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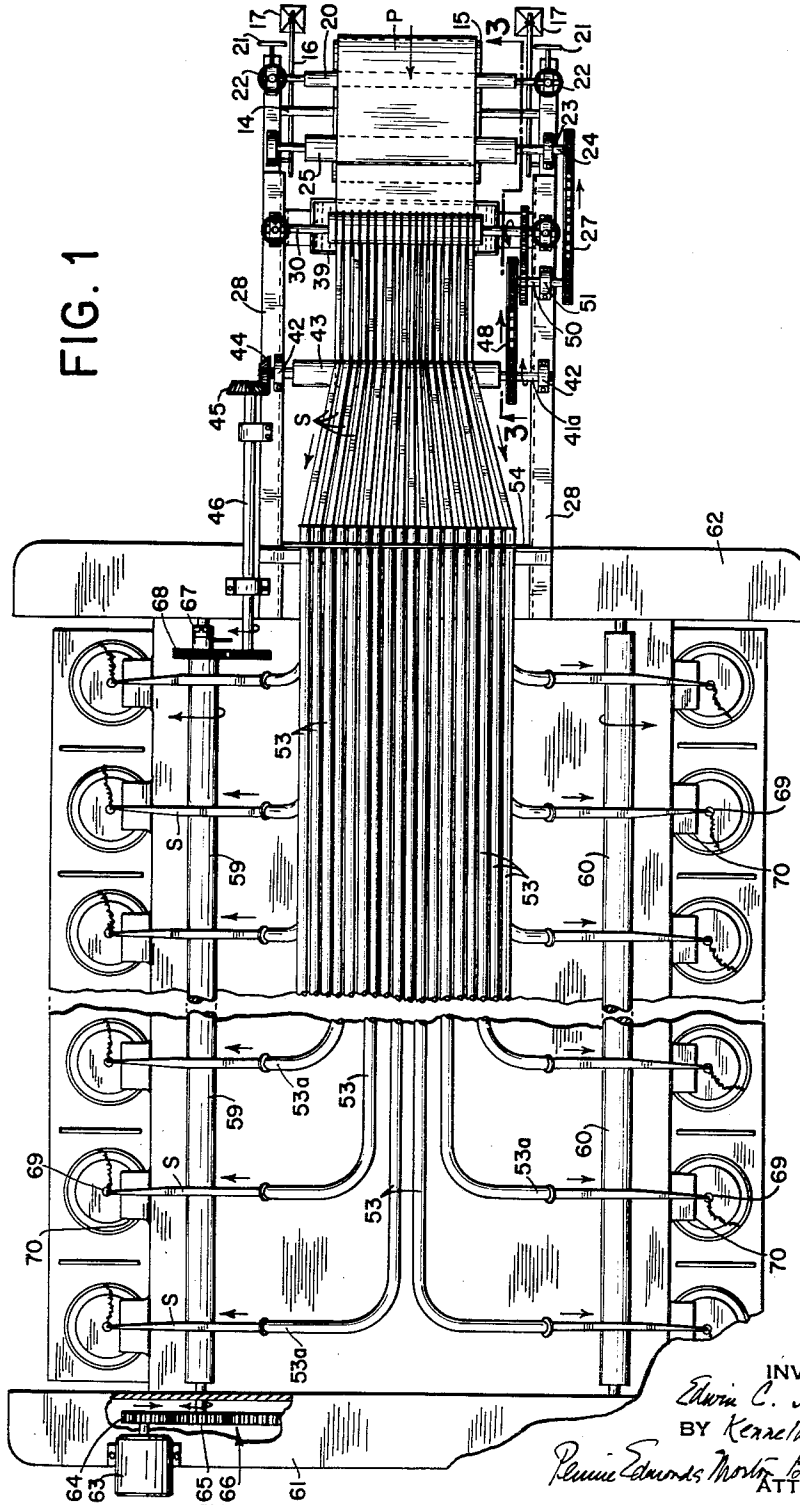
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METHOD AND APPARATUS FOR THE PRODUCTION OF PAPER YARN

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3 Sheets-Sheet 1

FIG. 1



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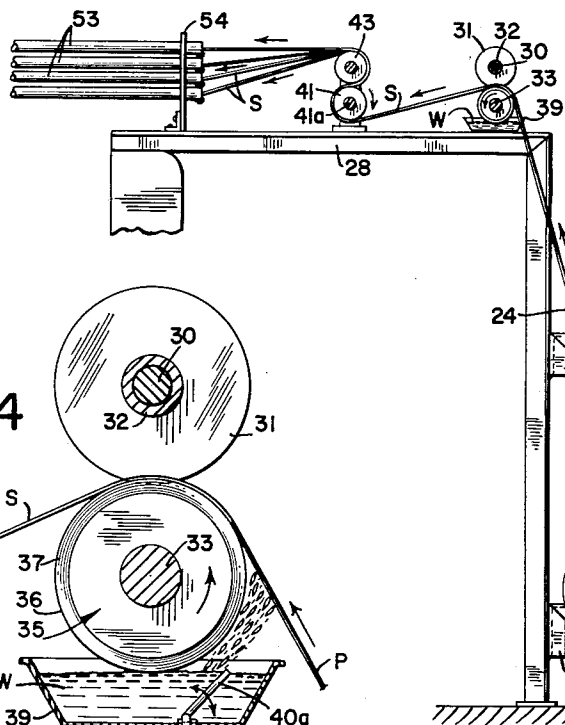


FIG. 3

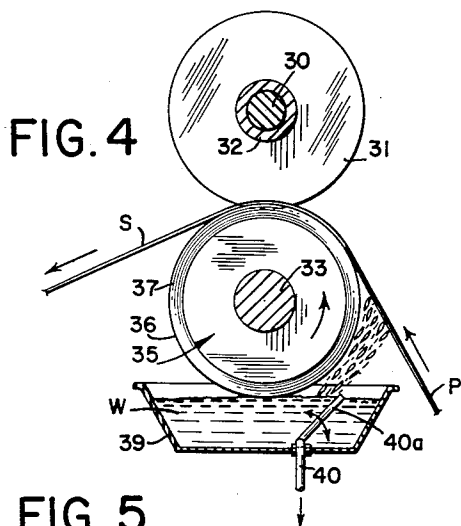


FIG. 4

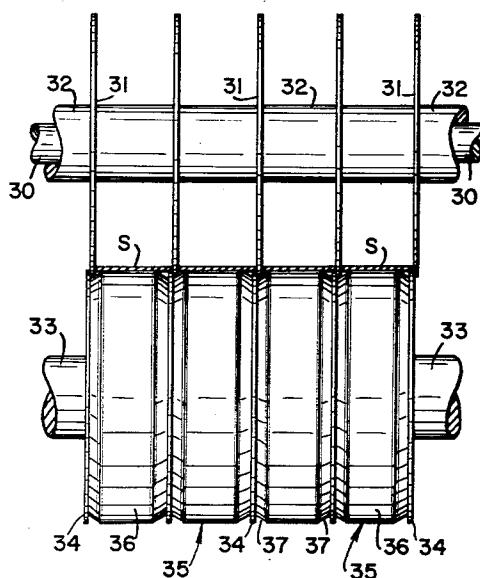


FIG. 5

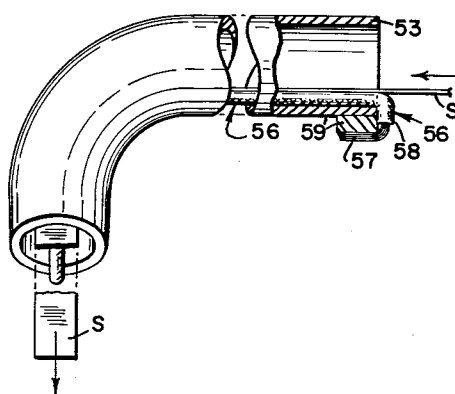


FIG. 6

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1

3,012,393

METHOD AND APPARATUS FOR THE PRODUCTION OF PAPER YARN

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This invention relates to the production of paper yarn by sub-dividing a wide web of paper into strips, twisting the strips, and forming the twisted strips into packages. More particularly, the invention is concerned with a novel method of producing paper yarn in the practice of which breakage of the paper strips is reduced and damage caused by a broken strip to adjacent strips is prevented. The invention also includes an apparatus for carrying out the method efficiently and offers other advantages to be pointed out hereafter.

The production of paper yarn by slitting into strips a wide web of paper drawn from a supply roll and twisting the strips has been carried on for many years and it is common practice in such manufacture to facilitate the twisting operation by utilizing moisture to soften the paper in the strips. In one method, the paper is dampened before being wound into the supply roll while, in another, the paper in the roll is dry and, after it has been slitted into strips, the strips are dampened. The use of a roll of moist paper is objectionable, in that the moisture content of the roll is likely to be non-uniform, particularly, if the roll is not used at once in yarn production, and the paper is weakened by the moisture, so that, if it is pulled from the roll, it may tear. Also, some types of paper when damp cannot be cut cleanly to form strips. In the prior methods, in which the dry paper is cut into strips and the strips are moistened, the moisture is frequently applied to the strips only a short distance from the twisting mechanisms and, in order to insure that the strips will be properly softened, a large amount of moisture is employed. Such excessive wetting weakens the paper, so that there is frequent breakage of the strips, unless high wet-strength paper, which is expensive, is used.

The present invention is directed to the provision of a method of making paper yarn, which is not subject to the disadvantages of the prior methods and can be employed without the use of special high wet-strength paper to produce paper yarn of uniform quality at a rapid rate and with little breakage. The desired results are achieved in the practice of the new method by applying moisture in a limited amount to the paper and slitting the paper so soon after it has been moistened that the moisture present does not interfere with the slitting operation. The moistened strips then travel a substantial distance before being subjected to twist and, during such movement, the moisture has a chance to permeate the strips and soften them. Also, during a major part of their movement, the strips are confined within guide tubes, which not only keep the strips apart and prevent a broken strip from doing damage to those adjacent to it but also prevent any substantial loss of moisture from the strips. The dry web is unwound from the roll by force applied to the web and the strips are moved from the slitting devices to the twisting mechanisms by forces applied to them. However, the forces required for such movement of the strips are so light that there is little danger of the strips being broken, even though the paper is softened and weakened by the moisture.

For a better understanding of the invention, reference may be made to the accompanying drawings, in which

FIG. 1 is a plan view of one form of the apparatus of the invention with the twister frame shown diagrammatically;

2

FIG. 2 is a view of the apparatus in front elevation;
FIG. 3 is a fragmentary sectional view on the line 3—3 of FIG. 1;

FIG. 4 is a vertical sectional view through the slitting mechanism;

FIG. 5 is a fragmentary front elevational view of the slitting mechanism;

FIG. 6 is a view, partly in elevation and partly in cross-section, of one of the guide tubes of the machine.

The machine illustrated comprises a frame 10 having uprights 11, on which are mounted brackets 12 carrying bearings 13 for the arbor 14 of a roll of paper 15. A lever 16 is pivoted on each bracket and is pressed against the arbor by a weight 17 depending from the end of the lever and acting through the lever to apply a braking force to the arbor.

The uprights 11 carry upper brackets 18, on which are mounted movable bearings 19 for the shaft of a tension roll 20 adapted to engage the paper web P drawn from the roll 15. The bearings for the tension roll are movable along the brackets by adjusting screws 21 and may be held in adjusted position by locking screws 22. The brackets 18 also carry bearings 23 for the shaft 24a of a lower feed roll 24, upon which rests an upper feed roll 25. The shaft 24a extends outwardly at one end beyond the adjacent bracket and carries a sprocket wheel 26, about which is trained a chain 27. The paper web P passes from the tension roll 22 over the top of roll 25, between rolls 25 and 24, around and beneath roll 24, and upward therefrom.

The frame 10 includes horizontal frame members 28, on which are mounted standards 29 having bearings for supporting the upper and lower shafts of a slitting mechanism. The upper shaft 30 carries a plurality of flat slitting disks 31 separated by spacer sleeves 32 encircling the shaft and the lower shaft 33 carries a series of similar slitting disks 34 separated by wetting rolls 35. Each wetting roll has a smooth central peripheral surface 36 and its outer edges 37 are chamfered. The spacing of the disks 31 and 34 on their respective shafts is the same and the bearings for the shaft 30 are adjustable by screws 38 so that corresponding disks of the two series may have overlapping portions which lie in face-to-face contact. The web of paper P passing between the sets of disks is slit thereby into strips S.

A pan 39 for a liquid is mounted on the frame member 28 beneath the wetting rolls and disks on the shaft 33 and is of such depth that the disks and rolls enter the pan. A body of water W is maintained in the pan and the level of the water is determined by an overflow pipe 40 which leads from the pan and has a pivoted upper end 40a lying within the pan and movable to vary the water level. In operation, the water level is adjusted by means of the end section 40a of the overflow pipe so that the edges of the disks 34 and the wetting surfaces 36 of the wetting rolls 35 will pick up the desired amount of moisture from within the pan and carry it to the web of paper about to pass between the series of disks and be slit into strips thereby.

From the slitting mechanism, the strips S pass beneath a feed roll 41, the shaft 41a of which is mounted in bearings in standards 42 rising from the frame members 28. The standards are also provided with bearings for the shaft of an upper feed roll 43 which rests upon the roll 41. The strips pass beneath and around roll 41, between rolls 41 and 43, and around and over the top of roll 43. The roll 41 is driven by a bevel gear 44 mounted at one end of the shaft 41a of the roll to mesh with a bevel gear 45 on a shaft 46. Near its other end, the shaft 41a carries a sprocket wheel 47 connected by a chain 48 to a sprocket wheel 49 on a shaft 50 in a bearing in the standard 51 rising from one of the frame

members 28. The shaft 50 also carries a sprocket wheel 52, about which is trained the chain 27.

The strips S leaving the roll 43 enter respective guide tubes 53 supported at one end in openings in a vertical plate 54 mounted on the frame members 28. The tubes extend over the top of a conventional twister frame generally designated 55 and are supported on the frame in any convenient manner. The tubes have end sections 53a leading outwardly and downwardly toward the spindles, which lie in rows at opposite sides of the twister frame. The tubes 53 may be made of metal or a suitable plastic and, to facilitate the passage of the damp strips through the tubes, each tube has an internal rib, which rests on the bottom of the tube in a diametrical plane, as shown in FIG. 6, and on which the strip is supported as it travels through the tube. The rib may be conveniently formed by cord 56 having a fibrous core 57 and a covering 58 of a wax-like synthetic material, such as a polytetrahaloethylene, of which the product sold commercially under the trademark "Teflon" is an example. In order to secure each cord in its tube, the cord is longer than the tube and folded around the end edges of the tube. The cover is stripped from the core of each exposed part of the cord and the core is then secured by adhesive to a block 59¹ attached to the outer surface of the tube near its end.

The diameter of the cords used in the tubes depends on the width of the paper strips employed and is about half that width. With this arrangement, only the central longitudinal area of a strip is in contact with the cord during the passage of the strip through its tube and, since the covering of the cord is wax-like, the strip moves along the surface of the cord with little drag on the strip.

Each strip leaving the end section 53a of a tube passes in contact with one or the other of a pair of driven rollers 59, 60, the shafts of which are mounted in bearings in the housings 61, 62 at the ends of the twister frame. A motor 63 mounted on top of housing 61 drives a gear 64 in mesh with a gear 65 on the shaft of the roll 59 and a train of gears 66 connects the gear 65 to a similar gear on the shaft of roller 60. A sprocket wheel, which is mounted loosely on the shaft of the roller 59 and can be connected to the shaft by a clutch 67, is connected by a chain 68 to a similar sprocket wheel on the shaft 46. The motor 63 thus drives the two rollers 59, 60, the feed rolls 41, 43, the shafts 30, 33 of the slitting device, and the feed rolls 24, 25.

From each of the rolls 59, 60, the strips pass through the usual pig-tail guides 69 mounted on plates 70 pivotally attached to the top of the twister frame at opposite sides of the top. From the guides, each strip passes through an anti-ballooning ring 71 mounted concentrically with a spinning ring 72 on a ring rail 73 at one side of the twisting frame. Each spinning ring is provided with the usual traveler 74, through which the strip passes on its way to a bobbin 75, on which the twisted strip or yarn is to be wound. Each bobbin is mounted on the usual spindle 76, which extends through a spinning ring and an anti-ballooning ring. The twister has two operative sides, each having a row of spindles, a ring rail, etc.

In the operation of the apparatus in accordance with the method, the feed rolls 24, 25 pull the paper web P from the roll 15 at a constant rate, regardless of the continuing decrease in the diameter of the roll, and the web travels from the feed rolls to the slitting device where the disks on the shaft 33 and the wetting rolls apply moisture to the web. Immediately thereafter and before the moisture has softened the web to a significant extent, the overlapping disks on the shafts 30, 31 slit the web into separate strips S. The shafts 30, 31 are driven so that they assist in advancing the strips and, beyond the slitting mechanism, the strips are advanced by the feed rolls 41, 43. The strips are then separated and individually guided by the tubes 53 to the desired locations on the rolls 59, 60. Beyond these rolls, the strips pass

through the pig-tail guides, the anti-ballooning rings, and the travelers and are wound on the bobbins. The travelers apply a drag to the strips passing through them and the strips are twisted in the usual way with the twist running from the bobbins back to the pig-tail guides 69.

The moisture applied to the paper just before it is sub-divided into strips by the disks permeates the paper in the strips as the latter advance toward the spindles of the twister frame. During such movement of the strips, the tubes act to guide them and to conserve the moisture therein. As a result, the strips can be softened to the extent necessary to permit them to be twisted into uniform yarns without the application thereto of an excessive amount of moisture. If the moisture were applied to the strips close to the spindles, the moisture would have little time to spread through the paper and it would, therefore, be necessary to use an excessive amount of moisture to soften the paper. Application of the moisture as far from the spindles as possible is, therefore, desirable, since, with this arrangement, the maximum time for migration of the moisture through the paper is provided and it is not necessary to apply a large amount of moisture for the desired softening of the paper. It is undesirable to use a roll of moist paper, however, since such paper is likely to be torn when being unwound from the roll and, in addition, clean cutting of the strips is difficult. The application of the moisture immediately ahead of slitting together with the conservation of the moisture in the strips on their way to the spindles gives the best results, in that the presence of the moisture does not interfere with slitting and a relatively small amount of moisture is required for softening the paper, because of the time afforded for the distribution of the moisture through the paper.

In the apparatus, the feed rolls 24, 25 acting on the dry paper supply the force required to unwind the web from the roll 15. The feed rolls 41, 43 advance the strips through the slitting machines and, since the slitting disks are driven, little force is applied to the strips by the rolls. From the rolls 41, 43, the strips are advanced partly by the driven rolls 59, 60 and partly by the winding operation, in which the yarns are wound on the bobbins. Since little force is applied to the strips in their travel from the slitting mechanism to the bobbins, there is little likelihood of the strips breaking. However, if a strip breaks, its flying end is confined within a guide tube where it is traveling close to other strips and damage to these strips by the broken strip is thus largely avoided.

We claim:

1. A method of making paper yarn from a wide web of dry paper wound into a roll, which comprises pulling the web from the roll by force applied to the web at a place near the roll, applying moisture to the paper web beyond the place of application of the pulling force and, immediately after the application of the moisture, slitting the paper into a plurality of strips, advancing the strips by force applied through the surfaces of the strips, twisting the individual strips and forming the twisted strips into packages, and enclosing and guiding the individual strips between the place where the advancing force is applied to the strips and the places where they are twisted.

2. The method of claim 1, in which the moisture is applied to one surface only of the web.

3. The method of claim 1, in which the strips are supported from beneath along longitudinal zones between their edges while they are enclosed and being guided.

4. The method of claim 1, in which the twisted strips are formed into packages by winding them on bobbins.

5. An apparatus for making paper yarn from a wide web of paper wound into a roll, which comprises a support for the roll, roll means for applying force to the web to cause rotation of the roll, means for applying moisture to the web, the roll means engaging the web between the support and the moisture-applying means, means for slitting the moistened web into strips, means

5

for applying force to the strips to advance them from the moistening and slitting means, guide tubes for enclosing and guiding the individual strips, and means for twisting the individual strips and forming them into packages.

6. The apparatus of claim 5, which includes means for applying tension to the web between the support and the feed roll means.

7. The apparatus of claim 5, in which the strips are advanced from the slitting means and the moistening means by a pair of feed rolls.

8. The apparatus of claim 5, in which the individual strips are wound on bobbins and twisted by means of spinning rings and travelers drawn about the rings by the strips.

9. The apparatus of claim 5, which includes spinning spindles in two parallel rows, each spindle having a support for a bobbin, a ring rail extending along each row of spindles, spinning rings mounted on the rails to encircle respective spindles, and travelers on respective rings, the guide tubes lying between the rows of spindles and having straight portions extending lengthwise of the rows and curved terminal portions extending from the straight portions toward respective spindles.

10. The apparatus of claim 9, in which each guide tube contains an internal rib engaging the strip passing through the tube between the edges of the strip and supporting the strip.

11. The apparatus of claim 5, in which the slitting means include a first series of spaced disks mounted for rotation on an axis on one side of the web and transverse thereto and a second series of spaced disks mounted for rotation on an axis parallel to the first axis and on the other side of the web, the disks of the first series having edge portions overlapping edge portions of the disks of the second series, and the moistening means include wetting rolls lying between the disks of one series and having peripheral wetting areas of the same diameter as the disks of such series and chamfered edges adjacent the disks providing spaces for receiving the disks of the other series, and means for supplying moisture to the peripheral wetting areas of the rolls.

12. The apparatus of claim 11, in which the peripheries of the wetting rolls and the edges of the disks of said

6

series between the rolls dip into a bath of water in a vessel.

13. The apparatus of claim 12, in which the vessel is provided with an adjustable overflow pipe to determine the height of the water level in the vessel.

14. In apparatus for producing paper yarn from a web of dry paper, the combination, with means for advancing the web, of means for applying moisture to the web and slitting the web, the moisture applying and slitting means including a first series of spaced disks mounted for rotation on a common axis at one side of the web, a second series of spaced disks mounted for rotation on a common axis at the other side of the web, corresponding disks of the two series having portions overlapping and substantially in face-to-face contact, wetting rolls of the same diameter as the disks of the second series disposed between adjacent disks of that series, and means for applying moisture to the edges of the disks of the second series and to the peripheral surfaces of the wetting rolls.

15. The combination of claim 14, which includes wetting rolls having peripheral surfaces narrower than the maximum width of the rolls.

16. In apparatus for producing paper yarn, the combination of means for advancing moist paper strips and means for guiding the strips, the guiding means including tubes enclosing individual strips, each tube containing an internal rib rising from its bottom in a diametrical plane and engaging the strip passing through the tube between the edges of the strip to support the strip.

17. The combination of claim 16, in which the rib is formed by a strand having a wax-like surface.

18. The combination of claim 17, in which the surface of the strand is made of a polytetrahaloethylene.

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