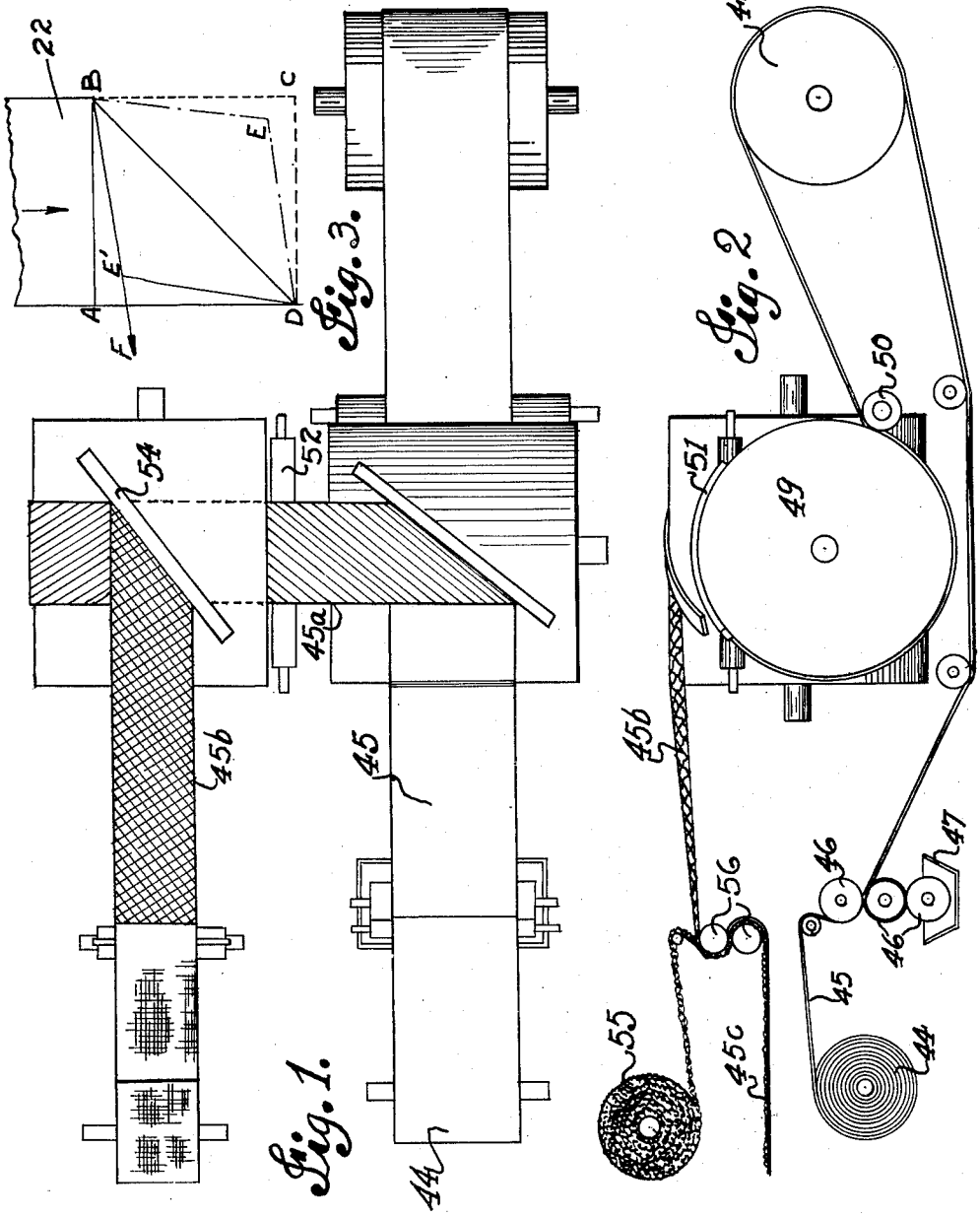
July 16, 1935. W. C. KEMP 2,008,181

ART OF PRODUCING MULTILATERAL STRETCHABILITY IN PAPER WEBS OR THE LIKE

Filed July 29, 1932 4 Sheets-Sheet 1



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ART OF PRODUCING MULTILATERAL STRETCHABILITY IN PAPER WEBS OR THE LIKE

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Fig. 4.

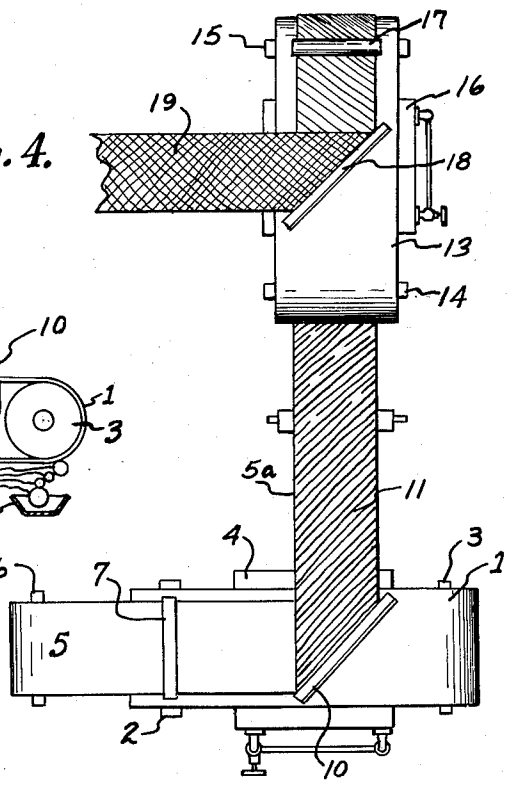


Fig. 5.

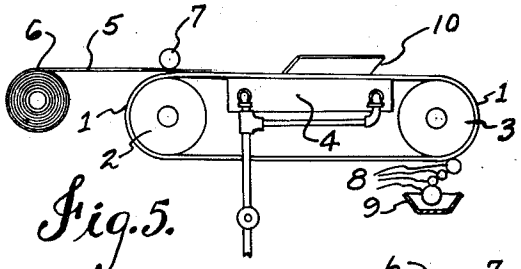


Fig. 6.

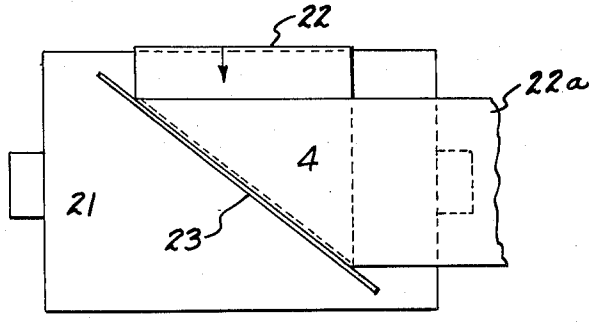
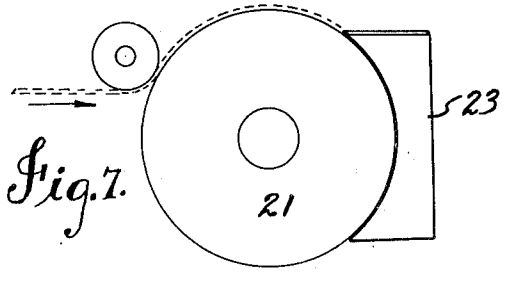


Fig. 7.



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Fig. 8.

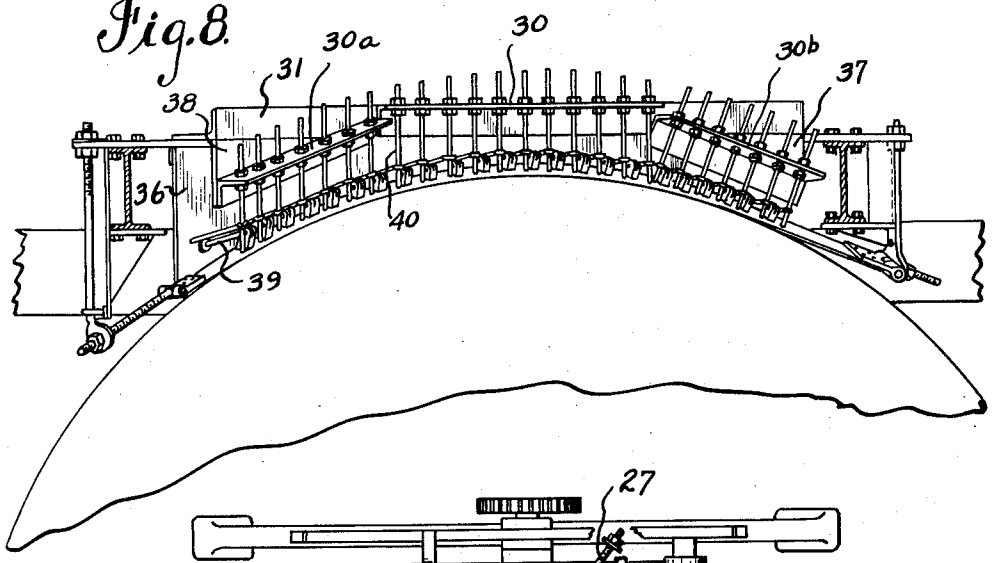


Fig. 9.

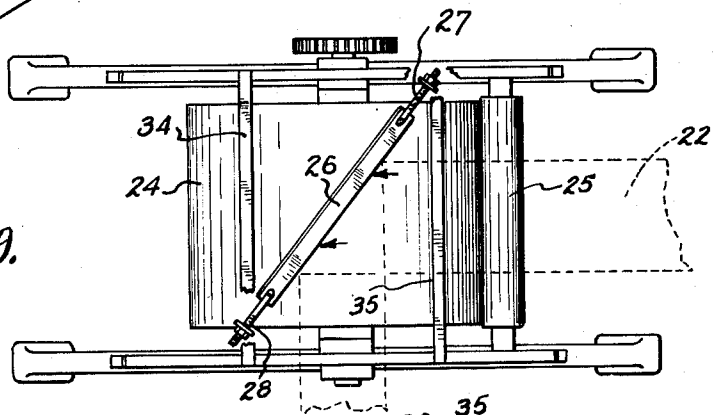


Fig. 10.

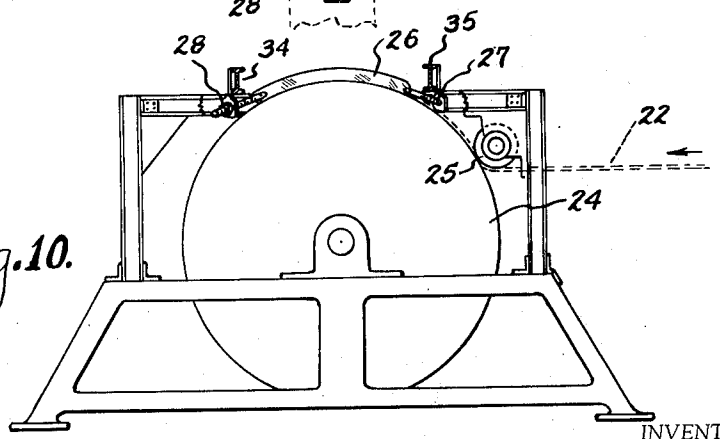
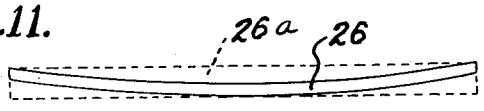


Fig. 11.



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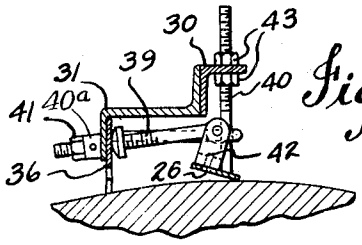


Fig.12.

Fig.13.

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Patented July 16, 1935 2,008,181

UNITED STATES PATENT OFFICE

2,008,181

ART OF PRODUCING MULTILATERAL STRETCHABILITY IN PAPER WEBS OR THE LIKE

William C. Kemp, Cincinnati, Ohio, assignor to The Paper Service Company, Lockland, Ohio, a corporation of Ohio

Application July 29, 1932, Serial No. 626,059

12 Claims. (Cl. 154—30)

The invention herein described is related to that disclosed and claimed in my copending application for Letters Patent, Ser. No. 558,884, filed August 24, 1931, and entitled A multi-laterally stretchable creped paper product. The said application, Ser. No. 558,884 relates to the product formed by the process and mechanism set forth in the present application.

In the ordinary art of creping a paper web, or the like, the web is caused to contact and adhere to a device presenting a moving creping surface, and is removed therefrom by a doctor, the action of which is to produce crinkles in the web. Such creping processes have been continuous in that a web of indefinite length may be run through the machine without stoppage. The creping crinkles have been made in the sheet normal, i. e. perpendicular to its line of motion and its major axis. The sheet is therefore contracted longitudinally by an amount equal to the stretchability formed therein, and is consequently stretchable longitudinally. It is not stretchable widthwise, i. e. in the direction of the crinkles, and the truss-like action of the crinkles increases the transverse stiffness of the web.

Creped paper as thus formed is not universally stretchable, and while it has been proposed to give it widthwise stretchability by corrugations, or the like formed therein, and while a creped and corrugated web is useful for a number of purposes, it does not have certain highly valuable characteristics of my improved product, as set forth in my copending application referred to.

It is a fundamental object of my present invention to provide means whereby, in a creping operation which may and preferably will be continuous, a web may be formed having universal stretchability.

The present case, being directed to the process and machine, relates to the aspect of producing in a web sets of crinkles which are non-coincident directionally, whereby the web is given normal directions of stretchability perpendicular to each set of crinkles, in a plurality of different directions. Another object of my invention is the provision of a machine and method for producing in a web at least one set of creping crinkles not perpendicular to the axis of said web, and/or to the direction of its motion, whereby a degree of transverse as well as lengthwise stretchability is imparted thereto. Still another object of my invention is to provide means and a method for imparting to a web crossing sets of creping crinkles, or the like, which sets, having what may be termed normal directions of stretchability disposed diagonally to each other, give in the preferred aspect of my product a web which is stretchable in all directions, and may easily be made equally stretchable in all directions. A general object of my invention may therefore be stated as the provision of a means and method for producing diagonal crepes in a web, and somewhat more specifically, crossing sets of diagonal creping crinkles. The word "diagonal" should be understood, as related to the axis of the web, as implying an angularity other than coincident with or at 90° to said axis; but should not be understood as limited to any specific angularity within the limits recited.

These and other objects of my invention which will be set forth hereinafter or will be apparent to those skilled in the art upon reading these specifications, I accomplish by that series of process steps and in that certain construction and arrangement of parts of which I shall now describe certain exemplary embodiments, reference being had to the accompanying drawings, wherein

Figure 1 is a semi-diagrammatic plan view of a mechanism for the production of double-diagonal creped products and joining them to a backing substance.

Fig. 2 is a side elevation of this apparatus.

Fig. 3 is a diagram illustrating the nature of the contraction in diagonally creped fabrics.

Fig. 4 is a plan view of a device employing creping surfaces having a planar movement at the creping point.

Fig. 5 is a side elevation of this apparatus.

Fig. 6 is a side elevation, and

Fig. 7 an end elevation of a roll equipped with a straight diagonal knife.

Fig. 8 is an end elevation of the supporting mechanism for a band knife type machine.

Fig. 9 is a diagrammatic representation of a band knife machine.

Fig. 10 is an end elevation thereof.

Fig. 11 illustrates the manner in which the knife is ground.

Fig. 12 is a sectional view taken along the lines 12, 12 of Fig. 13 showing the action of the knife and the supports therefor.

Fig. 13 is a plan view of the knife supporting structure of Fig. 8.

Briefly, in the practice of my invention, I provide a creping surface and a doctor knife, which are movable relative to each other. The web is bound to the surface in any way desired, and is removed therefrom by the doctor whereby the

crinkles are formed therein. The manner in which the web is caused to cling to the surface is not a limitation upon my invention, and I may adopt any of the several known creping processes, including, but without limitation, the water creping process and the process of the Rowe Reissue Patent No. 17,633. Indeed, under some circumstances I may employ means for producing crinkles in a sheet which do not include the ordinary surface and doctor arrangement; and by creping, where not otherwise specified, I desire to be understood as meaning any process of creping or crowding a sheet to form crinkles therein; and by the words "crepes" or "crinkles" I desire to be understood as meaning any relatively small and closely spaced type of rugosities designed to impart stretchability to the sheet, distinguishing these only from relatively large corrugations or embossed protuberances.

It is a characteristic of my process and apparatus, however, that the instrumentalities which contact, and form crepes or crinkles in the web, do so at an angle other than a right angle to the direction of travel of the web as it is fed to such instrumentalities. Since ordinarily webs of indefinite length will be treated in a continuous manner, this means also that the agencies aforesaid will act upon the sheet in a direction other than normal to its major axis.

In those embodiments of my invention where a creping surface and a doctor knife are employed, and the paper is caused to cling to the creping surface, the doctor will be set at an angle other than at a right angle to the direction of travel of said surface.

I shall describe my invention in connection with three modifications which seem to me of the greatest commercial importance, all of which are related to the general statement of the invention made hereinabove. In one of these modifications a creping surface is employed which, during the action of the doctor knife, moves essentially in a flat plane. In another modification a cylinder is employed, and a straight knife not parallel to the axis of the cylinder is caused to contact the cylindrical surface, being hollowed out for the purpose. In still another modification a cylinder provides the creping surface, and a knife in the form of a flexible band of steel or other suitable metal is caused to conform to the surface of said cylinder. As it crosses said surface diagonally, this knife will have a helical contour.

I have illustrated in Figs. 4 and 5 a modification of my invention in which a first creping surface is in the form of a band or belt of steel, or the like, 1, which passes around interspaced supporting drums 2 and 3. Intermediate these drums the band is supported by a table 4, or the like, to which steam or other fluid connection may be made for purposes of temperature control and/or lubricant connection between support and belt for reduction of friction. Instead of the table 4 other supporting devices may be employed, such as traveling conveyors, rolls, or discs arranged in echelon formation. It is merely essential that the band be supported over a considerable area by means satisfactorily strong and interposing as little frictional resistance to the movement of the belt as possible.

A web of paper, or the like, 5 may be drawn from a roll 6 and pressed into contact with the upper surface of the belt 1 by means of a pressure or back-up roll 7. For purposes of illustration the sheet may be bound to the surface by a film of thermoplastic substance, such for example as bitumen, and this may be applied by means of rollers 8 from a pan or reservoir 9, to the belt itself. A diagonal doctor 10 removes the web 5 from the creping surface, as shown, and produces therein diagonal lines of crepe 11 as shown in Fig. 4. The paper in this instance might be led up over the knife 10 by means of a bar, or disc-like rollers arranged in echelon, and the paper carried on to the second creping device more or less with its original direction of travel. This, while possible, is not particularly convenient; and I prefer to remove the paper as shown in Figure 4 by carrying it in upside down position away from the knife and at an angle to its original path of travel. The web 5a now has diagonal lines of creping therein and will have been contracted both lengthwise and widthwise as shown, depending upon the amount of stretchability placed therein. Where a second or crossing set of diagonal crinkles is desired in the web it may be led to a second creping surface formed by a belt 13 passing over interspaced rolls 14 and 15, and supported by an intermediate table or the like 16. The back-up or pressure roll 17 presses the web into adhering contact with the belt. Because the web has been reversed by the first creping operation, I have shown it passing to the under side of the belt 13, and following that belt to the upper side where it is removed by a second doctor 18, at an angle to the path of travel of the web. Of course, this procedure may be varied as desired. The second doctor 18, I have shown as set at such an angle as to form therein a set of crinkles 19, oppositely disposed to the crinkles formed by the first doctor 10. The web may again by the use of bars or echelon rolls, be led on in the same direction; but I have shown it removed from the second doctor in the same way in which it was removed from the first.

In some respects that is one of the simplest forms of my device for the reason that the creping surface is planar, and a straight knife 10 or 18 coacts therewith without having a special shape or configuration, such as is necessary when diagonal creping is to be accomplished upon the cylindrical surface of creping rolls. It will be understood that since both creping operations put diagonal crinkles into the web, each is accompanied by a theoretical longitudinal and widthwise contraction of the web. However, in ordinary practice there is a tendency in the second creping operation for the knife to remove some of the stretch placed therein by the first creping operation. Consequently it frequently happens that the amount of widthwise contraction resulting from the second creping step is less than would otherwise be expected. This can be compensated for, of course, by putting into the web in the first creping the desired amount of stretch, plus sufficient to compensate for the removal of stretch which takes place to some extent in the second creping operation. The residual stretchability of the sheet may be controlled in known ways; and obviously the second creping surface will move at a speed slower than the first by the amount of lengthwise contraction which it is desired to leave in the web after the first operation.

Moreover, with the straight creping surfaces moving in a planar path, it is much easier to lead the sheet over the knife and on substantially in the direction of its original travel, if this is desired, since there is no tendency to warp the sheet, as there is when it leaves a diagonal knife on a cylindrical or curved surface. Yet for operating reasons, I ordinarily prefer to employ creping cylinders and diagonally disposed knives

contacting the same. I have used with success two types of knives or doctors contacting cylindrical creping rolls; but there are some problems connected with the use of diagonal knives on creping cylinders which require explanation at this point. If a line be drawn upon the surface of a cylinder at a constant angularity to the axis thereof, this line will follow a helical path. A projection thereof into a plane would give a sinusoidal curve. On the other hand, if a cylinder were cut through at an angle to its axis other than a right angle, the line of cut, if projected into a plane, would be a straight line. If the surface of the cylinder were unrolled, however, the line of cut thereon would be a sinusoidal curve. Thus it appears that a straight knife hollowed out to contact the periphery of a cylinder will not give absolutely rectilinear crepes. While it would be possible to employ a sinusoidal knife, and while this may be done without departing from the spirit of my invention, yet a sinusoidal knife is difficult to make, to grind to shape, and to maintain. This difficulty is increased when it is remembered that the character of creping is modified and controlled by the V of the knife, so-called, which is the angle of the leading edge of the knife to a line drawn tangent to the cylinder at the meeting point. While a straight knife will tend to give sinusoidal lines of crepe, yet this tendency is not great enough to be of particular detriment where the width of the cylinder, or that portion of it which is contacted by the paper, is kept small in relation to the diameter of the cylinder. If this is done, straight run diagonal knives may be used to produce lines of creping which are to all intents and purposes rectilinear.

I have indicated diagrammatically in Fig. 6 a cylinder **21**, to which a web of paper **22** has been caused to adhere, and which moves with the cylinder in the direction indicated by the arrow. **23** is a straight, rigid knife hollow-ground to conform to the surface of the cylinder and disposed diagonally as shown, to the cylinder axis. This knife, as somewhat more clearly shown in Fig. 7, is a straight plate of metal disposed in a plane at an angle to the axis of the cylinder. The knife may extend straight away from the surface of the cylinder in the form shown, or the plane of the knife may be inclined with respect to the cylinder, as in the ordinary creping operation. In either case a complicated grinding problem is presented, since under such circumstances the hollowed edge of the knife requires a varying curvature, in order to produce a constant angularity of creping V. For these reasons, I prefer to use as a creping knife, a tensioned band as will hereinafter be described. Nevertheless, I have successfully manufactured double diagonal crepe papers with creping cylinders and straight, rigid knives of the form shown in Figs. 6 and 7.

It will be seen that a knife of this character must of necessity extend away from the surface of the cylinder a considerable distance, and that it must be supported by satisfactorily rigid supporting devices. This makes it impossible to lead the paper on immediately in the direction of its former travel, but makes it necessary at least to carry it away from the surface of the cylinder a sufficient distance to clear the knife and its supporting arrangements if it is to be carried on in the same direction at all. It will be understood that the surface of the cylinder **21** is curved, and to separate the paper from it along a line coincident with the knife **23** would result in a greater tensioning of the paper toward the edges of the sheet than at the center, the line of departure being distinctly curved. While this may be done, and while the paper may be carried over suitable bars or other supports so as to change its direction and/or plane, the most advantageous way to remove the paper from the cylinder **21** is back upon itself at an angle to its original path of travel, and upside down with respect to its former position, after which, of course, the path of travel may be additionally changed if desired. The sheet is shown leaving the cylinder **21** at **22***a* in a direction substantially at right angles to its original path of travel. The sheet portion **22***a* can thus come off the cylinder in a transversely arcuate or curved form, which does not require differential stretching, and the sheet may be flattened out by suitable bars, rolls, or the like, away from the surface of the cylinder without undue stretching.

The angularity of movement of the sheet portion **22***a* with respect to the portion **22** will be determined by a number of different factors, among which of most importance is the relationship between the angularity of the knife **23**, with respect to the path of travel of the sheet portion **22**, and the amount of stretch produced in the web.

These are important considerations and will now receive further explanation because, as will be apparent, the angularity with which the sheet portion **22***a* leaves the cylinder **21**, more or less in the direction of the axis of the cylinder, will influence the position of the second creping device to receive it most advantageously. Referring now to the diagram of Fig. 3, I have shown a sheet portion **22** moving in the direction of the arrow. For purposes of illustration I take a rectilinear portion of the sheet bounded by the lines *a*, *b*, *c*, *d*. The diagonal of this square D, B may be thought of as a diagonal creping knife arranged at an angle of 45°. The sheet may be thought of first as passing on over the knife with its original direction of motion. If no stretch were put into the sheet by the knife, the portion *a*, *b*, *c*, *d* would be a square, the lower right hand corner of the sheet reaching the point C. However, by the amount of stretch put into the sheet, the point C will tend to approach the knife D, B. Assuming that an arbitrary amount of stretch brings the corner of the sheet from C to E, the contracted or creped portion of the sheet will now be represented by the triangle D, B, E. This is what would happen if the sheet were led on over the knife. If, however, the sheet is turned back on itself and led off the creping surface at an angle to its original position, the creped portion will be represented by the triangle D, B, E', which is a projection of the triangle D, B, E. It will be obvious that the line B, E' does not coincide with the line B, A, but that the sheet will tend to come off in the direction of the arrow B, F, and therefore not at a right angle to its original direction of travel. It will be clear also that with a knife disposed at an angle of 45°, the sheet will not come off the creping surface in a direction at right angles to its original path of travel, unless the amount of stretchability put into the sheet is substantially nothing. As the stretchability increases, so does the angle, F, B, A increase. Moreover, the crinkles put into the sheet by the knife D, B will be parallel thereto in the sheet portion D, B, E'; but since the line F, B does not coincide with

the line A, B these crinkles will not be at an angle of 45° to the edge of the creped sheet represented by the line F, B. Both of these factors may be corrected, it will be clear, by changing the angularity of the knife D, B, as well as controlling the stretchability of the sheet. With any given angularity of knife, both the angularity of the crinkles with respect to the edge of the sheet and the angularity of the direction of travel of the sheet as it leaves the knife may be varied by varying the percentage of stretch left in the paper.

In ordinary practice the angularity of the crinkles with respect to the edge of the sheet is not of as great importance I believe, as the securing of a truly universally stretchable character in the sheet. If a sheet is substantially equally stretchable in all directions, it is for most purposes entirely satisfactory, and the exact angular relationship of the crepes to the edge of the sheet is relatively less important.

It will now be apparent that the direction of travel of the sheet as it leaves the knife may be controlled by the amount of stretchability put into the sheet by the said knife, or if the stretchability is to be maintained constant, the angularity of travel may be varied by changing the angularity of the knife.

The angularity of the crinkles is important in this, that considering but one set of crinkles, there is a normal stretchability perpendicular thereto, together with varying degrees of stretchability at an angle to the normal, varying from maximum in the direction of normal stretchability to substantially zero at right angles thereto. But with crossing sets of creping crinkles, it will be clear that the stretchability transversely or lengthwise of the web will be the resultant of stretchabilities realized from both sets of crinkles.

The resultant stretchability may also be varied by varying the relative speeds of the two creping operations as determined by the speed of travel of the web as it reaches the creping knives. For convenience in operation, particularly with creping cylinders, I prefer to take the web away from the knife at right angles, or at least at a fixed angularity for which my machine may be constructed. The proper angularity of the knife or knives may easily be determined in relation to a proposed amount of stretchability. Given such a set up of the apparatus it is comparatively easy, by varying the other factors, to produce a finished web having either substantially equal or divergent amounts of lateral and longitudinal stretchability.

In practice I have employed for both creping operations knives set at an angle of less than 45°, putting into the sheet a stretchability normal to the lines of crinkles sufficient to bring the line of departure of the sheet from the roll to an angle of substantially 90° to the original path of travel, and by control of machine speeds I have put into the sheet, as aforesaid, both laterally and longitudinally, a substantially equal amount of stretch, although the angularity of the crinkles is other than 45°, to the edges of the sheet. These factors may be varied, as hereinabove indicated, and my invention is not limited to particular angularities or amounts of stretch. I have hereinabove indicated that inasmuch as the second knife, while putting in stretchability due to crinkles oppositely disposed to the first set of crinkles, removes some of the stretch put in by the first creping operation. This is compensated for by putting in more stretch in the first operation than in the second. All of these factors can be varied for any given operation to produce the result desired.

Reverting to the mechanism comprising a knife and a roll, I have found it possible to employ a knife of flexible metallic material which is caused to contact a roll by being wrapped thereabout, as it were, in a helical fashion. In the diagrammatic illustrations in Figs. 9 and 10 I have shown a roll 24, to which the web of paper 22 is caused to adhere after being pressed thereagainst by the back-up roll 25. 26 is a knife in the form of a band of steel tensioned as at 27 and 28. A perfectly straight knife which is wrapped about a roll in this fashion will, in projection, follow a sinusoidal curve, but as respects the periphery of the cylinder, it will follow a helix at a constant angle to the axis of the cylinder. Moreover, if the leading edge of the knife is ground to a constant angularity, a constant creping V will be produced. A knife merely wrapped about the surface of a cylinder, however, gives rise to considerable friction. Moreover, it will tend to be displaced by the creping strains which in Fig. 9 are in the direction of the arrows. Consequently it is advisable to support the knife from the rear, as by supporting means extending between the knife 26 and a rearward support. I have further found that by supporting the knife from the rear in such a way that it is pushed forward, the knife may be tilted so that only its leading edge contacts the cylinder. This is diagrammatically illustrated in Fig. 10. When, however, the knife is pushed forward it leaves a true helical path, and instead of tending to make rectilinear crinkles, would tend to make somewhat arcuate crinkles. This may be compensated for, however, by using a curved knife and I have illustrated in Fig. 11 the knife 26 formed by grinding or cutting from a wider bar of metal 26a. A curved knife of the type shown in Fig. 11 may be tilted forward and still follow a truly helical path on the cylinder surface.

The essentials of a mechanism of this type are, of course, a creping cylinder and attendant mechanism, a helical or band type knife, means for tensioning the knife at its ends, and means for supporting the knife from the rear and tilting it forwardly, to which I have also found it desirable to add means for holding the leading edge of the knife down against the cylinder in a positive manner.

This organization is shown in plan in Fig. 13, where the creping cylinder 24, mounted in the usual frame, not shown, has above it a supporting mechanism indicated generally at 29. This supporting mechanism comprises an angle bar 30 attached to another angle bar 31, the whole being supported at its ends 32 and 33 on transverse rails 34 and 35 across the creping machine.

Reference to Fig. 8 will show that the main angle member 31 may have attached to one of its legs a curved plate 36, and will also show that the angle member 30 may have sidewise angularly disposed complementary angle members 30a and 30b. These last mentioned members are attached to plate portions 37 and 38, mounted upon the angle member 31. The reason for breaking the supports and the reason for the curved plate 36 will obviously be to cause the supporting structure to conform more or less to the arc of the circumference of the cylinder followed by the knife.

Rearwardly extending supporting members 39 and vertically extending holding members 40 are

provided, which may be more clearly seen in Fig. 12. The supporting members 39 are threaded rods held by the angle members 31, or the plate 36 attached thereto. They are provided with threaded sockets 40a and adjustment nuts 41. The rods 39 are held in bifurcated saddles 42 on the knife 26, and their action in pushing the knife forward and in tilting it will be readily understood.

The particular supporting members 40 are threaded rods contacting the knife near its forward edge, and held to the angle member 30 by nuts 43.

An exemplary machine embodying the organization just described is shown in plan and elevation in Figures 1 and 2. Here the web 45 is taken from a roll or source of supply 44 and is led between coating rollers 46, the lower of which turns in a pan 47 of asphalt or other thermoplastic adhesive. In this way the web 45 is coated upon one side with the adhesive, after which it may be carried around a cooling or tempering drum 48, and conducted to the creping cylinder 49 to which it is pressed by a pressure roll 50. It is creped from this drum by means of the knife 51, leaving the drum coated-side-up in a direction preferably at 90° to its original path of travel as shown at 45a. After passing over a straightening and/or pressing roller 52, it is carried around a second creping drum 53 so as to be bound thereagainst by the thermoplastic adhesive upon the surface of the web. Next the web is removed from cylinder 53 by a diagonally disposed knife 54 putting into it a second set of crinkles at an angle to the first. The web comes off this cylinder as shown at 45b, preferably at right angles to its path of travel before it reaches the knife 54. Again its coated side will be uppermost. Where it is desired to back the web as by the addition thereto of burlap, such a fabric from a roll 55 may be led and pressed against the adhesive coated surface of the web by rolls 56. The backed product is indicated at 45c.

The particular creping operation employed by me, by which I mean the nature of the actual crinkle forming step as distinguished from the manner of forming crinkles disposed in accordance with my invention, is not a limitation upon my invention. I may employ a water creping process in whole or in part or an asphalt creping process or any other process whereby crinkles are put into the sheet by creping or crowding, or I may employ one type of creping in one of my stages and another type in another stage. Where creping is accomplished by the positive action of a thermoplastic adhesive, the second creping step may be carried on with or without the addition of more of the adhesive substance. In any event, the second creping operation has been found to contribute to the impervious character of the web.

In the practice of my invention, I may employ one or more creping steps, as may be desired. One creping step producing diagonal crinkles will give both lateral and longitudinal stretchability. Substantially equal stretchability in all directions may be obtained in my invention, as hereinabove pointed out, by two creping operations, each producing diagonal crinkles. Special effects may be obtained by combining an ordinary crinkling step with a diagonal crinkling step, or a plurality thereof; or I may employ a plurality of diagonal crinkling steps designed to produce crinkles having a plurality of different directions, whether oppositely inclined to the major axis of the paper or not.

My invention is not restricted to any particular character of creping or crowding operation, nor is it restricted to operations upon any particular character of web. In addition to paper I may, by way of example, but without limitation, crepe other materials, such as leather, imitation leather, metal foil, woven fabrics and composite fabrics of various classes.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent, is:—

1. In a machine for producing creped webs, means for causing a movement of a web with relation to a crowding device, and a crowding device having contact with said web along a line having less than a right-angled relationship to the direction of movement of said web.

2. In a machine for producing creped webs, means providing a continuously moving, substantially smooth creping surface, a creping doctor adapted to remove a web from said surface, and means for maintaining the line of substantial contact between said doctor and said surface at other than a right angle to the direction of movement of said surface.

3. In a creping device, means providing a continuously moving creping surface to which a web may be caused to adhere, and a knife having a line of contact with said web diagonally disposed with reference to the path of movement of said surface and arranged to remove said web therefrom.

4. In a creping device, means providing a continuously moving, substantially smooth creping surface to which a web may be caused to adhere, a portion at least of the path of movement of said surface lying in a flat plane, and a knife having a line of contact with said web diagonally disposed with respect to the path of movement of said surface and arranged to be held in substantial contact with said surface of said plane.

5. In a creping device, a creping cylinder, a creping knife adapted to be held in substantial contact with said cylinder, said creping knife being disposed at an angle to the axis of said cylinder and having a contacting surface disposed to contact the surface of said cylinder over a curved line of substantial length.

6. In a creping device, a creping cylinder, a diagonally disposed knife having a linear edge shaped to contact the surface of said cylinder along a line of substantial length between parallel circumferences of said cylinder which are interspaced a distance less than the diameter of said cylinder.

7. In a creping device, a creping cylinder, a creping knife of band form and bent to contact the surface of said cylinder along a substantially helical line, and means for supporting said knife in a position in which one of its edges contacts the surface of said cylinder.

8. In a creping device, a creping cylinder, a creping knife of band form and bent to contact the surface of said cylinder along a substantially helical line, and means for supporting said knife in a position in which one of its edges contacts the surface of said cylinder, said means arranged to displace said knife against the direction of rotation of said cylinder so as to tilt the trailing edge of said knife away from said cylinder.

9. In a creping device, a creping cylinder, a

creping knife of band form and bent to contact the surface of said cylinder along a substantially helical line, and means for supporting said knife in a position in which one of its edges contacts the surface of said cylinder, said means arranged to displace said knife against the direction of rotation of said cylinder so as to tilt the trailing edge of said knife away from said cylinder, and means for tensioning said knife on said cylinder.

10. In a creping device, a creping cylinder, a creping knife of band form and bent to contact the surface of said cylinder along a substantially helical line, and means for supporting said knife in a position in which one of its edges contacts the surface of said cylinder, said means arranged to displace said knife against the direction of rotation of said cylinder so as to tilt the trailing edge of said knife away from said cylinder, said knife being formed hollow so that when so supported the leading edge of said knife will contact said cylinder along a helical line.

11. In a creping device, means for moving a web, a crowding device disposed at an angle to said line of movement, means for removing the web from contact with said crowding device at an angle to its first direction of motion, a second means for moving a web adapted to receive said web in said second direction of motion, a second crowding means angularly disposed with reference to said second moving means, and means for removing said web from contact with said second crowding device at an angle to said second direction of movement.

12. In a creping device, means presenting a creping surface, and a creping doctor angularly disposed thereto, a second means presenting a creping surface and a second doctor angularly disposed thereto, said creping doctors being respectively oppositely disposed to the major axis of a web to be treated thereby as it reaches said creping doctors.

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