Oct. 18, 1960 W. G. FAW 2,956,328

BULK BEAMER PROCESS AND APPARATUS FOR MANUFACTURING BULK YARN

Filed Aug. 8, 1956

Fig. 1

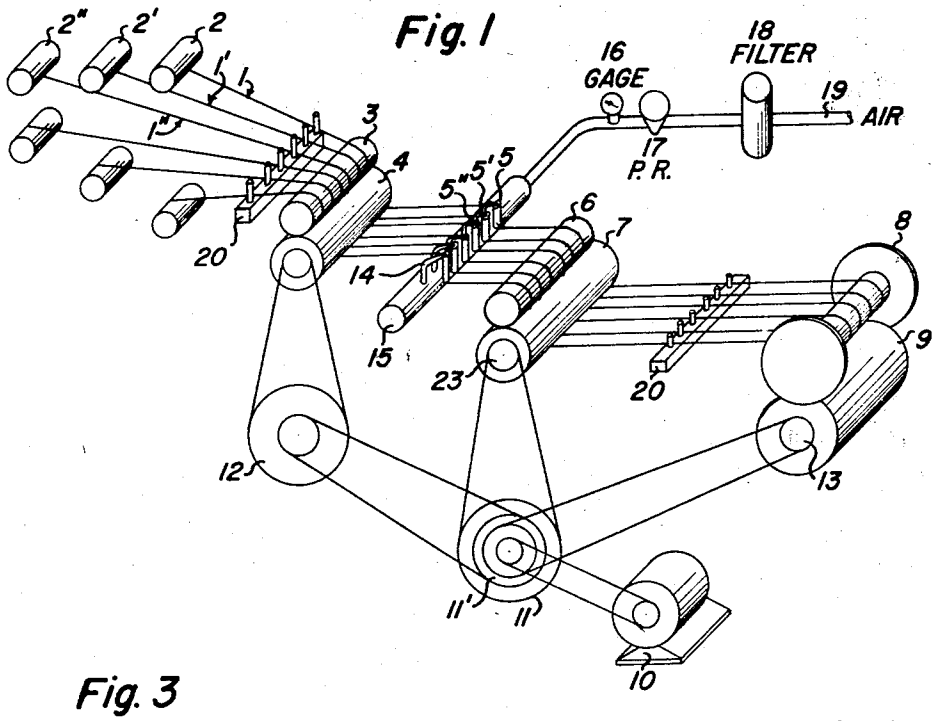


Fig. 3

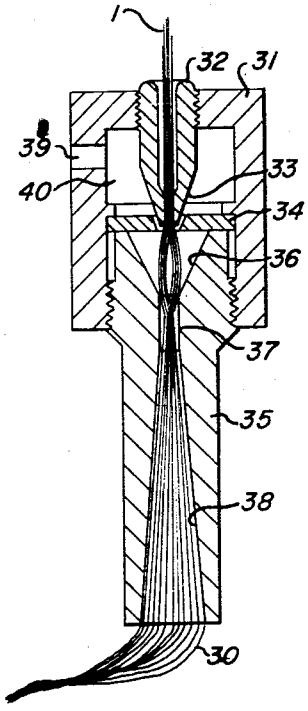
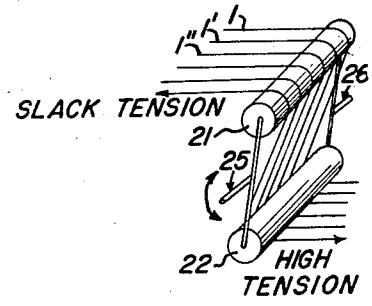


Fig. 2



WENDELL G. FAW
INVENTOR.

BY Daniel L. Maguire
Harold N. Powell

ATTORNEYS

United States Patent Office 2,956,328 Patented Oct. 18, 1960

2,956,328

BULK BEAMER PROCESS AND APPARATUS FOR MANUFACTURING BULK YARN

Wendell G. Faw, Kingsport, Tenn., assignor to Eastman Kodak Company, Rochester, N.Y., a corporation of New Jersey

Filed Aug. 8, 1956, Ser. No. 602,868

6 Claims. (Cl. 28—32)

This invention relates to an apparatus and process for converting continuous multi-filament yarn directly in one operation into a bulked yarn wound on a beam suitable for use in subsequent textile operations. More particularly this invention relates to special process and apparatus for bulking a plurality of ends of heavy denier yarn, winding up the bulked yarn on a beam in order to obtain a bulked yarn especially suitable for direct use as the yarn supply on a carpet machine of the needle tufting type.

In the prior art it has been the practice to supply rug machines with individual supply packages each containing only one end of yarn. This may result in considerable loss of time in recreeling a rug tufting machine when the thousand or more individual packages run empty. Prior to the present invention it has been the practice to prepare bulk yarn for the carpet trade by bulking each end of yarn on an individual spindle position of a redraw or twisting machine with a subsequent reconing process. It will be recognized that such prior practices do no exhibit maximum efficiency and may be wasteful of manpower and expensive machinery. In addition to the economic waste just mentioned, the handling of yarn for the rug trade on separate packages may present further problems in that there may be some lack of uniformity in the yarn. That is, some of the yarn on certain individual packages having been prepared under different tension conditions may not, when fabricated, exhibit the same loop structure or appearance as other yarn bulked under different conditions.

It is apparent, therefore that the development of a process and apparatus whereby bulked yarn in the form of a plurality of ends of continuous multi-filament bulk yarn on a section beam in suitable form for direct use as the supply package on a rug machine, represents a highly desirable result.

This invention has for one object to provide an improved process and apparatus for converting continuous multi-filament yarn directly into bulked yarn on a beam. Still another object is to provide improved process and an apparatus from which may be obtained a better supply package of bulked yarn for rug machines. Another object is to simplify the process and apparatus used for producing bulk yarn for the rug trade. Still another object is to prepare bulked yarn in a form that expensive recreeling and handling operations are minimized or eliminated and non-uniform tufting is eliminated due to tension irregularities in withdrawing yarn from individual cores. Another object is to provide a novel apparatus combination for carrying out the aforesaid processes. Still another object is to provide an apparatus wherein yarn may be bulked and beamed and wherein particularly uniformity and evenness of the yarn on the beam is obtained by a common drive arrangement of the apparatus parts. Other objects will appear hereinafter.

For a further understanding of our invention reference will be made to the attached drawing forming a part of the present application. In the attached drawing:

Fig. 1 is a semi-diagrammatic, side elevation, schematic view of the overall combination of apparatus arrangement in which the yarn may not only be bulked, but may be beamed;

Fig. 2 is a detailed, schematic view of alternative construction of a part of the apparatus;

Fig. 3 is a detailed, sectional view of an air jet construction such as may be used in my apparatus.

Referring now to Fig. 1, a plurality of yarn ends **1**, **1'**, **1''**, etc., of a suitable type of yarn, are contained on a plurality of conventional supply packages **2**, **2'**, **2''**, etc. These yarn ends are collected into a sheet of ends in conventional manner by suitable guides and eyelets (not shown) and passed around the weighted idler roll **3** and then around feed roller **4**. This feed roller **4** is adapted to run at a predetermined speed, which speed may be substantially exactly correlated with the speed of operation of certain other parts of my apparatus as will be explained in further detail hereinafter. For example, feed roller **4** might be operated at a speed of say around 50 yds./min. surface speed.

The sheet of yarn ends from feed roller **4** are fed to a bank of bulking jets **5**, **5'**, **5''**, etc. These jets are preferably of a construction such as shown in Fig. 3 and which will be described in detail hereinafter. That is, each individual yarn end is passed through a separate jet. For example, end **1** passes through jet **5**, end **1'** through jet **5'**, and end **1''** through jet **5''**. However, it will be noted that these jets may be supplied by the same air supply **15** thereby rendering it possible to bulk the yarn substantially exactly the same, if this is desired. In other words, it is possible in my new apparatus to give the yarn substantially the same identical treatment, thereby obtaining remarkable uniformity of product.

The yarn ends thus bulked pass from the jets preferably at an abrupt angle as shown, to the take-up roll **7** with its associated idler roll **6**. These take-up rolls are designed to revolve at a slower speed than rolls **3** and **4**. For example, the surface speed of the take-up rolls might be 20% slower than the surface speed of rolls **3** and **4**. As will be described hereinafter, this can be accomplished in a correlated manner by means of the common drive.

The take-up rolls are positioned in series with the beam **8**. This beam may be the usual beam employed in the textile trade for beaming yarn. On the way to the beam the yarn passes through a reed assembly **20** or other appropriate means for aligning and distributing the bulk yarn on the beam **8**. The wind-up on beam **8** is accomplished by means of the rotating drum **9** whose surface speed slightly exceeds that of rolls **6** and **7** and as observed from the drawing, this speed may be correlated by means of a special drive.

That is, a special drive in accordance with the present invention for the rolls **3** and **4**, **6** and **7**, drum **9** and beam **8** comprises a drive motor **10** which is interconnected by a belt or chain drive with a set of sprockets. That is, a sprocket or pulley **11** of a certain size may be provided for driving roll **7** at **23**. By varying the respective diameters of these drive means **11** and **23** it can be seen that take-up roll **7** can be driven at any predetermined speed. By this construction it is very easy to control the bulking of the yarn. When the roll **7** is driven slower this permits more contraction of the yarn; hence greater bulk. In a similar manner the central sprocket drive means **11'** is connected with **12** and **13**. Here again by the choice of suitable size sprockets or sheaves, or by using other devices for obtaining different speeds as may be chosen, the entire control of the feed and take-up of the yarn through my apparatus may be controlled, if desired. Inasmuch as all of these parts may be driven by the common motor drive **10**, uniformity of product is achieved.

Referring now to Fig. 2, as an alternative to the take-up roll assembly **6** and **7**, construction such as shown in this figure may be used. That is, the bulked yarn sheet from the jet may be passed over a rod **21** and then back around another rod **22**. These parts are constructed so that the rods may be rotated to give the desired degree of snubbing or wrap of the yarn around the rods. This can be varied to vary the tension of the yarn wound on the beam. In further detail, suitable means for rotating the rods might comprise a central horizontal axle **25, 26** on the rod assembly supported in plain bearings or holes in the machine framework with locking set screws to hold the rod assembly in the desired position. If more tension is desired in the yarn going onto the beam, the rod assembly is rotated clockwise; if less tension is desired, it is rotated counterclockwise. If still higher wind-up tensions are required, additional rods may be added to increase the amount of snubbing of the yarn.

Referring now to Fig. 3, I have shown in this figure, on an enlarged scale, a jet construction such as I prefer to use for parts **5, 5'**, and **5''** in Fig. 1. This jet device comprises the body member **31** which has threaded into its upper end a tube **32** terminating in the nozzle **33** at its lower end. Closely adjacent and concentric to the nozzle is an orifice plate **34**. Just below and abutting the orifice plate is a venturi tube **35** threaded into the body **31** and having an entrance throat **36** and a straight portion **37** about equal in diameter to the orifice plate opening. An exit throat **38** having a taper of about 10° included angle is provided in the jet device at the exit end thereof. An entrance for air is provided at **39**, which entrance leads into the air chamber **40**. Yarn **1** enters the intake tube **32** and is mixed with the air stream at the orifice plate **34**. Mixing continues until the yarn leaves the exit taper into the venturi. Here the expansion of the air also expands the bundle of filaments until the filaments are separated and spaced apart. As discussed above, the yarn leaves the jet at an abrupt angle (as it is taken up on take-up rolls **6** and **7**) and the turbulence of air and loosened filament structure at this point results in a tangling of the filaments.

The air pressure used in operating such jet is a variable depending on the degree of entanglement or loopiness desired, and on the filament size. Larger filaments and heavier denier yarns and faster processing speeds usually require higher air pressures. Preferably clean, dry, oil-free air is employed and as shown in Fig. 1 the air is cleaned by filter **18**. A pressure regulator is inserted at **17** and a gauge at **13** serves to give adequate control of the air pressure.

The operation of my new apparatus is believed apparent to a substantial extent from the description which has already been set forth. However a brief recapitulation will aid in a better understanding of the present invention. Referring to Fig. 1, the yarn which will be contained on packages **2, 2', 2''** may be any of the usual types of yarn for manufacturing rugs. For example, the yarn might comprise a material with 240 filaments of 20 denier size, or 480 filaments of 10 denier size.

A particularly interesting aspect of yarn choice is as follows. The yarn on the packages might be composed of various filament sizes to approximate the filament size disposition found in wool. For example, considering a carpet yarn, the overall choice of the supply would be such that there would be an average filament denier of about 9 denier per filament, and a range from 2 to 25 denier. The distribution of filaments of various sizes would be as follows:

10%	3 D/F	15%	12 D/F
20%	5 D/F	10%	16 D/F
40%	8 D/F	5%	20 D/F

Such type of yarn with various filament sizes as indicated automatically delivers a beamed yarn made up into a rug which compares favorably with wool.

In most instances I would prefer to use round cellulose ester yarn such as cellulose acetate yarn on the packages **2**. However, various other yarns of different compositions and cross sections may be processed in accordance with the present invention. For example, the yarns may be of **Y** or **C** cross section or other such special cross section, and the yarn in addition to being of cellulose acetate, may be polyester, polyamide, polyacrylonitrile or the like synthetics. The yarn in all instances, as is believed apparent from the description which has preceded, would be multi-filament having at least 30 filaments at a minimum. The yarn may be either twisted or untwisted. In some instances a twist of 1 to 7 turns would be employed, although in general on carpet yarns zero twist is preferred.

Therefore, suitable yarn from packages **2** is drawn up from the packages by feed rolls which are driven at a certain predetermined speed by pulley **12**. The plurality of yarn ends are simultaneously fed through a plurality of jets **5, 5', 5''**, etc., these jets being of construction already discussed in detail under Fig. 3, and have supplied thereto a uniform and common source of air through the air header.

The plurality of yarn ends are uniformly bulked and then taken up by take-up rolls **6** and **7**, said rolls being driven at a predetermined roller speed by means of drive **23**. The bulked yarn from take-up rolls **6** and **7** then is packaged on the beam **8**. In this manner not only is the yarn on a beam and thereby in a much easier form for utilization in rug making, but since the yarn has been substantially uniformly bulked and held under comparable tension conditions throughout my process, the resultant yarn is more uniform than might be experienced from making rugs from individual packages. A further understanding of my invention will be had from a consideration of the following examples:

Example I

In accordance with this example eight zero twist yarn supply packages containing 4800 denier, 400 filament, **C** section cellulose ester yarn are used. The yarn ends from the supply packages pass around the weighted idler roll **3** and then around feed roller **4** which is operating at a speed of 25 yd./min. From the feed roller the yarn ends are fed to the jets (**5, 5', 5''**) where filtered air at a pressure of 20 p.s.i. gage bulks the yarn. After bulking in accordance with my invention, the yarn ends pass from the jets to take-up roll **7** operating at a speed of 20 yd./min. In passing from the jet to the take-up rolls the filaments are severely tangled due to the turbulence of the air. The bulked, tangled yarn then proceeds to the wind-up on beam **8**, which is accomplished by means of drum **9** driven at a surface speed of 20.5 yd./min. The speed of take-up roll **7** and drum **9** are directly correlated to the predetermined rate of speed of feed roll **4**. The yarn thus produced in accordance with my invention comprised 5300 denier, 400 filament **C** section bulked rug yarn containing crunodal type yarn loops and a severely entangled filament structure which resists the removal of the loops under normal processing of the yarn into a rug. When beam **8** was full it was used as the yarn supply to an eight needle tufting machine and swatches of rug material were made. Examination and testing of these swatches indicated an excellent quality, uniform product had been obtained.

Example II

Eight supply packages of regular section cellulose acetate, 2200 denier, 180 filament, .75 **Z** twist yarn are used for the yarn supply. The feed roll **4** speed was 50 y.p.m. The yarn was treated in the jets at 25 p.s.i. air pressure and then passed to the take-up rolls **6** and **7** which were set at a speed of 40 y.p.m. It then passed to the beam which was operated at 41 y.p.m. The treated yarn was characterized by a tangled loopy filament appearance and the final denier was 2700.

Example III

The yarn of Example II was treated in the same manner except that the rolls 6 and 7 were replaced by the friction rods of Fig. 2. The yarn was fed to the jets by the feed rolls at a speed of 50 y.p.m. From the jets it passed over and around the tension rods so that 270° of yarn wrap on the rods was obtained. The beam speed was 41 y.p.m. The yarn tension between the jets and the tension rods was 0–10 grams in each yarn strand. The tension in each yarn strand between the rods and the beam was 200 to 250 grams.

The above examples are directed to a process and apparatus for the production of small rugs. However, by increasing the number of packages, say to 40 or 80 yarn packages, and increasing the roll widths, beam size and number of jets, any size beam may be produced. For example, in a rug machine requiring 800 ends of yarn, 10 beams containing 80 ends of yarn each could be made up. That is, in Fig. 1 the number of threads, jets and the like would be increased so that beam 8 of Fig. 1 would have 80 ends wound thereon.

As described above, in my apparatus it is possible to vary the several roll speeds to give faster or slower speeds or more or less bulking, or more or less wind-up tension, as may be desired. The denier of the yarn may be varied for any particular end use. While I have described in particular the preparation of beams of bulked yarn for use in carpet manufacture, and the process and apparatus of the present invention are particularly useful for this purpose, my invention is not limited to producing beamed yarn for only this purpose. For example, 1000 denier beamed yarn produced in accordance with the present invention may be used for chenille bed spreads. Or, in a similar manner, 300 denier yarn may be processed to obtain warp beams for use in woven fabric looms.

As apparent when processing different denier yarns and the like, the particular air pressure used and other details of operation may be varied. While in the above examples air pressures of 20 lbs./sq. in. gage have been mentioned, the air pressure may vary from say 8 lbs./sq. in. to 50 lbs./sq. in. The jet of Fig. 3 is designed so that in the area of the orifice and venturi throat the air velocity is sonic or supersonic.

The yarn prior to processing in my apparatus is preferably treated with a yarn treating agent having a high electrical resistivity such that the generation of static electricity on the yarn is not appreciably inhibited, which static charge aids in causing filament separation in the bulking jet. Said agent also has the property of causing the yarn to have a high scroop value or ratio of static friction to dynamic friction, said scroop being of material assistance in preventing the removal of the yarn loops and entanglement in subsequent processing under tension of the yarn.

A valuable feature of my process and apparatus is that I am able to bulk or loft zero twist yarn and package it without imparting twist thereto. Such processing of zero twist yarn is specifically illustrated in Example I hereof. In such operations on zero twist yarn, the speed is generally kept below 50 yds./min. and the air pressure below 50 lbs./sq. in.

While I prefer in many instances to process zero twist yarn, my process and apparatus will also satisfactorily function on pretwisted yarn. For example, the yarn on packages 2, 2', etc. may have, for example, from ½ to 7 or 8 turns therein.

It is apparent from the foregoing description that an improved method and apparatus have been provided whereby bulk yarn of improved uniformity may be obtained on beams, thereby rendering bulk or lofted yarn more useful in the textile trade inasmuch as said beams are more readily adapted to use in weaving processes.

I claim:

1. The process for the manufacture of beamed, bulked yarn particularly suitable for carpet manufacture which comprises providing a plurality of packages of yarn from which the yarn is delivered to feed rolls, said yarn being characterized by being continuous, multi-filament yarn of varying denier from 3 to 20 denier and having fiber distribution as follows: 10%—3 D/F, 20%—5 D/F, 40%—8 D/F, 15%—12 D/F, 10%—16 D/F, 5%—20 D/F, passing said yarn of varying denier through a plurality of air jets, said plurality of jets being supplied by a common air supply whereby the ends are subjected to substantially the same air treatment and are thereby bulked, taking the bulked sheet of ends away from said jets by means of take-up rolls operating at a lower speed than the speed of the first-mentioned rolls, passing the bulked yarn thus taken up on the last mentioned rolls to a rotating beam, said passage being through means whereby the bulk yarn is uniformly positioned on said beam, and rotating the beam containing the bulked yarn by drive means which is correlated to the rotation of the other rolls aforementioned.

2. The process for manufacturing beamed, bulked yarn which comprises gathering from a plurality of separate packages a sheet of continuous, multi-filament yarn ends, conducting these ends around a single elongated feed roller for all of said ends rotating at a predetermined speed, passing said sheet of ends from the single elongated feed roller through a plurality of air jets, said plurality of jets being supplied by a common air supply whereby the ends are subjected to substantially the same air treatment and are thereby bulked, taking the bulked sheet of ends away from said jets by means of a single elongated take-up roll operating at a lower speed than the speed of the first-mentioned roll, passing said bulked yarn to a rotating beam of a length sufficient to receive all of said ends, said passage being through means whereby the bulk yarn is uniformly positioned on said beam, and rotating the beam containing the bulk yarn by drive means which is correlated to the rotation of the other rolls aforementioned.

3. The process of manufacturing beamed bulked yarn suitable for rug production which comprises feeding at least 8 ends of zero twist yarn of C section filaments from separate packages onto a single feed roll which receives all of said ends, feeding the yarn aforesaid at the same rate of speed for all the yarn through a plurality of air bulking jets operating from a common air supply, taking up the bulked yarn from said jets onto a single elongated take-up roll at the same rate of speed for all the yarn, delivering the bulked yarn from the take-up roll to a beam, and rotating the beam and rolls by means of a common and correlated drive whereby the take-up roll is operated at a slower speed than the feed roll and the bulked yarn is wound on the beam in a uniform manner.

4. An apparatus for producing beamed, bulked yarn which comprises means for feeding yarn ends from a plurality of packages to a single elongated feed roll for all of said ends, a plurality of air jets provided with a common air supply positioned between said feed roll and a single elongated take-up roll for all of said ends, said take-up roll being adapted to deliver bulk yarn through distribution means to a beam whereby the bulked yarn is deposited uniformly on said beam, and driving means interconnected and associated with all of said rolls and said beam so that the take-up rolls may be rotated at a slower speed than both the feed rolls and the beam.

5. A process in accordance with claim 2 wherein said drive means is further characterized by the maintenance of a constant linear surface speed ratio between the aforementioned rolls and rotating beam.

6. In a process for manufacturing beamed, bulked yarn which comprises gathering from a plurality of separate packages a sheet of continuous, multi-filament yarn ends, conducting these ends around a feed roller means for all of said ends, said roller means rotating at a pre-

determined speed, passing said sheet of ends from the feed roller means through a plurality of air jets, said plurality of jets being supplied by a common air supply whereby the ends are subjected to substantially the same air treatment and are thereby bulked, the improvement feature which comprises taking the bulked sheet of ends away from the jets by snubbing them over a pair of adjustable tension rolls to maintain relatively low tension on the downstream side of the jets, and then passing said bulked yarn to a rotating beam of a length sufficient to receive all of said ends, said passage being through means whereby the bulked yarn is under tension which is uniform from end to end, and rotating the beam containing the bulked yarn by drive means which is correlated to the rotation of the roll means aforementioned.

References Cited in the file of this patent

UNITED STATES PATENTS

2,037,512	Kahlisch	Apr. 14, 1936
2,224,665	Bradshaw et al.	Dec. 10, 1940
2,439,039	Coe	Apr. 6, 1948
2,593,320	Lewis et al.	Apr. 15, 1952
2,671,942	Milne	Mar. 16, 1954
2,829,420	Grist	Apr. 8, 1958
2,852,906	Breen	Sept. 23, 1958

FOREIGN PATENTS

161,076	Australia	Feb. 10, 1955
816,215	Germany	Oct. 8, 1951