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FILE YARN UNIT FOR USE IN THE MANUFACTURE OF PILE FABRICS

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ABSTRACT OF THE DISCLOSURE

A woven fabric is connected to the pile yarns of a pile fabric wherein elongated pile yarns are arranged in a row, and the yarns are held together in a unit by a pair of web portions fixed to each other in spaces between the pile yarns, and having only frictional engagement with the pile yarns.

This application is a division of my copending application Ser. No. 574,980, filed Aug. 25, 1966, and now U.S. Pat. No. 3,415,558.

The present invention relates to pile fabrics capable of being used for carpeting, rugs, and the like, as well as to articles used in the manufacture of such fabrics.

Although there are at the present time many known methods for manufacturing pile fabrics of the above general type, they are in general unsatisfactory and complex. Because of several disadvantages, many known methods are not used in practice.

It is a primary object of the present invention to provide pile yarn units in which a plurality of pile yarns are assembled in an extremely convenient way.

In accordance with the present invention, use is made of pile yarn units each of which includes a plurality of yarns arranged in spaced, substantially parallel, side-by-side relation, the pile yarns of each unit being connected together by tapes which only frictionally engage the pile yarns and which are joined to each other only in spaces between the pile yarns.

The invention is illustrated by way of example in the accompanying drawings which illustrate preferred embodiments of the invention, and in which:

FIG. 1 is a fragmentary perspective illustration of the manner in which a pile yarn is tied and knotted to a filling yarn of a woven fabric, in accordance with the invention;

FIG. 2 is a partly fragmentary elevation of a pile yarn unit according to the invention;

FIG. 3 is a bottom end view of the unit of FIG. 2;

FIG. 4 is a fragmentary elevation of pile yarn units of the invention;

FIG. 5 fragmentarily illustrates a tape of a pile yarn unit;

FIG. 6 is another embodiment of a pile yarn unit according to the invention;

FIG. 7A is a fragmentary elevation of a further possible embodiment of a pile yarn unit of the invention;

FIG. 7B is a fragmentary elevation of yet another embodiment of a pile yarn unit according to the invention;

FIG. 8 is a fragmentary elevation of a further embodiment of a pile yarn unit according to the invention;

FIG. 9 is a fragmentary front elevation illustrating how a pile yarn unit is situated on the apparatus of the invention;

FIG. 10 is a partly sectional and schematic side view of a structure, such as that shown in FIG. 9, FIG. 10 illustrating an initial stage in the method of the invention;

FIG. 11 shows a stage in the method of the invention subsequent to that of FIG. 10, FIG. 11 also illustrating the structure of the invention in a partly sectional schematic side view;

FIG. 12 is a partly sectional schematic side view showing a stage in the method of the invention subsequent to that of FIG. 11.

Referencing to FIG. 1, the individual pile yarns 8 are each knotted to a filling yarn 2 of a woven fabric made up of the filling or weft yarns 2 and the warp yarns 3, as indicated in FIG. 1. The pile yarns 8 which are knotted to the woven fabric, in the manner shown in FIG. 1 for one of the pile yarns, each have elongated portions 8a projecting from the woven fabric so as to form the pile of the finished fabric. FIG. 1 also illustrates the knot 8b by which the pile yarn is fixed to the fabric. The knot 8b is situated at an intermediate portion of the pile yarn, which is in a single length having the elongated portions 8a extending from the knot to form part of the pile.

PILE YARN UNITS

Referring now to FIGS. 2–8, a plurality of the pile yarns 8 are grouped together to form pile yarn units which may have any of the structures illustrated in FIGS. 2–8, for example. The individual pile yarns of each unit are held together by a tape means which includes at least a pair of elongated web portions. The pair of elongated web portions of the tape means of the invention only engage the yarns frictionally. The pair of web portions of the tape means are substantially coextensive with each other and are joined to each other only in spaces between the successive yarns, as by being glued, welded or otherwise fastened to each other, for example.

Thus, referring to FIGS. 2 and 3, it will be seen that the tape means of this embodiment includes the upper tape assembly 10 of FIG. 2, this assembly 10 including the front tape 11 and the rear tape 12. The tape means of this embodiment also includes the lower tape assembly 13 made up of a front tape 14 and a rear tape 15, as viewed in FIG. 2. The latter tapes 14 and 15 are also illustrated in FIG. 3.

The tape assemblies 10 and 14 frictionally engage the free ends of the yarns 8. The pair of tapes 11 and 12 of the assembly 10 are glued or welded to each other only at the areas 10a situated between the yarns 8, while the pair of tapes 14 and 15 of the tape assembly 13 are joined to each other, as by welding or gluing, only in the spaces 13a situated between the yarns 8. Although each pair of tapes of a tape assembly are joined to each other only in the spaces between the yarns, nevertheless the areas at which the tapes are joined to each other approach so closely to the yarns themselves that the tapes have a tight frictional grip on the yarns while at the same time only engaging the latter frictionally. Thus, as may be seen from FIG. 3, at least one of the tapes, tape 14 in this example, will conform to the configuration of the yarns 8. In this way there are no deposits of any cement or other adhesive material on the yarns themselves.

A unit as shown in FIGS. 2 and 3 can be separately manufactured in the form of an elongated strip of relatively great length from which sections of required length can be separated.

Moreover, it will as a rule be advisable to form units as shown in FIGS. 2 and 3 initially from yarns of relatively long length which are advanced either continuously or in a stepwise manner, and which are situated at the required distance from each other, in side-by-side relation. Predetermined lengths of the yarns 8, such as lengths
ranging from 7 to 13 cm., are then provided with the tape means of the invention in a form somewhat different from that shown in FIGS. 2 and 3.

Thus, as shown in FIG. 4, the individual lengths of yarns 8 which come from any suitable source have pairs of tapes joined thereto, in the manner shown in FIG. 4, at distances from each other which will correspond to the required lengths of the yarns of a unit, as shown in FIGS. 2 and 3. The tapes which are joined to the yarns at this time have a width which is double the width of the tapes shown in FIG. 2. In this way there is provided a structure as fragmentarily illustrated in FIG. 4, where elongated contacts 4a, 4b, 4c, 4d, etc., have been made with the tapes joined thereto at predetermined intervals corresponding to the required lengths of the yarns of any one unit. The pairs of joined tapes of FIG. 4 are then cut at an intermediate line, such as the dotted lines shown in FIG. 4, situated midway between the opposed side edges of the tapes themselves, and this cutting extends through the yarns 8 themselves, so that in this way it is possible to derive, from a supply as shown in FIG. 4, units as indicated in FIGS. 2 and 3. Thus, the tapes of FIG. 4 which are double the widths of the tapes of FIG. 2, after being cut mid-way between their side edges will form the tapes of FIG. 2 with individual lengths of yarns 8 extending between pairs of successive tapes to provide a pile yarn unit as shown in FIG. 2. It is possible to cut through the structure along the dotted lines to provide an upper unit made up of the tape portions 11a, 12a, 14a, and 15a, while the second unit will be made up of the tape portions 11b, 12b, 14b, and 15b, and a third unit will include the series of yarn lengths 8 extending between the tape portions 11c, 12c, 14c, and 15c, and so on.

Pile yarn units of the type described above can be altered in many different ways in accordance with the invention. Thus, as shown in FIGS. 13 of FIGS. 2 and 3 can be composed of single tapes such as the tape 16 shown in FIG. 5. In this case, a single tape 16 which is double the width of the tape 11 and 12, for example, is folded along a fold line situated midway between the opposed side edges of the tape so as to provide in this way a pair of coextensive web portions respectively corresponding to the tapes 11 and 12, and the ends of the yarns 8 are received between these web portions which are then welded or glued to each other in the manner described above. In this way it is possible to provide a tape means where the ends of the yarns are joined to a single tape, suitably folded as shown in FIG. 5.

As will be apparent from the description which follows, a pile yarn unit of the invention is suspended from a suitable suspending means which enables the individual pile yarns to cooperate with additional structure of the invention so as to practice the method of the invention for tying and knotting the pile yarns to the woven fabric. The suspending means can include an elongated bar having hooks or other means, such as suitable pins, extending therefrom, as described below. In order to provide cooperation between the pile yarn units and the suspending means, the individual tapes may be formed with a row of openings, such as the openings 14d and 15d shown in FIG. 6 situated in the spaces substantially midway between the successive pile yarns 9. With a pile yarn unit of this type, where the suspending means includes a row of elongated pins whose spacing corresponds to the spacing between the row of openings 14d and 15d, the pins may be received in these openings for a purposed described below. Of course, the diameter of the pins which extend through these tape openings should correspond to the size of these openings.

Moreover, it becomes possible with this construction to suspend from such a suspending means a unit which includes only a single pile yarn. In this case, the suspending means will also frictionally engage the ends of the yarn but will project therefrom through approximately one half the distance normally provided between a pair of successive pile yarns, with the ends of such a tape having notches corresponding to one-half of the openings 14d or 15d. The pins can be received in these notches for supporting a single yarn in this way.

In some cases where more complex patterns are required or for other reasons, it may be necessary to provide, at a single location, one single pile yarn of a given color, and thus in order to take care of a situation of this type it is possible to provide a pile yarn unit which has but a single yarn.

In the case where only individual pile yarns of a given color, for example, are to be situated by themselves at relatively great distances from each other in the pattern, units as shown in FIGS. 7A and 7B can be used with advantage. In this case, the pile yarns are joined in the same way to the tape means, but the spaces between the yarns are considerably greater. The dotted lines of FIGS. 7A and 7B indicate the normal spacing of the pile yarns from each other. In FIG. 7A every other pile yarn is omitted from an arrangement as shown in FIG. 2, for example, so that the spacing between the yarns of FIG. 7A is double that of FIG. 2. If the successive pile yarns of a normal unit are designated I, II, III, IV, V, etc., then in the unit of FIG. 7A the second, fourth, sixth, eighth, etc. yarns have been omitted. With an arrangement as shown in FIG. 7B, after each pile yarn which is present in the unit of FIG. 7B, a pair of pile yarns of a normal distribution as shown in FIG. 2, for example, are omitted, so that with respect to enumerating the pile yarns as set forth above, yarns II and III, then yarns V and VI, and then yarns VIII and IX, and so on, have been omitted in the unit of FIG. 7B.

Any desired variations of this type may be provided. Thus, with reference to a normal distribution as shown in FIGS. 2 and 6, for example, it is possible to omit three or more successive yarns, permit the next yarn to remain and then again to omit three or more yarns, and so on. Thus, a limitless variety may be provided for the pile yarn units of the invention, in accordance with the particular pattern in which is desired in the pile yarn fabric manufactured according to the invention.

Moreover, it is possible to provide pile yarn units in which, while the several yarns are situated at the normal distance from each other, these yarns have different colors arranged in a predetermined sequence which repeats itself, so that, for example, black, yellow and white yarns can follow each other in a given sequence along the unit. Moreover, an arrangement as shown in FIGS. 7A and 7B can be used with advantage for blending into the final pile fabric selected colors from a supply of pile yarn units each of which is composed of only a single color for the yarns thereof, with these different units combined together in any desired manner.

It is also possible to provide pile yarn units in accordance with the invention wherein the yarns are in the form of hair-needle type loops, as indicated in FIG. 8. In this case all of the ends of the yarns are situated in a single row and can be situated between separate tapes of a tape means, or between web portions of a single tape of the type shown in FIG. 5. In this case also the portions of the tapes situated in the spaces between the ends of the yarns are joined to each other in the manner described above. In the particular examples shown in FIG. 8, the ends of all of the yarns are only frictionally held between tapes 17 and 18 which are welded or glued together at the areas 17a.

**METHOD OF TYING AND KNOTTING**

The manufacture of a pile fabric according to the invention takes place in the following manner:

Referring to FIGS. 9 and 10, a pile yarn unit as described above is placed on a suspending means formed by an elongated bar 31 having a plurality of pins, hooks, or the like 30, fixed to and projecting therefrom in the manner shown in FIGS. 9 and 10, for example. Thus, in the illustrated embodiment, the bar 31 carries sub-
stantially hook-shaped pins 32 which are distributed in a row in accordance with the distribution of the meshes of the woven fabric. This distribution corresponds also to the distribution of the yarns of a yarn unit. The tying and knotting apparatus includes below the suspending means 31, 32, a substantially parallel row of tying needles 33, indicated in FIGS. 9 and 10. The row of tying needles 33 also has the several needles thereof spaced from each other according to the spacing of a row of meshes of the woven fabric, as well as according to the spacing of the hook pins 32 and the distribution of the pin yarns. However, it is to be noted that, while the pins 32 are situated directly over the needles 33, respectively, when a yarn unit of the invention is suspended from these pins 32, that the yarns 8 hang down, these yarns 8 become situated beside the needles 33 in the spaces therebetween, as indicated most clearly in FIG. 20 of my copending application. Thus, the several pins 32 are respectively aligned with the needles 33, and the elevation of the needles 33 with respect to the needles 32 is such that the needles 33 become situated somewhat above the centers of the hanging yarns 8.

Although straight pins can be received in openings, such as openings 18 of FIG. 6, when hook-shaped pins 32 are used, they are received between the pins and beneath the upper tape assembly which simply rests at its lower edge on the pins 32.

With a yarn unit of the invention thus suspended from the suspending means 31, 32, the lower tape assembly 13 is grasped by the operator and initially advanced to the left. Then the tape assembly 13 is raised upwardly and placed on the pins 32, respectively, of the suspending means, and in this way an arrangement as shown in FIG. 9 is achieved. It will be noted that now, as also illustrated in FIG. 10, each pile yarn 8 extends around a needle 33 with an intermediate portion of each pile yarn extending around one side of the needle 33 and with elongated portions of the pile yarn extending from its intermediate portion past the needle 33 to the opposite side thereof. Thus, in the particular example illustrated in FIGS. 9 and 10, each pile yarn 8 has its intermediate portion passing around the lower side of a tying needle 33, and its elongated portion extending from its intermediate portion upwardly past the needle 33 to the upper side thereof.

With the plurality of pile yarns having thus been positioned with respect to the plurality of tying needles 33, the woven fabric 1 is placed on the needles 33. The filling yarn 2, to which the several pile yarns are to be tied, extends between and separates two rows of adjoining meshes of the fabric from each other; and the needles 33 are inserted through the adjoining pairs of meshes. At the beginning of the tying of the pile yarns to the woven fabric, the lowest row of meshes have the needles inserted therethrough, and then after the pile yarns have been tied to the upper filling yarn of this lower row of meshes, the second row of meshes is placed with the needles 33 respectively passing therethrough, and the pile yarns are tied to the second filling yarn, and so on. In FIG. 10 it is assumed that the filling yarns of the fabric have already had the pile yarns tied thereto, and that the method is now going forward with the next filling yarn. For example, it can be assumed that the lower six filling yarns have already had pile yarns tied thereto and that the method is now going forward with the seventh filling yarn from the bottom.

This seventh filling yarn will rest directly on top of the tying needles 33, with the latter passing through the row of meshes, situated just beneath this seventh filling yarn. The part of the woven fabric to which these pile yarns have not yet been tied, and which extends above the filling yarn to which the pile yarns are to be tied, is turned downwardly, in the direction of the arrow shown in the upper left of FIG. 10, with the filling yarn which rests on the needle 33 acting as a turning axis, and the next row of meshes, which are respectively in alignment with the meshes through which the needles 33 extend, are displaced along the needles 33 so that the latter also extend through this next row of meshes. The tying yarn will hang in the manner shown in FIG. 11, where the filling yarn to which the pile yarns are to be tied forms the uppermost edge of the double fabric which hangs down from this uppermost edge with the filling yarn which forms the uppermost edge resting directly on the needles 33 and with the latter passing through the adjoining rows of meshes which are separated by the upper filling yarn. When the woven fabric thus placed on the tying needles 33, the woven fabric is displaced, in the direction of the arrow shown just above the needle 33 in FIG. 10, closer to the pile yarns 8, so that the parts will have the position indicated in FIG. 11.

The suspending means 31, 32 is capable of being displaced from its support 75, indicated schematically in FIGS. 10-12, and at this time this suspending means is displaced from its support 75 manually by the operator, so that it is moved from the position of FIG. 11 to the position of FIG. 12, bringing the elongated portions of the several pile yarns 8 across the uppermost filling yarn to the side of the latter opposed to that side thereof where the intermediate portions of the pile yarns 8 are situated. In this way, the parts will assume the position shown in FIG. 12.

The several needles 33 includes, at their front ends, gripping means 34 displaceable between open receiving, non-gripping positions and closed, yarn-gripping positions, in a manner described in my copending application. With the several gripping means 34 in their open, non-gripping positions, the ends of the pile yarns 8 adjacent the tapes 10 and 13 are placed into the gripping means 34 at the several needles 33, so that at each needle 33 the ends of a pair of elongated portions of a single pile yarn are held in the gripping means 34, in the manner indicated in FIG. 12. After the ends of the several pile yarns have thus been situated in the several gripping means 34, respectively, these several gripping means are closed so as to grip the ends of the pile yarns, and the spacing of the gripping elements of each gripping means is such that the ends of a pile yarn can easily be introduced between the pair of gripping elements, while at the same time in the closed position of the gripping means the ends of a pile yarn are tightly gripped.

With the parts thus located in the position indicated in FIG. 12, the suspending means is manually removed simply by displacing it to the left, as viewed in FIG. 12, and now the suspending means is returned to its initial position on the support 75.

The parts will be in the position indicated in FIG. 15 of my copending application. At this time the fabric 1 is stripped from the tying needles 33. As a result of the movement of the woven fabric 1 from the needles 33, the uppermost filling yarn, to which the several pile yarns are to be tied and knotted, engages and slides along the pile yarns so as to pull the pile yarns themselves from the needles 33. The filling yarn moves along the elongated portions of the pile yarns which are connected to the needles 33, and the filling yarn advances the intermediate portions of the pile yarns along the elongated portions thereof, these intermediate portions thus becoming situated in a position extending part of the way around the elongated portions of the pile yarns which are still connected to the needles 33. In this way, the position of the parts shown in FIG. 15 is achieved of my copending application.

Thus, the filling yarn to which the pile yarns are to be tied necessarily pulls up behind itself the intermediate portions of the pile yarns which initially extend around the undersides of the needles 33. These intermediate portions of the pile yarns are thus pulled along the elongated pile yarn portions.

The stripping of the woven fabric from the needles 33 will cause the tapes 10 and 13 to be frictionally dis-
placed from the ends of the pile yarns. They simply fall, and can be collected as scrap.

The woven fabric is then pulled downwardly toward the left or horizontally to the left if preferred, so that the several pile yarns are tightly knotted onto the filling yarn. The tightness of the knots is determined by the force with which the free ends of the pile yarns are still gripped by the plurality of gripping means 34 of the several needles 33. Once the several pile yarns have been tied onto the filling yarn with knots which are sufficiently tight, the woven fabric is displaced further, after the plurality of gripping means have been partly or fully opened, so as to displace the pile yarns from the apparatus. The parts will now have the position of Fig. 16 of my copending application.

It is to be noted that, with this method, each pile yarn has its intermediate portion partly surrounding the elongated portions of the pile yarn, which extend from the intermediate portion, with these elongated portions being completely looped around the filling yarn and extending therefrom to form the pile portions of the fabric itself.

Of course, the method is not limited to single tying needles but is practiced with a complete row of needles 39 and simultaneously on all of the pile yarns of a given pile yarn unit. For example, where a row of 99 tying needles 33 is provided and, with a corresponding width of woven fabric, all of these needles are to be used, then it is possible with the invention to tie 99 pile yarns simultaneously to a single filling yarn of the woven fabric. The method has been carried out at each needle in the manner indicated in Figs. 10–12 for a single needle and pile yarn. Inasmuch as the structure is arranged as shown in Fig. 9, it is apparent that all of these operations will take place simultaneously at each tying needle.

In the event that a pile yarn as shown in Fig. 8 is used, it is necessary to pass the pile yarns around the tying needles. In a single step, it is possible to place the unit of Fig. 8 in a position where the needles extend through the loops formed by the yarns, and in this case the tape of Fig. 8 will rest on the pins 32. The simple placing of the tape on the pins 32, while the needles 33 pass through the loops of the pile yarns, is sufficient initially to start off the method in the position indicated in Fig. 9. Then the method is carried out in the manner described above.

What is claimed is:

1. A pile yarn unit to be used in the connection of pile yarns of the unit to a woven fabric, said unit comprising a plurality of elongated pile yarns arranged beside each other in a row and being spaced apart from each other, and elongated tape means extending across and engaging said pile yarns for holding them together in the unit, said tape means including a pair of web portions joined to each other in spaces situated between the pile yarns to maintain said pile yarns in said spaced apart relationship, and said tape means having only a frictional engagement with said pile yarns.

2. The combination of claim 1 and wherein each pile yarn is in the form of a loop having a pair of adjoining ends and said tape means having only a pair of elongated web portions engaging said adjoining ends of said pile yarns.

3. The combination of claim 1 and wherein one pair of webs of said tape means extends across and frictionally engages the pile yarns at one of the ends thereof and another pair of webs of said tape means extends across and frictionally engages the pile yarns at the other of the ends thereof.

4. The combination of claim 1 and wherein said tape means includes a single elongated tape having a pair of opposed side edges and folded longitudinally between said opposed side edges so as to have an intermediate fold line, and said web portions of said tape means being situated on opposite sides of said fold line.

5. The combination of claim 1 and wherein said tape means is formed with openings passing through said web portions thereof at locations situated between said pile yarns.

6. The combination of claim 1 and wherein pairs of said web portions of said tape means extending across and frictionally engaging said pile yarns at predetermined intervals are situated at given distances from each other to define predetermined lengths of said pile yarns extending between successive pairs of web portions, so that each pair of web portions can be cut between its opposed side edges together with the pile yarns to separate a section of the pile yarns extending between successive pairs of web portions while the ends of the pile yarns remain frictionally held by the cut web portions.

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