves and having at least one design element area formed on the background area and the other of which rolls is a mating roll whose surface at least during the passage of the paper between the said rolls conforms to the pattern on the aforesaid metal die roll, and maintaining the moisture content of the sheet just prior to the passage of said sheet between said rolls between about 6% and about 13% and maintaining the surface of at least one of said rolls at a temperature between about 150° F. and about 400° F., the speed of passage of said sheet between said rolls being at least about 50 feet per minute and related with the temperature of said roll so that generally higher temperatures are employed with the highest speeds and generally lower temperatures with the lowest speeds, to heat said moisture-containing sheet during its passage between said rolls to reproduce and set in said sheet a clearly defined pattern corresponding to the pattern on said die roll.

5. The process of forming thin, soft, absorbent creped paper of facial tissue type of provide a surface having contrasting light reflectance characteristics simulating the appearance of fine damask linen which comprises molding and compacting a multi-ply sheet of said paper, by passing said sheet between two rolls, after each ply thereof has passed completely through the drying section of a paper machine, one of which rolls is a metal die roll having on its surface a background area formed by a plurality of small, narrow, closely adjacent, parallel V-shaped grooves and having at least one design element area formed on the background area and the other of which rolls is a mating roll whose surface at least during the passage of the paper between the said rolls conforms to the pattern on the aforesaid metal die roll, the basis weight of each ply being between about 9 and about 15 pounds per ream of 2,880 square feet, and maintaining the moisture content of the sheet just prior to the passage of said sheet between said rolls between about 6% and about 13% and maintaining the surface of at least one of said rolls at a temperature between about 150° F. and about 400° F., the speed of passage of said sheet between said rolls being at least about 50 feet per minute, whereby to heat said moisture-containing sheet during its passage between said rolls to reproduce and set in said sheet a clearly defined pattern corresponding to the pattern on said die roll.

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