Feb. 11, 1936. F. C. HALE ET AL 2,030,252

MANUFACTURE OF TEXTILE MATERIALS

Filed Nov. 2, 1933

FIG. 1

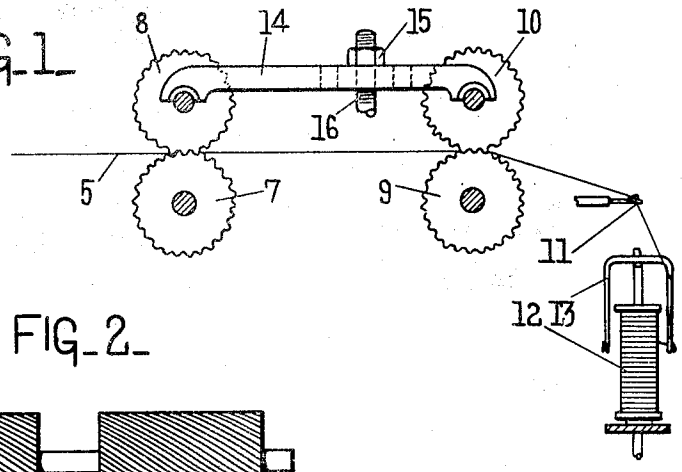


FIG. 2

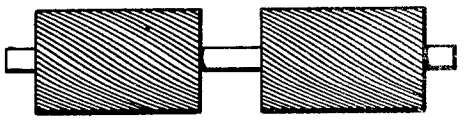


FIG. 3

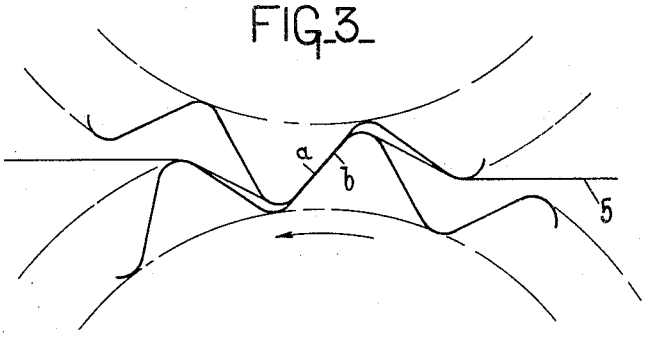
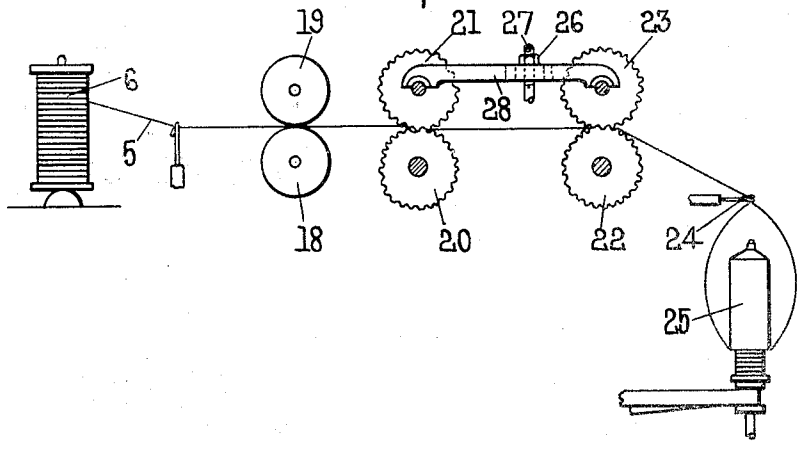


FIG. 4



Inventors:
Frank C. Hale
George C Tyce
by
J. Sellers and Williamson
Attorneys

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UNITED STATES PATENT OFFICE

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MANUFACTURE OF TEXTILE MATERIALS

Frank Corbyn Hale and George Crawford Tyce, Spondon, near Derby, England, assignors to Celanese Corporation of America, a corporation of Delaware

Application November 2, 1933, Serial No. 696,374
In Great Britain November 18, 1932

4 Claims. (Cl. 19—1)

This invention relates to the manufacture of textile materials, and in particular to yarns having a basis of continuous filaments, but having the appearance of spun yarn, that is yarn made from staple fibre.

In the manufacture of spun yarn from artificial fibres, the usual practice is to cut continuous artificial filaments or waste filaments into comparatively short lengths, for example of 1½ to 2 inches or more to produce a staple of similar length to cotton fibres, or of 4, 7, 9, 12 inches or more to produce a staple somewhat similar in length to wool, and then subject the staple fibres produced alone or mixed with other natural or artificial fibres of suitable length to a series of operations appropriate to the length of the fibre, such operations being similar to those accorded to natural fibres such as cotton or wool, including opening, carding, drawing and spinning. These operations represent considerable expense in the production of such yarns, since they involve a relatively slow transformation of the initial fibrous material to a finished yarn.

The object of the present invention is to produce yarn having an appearance similar to that of yarn made from spun fibre while avoiding the necessity for forming continuous filaments into short lengths and spinning the fibres thus produced. The particular object of the present invention is to produce means which will enable a bundle of thread of continuous filaments to be firmly gripped at two points so that a breaking tension can be applied to the filaments so as to transform the filaments in the bundle of thread into staple lengths without destroying the continuity of the filamentous material.

According to the invention gripping means are employed which comprise a grooved roller adapted to engage a bundle of filaments so as to kink the filaments without, however, introducing any danger of cutting or breaking the filaments merely by their contact with the grooved surface of the roller. For this purpose the grooves and the teeth formed between the grooves have a rounded contour so that the filaments while being kinked pass smoothly over the surface of the teeth and grooves with which they happen to be in contact. Conveniently each gripping device comprises two such rollers, the teeth of one roller meshing with the grooves of the other so that the filaments are caused to follow a sinuous path afforded by a relatively loose engagement of the two rollers. Preferably, the profile of the roller teeth is such that contact with the filaments is effected progressively and continuously along the sides of the teeth, and in order to prevent the possibility of "rubbing" the maximum rolling action, such as is obtained by an involute profile, is desirable. With such a smooth rounded profile of the inter-engaging teeth and grooves firm gripping is obtained without danger of the filaments being cut.

Two such gripping devices are arranged to engage the filaments at an appropriate distance apart in accordance with the length of staple to be produced, and one such device is driven at a speed sufficiently greater than that of the other device that by reason of the firm gripping afforded by each device the filaments are extended beyond their breaking point and the bundle is transformed into staple lengths, breaking occurring more or less at random along the length of the bundle.

By reason of the danger of cutting of the filaments by the mere engagement of the gripping devices with the bundle being avoided, severance of the bundle as a whole does not take place, but each filament is more or less in turn subjected to the breaking force. As a result the material is transformed into staple fibres of fairly even lengths which thereafter are spun and/or twisted in a manner similar to that employed for rovings produced from slivers of cotton, wool or other staple fibres. One roller only of each gripping device may be made with smooth teeth, as described above, and the opposing roller may be substantially plain and of somewhat flexible character so as to provide a firm engagement of the filaments nipped between the rollers. When treating substantially delicate filaments, however, it is preferred that two inter-engaging rollers be employed as a gripping device, so that a firm grip is easily obtained without the use of pressure liable to damage either the filaments or the rollers.

Conveniently twisting may be performed continuously with the conversion of the filaments into staple fibres. For example the fibrous mass may proceed direct from the gripping devices to a flyer spindle which exerts the requisite degree of twist, the material thus produced being afterwards subjected to a further twisting operation with or without draft as required in accordance with the size of the original bundle of filaments and the count of yarn to be produced.

Suitable bearings may be provided for the rollers to provide a passage between the rollers of the requisite width in accordance with the size of the filament bundle under treatment. It is to

be understood, however, that the breakage of the filaments depends essentially on the firm grip obtained by forcing them into a sinuous path at each gripping device rather than on the application of any considerable pressure.

The invention is applicable to the production of fibrous yarns from all kinds of continuous or substantially continuous filaments or mixtures of continuous filaments. Among artificial continuous filament yarns which may be converted according to the invention may be mentioned cellulose acetate or other organic derivatives of cellulose, such as other cellulose esters, e. g. cellulose formate, propionate and butyrate, and cellulose ethers such as ethyl, methyl and benzyl cellulose, and viscose, nitrocellulose, and cuprammonium yarn.

Forms of apparatus suitable for carrying out the process according to the invention will now be described in greater detail with reference to the accompanying drawing in which:—

Fig. 1 shows in part cross-sectional end elevation grooved breaking rollers and twisting apparatus;

Fig. 2 shows a modified form of breaking roller;

Fig. 3 is a large scale diagrammatic representation of a suitable type of profile for the grooves of breaking rollers, and

Fig. 4 shows in part cross-sectional end elevation a modified form of breaking and twisting apparatus.

As shown in Fig. 1 a continuous filamentary bundle **5** (preferably in untwisted form or having but little twist) unwinding from a supply package **6** (Fig. 4) is led through the nips of two pairs of grooved breaking rollers **7**, **8** and **9**, **10**, over a guide **11** and to the bobbin **12** of a flyer spinning device **13**. The nips of the grooved rollers (to be described later) are formed and arranged so as to obtain firm grip over a relatively considerable length of the filaments without introducing any danger of cutting or breaking the filaments merely by contact therewith.

The rate of rotation of the rollers **9**, **10** is so much in excess of the rate of rotation of the rollers **7**, **8** that the filaments comprising the bundle **5** are extended beyond their breaking point and are converted directly into a fibrous mass which is delivered to the flyer **13** as a coherent bundle. The fibres comprising the bundle are broken to a length corresponding to the "ratch", or distance between the axes of the rollers **7**, **9**, which distance can be adjusted in accordance with the fibre length desired. The fibrous nature of the bundle usually maintains continuity of the bundle though the originally continuous filaments have been broken. If desired, however, supporting means such as a travelling endless band, or carriers, may be situated beneath the bundle between the breaking rollers in order to prevent "falling" or wastage of the fibres or filaments.

The profile of the grooves and teeth of the breaking rollers (Fig. 3) is designed to give the maximum amount of deviation of the bundle **5** passing through the respective nips so that, as explained above, a relatively considerable length of contact therewith enables tension requisite for rupturing the filaments to be achieved with relatively low pressure between the two pairs of rollers. Thus, as shown clearly in Fig. 3, the teeth of the grooved rollers cause not only considerable deviation of the bundle from a straight line, thereby providing a considerable surface of contact with a correspondingly firm grip on the bundle, but the profile of the teeth is such that pressure contact is effected progressively and continuously along almost the whole side of each tooth as the rollers rotate. This combination of maximum deviation and length of pressure surface is obtained conveniently by the use of teeth having a pressure angle of 45°–60°, the illustration showing teeth having a pressure angle of about 45°. In order to obtain the maximum rolling action between the upper and lower teeth compatible with such pressure angle, the profile of the teeth approximates as closely as possible to involute, thus avoiding rubbing which might tend to damage the bundle. The teeth extremities are smoothed in order to avoid local nipping which also might tend to damage the bundle.

It is to be understood that for purposes of clarity the roller grooves in all the drawings (and particularly in Fig. 3), are greatly magnified, a suitable practical depth of groove being say 1/40 inch.

The upper rollers **8**, **10** are rotated by contact with the lower rollers **7**, **9** which may be driven in any suitable manner. One method of regulating the pressure between the faces of opposing teeth comprises applying a braking force to the upper rollers, thus offering increased resistance to rotation thereof, and consequently increasing the pressure on the bundle between the opposing faces of engaging teeth. The faces are indicated at *a* and *b* in Fig. 3. The braking action is conveniently effected by a bridge-piece **14** which is adapted to ride at its extremities on the axles of the upper rollers **8**, **10**, and which is tightened or slackened by a nut **15** and a bolt **16**. The requisite pressure for filament gripping purposes is thus adjustable as desired. As the bundle **5** is in a fibrous state when passing through and beyond the nip of the rollers **9**, **10**, however, substantially no tension can be imparted thereto by mere surface contact with the roller teeth and slight pressure alone, as the lack of continuity of the fibres in the bundle precludes the possibility of transmitting force along the bundle.

The gripping force due to pressure at the nip of the rollers **9**, **10** is therefore increased in order to prevent undue slippage of the fibres, which otherwise might occur, by adjusting the position of the bolt **16** along the length of the bridge-piece **14**, the bridge-piece being provided with a plurality of holes (shown in dotted lines) at different positions along its length for the reception of the loading bolt.

The teeth of the rollers may run parallel to the axis of the rollers, or if desired they may be inclined thereto. For example, they may be arranged helically along the roller surface, a spiral angle of about 30° being found suitable. A pair of such rollers is shown in Fig. 2. The use of helically grooved rollers enables the vertical loading of the roller shaft to be reduced for the treatment of a given bundle, as the tendency to axial-thrust (which is opposed by the roller bearings) increases the amount of pressure on the filaments, which pressure travels across the teeth of the rollers from end to end, and in addition to ensuring steady running of the rollers, ensures even gripping of the filaments or fibres. The profile of the teeth of the helically grooved rollers is, of course, substantially the same as that explained above.

As shown in Fig. 4, the continuous filamentary bundle **5** unwinding from the supply package **6** is led through the nip of a pair of relatively smooth-faced rollers **18**, **19** prior to passing through the

nips of two pairs of grooved breaking rollers **20**, **21** and **22**, **23** of the type described with reference to the preceding figures. Upon leaving the nip of the rollers **22**, **23** the now fibrous bundle passes over a balloon guide **24** and is twisted and wound directly into yarn by a cap spinning device **25**.

The nip rollers **18**, **19** relieve the first pair of breaking rollers **20**, **21** of the necessity of drawing the bundle **5** from the supply package **6**, and feed the bundle under substantially constant tension to the breaking rollers. The rollers **18**, **19** may grip the bundle **5** with any desired pressure and may be covered with suitable covering material such as e. g. leather or rubber.

The grooved breaking rollers can be made of any suitable material for example steel or other metal rollers may be employed. It may, however, be advantageous to employ materials which offer a higher co-efficient of friction to the filaments under treatment than is possible with a metallic or other smooth gripping surface. Thus, one or both grooved rollers of each pair may be made of material incorporating synthetic resin or other strong binder, for example; the roller material may be made of layers of canvas, linen, or other fabric treated with synthetic resin and blocked to form a hard material from which the rollers can be cut. Preferably the fabric layers are transverse to the axis of the rollers so as to make the surface of the rollers uniform, especially as regards their gripping action. Such composite materials have a certain amount of resiliency which is an aid in gripping the filaments, as well as reducing any tendency for the whole bundle to be cut at the nip.

The use of composite materials, as indicated above, for the rollers enables an irregular but more or less predetermined incidence of breakage of the individual filaments to be effected by incorporating in the materials suitable abrasives such as carborundum and emery. These materials can be applied in the formation of the roller material so as to be evenly distributed over the surface of the rollers produced from the material, so that on tension being imparted by the gripping devices the filaments are engaged by the particles of abrasive and severed near the point at which they are gripped.

If desired the continuous filaments may be rendered temporarily brittle prior to breakage, in the manner explained in detail in U. S. application S. No. 696,183 filed November 1, 1933. Thus the lower of the first pair of breaking rollers **7** or **20** may be hollow and adapted to receive refrigerant cooled to a suitable temperature so as to cool the filaments and render them brittle. Or, alternatively or in addition to cooling one of the first pair of breaking rollers an auxiliary hollow cooling roller may be arranged so as to contact with the filaments prior to their entering the nip of the first pair of breaking rollers. For example the roller **18** of Fig. 4 may conveniently be adapted to act as a cooling roller, and if further cooling is desired cooling pipes may be placed in the vicinity of the bundle passing between the nips of the two pairs of breaking rollers **7**, **8** and **9**, **10** or **20**, **21** and **22**, **23**. Filaments so broken retain their extensibility upon recovery from the brittle condition. If the filaments are broken at normal temperature, however, thereby tending to lose some extensibility, they may be conditioned after breakage in the manner described in U. S. application S. No. 696,184 filed November 1, 1933.

In order to enable a fairly close measure of control to be obtained over the length of the fibre produced so as to obtain a spun yarn as uniform as possible in structure and consequently of fairly high strength, the strength of the filaments under treatment may be modified at intervals along their length, for example, in the manner described in U. S. application S. No. 677,218 filed 23rd June, 1933.

Again, the filaments may vary in denier at intervals along their length so that breakage occurs at the thinner and weaker parts when the filaments are subjected to a breaking load. The breaking of such filaments is described in detail in U. S. application S. No. 674,829 filed 8th June, 1933.

While the above process has been described with reference to the treatment of one bundle only, it is to be understood that as many bundles as desired may be treated in the same apparatus, the rollers being of substantial length and adapted to supply a plurality of twisting and winding devices. If desired, the broken fibrous masses of more than one bundle may be united as one end at the twisting device, or after being broken the bundles may be drawn and reduced in cross section prior to being twisted and wound, as described in U. S. application S. No. 696,183.

Where the materials are subject to electrification, as for example in the case of cellulose acetate or other organic derivatives of cellulose, hygroscopic materials may be applied to the materials. For example, hygroscopic bodies may be applied as described in U. S. application S. No. 614,853 filed 1st June, 1932, the filaments preferably being dried before breaking.

What we claim and desire to secure by Letters Patent is:—

1. In a process for the production of yarns of fibrous character, the continuous and successive steps of gripping a plurality of continuous filaments at at least two points along the length of the filaments by associated pairs of toothed rollers adapted to cause the filaments to follow a smooth sinuous path under pressure, rotating said rollers in such a manner as to subject said filaments to a breaking load so as to break said filaments into associated fibres of a length corresponding to the distance between the pairs of rollers, and spinning said associated fibres into yarn.

2. In a process for the production of yarns of fibrous character, the continuous and successive steps of gripping a plurality of continuous filaments at at least two points along the length of the filaments by pairs of inter-engaging toothed rollers adapted to cause the filaments to follow a smooth sinuous path, adjusting the pressure between the teeth of said inter-engaging rollers, rotating said rollers in such a manner as to subject said filaments to a breaking load so as to break said filaments into associated fibres of a length corresponding to the distance between the pairs of rollers, and spinning said associated fibres into yarn.

3. In a process for the production of yarns of fibrous character, the continuous and successive steps of gripping a plurality of continuous filaments at at least two points along the length of the filaments by associated pairs of helically toothed rollers adapted to cause the filaments to follow a smooth sinuous path under pressure, rotating said rollers in such a manner as to subject said filaments to a breaking load so as to break said filaments into associated fibres of a length

corresponding to the distance between the pairs of rollers, and spinning said associated fibres into yarn.

4. In a process for the production of yarns of fibrous character, the continuous and successive steps of gripping a plurality of continuous filaments of cellulose acetate or other organic derivative of cellulose at at least two points along the length of the filaments by associated pairs of toothed rollers adapted to cause the filaments to follow a smooth sinuous path under pressure, rotating said rollers in such a manner as to subject said filaments to a breaking load so as to break said filaments into associated fibres of a length corresponding to the distance between the pairs of rollers, and cap spinning said associated fibres into yarn.

FRANK CORBYN HALE.
GEORGE CRAWFORD TYCE.