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K. HAMILTON

2,407,926

PAPER YARN

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Fig. 1,

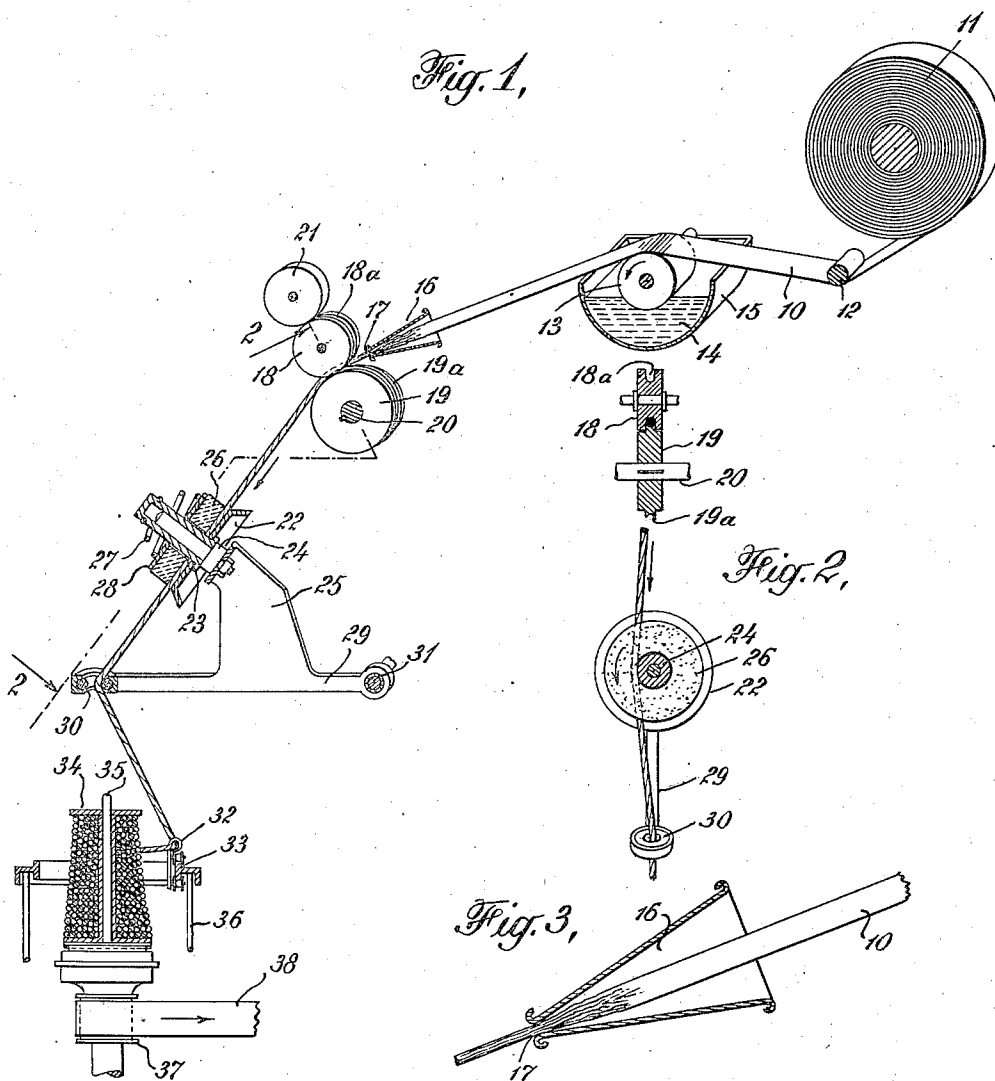


Fig. 2,

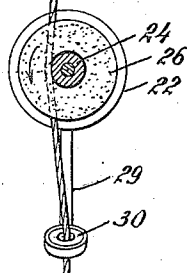


Fig. 3,

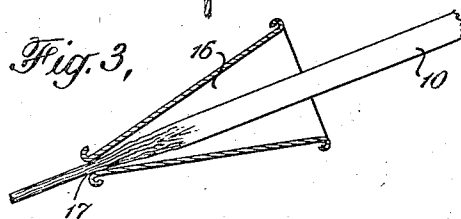
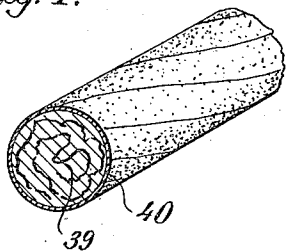


Fig. 4,



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PAPER YARN

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7 Claims. (Cl. 57—154)

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This invention relates to strands which are made by twisting a narrow strip of paper about its longitudinal axis and are variously referred to as paper yarn, cord, twine, etc. More particularly, the invention is concerned with a novel paper yarn having characteristics which make it superior to prior similar yarns for certain purposes, and with a method and apparatus by which the new yarn may be readily produced at low cost.

Paper yarn has been manufactured and used in the production of textile fabrics for some time, and, for some purposes, such yarn is generally acceptable. As made heretofore, the yarn is quite stiff and wiry and it can thus be employed to advantage for the stuffer warps in pile fabrics used for floor coverings, in that the yarn gives body to the fabric and stiffens it so that it will lie flat on the floor. More recently, it has been proposed, because of the shortage of more commonly used materials, to employ paper yarn as the weft or filling yarn in such fabrics but, for that purpose, the prior paper yarn has been found quite unsatisfactory.

The difficulties encountered in attempting to use the prior paper yarn for filling purposes in fabric production arise from the stiffness of the yarn, as a result of which it can not readily be bent sharply and is subject to kinking. When inserted in a shed by a needle or a shuttle, the yarn overruns, so that loose loops are formed at the edges of the fabric and the selvages are unsatisfactory. Kinking of the yarn produces imperfections in the fabric, as, for example, in pile fabrics, a kink in the filling may cause separation of the pile tufts, so that the pile appears to have spaces from which the tufts are missing. The prior yarn may be readily made flexible enough to avoid the difficulties above mentioned by wetting it, but when that is done, the yarn becomes so weak that it breaks frequently during the weaving operation.

The present invention is, accordingly, directed to the provision of a paper yarn, which is both sufficiently flexible to permit its insertion as weft in a fabric made on either a needle loom or a shuttle loom, and sufficiently strong to enable it to withstand the strains to which it is subjected in weaving without being broken. The new yarn, once incorporated in a fabric, may be readily modified to give it the stiffness of prior paper yarn so that it will impart the desired stiffness and body to the fabric.

The new yarn differs from ordinary paper yarns in that it contains moisture in its interior,

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so that it is flexible, and it is provided on its outer surface with a thin flexible substantially continuous film or coating that is impenetrable by moisture. The coating serves to retain the moisture in the interior of the yarn, so that the yarn remains flexible indefinitely, while the coating is in place. The coating serves the further purpose of adding to the wet strength of the yarn, so that the moist flexible yarn, which would otherwise be too weak for satisfactory use in weaving, may be readily woven into fabrics without being broken. The coating is preferably made of a material which is volatile at elevated temperatures, and, when such a material is used, the coating remains in place under ordinary conditions but can be driven off by heat, so that the yarn will then dry out and become stiff, as desired. The coating may advantageously be made of a material having lubricating qualities, and a coating of such a material enables the yarn to pass readily through and around guides without wear.

The new yarn may be made in various ways, as, for example, a strip of paper of the desired width and weight may be formed into yarn by conventional methods. The yarn may then be treated to cause it to take up the moisture required to make it flexible, after which it may be given the coating which retains the moisture and increases the wet strength of the yarn. Preferably, however, the paper is moistened prior to the forming and twisting operations and the coating is applied after the yarn has been partially formed and before the twisting is completed. By this method, the number of operations in the production of the new yarn is reduced and a better product results, since during the completion of the twisting, the coating material is distributed on the surface of the yarn to form a continuous external layer.

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

Fig. 1 illustrates diagrammatically apparatus used in the production of the new yarn according to the method of the invention;

Fig. 2 is a sectional view on the line 2—2 of Fig. 1;

Fig. 3 is a longitudinal sectional view through a part of the apparatus; and

Fig. 4 is a perspective view of the new yarn on an enlarged scale, the yarn being shown partly in cross-section.

The new yarn is made of a strip of a suitable paper, such as a kraft paper, and the width of the

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strip and the weight of the paper stock are chosen to give the yarn the desired size and strength. In the production of the yarn, the strip is drawn from a roll 11 and first moistened. For this purpose, it may be passed beneath a guide 12 and then over and in contact with a roller 13 partially immersed in liquid 14 in a vessel 15. The liquid used is water to which preferably, a small amount, such as from 1% to 5%, of wool oil has been added in emulsion form. The moistening agent may also include a small amount of a penetrant. In the moistening operation, the paper takes up about 25% of its weight in moisture and it becomes highly flexible but is weakened.

The moistened strip passes from the moistening device through a condensing device, which may appropriately take the form of a trumpet 16. This trumpet has a discharge orifice 17 of substantially less diameter than the width of the strip and in its passage through the trumpet, the strip is condensed and crushed together. The condensing of the strip may produce random folds extending generally lengthwise and, if desired, the strip may have its edges turned in, before it is threaded through the trumpet.

The condensed strip issuing from the trumpet then passes between upper and lower compressing rolls 18, 19. Roll 18 is formed with a circumferential channel 18a and roll 19 is formed with a circumferential rib 19a which enters channel 18a. The bottom of the channel and the peripheral edge of the rib are shaped to define a circular orifice through which the strip passes for further condensation. Roll 19 is mounted on a driven shaft 20 in fixed bearings and roll 18 is mounted for floating movement. A weighting roll 21 rests freely on roll 18 and serves to press it toward roll 20.

The condensed strip emerging from between rolls 18, 19 is next given a coating of a material which is impenetrable by moisture, and thus serves to retain the moisture in the finished yarn as well as to strengthen the yarn. Various materials are suitable for the purpose, but it is desirable to use a material which is volatile at elevated temperatures, so that the coating can be driven off by heat and the yarn will then dry out and have the stiffness and strength of ordinary paper yarn. Materials having lubricating qualities are preferred, and waxy materials, and specifically paraffin, are satisfactory.

The coating may be applied to the condensed strip in various ways, and one convenient apparatus for the purpose includes a saucer-shaped disc 22 mounted on a shoulder 23 on a stud 24 bolted to the end of a bracket 25. Disc 22 is free to rotate on the shoulder and a block 26 of coating material is mounted on the stud for rotation and forced toward the flat convex face of the disc by a light spring 27. The spring is anchored at one end on the stud and at its other end bears against a plate resting on the outer face of block 26. The bracket 25 may be mounted in any appropriate manner and, in the construction shown, it is attached to an arm 29 formed with an opening at one end, in which is mounted a porcelain guide 30. Arm 29 is pivoted at 31 on any suitable support and can be swung upwardly in a clockwise direction about its pivot.

The condensed strip issuing from between rolls 18, 19 passes between the flat convex face of disc 22 and the body of coating material. The center of stud 24 is aligned with the orifice defined by rolls 18, 19, but the diameter of the stud is such that the strand is forced slightly out of its nor-

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mal path of travel between the orifice and guide 30 and is thus kept taut. The movement of the strand between the disc and the block of coating material causes the latter to rotate so that fresh surfaces on the block are continuously brought into contact with the strand.

Beyond the coating device, the strip passes through guide 30 and thence to a conventional twisting and winding mechanism. As illustrated, this mechanism includes a traveler 32 mounted for free movement about a ring 33 which is mounted for vertical movement with reference to a spool 34 on spindle 35. For this purpose, ring 33 may be supported on vertical shafts 36 actuated by cams to raise and lower the ring in the proper manner. The spindle is supported for rotation in suitable bearings (not shown) and is provided with a pulley 37 about which is trained a belt 38 for rotating the spindle and spool. In the operation of the mechanism, the drag of the traveler results in the twist being imparted to the strip as it is wound on the spool. The twist runs backwardly from the traveler up to the guide 30 and through the coating apparatus to the orifice defined by rolls 18, 19. Between the orifice and guide 30, the strip is only partially twisted and the coating material is thus applied before the twisting is completed.

In the finished yarn, the paper forming the interior of the yarn, as indicated at 39, contains the moisture that the paper has picked up. The outer surface of the yarn is provided with a thin coating 40 of material derived from the block 26 and it is found in practice, when paraffin is used, that the coating amounts to about 1% by weight of the yarn. At the time of the application of the coating to the partially twisted strip, the strip has crevices in its surface into which the coating does not always penetrate. However, as the twisting is completed, the surface areas on the partially twisted strip that have received the coating are brought together, so that the layer of coating material becomes substantially continuous over the entire outer surface of the yarn.

The application of the coating material serves to retain the moisture that has been picked up by the paper and, because of the presence of the moisture, the new yarn is highly flexible, so that it can be readily used as filling in the weaving of fabrics. The new yarn will make sharp bends and can be easily conducted through guides, the needle eye, etc. The coating increases the wet strength of the yarn substantially and tests indicate that the coated yarn is at least 15% stronger than moist yarn made in the same manner but without the coating. The coating serves another purpose, in that it acts as a lubricant, so that the yarn runs smoothly through and around guides without causing wear thereof. Because of its flexibility, increased wet strength, and the lubricating quality of its surface, a lighter weight of the new yarn may be used as filling in the weaving operation than would be otherwise required.

After the new yarn has been finished, it may be stored for indefinite periods before use, and it retains its flexibility and strength during such storage. If the yarn were not provided with the coating, the moisture on it would evaporate in the course of time, and, as the yarn dried out, it would become stiff. The moisture originally present would also be likely to cause it to mildew or to become locally weakened because of uneven drying. After the yarn has been employed in a fabric, it can be readily made to become stiff and

wiry, like ordinary paper yarn, by removal of the coating. For this purpose, it is only necessary to subject the fabric to heat which will volatilize the coating and dry out the yarn. In the finishing of most pile fabrics, it is customary to apply sizing to the back and then to pass the sized fabric through a dryer. In the heating incident to the drying of the sizing in the usual way, the coating is removed from the new yarn and the paper is dried out so that the yarn assumes the desired stiffness.

The production of the new yarn in accordance with the method described offers various advantages, in that the application of moisture and the coating is carried on as an incident to the production of the yarn and requires only minor additions to the usual equipment. Also, the application of the coating to the partially twisted strip insures that the finished yarn will have a coating which is substantially continuous. It is to be understood, however, that the new yarn may be made by other methods and, also, that conventional yarn may be converted to the new yarn, if desired. Thus, the strip may be converted into yarn by ordinary methods and the finished yarn may then be moistened and coated in a separate operation. As the finished yarn is tightly twisted, it is difficult to impart to it the desired moisture content, but this can be done by passing the yarn through a bath for a sufficient length of time, or placing the yarn packages in a moist atmosphere. After the yarn has taken up sufficient moisture to make it flexible, it may be coated, for example, by means of the coating device disclosed. The moistening and coating carried on in operations independent of the formation of the yarn involve the use of additional equipment and labor, but, even so, the conversion of the ordinary stiff, wiry yarn to the new yarn may be advantageous, particularly for the owner of a considerable stock of the conventional yarn.

I claim:

1. A yarn which comprises a strip of paper containing a substantial quantity of water distributed throughout the paper, the strip being formed with random generally longitudinal folds and twisted about its longitudinal axis, and a substantially continuous coating impenetrable by water covering the outer surface of the twisted strip, the water within the paper making the twisted coated strip flexible and the coating both adding to the wet strength of the twisted strip and preventing the escape of water therefrom.

2. A yarn which comprises a strip of paper containing a substantial quantity of water distributed throughout the paper, the strip being formed with random generally longitudinal folds and twisted about its longitudinal axis, and a thin substantially continuous coating impenetrable by water covering the outer surface of the twisted strip, the water within the paper making the twisted coated strip flexible and the coating adding to the wet strength of the twisted strip, preventing escape of the water from the paper,

and being made of a material having lubricating qualities.

3. A yarn which comprises a strip of paper containing a substantial quantity of water distributed throughout the paper, the strip being formed with random generally longitudinal folds and twisted about its longitudinal axis, and a thin substantially continuous coating of a waxy material covering the outer surface of the twisted strip, the water within the paper making the twisted coated strip flexible and the coating being impenetrable by water and preventing the escape of the water from the paper and also adding to the wet strength of the twisted strip.

4. A yarn which comprises a strip of paper containing a substantial quantity of water and a less amount of oil, the water and oil being distributed throughout the paper, and the strip being formed with random generally longitudinal folds and twisted about its longitudinal axis, and a substantially continuous coating impenetrable by water and unaffected by the said oil covering the outer surface of the strip, the water and oil within the paper making the twisted coated strip flexible and the coating both adding to the wet strength of the twisted strip and preventing escape of moisture therefrom.

5. A yarn which comprises a strip of paper containing a substantial quantity of water of the order of about 25% of the weight of the paper, the water being distributed throughout the paper and the strip being formed with random generally longitudinal folds and twisted about its longitudinal axis, and a substantially continuous flexible coating of a substance insoluble in water and volatile at elevated temperatures covering the outer surface of the twisted strip, the water within the paper making the twisted coated strip flexible and the coating both adding to the wet strength of the twisted strip and preventing the escape of water therefrom.

6. A yarn which comprises a strip of paper containing a substantial quantity of water distributed throughout the paper, the strip being longitudinally folded and twisted about its longitudinal axis, and a substantially continuous coating impenetrable by water covering the outer surface of the twisted strip, the water within the paper making the twisted coated strip flexible and the coating both adding to the wet strength of the twisted strip and preventing the escape of water therefrom.

7. A yarn which comprises a strip of paper containing a substantial quantity of water distributed throughout the paper, the strip being longitudinally folded and twisted about its longitudinal axis, and a thin substantially continuous coating impenetrable by water covering the outer surface of the twisted strip, the water within the paper making the twisted coated strip flexible and the coating adding to the wet strength of the twisted strip, preventing escape of the water from the paper, and being made of a material having lubricating qualities.

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