Aug. 8, 1961 H. KLENK 2,995,180

METHOD OF PRODUCING PEARL CREPE PAPER AND APPARATUS THEREFOR

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Fig. 1

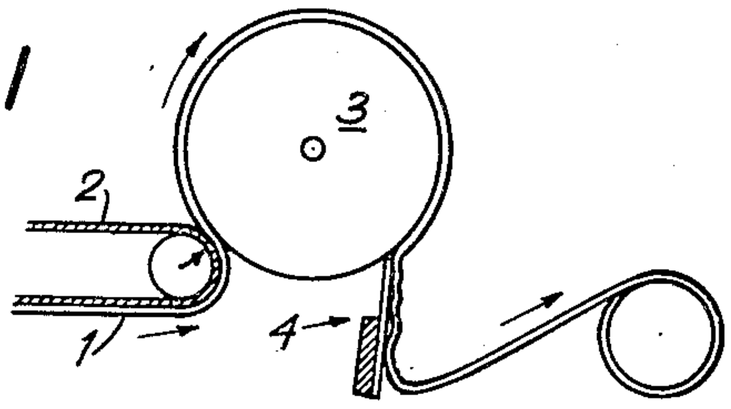


Fig. 2

PRIOR ART

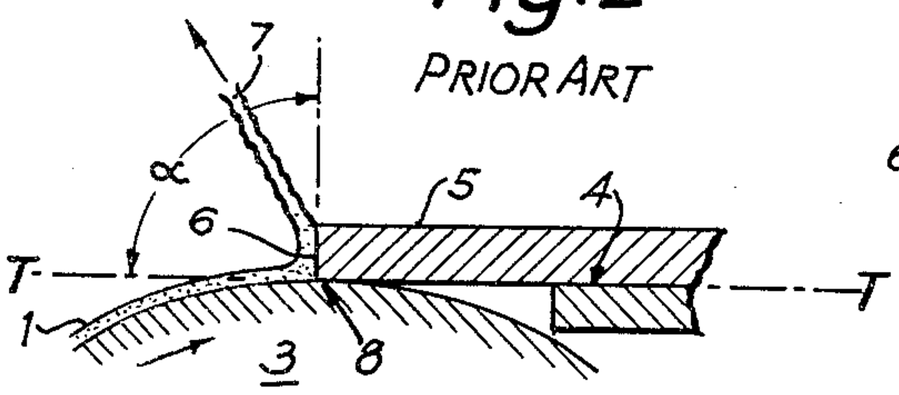


Fig. 3

PRIOR ART

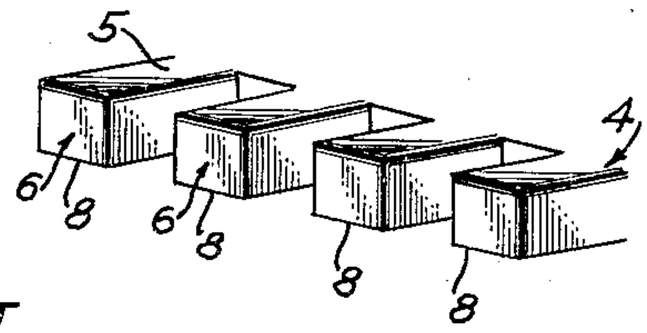
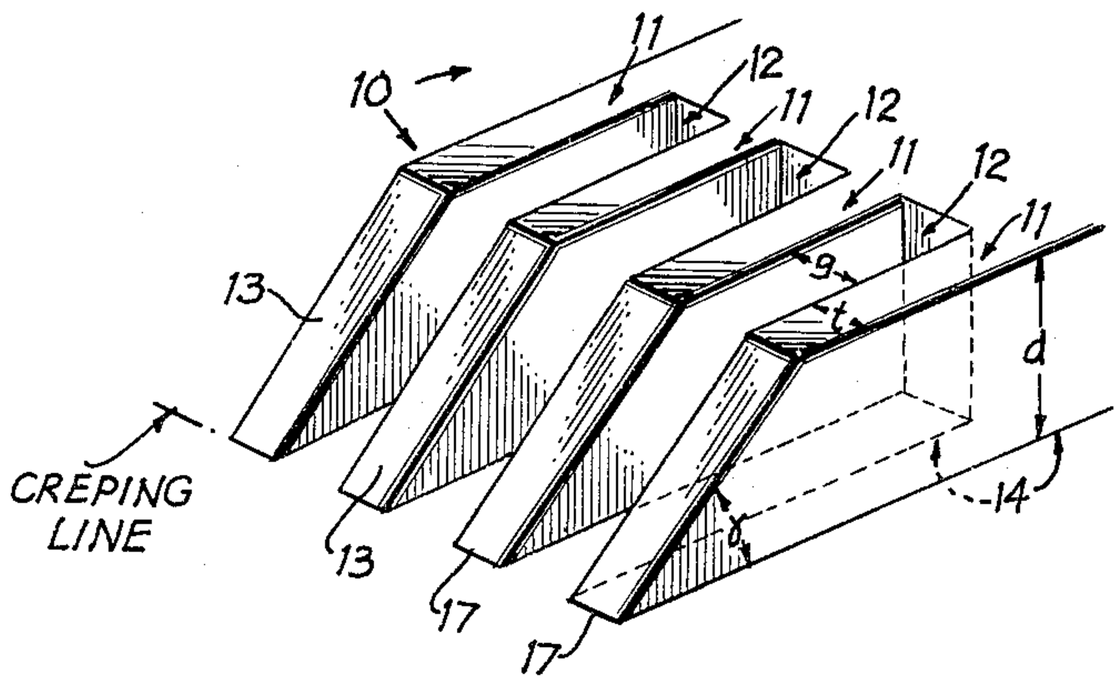


Fig. 4



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METHOD OF PRODUCING PEARL CREPE PAPER AND APPARATUS THEREFOR

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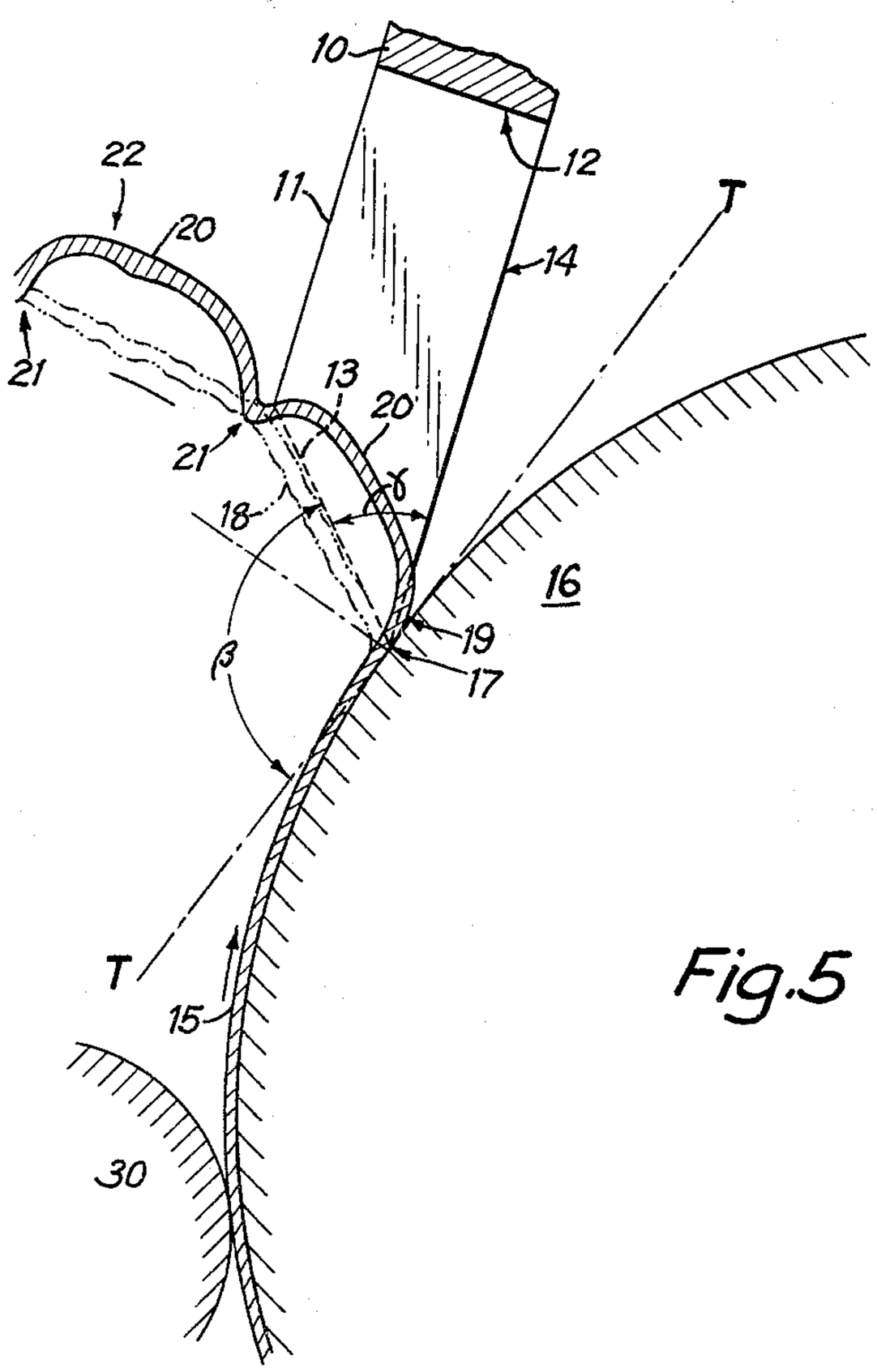

Fig.5

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METHOD OF PRODUCING PEARL CREPE PAPER AND APPARATUS THEREFOR

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Fig. 6

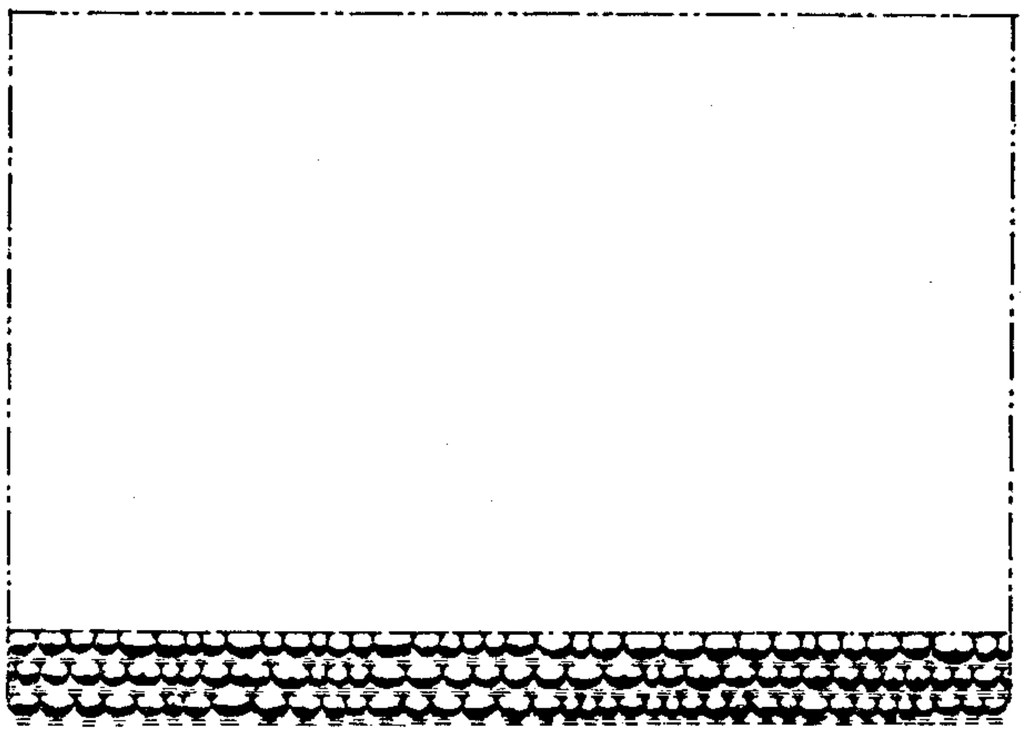

Fig. 7

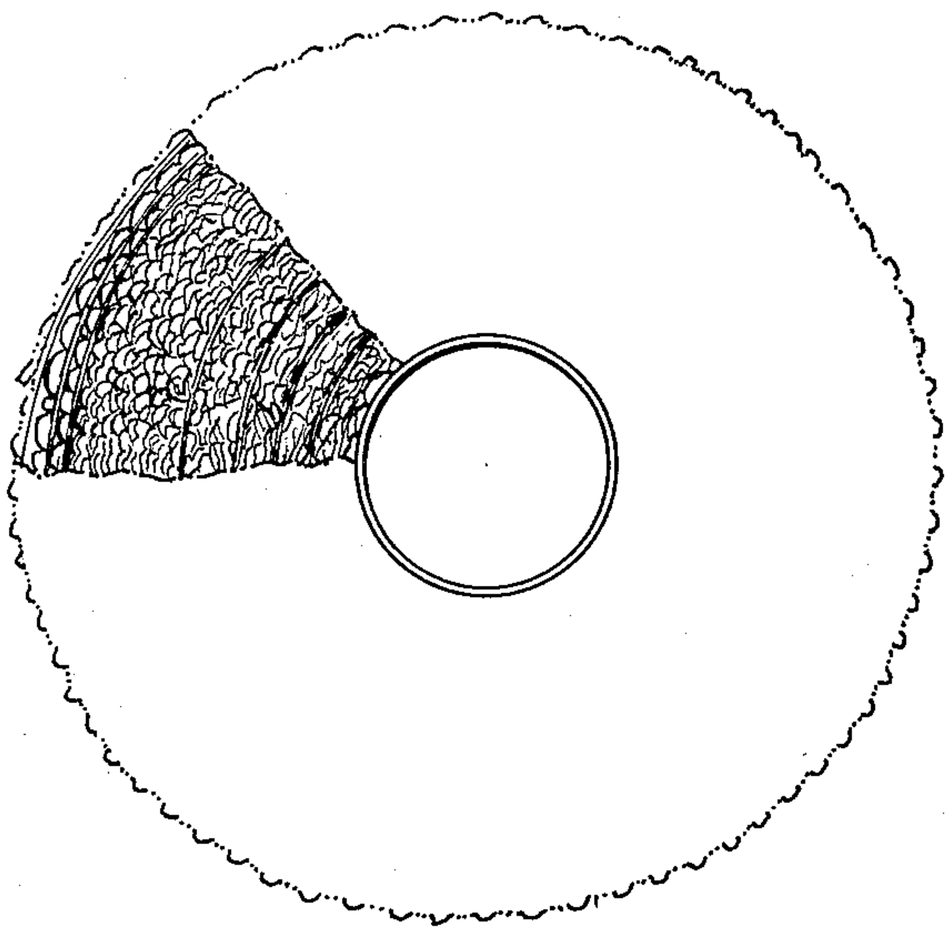

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Fig.8

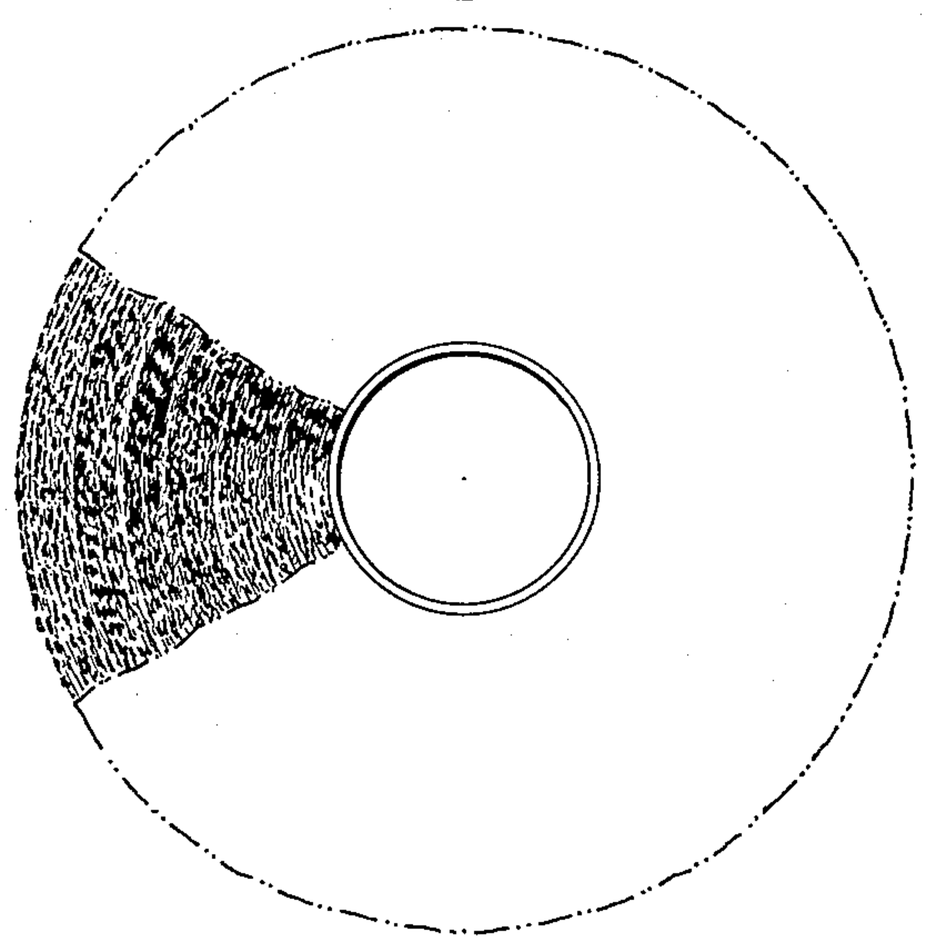

Fig.9

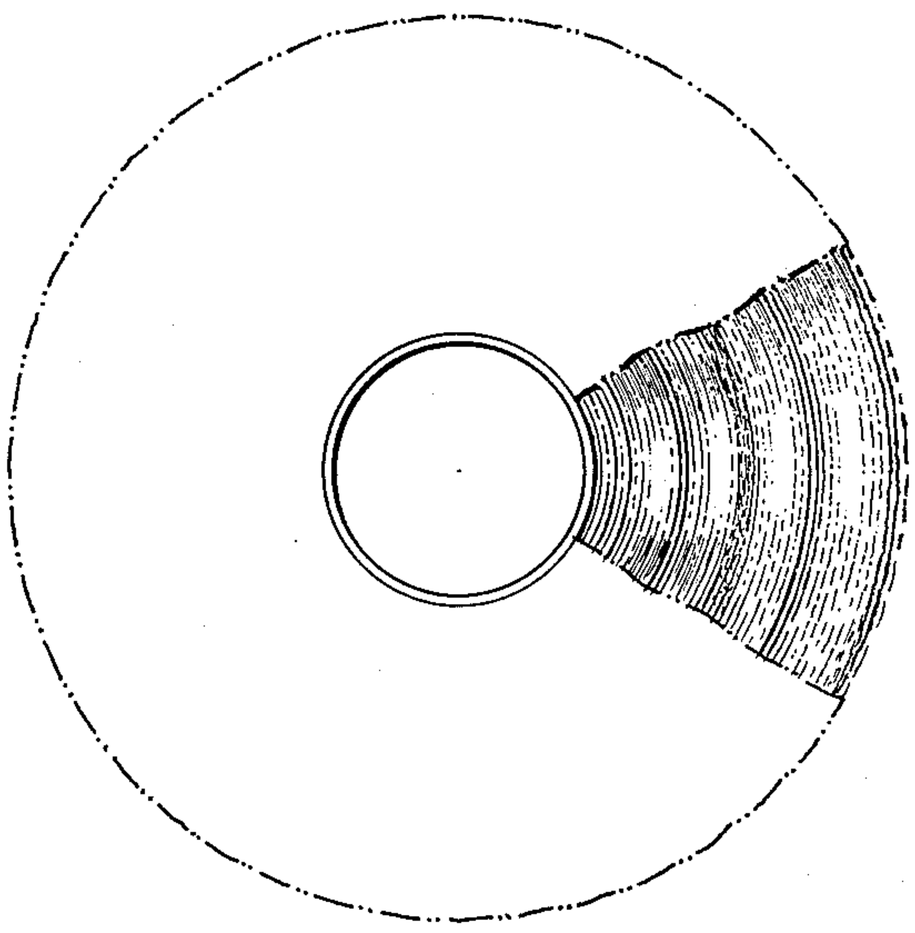

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Fig. 10

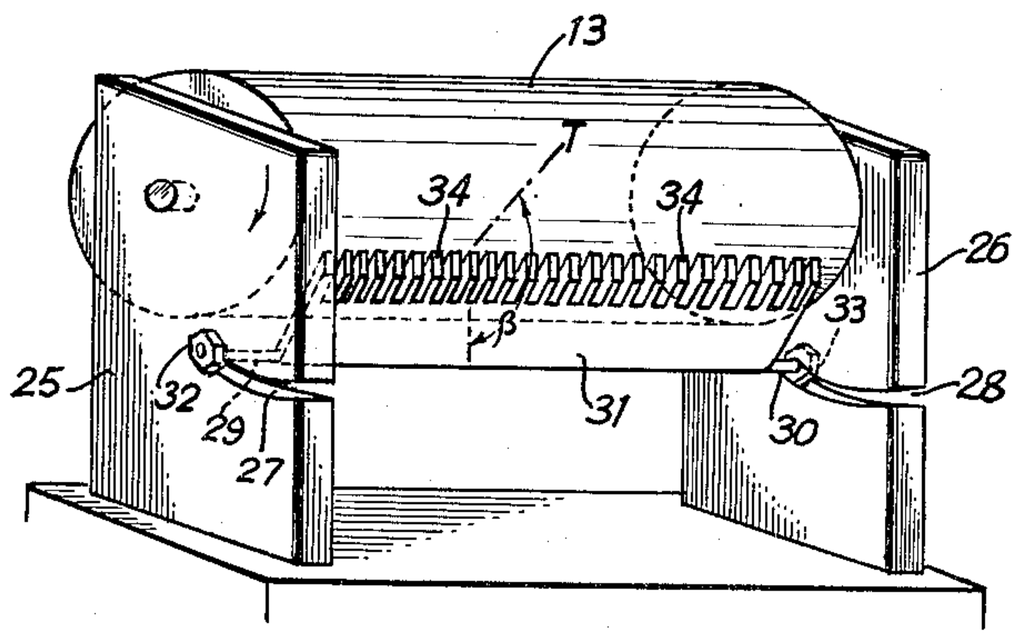
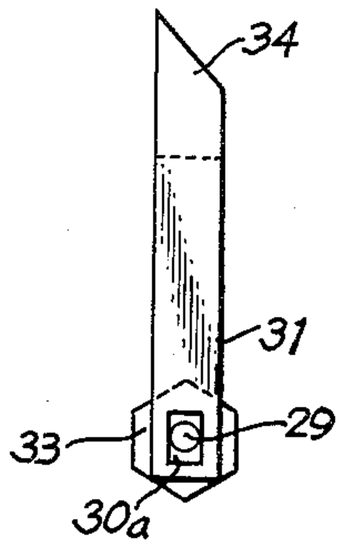


Fig. 11



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METHOD OF PRODUCING PEARL CREPE PAPER AND APPARATUS THEREFOR

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6 Claims. (Cl. 154—30)

This invention relates to an improved method of producing pearl crepe paper and apparatus for the production of such paper. It more particularly relates to the production of such paper which is suitable for hygienical purposes.

"Pearl crepe paper" is a specific type of paper which I have described, for instance, in my Swiss Patent No. 334,336.

The pearl crepe paper with which this invention is concerned, is different in its outer appearance as well as its internal texture from any other known crepe papers. Such papers have been described, for instance, in the United States Patents 1,595,991 to W. H. Cannard issued August 17, 1926 and 2,251,513, also to W. H. Cannard issued August 5, 1941, furthermore in the British Patents 354,506; 389,832; and 473,300. The paper described in the last-mentioned patent in particular is an embossed crepe paper produced in a first drying and creping and a second embossing stage, thus showing striations transversely to the length of the web across the entire diameter of the latter and embossed wells on one side and protrusions on the other side extending, for instance, in longitudinal direction of the web. This paper has two surfaces of substantially equal smoothness and is relatively expensive to manufacture.

The pearl crepe paper with which the invention is concerned, differs from all known papers in that it possesses one rough side and one smooth side, and bears on the smooth side pearls protruding in such a manner that they form rows extending in longitudinal direction of the paper, which pearls are closely adjacent each other so as to form a relatively sharp ridge on the opposite surface between corresponding grooves, the aforesaid pearls of parallel rows also being aligned with each other transversely to the length of the paper. These pearls may be substantially of circular or of elliptic or oval cross section. The rows may extend straight or in undulating arrangement parallel with each other over the length of the paper. Between the rows of pearls the paper shows a conventional creping in the form of striations transverse to the length of the paper.

It is an object of my invention to provide an improved method and especially simple apparatus to produce such pearl crepe paper, in which the degree of creping, that is in particular the height and shape of the pearls on the one surface and the corresponding grooves, wells, or recesses on the opposite paper surface, can be easily controlled.

It is another object of my invention to provide a device for use in machines for pearl crepe paper manufacturing of conventional construction, which device permits to vary and control the type of pearl forming attained by the creping process with regard to the height, size and shape of the pearls being formed.

Especially, it is the object of my invention to provide a novel method and apparatus for producing pearl crepe paper from all kinds of very thin paper for hygienic purposes and for controlling the degree of creping in such a manner that, for a given number of sheets in a roll of hygienic paper, the finished reeled-up pearl crepe paper always forms rolls of one and the same diameter.

The nature of my invention and the characteristic features by which the same differs from the known art will be easily understood from the description oft he invention

in connection with the accompanying drawings in which

FIGURE 1 illustrates the steps of a conventional method of making creped paper involving use of a conventional doctor blade;

FIGURE 2 is a cross sectional view of the creping region showing the creping end of a conventional doctor blade;

FIGURE 3 is a perspective view of the front part of a conventional doctor blade;

FIGURE 4 illustrates in perspective view the front part of a doctor blade according to the invention;

FIGURE 5 shows the formation of pearl creping paper by the method according to the invention and with the doctor blade illustrated in FIGURE 4;

FIGURE 6 is a top view of a piece of pearl crepe paper produced by the method according to the invention;

FIGURES 7 to 9 are lateral views of three rolls of pearl creped paper produced according to the invention with different types of pearls and correspondingly different numbers of sheets per roll, but equal roll diameters;

FIGURE 10 illustrates schematically details of mechanical positioning means for the doctor blade relative to the creping cylinder, and

FIGURE 11 shows a detail of the doctor blade if adapted for oscillations transverse to the movement of the paper web.

By some of the known methods, one of which is illustrated in FIGURE 1, there can be produced a pearled and/or creped paper which is manufactured with a toothed scraper and whereby an uncreped paper web **1** is transferred from a conveying belt **2** on to a drying cylinder **3** and is then creped by lifting the still moist web from the cylinder **3** by means of a doctor blade **4** which comprises teeth **5** having front end faces **6** which are at right angle to the general direction in which the teeth **5** protrude from blade **4**.

It will be noted particularly from FIGURE 2 that the paper web **1** is lifted from cylinder **3** on to the end face **6** of doctor blade, thus forming an angle α which is acute up to 90°, but cannot be an obtuse angle, since end face **6** must be in immediate contact with the surface of cylinder **3** to avoid slipping of the still moist web **1** below the doctor blade and tearing of the web.

Consequently, it has only been possible to pearl crepe with this known method wrapping papers and the like strong paper on a kraft paper basis having paper weights of, for instance, 70 grams per square meter (g./m.^{2}) and higher. It was, however, impossible to produce with this known method and device pearl crepe paper for hygienic purposes from the necessary fine kinds of paper having paper weights in the order of 15 to 40 g./m.^{2}

Particularly in the moist state in which these papers have to be pearl-creped, such fine papers have such low tensile strength that they invariably tear when subjected to the illustrated known method of pearl-creping. The reason therefor is that at a given angle α which is in the vicinity of 90% or even greater, the doctor blade front edges at **8** will begin to cut in at the ridges formed between adjacent pearls.

As it is impossible for obvious geometrical reasons, to give the doctor blade end faces **6** a position relative to the tangential T—T to the surface of cylinder **3** through the creping line at **8** (in FIGURE 2), which would assume an angle α greater than 90°, it had not yet been possible to produce fine toilet pearl crepe paper.

Fine pearl crepe paper suitable for toilet and other hygienical purposes, for instance as facial tissue paper can, however, be produced without difficulty in a single step of operation and without any costly embossing machinery, by the method and device according to my present invention, whereby an uncreped, still moist, fine paper web, of a weight of about 15 to 40 g./m.^{2}, is lifted from

a web-conveying rotating cylinder by means of a tooth bearing doctor blade extending transversely to the direction of movement of the web with the cylinder, the teeth of which dector blade have front end faces forming an actue angle with the bottom surface of the teeth, so that the paper web is lifted on to a plurality of rising slopes under an angle β larger than 90°.

According to another important feature of my invention the ratio of the width of the teeth to that of the gaps between the teeth and the angle of inclination β of the sloping end faces of the teeth to the afore-mentioned tangential T—T can be so varied, that rows of pearls of a desired size, shape and height are formed in the paper intermediate parallel rows of transversely extending ordinary striations.

I have discovered that variation of the angle of inclination β in the range between about 105 and 125°, which variation is possible owing to the shape of the doctor teeth according to my invention, makes it possible to pearl crepe fine paper having paper weights between 15 and 40 g./m.^{2} and attain pearls of varying height, maximum height being attained with an angle β of about 117°.

Below 105°, i.e. well beyond the maximum angle α of 90° attainable with known pearl-creping devices, the paper web begins to tear at the sharp edges of the doctor teeth. That is why only strong paper, for instance, kraft paper could be pearl-creped with the known devices.

When working with angles β between 117° and 125° pearls are obtained which are flatter, but of increasingly elongated shape; between 117° and 105°, pearls are obtained which are of shorter oval shape and also less high than the pearls obtained at 117°.

FIGURE 4 illustrates part of a doctor blade **10** according to the invention bearing teeth **11** having therebetween gaps **12**. The front end faces **13** of teeth **11** are oblique to the plane in which the doctor blade **10** extends, so that they form an acute angle γ with the bottom face **14** of the doctor blade. The thickness d of the blade and the ratio

$$\frac{\text{width of gap}}{\text{width of tooth}} = \frac{g}{t}$$

together with the angle of inclination β (FIGURE 5) of the blade determine the shape of the pearls being formed.

In the latter figure, the uncreped web **15** is supported on cylinder **16** until it reaches the creping zone where it contacts the sharp blade edges **17**. While parallel zones **18** of the paper web move up the sloped surfaces **13** of the teeth the intermediate longitudinal paper zones adhere somewhat longer to the cylinder **16** as at **19**, thus forming pearls **20**, while the zones **18** are given striations transverse to the direction of movement of the web **15**. As a finished pearl leaves the doctor blade it forms a rather sharp ridge **21** with the next following pearl, so that the surface of the paper bearing the ridges **21** is rougher than the opposite surface at **22**.

Pearls of maximal height and frusto-spherical appearance are formed if the aforementioned ratio of gap to tooth width g/t is 1:1, larger, elongated pearls are obtained if the ratio d/g is, for instance, 2:1, and shorter oval pearls are produced with a g/t ratio smaller than 1:1, such as, for instance, 1:2.

Rolls of toilet paper are usually manufactured with standard leaf numbers. Corresponding adjustment of the angle β permits to so control the height of the pearls that papers of varying roughness on the ridge side of the paper can be obtained so that the standard leaf numbers, for instance 150, 200, 300, 400, 500 up to 1,000 leaves per roll, can be strictly observed while maintaining at the same time the diameter of the roll constant.

The latter fact has the great advantage that automatic wrapping and labelling equipment does not have to be re-adjusted each time paper of different pearl-creping is produced. Furthermore, regardless of the type of pearl crepe, all rolls will fit into the standard unreeling devices.

FIGURE 6 illustrates a sheet of pearl-creped paper according to the invention and FIGURES 7, 8 and 9 show different types of pearl crepe paper wound up to form rolls of equal diameter each having a different standard number of leaves, FIGURES 7 showing a roll with 150, FIGURE 8 a roll with 400, and FIGURE 9 a roll with 1,000 leaves.

Finally, FIGURE 10 illustrates a simplified arrangement of means for adjusting the angle β. In this figure, web-carrying roll **13** is mounted between two standards **25** and **26**. In arcuate slots **27** and **28** in these standards, there are inserted the supporting pins **29** and **30** of doctor blade **31**, and held rigidly in position in these slots by fastening nuts **32** and **33** or equivalent mechanical means. The angle β between the tangential T to the cylinder surface and the sloped front end faces **34** of teeth **35** of the doctor blade **31** can be adjusted by correspondingly loosening and refastening the nuts **32**, **33** in a different position in slots **27** and **28**.

Of course, these doctor blade adjusting means can be suitably combined with such means as are illustrated in British Patent 354,506 for imparting an oscillating motion to the doctor blade in a direction transverse to the movement of the web indicated by arrow W in FIGURE 10. The doctor blade **31** is then slidably arranged on pins **29** and **30** and prevented from rotation about the pins by a polygonal shape of the portion **30***a* of the pins inserted in the doctor blade **31**, as shown, for instance, in FIGURE 11.

Angle γ has obviously a limit value which must not be exceeded or it becomes impossible to attain an angle of inclination β in the order of 105 to 55°. Theoretically, this limit value is 63° if an angle β of 117° is to be attained, and 55° for attaining an angle β of 125°. However, I prefer to use angles γ in the order of 48° for producing normal pearls of full height, 40° for elongated pearls, and 60° for shorter, smaller pearls.

These results are compiled in the following Table I:

TABLE I

Pearl shape	I. Large, elongated	II. High, round	III. Small, short
Ratio gap: tooth width $g:t$	$g:t$=2:1	$g:t$=1:1	$g:t$=1:2
$\sphericalangle\beta$	40°	48°	60°
$\sphericalangle\alpha$	125°	117°	105°
Number of leaves per roll (diam.=12 c. m)	1,000	150 to 200	400

The invention will be further illustrated by two examples of how to carry out the same in practice. Of course, these examples are not to be considered in any form as limitative of the scope of the invention:

Example I

A fine paper having a weight of dry matter of 40 g./m.^{2} is applied onto a cylinder **16** under a contact line pressure (for instance effected by a pressure roll **30**) of 60 kg./cm. in a moist state containing about 20% by weight of moisture. The speed of the cylinder **16** is 100 meters per minute and the cylinder is heated to about 110° C.; the circumferential distance of the cylinder in contact with the paper web is 10 meters, for instance on a cylinder having a diameter of 3.60 meters.

The paper is pearl-creped under the conditions set forth in column II of Table I. With a creping effect of about 20% the creped paper is withdrawn from the teeth of doctor blade **10** with a speed of 80 meters per minute. A paper as illustrated in FIGURE 6 is obtained.

Example II

A sulfite cellulose self-homogenizing paper is applied to cylinder **16** under a line pressure of about 100 kg./cm.;

the paper has a dry weight of about 28 g./m.^{2} and is applied with a moisture content of 20% of the total weight. The cylinder has the same dimensions and the same contact circumference as in the preceding example, and is heated to about 145° C. by overheated vapor having a pressure of 3 atmospheres excess pressure. In order to attain a creping of 20% of the length of the paper, the withdrawal speed of the pearl-creped paper from the teeth of the doctor blade 10 is 160 meters per minute. By selecting a doctor blade as set forth in column I of Table I and using an angle β of 125° it is possible to produce a pearl crepe paper of which 1,000 leaves can be wound up in a roll of 12 cm. diameter.

The method and apparatus according to the invention are suitable for pearl creping fine paper for use as toilet paper, paper towels, paper napkins, paper table cloths and many similar products all of which differ from similar products manufactured by known processes in that they have a smooth and a rough side. These new products are thus applicable depending on the individual wishes of the user.

It will be understood that this invention is susceptible to further modification and, accordingly, it is desired to comprehend such modifications within this invention as may fall within the scope of the appended claims.

I claim:

1. A method of manufacturing pearl crepe paper having one rough and one substantially smooth side, comprising the steps of carrying a web of fine uncreped paper having a weight from about 15 to about 40 grams per square meter about a heated cylinder circumferentially for a determined length and lifting the still moist web from the cylinder by means of a toothed doctor blade, the teeth of which have sharpened ends and bear end faces which are adjusted to form such an acute angle with the tangential plane through the lifting line transverse to the cylinder, that the paper web is lifted from the cylinder under formation of an angle of 105 to 125° in the web, whereby rows of pearls are formed registering with the gaps between the teeth of the doctor blade, and transversely creped rows are formed parallel with and intermediate said rows of pearls, where the teeth of the doctor blade contact the paper web, the angle in said web being

adjusted to a determined inclination, thereby to determine the shape, size and height of the pearls being formed.

2. A method as described in claim 1, wherein said uncreped web has a moisture content of about 20% by weight.

3. A method as described in claim 1, wherein said angle in said web is about 117° so as to form substantially frusto-spherical pearls of maximum height in said paper web.

4. In an apparatus for manufacturing pearl crepe paper having one rough and one substantially smooth side, a doctor blade comprising a plurality of wedge-shaped teeth having a bottom surface and each of said teeth ending in a front end face inclined toward said bottom surface at an angle of maximally 63°.

5. In an apparatus for manufacturing pearl crepe paper having one rough and one substantially smooth side, a doctor blade comprising a plurality of wedge-shaped teeth having a bottom surface and each of said teeth ending in a front end face inclined toward said bottom surface at an angle of maximally 63°, said doctor blade having gaps between said teeth, the ratio of the width of said gaps to that of said teeth varying between 1:2 and 2:1.

6. In an apparatus for manufacturing pearl crepe paper having one rough and one substantially smooth side, the combination of a cylinder adapted for bearing a moist paper web about part of its circumference, a doctor blade comprising a plurality of wedge-shaped teeth having a bottom surface and each of said teeth ending in a front end face inclined toward said bottom surface at an angle of maximally 63°, said doctor blade contacting said cylinder with a lifting edge formed by the inclined end face and the bottom surface of said teeth, and means for altering the angle formed between said inclined end faces and the tangential plane on said cylinder on the side from which said paper web approaches said edge through said lifting edge between 105° and 125°.

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