

Dec. 17, 1940.

W. POOL

2,224,923

MANUFACTURE OF STAPLE FIBER YARN

Filed Oct. 6, 1938

FIG. 1

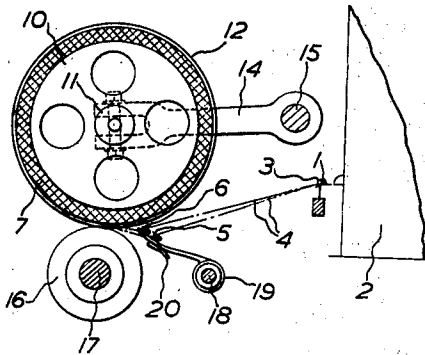


FIG. 2

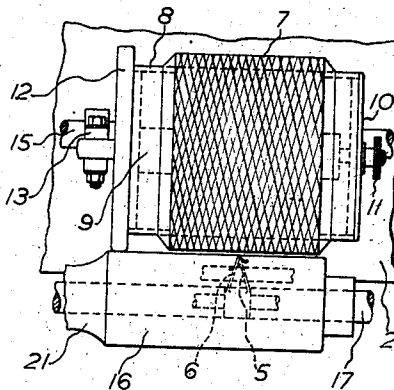


FIG. 3

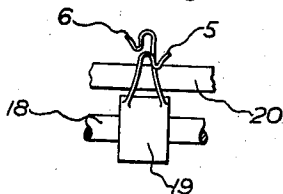


FIG. 4

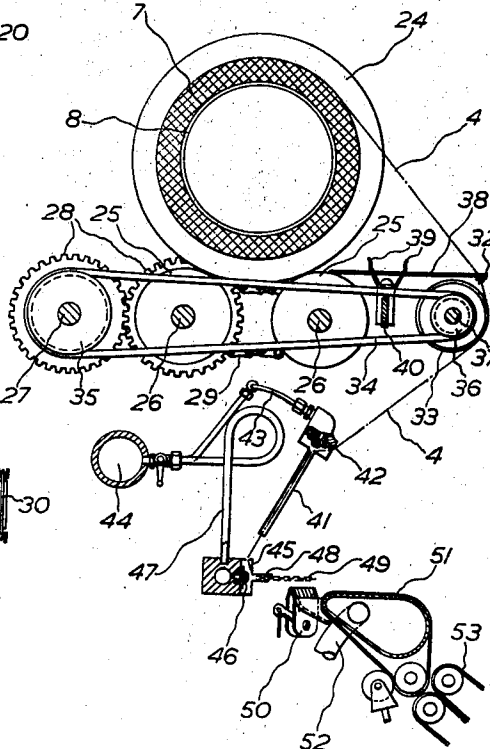
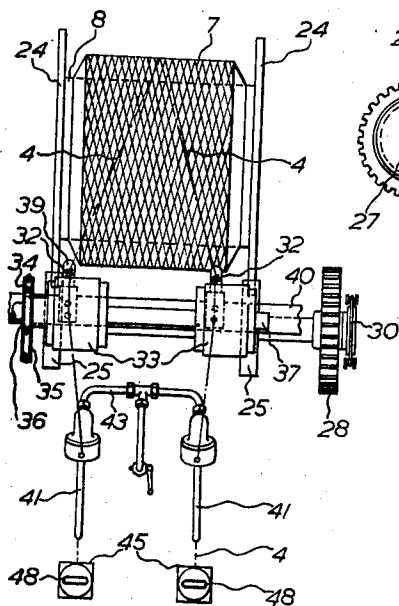


FIG. 5



WILLIAM POOL
Inventor

by *W. H. McKeown*
Attorney

UNITED STATES PATENT OFFICE

2,224,923

MANUFACTURE OF STAPLE FIBER YARN

William Pool, Spondon, near Derby, England, assignor to Celanese Corporation of America, a corporation of Delaware

Application October 6, 1938, Serial No. 233,536
In Great Britain October 29, 1937

7 Claims. (Cl. 18—54)

This invention relates to the manufacture of staple fiber yarn, and in particular to the manufacture of staple fiber yarn from continuous filaments.

5 According to the present invention staple fiber yarns or like products are produced by extruding a spinning solution in the form of a bundle of continuous filaments, drawing said filaments from the point of extrusion and winding them on a package support by positively rotating said package support, so that the denier of the bundle varies inversely with the varying diameter of the package during its formation, and subsequently positively rotating said package support to permit the withdrawal of the filaments, separating the filaments from each other, cutting successive groups of separated fibers of predetermined length from the ends of the separated filaments, assembling said groups in such a manner that the forward ends of fibers of each group extend beyond the rearward ends of fibers of the preceding group and compacting the assembled groups of fibers into a coherent staple fiber product of substantially uniform denier, for example in the manner described in U. S. applications S. Nos. 155,226 filed 23rd July 1937 and 168,862 filed 14th October 1937.

The positive driving of the package support during the production of the filaments results in the peripheral speed of the package increasing with the diameter of the package, and in consequence in progressive diminution in the denier of the individual filaments as well as of the total bundle of filaments, since the linear rate of production of the filaments is determined by the package drawing the filaments from the jet at a speed always equal to its peripheral speed. However, the positive driving of the package support in the unwinding operation provides a direct compensation for this diminution, the rate of unwinding gradually decreasing with decrease in package diameter. Consequently, the rate of feed of the filaments in the unwinding operation is constant as far as weight is concerned, and the resultant product is of substantially uniform weight, although the denier of its individual fibers progressively increases from the beginning of the operation on the material of a particular package to the end. A uniform rate of cutting produces fibers whose length diminishes as the supply package is consumed, but this diminution in length is compensated by the progressive increase in fiber denier.

A further feature of the invention is the simultaneous production of a plurality of staple

fiber yarns from a single package produced by winding a bundle of continuous filaments in the manner described above, the method of winding permitting the filaments to be laid on the surface of the package in such a way that they can be withdrawn from the package as a plurality of ends quite separate from each other. This advantageous result is obtained because the filaments are merely laid on the package and are not pressed in between each other or into the surface of the package as in the case of the usual drum-winding operation used for packaging yarn at constant speed. This further method of operation according to the invention enables the product of a single spinning jet in the continuous filament producing machine to be formed into a plurality of staple fiber products of low or relatively low weight, without requiring the use of more than one winding unit to deal with the product of the one jet.

The unwinding of the continuous filaments by positive driving of the package support causes the filaments to be delivered from the package at a rate proportional to the delivery speed of the package, and the further delivery of the filaments, whether as a single bundle or as a plurality of bundles, for the cutting from them of groups of fibers intended for assembly into a staple fiber product, should be effected in such a way as not to influence the rate of delivery of the filaments from the package.

A further feature of the invention therefore resides in the provision of an air jet for forwarding the filaments delivered from the package, the non-positive urging of the filaments by the jet enabling them to be delivered at a speed equal precisely to the peripheral speed of the package throughout the unwinding operation.

By way of example a form of mechanism suitable for carrying out the invention will now be described in greater detail with reference to the accompanying drawing in which:

Fig. 1 is a side elevation and Fig. 2 a front elevation of a winding unit for winding a continuous filament artificial yarn continuously with its production;

Fig. 3 shows a detail of the mechanism of Figs. 1 and 2; and

Figs. 4 and 5 are a side elevation partly in section and front elevation respectively of an unwinding mechanism suitable for the purposes of the present invention.

Referring to Figs. 1 and 2 a continuous filament artificial yarn 1 is drawn from the spinning cabinet 2 in which it is produced and led

through a guide 3 which it leaves in the form of two separated bundles of filaments 4. The bundles 4 are led separately through a pair of guides 5, 6 to a package 7 on which they are traversed by means of the guides 5 and 6. The package 7 is built on a package support 8 secured to a spindle 9 by means of an end plate 10 and a screw 11, which clamp the package support 8 against a large driving flange 12 carried by the spindle 9. The spindle 9 is pivotally secured at 13 to an arm 14 swinging about a shaft 15. The driving flange 12 rests on a driving roller 16 mounted on a shaft 17, the shafts 15 and 17 extending the whole length of the spinning apparatus 2 and serving a large number of winding units. The rotation of the flange 12 by means of the roller 16 rotates the package 7 at a constant angular speed so that the bundles of filaments 4 are wound on the package.

The guides 5 and 6 are shown in greater detail in Fig. 3. They are traversed by means of a shaft 18 carrying a collar 19 on which the guides 5 and 6 are formed, the guides being made of bent wire and being supported in their traverse by means of a supporting bar 20. By these means the two bundles of filaments 4 are led in slightly spaced relationship to the package 7. The tangential paths followed by the two bundles to the periphery of the package 7 are slightly different, and the two bundles are laid on the package out of phase with each other, so that they are subsequently able to leave the package as separate bundles without difficulty. Since the package 7 rotates at a constant angular speed, and since its diameter increases slightly during the winding operation, its peripheral speed also increases slightly. As a consequence, the denier of the filaments falls slightly from the inside to the outside of the package, the rate of delivery from the spinning cabinet 2 being constant in terms of weight, and the delivery in terms of length of yarn being determined by the peripheral speed of the package 7. Thus, each turn of yarn round the package represents a certain winding time, and a certain weight of yarn, the length of a turn of yarn varying from inside to the outside of the package.

When the package 7 is completed the arm 14 is raised and the spindle 9 pivoted outwards, so that the completed package may be replaced by a new package support 8. In the meantime the yarn delivered from the spinning cabinet 2 is collected on the driving roller 16 which extends past the guides 5 and 6, for this purpose, the yarn thus collected being slid off to a narrow portion 21 of the roller 16 and subsequently cut off as waste.

Unwinding of the package formed on the mechanism shown in Figs. 1 and 2 is effected by the mechanism shown in Figs. 4 and 5 in which the package support 8 is provided with a pair of driving flanges 24 for the purpose of unwinding, the driving flanges 24 resting on two pairs of friction wheels 25. The friction wheels 25 are mounted on shafts 26 which are driven from a shaft 27 by means of gears 28 and a driving chain 29 passing round sprockets 30. By these means the package 7 is rotated at a constant angular speed and the bundles of filaments 4 wound thereon are delivered at a constant rate in terms of weight, each rotation of the package 7 representing a fixed weight of yarn by reason of the manner in which the package was wound.

The bundles 4 leaving the package 7 pass through guides 32 and over rollers 33 surfaced with rubber, gutta-percha, or other material appropriately removed in the electro-static series from the basic material of the filaments, as is described in U. S. application S. 233,535 filed October 6, 1938. The rollers 33 are driven at a speed greater than the rate of delivery of the bundles 4 from the package 7 by means of a belt 34 and pulleys 35, 36, the pulley 35 being mounted on the shaft 27 and the pulley 36 on the shaft 37 carrying the rollers 33. In consequence the rollers rub against the bundles of filaments 4 and cause them to be charged with static electricity. The arc of contact made by the filaments with the roller 33 may be adjusted by adjusting the position of the guide 32. The guide 32 is formed at the end of a rod 38 passing through holes in a pair of spring elements 39, the spring in the elements 39 and their obliquity holding the rod 38 firmly therein. By pinching the members 39 together, however, the rod 38 may be slid in or out to adjust the arc of contact of the filaments on the rollers 33. The members 39 are mounted on a traverse bar 40, by means of which the guides 32 are traversed to and from along the length of the rollers 33.

From the rollers 33 the bundles 4 are led through a guide tube 41 having an internal nozzle 42 supplied through a pipe 43 with compressed air from a header 44, the current of air through the tube 41 drawing the filaments from the package 7, over the rollers 33, and into and through the tube 41. As is shown in Fig. 5, there are two tubes 41, one for each of the two bundles of filaments 4 wound on the package, and the firm but non-positive pull of the air jets, together with the manner in which the bundles 4 were wound, draws the bundles from the package and prevents filaments belonging to one bundle becoming attached to the other.

From the tube 41 the bundle 4 is conducted to a guide member 45 provided with an internal air nozzle 46 supplied from the header 44 by means of a tube 47. The blast through the air nozzle 46 blows the filaments through a diverging nozzle 48 by means of which they are spread out in the form of a flat band 49. By means of the diverging nozzle 48 and by reason of their electrification on the roller 33 the filaments in the bundle 4 are separated from each other to permit successive groups of separated fibers to be cut from the end of the bundle by means of a cutter 50 of the hair clipper type in the manner described in U. S. application S. No. 155,226 filed July 23, 1937. As described in that specification the successive groups of separated fibers are drawn on to a band 51 by suction induced through a suction pipe 52 in such a manner that the forward ends of fibers of each group extend beyond the rearward ends of fibers of the preceding group. The fibers are then compacted into a coherent staple fiber product by means of rubbing bands 53.

Having described my invention what I desire to secure by Letters Patent is:

1. Process for the production of staple fiber yarns and like products, said process comprising taking a package formed of a bundle of filaments that has a denier varying inversely with the diameter at which it is wound on the package, rotating said package at a definite speed such as to permit the withdrawal of the bundle of filaments at a rate varying inversely with the denier of the bundle, separating the filaments

from each other, cutting successive groups of separated fibers of predetermined length from the ends of the separated filaments, assembling said groups in such a manner that the forward ends of fibers of each group extend beyond the rearward ends of fibers of the preceding group, and compacting the assembled groups of fibers into a coherent staple fiber product of substantially uniform denier.

2. Process for the production of staple fiber yarns and like products, said process comprising extruding a spinning solution in the form of a bundle of continuous filaments, drawing said filaments from the point of extrusion and winding them on a package support by rotating said package support at a definite speed, so that the denier of the bundle varies inversely with the varying diameter of the package during its formation, and subsequently rotating the package at a definite speed such as to permit the withdrawal of the bundle at a rate varying inversely with the denier of the bundle, separating the filaments from each other, cutting successive groups of separated fibers of predetermined length from the ends of the separated filaments, assembling said groups in such a manner that the forward ends of fibers of each group extend beyond the rearward ends of fibers of the preceding group and compacting the assembled groups of fibers into a coherent staple fiber product of substantially uniform denier.

3. Process for the production of staple fiber yarns and like products, said process comprising taking a package formed of a bundle of filaments that has a denier varying inversely with the diameter at which it is wound on the package, rotating said package at a definite speed such as to permit the withdrawal of the bundle of filaments at a rate varying inversely with the denier of the bundle, splitting said bundle into two smaller bundles and, in each bundle, separating the filaments from each other, cutting successive groups of separated fibers of predetermined length from the ends of the separated filaments, assembling said groups in such a manner that the forward ends of fibers of each group extend beyond the rearward ends of fibers of the preceding group, and compacting the assembled groups of fibers into a coherent staple fiber product of substantially uniform denier.

4. Process for the production of staple fiber yarns and like products, said process comprising extruding a spinning solution in the form of a bundle of continuous filaments, drawing said filaments from the point of extrusion and winding them on a package support by rotating said package support at a definite speed, so that the denier of the bundle varies inversely with the varying diameter of the package during its formation, subsequently rotating the package at a definite speed such as to permit the withdrawal of the bundle at a rate varying inversely with the denier of the bundle, splitting said bundle into two smaller bundles, and, in each of said smaller bundles, separating the filaments from each other, cutting successive groups of separated fibers of predetermined length from the ends of the separated filaments, assembling said groups in such a manner that the forward ends of fibers of each group extend beyond the rearward ends of fibers of the preceding group and compacting the assembled groups of fibers into

a coherent staple fiber product of substantially uniform denier.

5. Process for the production of staple fiber yarns and like products, said process comprising extruding a spinning solution in the form of a bundle of continuous filaments, drawing said bundle from the point of extrusion, dividing said bundle into two smaller bundles, and winding them on a single package support by rotating said package support at a definite speed, so that the denier of the bundles varies inversely with the varying diameter of the package during its formation, subsequently rotating the package at a definite speed such as to permit the withdrawal of the bundles at a rate varying inversely with their denier, and, in each bundle, separating the filaments from each other, cutting successive groups of separated fibers of predetermined length from the ends of the separated filaments, assembling said groups in such a manner that the forward ends of fibers of each group extend beyond the rearward ends of fibers of the preceding group and compacting the assembled groups of fibers into a coherent staple fiber product of substantially uniform denier.

6. Process for the production of staple fiber yarns and like products, said process comprising taking a package formed of a bundle of filaments that has a denier varying inversely with the diameter at which it is wound on the package, rotating said package at a definite speed such as to permit the withdrawal of the bundle of filaments at a rate varying inversely with the denier of the bundle, non-positively withdrawing the filaments from said positively rotating package by means of an air jet, separating the filaments from each other, cutting successive groups of separated fibers of predetermined length from the ends of the separated filaments, assembling said groups in such a manner that the forward ends of fibers of each group extend beyond the rearward ends of fibers of the preceding group, and compacting the assembled groups of fibers into a coherent staple fiber product of substantially uniform denier.

7. Process for the production of staple fiber yarns and like products, said process comprising extruding a spinning solution in the form of a bundle of continuous filaments, drawing said bundle from the point of extrusion, dividing said bundle into two smaller bundles, and winding them on a single package support by rotating said package support at a definite speed, so that the denier of the bundles varies inversely with the varying diameter of the package during its formation, subsequently rotating the package at a definite speed such as to permit the withdrawal of the bundle at a rate varying inversely with the denier of the bundle, non-positively withdrawing the filaments from said positively rotating package by means of an air jet, and, in each bundle, separating the filaments from each other, cutting successive groups of separated fibers of predetermined length from the ends of the separated filaments, assembling said groups in such a manner that the forward ends of fibers of each group extend beyond the rearward ends of fibers of the preceding group and compacting the assembled groups of fibers into a coherent staple fiber product of substantially uniform denier.

WILLIAM POOL.