

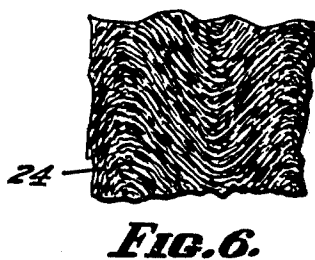
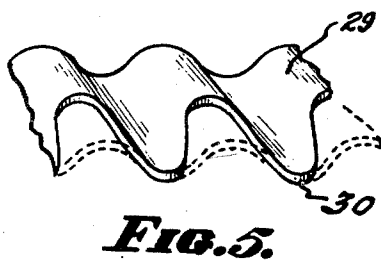
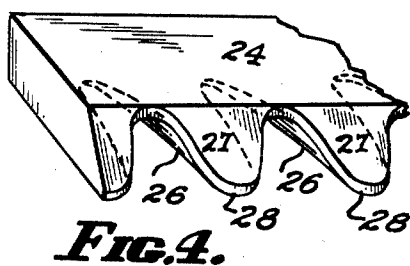
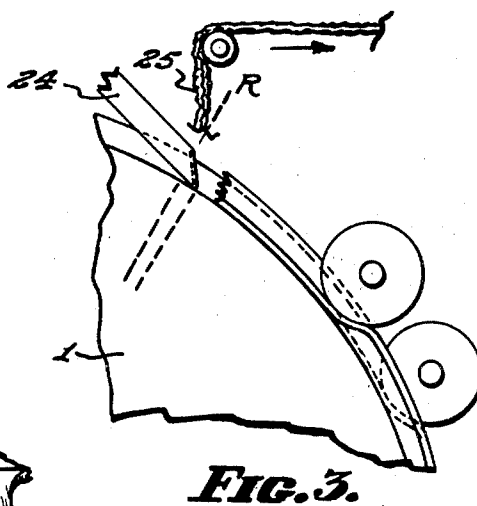
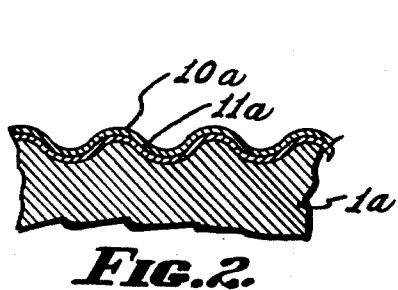
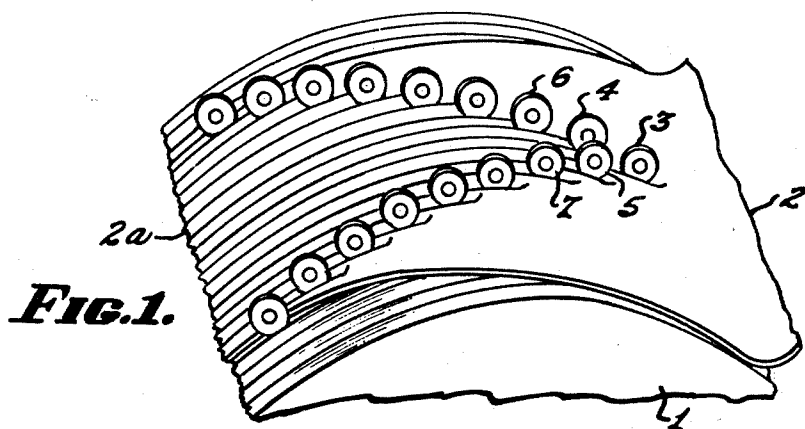
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2,494,723

CREPING CORRUGATED PAPER

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CREPING CORRUGATED PAPERS

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319,641. Divided and this application February
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8 Claims. (Cl. 154—33.05)

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This application is a division of my copending application Serial No. 319,641, filed February 19, 1940, now Patent No. 2,425,207, which in turn is a continuation in part of the application which matured into Patent 2,190,680.

Fundamentally my invention relates to the corrugating and creping of papers or other webs, and finds its most important, though not exclusive application, in the formation in webs of corrugations which are parallel to the longitudinal axis of the web and which may be formed in a continuous manner, together with the creping of such webs while in corrugated conditions.

My invention relates to a novel step or series of process steps which have importance in a plurality of different fields, among which may be mentioned, but without limitation, the corrugating and creping of webs as a part of a substantially unitary operation, the creping of previously corrugated webs, and the production of special types of creped papers.

In this case I describe and claim the process and apparatus for forming products in which the widthwise gathering produced by corrugating is in greater or less degree transformed into sinuosities of the creping crinkles.

The fundamental and ancillary objects of my invention will be set forth hereinafter, or will be entirely clear to the skilled worker in the art on reading these specifications. For clarity in the disclosure, which is to follow, reference is now made to the drawings, wherein:

Figure 1 is a semi-diagrammatic perspective view of one form of corrugating mechanism in connection with which my invention may be carried on.

Figure 2 is a sectional view of a portion of one type of corrugating surface showing one method of binding the web to that surface.

Figure 3 is a semi-diagrammatic elevation of means for corrugating and thereafter creping a web in which the corrugated character of the web is partially or wholly converted into a wavy conformation of the creping crinkles.

Figure 4 is a partial perspective view of a doctor usable with the mechanism of Figure 3.

Figure 5 is a partial perspective view of another doctor usable with the mechanism of Figure 3.

Figure 6 is a plan view of a creped web in which corrugations have been converted into a wavy configuration of the crinkles.

I shall first describe the corrugating portion of my apparatus. In the production of longitudinally corrugated sheets, by continuous proc-

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esses, as set forth in the patent of Rowe and Morris No. Re. 20,970, dated January 3, 1939, the web is actually taken up or gathered transversely. It is therefore not possible to contact the web simultaneously across its width with gathering elements which interdigitate simultaneously and completely to produce the desired gathering. If this were done, the web would bind and split. As a consequence it is the usual practice to begin to gather the web at one point (usually, though not necessarily, in the center of it) and then as the web moves, progressively form additional lateral gatherings until ultimately the whole web is gathered transversely. Ordinarily a central longitudinal corrugation is formed first and after this has been formed, another corrugation is formed on each side of it, the additional corrugations being formed in pairs until the operation is completed for any given length of the web. If it is assumed that corrugating is being done by presenting to the web upon one side, means providing a corrugated surface, and by presenting to it on the other side, means which successively and progressively depress the paper between the lands or ridges of the first mentioned corrugating means it will be found in actual practice that there are forces tending to cause previously formed corrugations to come out or be lost during the progress of the web. One of these forces is the natural resilience of the web which causes it to tend to become flattened out after it has been corrugated. Another of these forces is the actual pull on a previously formed corrugation, caused by the depressing of laterally disposed portions of the web to form additional corrugations. As a consequence, it has been found in actual practice, given corrugating means upon one side of the web and depressing means on the other which act successively to form corrugations by interdigitation, some means must also be provided for holding previously formed corrugations as such, at least until the formation of laterally adjacent ones. This presents a substantial mechanical problem, which problem has been solved mechanically by the teachings of said Rowe and Morris, to which reference has been made.

Essentially in the practice of my invention, I accomplish this purpose by binding the paper to a corrugating means, at least at the time of the formation of any given corrugation in a way which will be positive.

As an exemplary machine and procedure, I have illustrated in Figure 1, a cylinder 1, which is grooved on its peripheral surface. A suitable

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web 2 is led to the surface of this cylinder in any suitable way, and in order to form corrugations therein, the paper is successively depressed into the grooves of the cylinder by a series of progressively acting elements starting with a center roller or sheave 3, followed by laterally adjacent ones 4 and 5, and additional pairs of laterally adjacent ones 6 and 7, etc. This arrangement alone would not be commercially successful for the manufacture of corrugated paper without the provision of holding means as aforesaid. This holding means I provide by adhesively binding the paper to the cylinder as the corrugations are formed therein, the adhesive being sufficient to maintain the corrugations while others are being formed.

By this I mean that the adhesive must be of such character or so used as not to interfere with the widthwise contraction of the sheet during corrugating but must effectively act as holding means after the corrugations have been formed. Thus an adhesive may be employed which is rendered tacky only after the corrugations have been formed, as hereinafter set forth. Or an adhesive may be employed which is soft and slippery enough to permit side slip of the web during corrugating, but which, once the web has been pressed down into a groove will quite strongly resist the direct lifting action encountered when adjacent corrugations are being produced. The adhesive may be applied either to the web or to the cylinder or to both, by any suitable means.

I may coat either the entire surface of the cylinder or the entire surface of the paper or both with adhesive, prior to the corrugating of the paper. It is also possible to employ an adhesive substance which is normally non-adhesive or which has been caused to assume a non-adhesive state, and then to develop adhesiveness therein as and when desired, viz., upon the corrugating of the paper. Asphalt or other bituminous substances, though not the only adhesives which I may employ, are highly advantageous for certain types of work. Bitumens may be chosen which are substantially non-adhesive at ordinary temperatures, but which may be caused to become adhesive upon the application of heat; and heat may be applied either by external means, by controlling the temperature of the corrugating member 1, or by heating the depressing means 3, 4, 5, etc. This is also true of other thermoplastic substances, including but without limitation, incompletely polymerized synthetic resins.

One procedure suitable for permitting the corrugating of the web while binding the paper web to the cylinder substantially throughout the area of the web so as to permit over-all creping, is to coat the web with a thermoplastic substance tempered to a non-adhesive condition, employ an unheated or even cooled cylinder, and develop adhesiveness by the use of heated deforming elements, followed by a heated, grooved roll or equivalent device just ahead of the creping line, or line of engagement of the doctor with the web.

My process and mechanism is adaptable to the corrugating of papers which have not previously been creped, as has been seen. If plain paper is being operated upon, it may be creped transversely at the time of the removal of such paper from the corrugating means. I am aware that it has hitherto been suggested to lead paper on to a corrugated cylinder and remove it therefrom by a serrated knife so as simultaneously to crepe and wave the paper. This however, has not

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proved to be practicable, and so far as I know there has hitherto been no commercially successful operation of this kind. While it is true that no successful way has been found to bind the paper to the corrugated cylinder, and that moisture alone cannot be depended upon, while the use of vacuum or air blasts has likewise not been a success, and while a positive adhesive union of the paper and the corrugated cylinder or the like solves this aspect of the difficulty, yet the failure of the prior art to crepe successfully from a grooved cylinder has in my opinion been due to a lack of understanding of the principles which I shall now set forth.

Consider the situation shown in Figure 2, a corrugated cylinder 1a, with a paper web 10a cemented solidly to the surface thereof, over its entire area, by the cementing medium 11a, which may in this case be an asphalt or the like, but may also comprise a number of other adhesives, such as latex, rubber-resin combinations, incompletely polymerized synthetic resins, etc. It is possible merely to scrape the web from the cylinder with a sharp knife, that is to say a knife or doctor contacting the cylinder and having so large a meeting angle of its surface with the surface of the cylinder as to exert only a lifting action upon the web. This is feasible if the knife is so disposed as not to tear the web by lifting parts of the web from the ridges or lands of the cylinder before closely adjacent parts are lifted from the bottoms of the grooves.

But if the problem is to crepe the web as it is removed from the grooved cylinder, whereby the web will have longitudinal stretchability imparted to it, the first desideratum is the use of a knife or doctor which has a meeting angle of its surface with the surface of the cylinder so small as to crowd the paper back upon itself to form creping crinkles in it, that is to say, in order to crepe one must employ a doctor which will provide a proper "creping angle" or "creping V." For commercially desirable amounts of longitudinal stretchability a creping V of no larger than 90° is desirable; and the amount of stretchability will be influenced by the creping angle or V.

In making a product stretchable both widthwise and lengthwise, where the product is creped as it is removed from a corrugated surface, if the crinkles are formed in such a way as to tend to take up the sheet widthwise, they can only do this to the extent that they flatten the corrugations. Thus there are two extreme operations, the production of a crinkled web in which the lateral stretchability arises from corrugations, and the production of a crinkled web in which the lateral stretchability has been absorbed in a configuration of the crinkles, and the corrugations as such have disappeared, between which there is a range of intermediate results. To the extent that the transverse stretchability inherent in the corrugations is transferred to the crinkles, the crinkles (when the web is viewed in plan) assume the zigzag or herringbone conformation shown at 24 in Figure 6.

Efforts to form such a product (either fully herringboned and flat, or partly herringboned and partly corrugated) involve the formation of crinkles in the web which for the most part lie aslant to the major axis of the web when the web is viewed in plan. While the possibility of the formation of such products has hitherto been suggested, the commercial failure of the art has been due to a lack of understanding of the factors involved and the mode and mechanism for the suc-

cessful formation of such herringbone or zigzag crinkles. It is clear enough that their formation involved a creping means which will remove the web from the valleys of the corrugated cylinder before its removal from the ridges. But the crinkles must be formed in such a way as to translate the wavy transverse section of the web into more nearly a flat plane; provision must be made for the removal of the web from the grooved cylinder in a more or less flattened condition; and sufficient longitudinal stretchability must be provided to make the product interesting commercially.

Taking the last of these considerations first, a creping V of the required small angularity must be provided if sufficient stretchability in any direction is to be derived from the crinkles; but the art has not hitherto understood how to provide such a creping V in a doctor producing zigzag crinkles and having the other characteristics for operability. Further, it will be apparent that where the crinkles are disposed at an oblique angle to the major axis of the web, a portion of the stretchability resident in the crinkles is derivable transversely of the web, and a portion longitudinally. This is why it is possible to produce from a corrugated sheet a substantially flat sheet where the transverse gathering produced by corrugating has been translated into the transverse stretchability resident in the oblique crinkles. The stretchability in any given direction is a function not alone of the linear gathering of the web in a direction perpendicular to the direction of the crinkles but also of the angular relationship of the crinkles to the direction of stretch. It follows from this that if a web has been gathered widthwise a certain amount by corrugating, and if this web is transformed into a flat herringboned web in which the lateral gathering is now wholly resident in crinkles having a certain angular relationship to the major axis, there is theoretically only one longitudinal stretchability possible under these circumstances. From this, again, it follows that in a flat herringbone sheet where the widthwise gathering is predetermined, if the longitudinal stretchability is to be varied, the angle of the crinkles to the major axis must be varied.

To form a herringboned sheet, therefore, the linear gathering perpendicular to the direction of the crinkles must be produced with references to the angularity of the crinkles to the major axis of the web. Another way of stating this is, having provided a creping V capable of producing a given linear gathering perpendicular to the crinkles, the knife must be configured to remove the web from the valleys of the corrugated creping surface sufficiently ahead of the points where the web is removed from the lands or ridges to give the needed angularity of the crinkles. With these factors in mind, however, it is possible to configure a knife and provide a creping V which with a given widthwise gathering will provide a desired longitudinal stretchability. Of course, in designing a knife, other factors affecting the action of the knife must be taken into account, such as the weight and other characteristics of the web, and the weight and consistency of the coating thereon. Some leeway is possible. If the widthwise gathering taken up by the crinkling operation is not equal to the gathering due to the corrugating, the resultant creped web will not be flat. If the creping tends to take the web up widthwise more than the gathering due to corrugating, the web will lose the excess

stretchability by the stretching of the crinkles immediately after they are formed, (with a concomitant change in angularity of crinkles) if the web is strong enough to stand the strain and if the disparity is not too great.

There remains the problem of removing the web. Under the circumstances outlined the web will be removed from the creping line in a direction oblique to the tangent, and must be so removed. Theoretically there is but one correct angle of removal for any given set of the conditions discussed above. Actually there is an appreciable latitude. Nevertheless, the knife must be devoid of configurations which would interfere with the movement of the web in substantially the correct plane of removal.

In Figure 3 I have shown the web corrugated by being made to conform to the grooved surface of the cylinder 1. The web is removed from the cylinder by a doctor 24 disposed generally neither tangentially nor radially, but at an obtuse angle to the tangent. The herringboned web 25 is shown as being removed neither in a tangential nor a radial direction but along an intermediate plane. In Figure 4 I have shown the knife 24 in greater detail. The under side of the knife has been grooved to permit it to conform with the grooving of the cylinder at the angle at which the knife is disposed. The leading edge of the knife has been beveled as at 27 along such a plane as to permit removal of the web in the direction shown at 25. The portion of the knife which forms the creping V is indicated at 28. Taking into account the bevel 27 and the V portion 28, together with the general angularity of the knife to the tangent, the knife has been so configured as to remove the web from the valleys of the cylinder far enough in advance of the points of removal of the web from the lands or ridges, to give the required general angularity to the crinkles.

In Figure 5, I have shown a corrugated knife 29, cut away to permit its application to the cylinder at an angle to the tangent. The creping V is shown at 30. The corrugated knife, being of uniform thickness where it contacts the cylinder does not require beveling. I prefer when forming the creping V portion of any of these knives to take into account the differing angularities of different portions of the ridges and valleys of the cylinder, and grind the V portion of the knife to give a creping V of constant angularity throughout.

My process is applicable to webs in general including but without limitation webs of paper or other felted fibrous material, cloth and textiles, and amorphous films such as the regenerated cellulosic materials, the rubber hydrochlorides, and to thin sheet materials generally such as backed or unbacked metall foils.

Modifications of my invention may be made without departing from the spirit thereof, and I do not desire my invention to be limited otherwise than as stated in the appended claims, wherein I have endeavored to set forth what I believe to be the essential novelty of my invention.

I claim:

1. Apparatus for producing a multi-laterally stretchable web which comprises a grooved cylinder, means for causing the web to conform to the surface of the cylinder whereby the web is contracted widthwise, and whereby the web may be caused to adhere to the surface of the cylinder with the interposition of an adhesive therebetween, and creping means for removing the

web from the surface of the cylinder in corrugated and creped condition, said means comprising a doctor having a portion forming with the surface of the cylinder a creping V along a sinuous line across the face of the cylinder, the angle of the creping V throughout said line being not greater than substantially 90°, said doctor further having its portions which lie within the grooves of said cylinder extending beyond the radial plane which includes the points of contact of said doctor with the lands between said grooves whereby as to remove the web from the valleys of said cylinder in advance of its removal from the peaks thereof.

2. Apparatus for producing multi-laterally stretchable webs comprising a grooved cylinder, means for causing a web to conform to the surface of said cylinder whereby the web is taken up widthwise and corrugated and whereby the web may be caused to adhere to the surface of the cylinder with the interposition of an adhesive therebetween, and means for removing the web from the surface of the cylinder in creped form under condition where a portion of the widthwise gathering is transferred to the crinkles, said means comprising a doctor presenting a creping V of not substantially greater than 90° to the tangent of the cylinder and having its portions which lie within the grooves of said cylinder extending beyond the radial plane which includes the points of contact of said doctor with the lands between said grooves whereby to remove the web from the valleys of the corrugations in the cylinder in advance of the removal thereof from the crests of the corrugations and having a creping angle proper for the production of a given stretchability under given creping conditions, said doctor having all its portions lying below a plane, at an angle to the tangent, suitable to the degree of widthwise gathering taken up in the formation of the crinkles by said doctor, whereby to permit removal of said web from said cylinder substantially in said plane.

3. Apparatus for producing multi-laterally stretchable webs comprising a grooved cylinder, means for causing a web to conform to the surface of said cylinder whereby the web is taken up widthwise and corrugated, and whereby the web may be caused to adhere to the surface of the cylinder with interposition of an adhesive therebetween, and means for removing the web from the surface of the cylinder in creped form under conditions where a portion of the widthwise gathering is transferred to the crinkles, said means comprising a doctor shaped to remove the web from the valleys of the corrugations in the cylinder in advance of the removal thereof from the crests of the corrugations and having a creping angle proper for the production of a given stretchability under given creping conditions, said doctor being cut away as to permit removal of said web from said cylinder in a direction, at an angle to the tangent, suitable to the degree of widthwise gathering taken up in the formation of the crinkles by said doctor, said doctor comprising a body of metal angularly disposed to said tangent, grooved beneath so that the leading portions of said doctor will conform to the corrugations of said cylinder, shaped along the line of conformation with a sinuous surface to provide the said creping angle, and shaped slopingly back from the creping angle portion to provide for the angular removal of said web.

4. Apparatus for producing multi-laterally

stretchable webs comprising a grooved cylinder, means for causing a web to conform to the surface of said cylinder whereby the web is taken up widthwise and corrugated and whereby the web may be caused to adhere to the surface of the cylinder with the interposition of an adhesive therebetween, and means for removing the web from the surface of the cylinder in creped form under conditions where a portion of the widthwise gathering is transferred to the crinkles, said means comprising a doctor shaped to remove the web from the valleys of the corrugations in the cylinder in advance of the removal thereof from the crests of the corrugations and having a creping angle proper for the production of a given stretchability under given creping conditions, said doctor being cut away as to permit removal of said web from said cylinder in a direction, at an angle to the tangent, suitable to the degree of widthwise gathering taken up in the formation of the crinkles by said doctor, said doctor comprising a body of metal of substantially uniform thickness shaped to conform to the surface of said cylinder, the leading portion of said body being cut away at an angle and the edge of said portion so shaped as to provide a creping angle.

5. A process of producing multi-laterally stretchable webs which comprises causing said webs to conform to the surface of a grooved cylinder, adhering said webs to said cylinder with the interposition of an adhesive therebetween, and removing said webs from said cylinder by a doctor shaped to remove the web first from the valleys of the corrugations in said cylinder and afterwards from the crests thereof, said doctor being shaped to provide a creping angle, of not greater than substantially 90°, throughout the line of contact with said surface and conducting the web away from said doctor at an angle to the tangent of said cylinder proportioned to the degree of lateral and longitudinal stretchability of said web so removed.

6. A process of imparting multi-lateral stretchability to a web which comprises causing said web to conform to a grooved surface and binding said web to said surface by means of an adhesive, afterward removing said web from said surface first in the valleys thereof and thereafter from the peaks thereof by a doctor having a creping V of not more than substantially 90° while forming oblique crinkles in said web, proportioning the angularity of said crinkles and the amount of stretchability produced thereby to the widthwise gathering of the web so as to produce a web which is longitudinally stretchable, and in which the corrugations have in part at least been taken up by the widthwise gathering due to oblique creping crinkles.

7. A process of imparting multi-lateral stretchability to a web which comprises causing said web to conform to a grooved surface and binding said web to said surface by means of an adhesive, afterward removing said web from said surface first in the valleys thereof and thereafter from the peaks thereof by a doctor presenting a creping V of not more than substantially 90° throughout, while forming oblique crinkles in said web, proportioning the angularity of said crinkles and the amount of stretchability produced thereby to the widthwise gathering of the web so as to produce a web which is longitudinally stretchable, and in which the corrugations have in part at least been taken up by the widthwise gathering due to oblique creping crinkles, and carrying said

web away from said surface at an angle determined by the lateral and longitudinal stretchability thereof.

8. A process of imparting multi-lateral stretchability to a web which comprises causing said web to conform to the surface of corrugated means with the interposition of an adhesive substance therebetween, removing said web from said surface by means of a doctor and shaping said doctor to produce oblique crinkles therein by providing said doctor with portions extending forwardly into the corrugations of said cylinder beyond a radial plane including the points of contact of said doctor with the tops of said corrugations, and further shaping the edge of said doctor contacting said cylinder, to provide a creping

angle of not more than substantially 90° throughout whereby sufficient stretchability is imparted to said web to cause the corrugations in said web to be transformed in substantial part at least into widthwise stretchability resident in oblique portions of sinuous crinkles.

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REFERENCES CITED

The following references are of record in the file of this patent:

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Number	Name	Date
2,190,680	Rowe	Feb. 20, 1940
2,425,207	Rowe	Aug. 5, 1947