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3,049,397

PROCESS OF MAKING SPACE-DYED YARN

Filed April 3, 1958

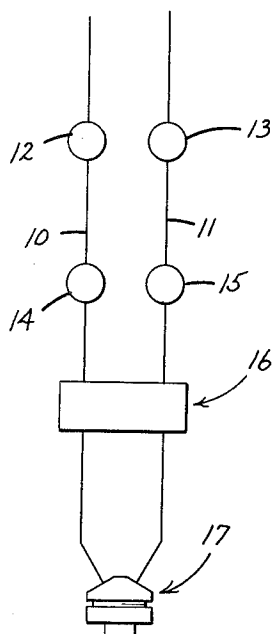


Fig. 1

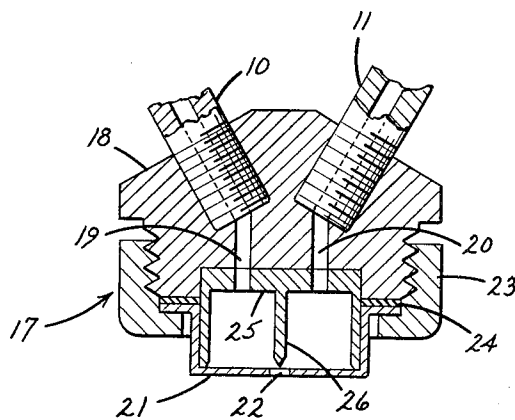


Fig. 2

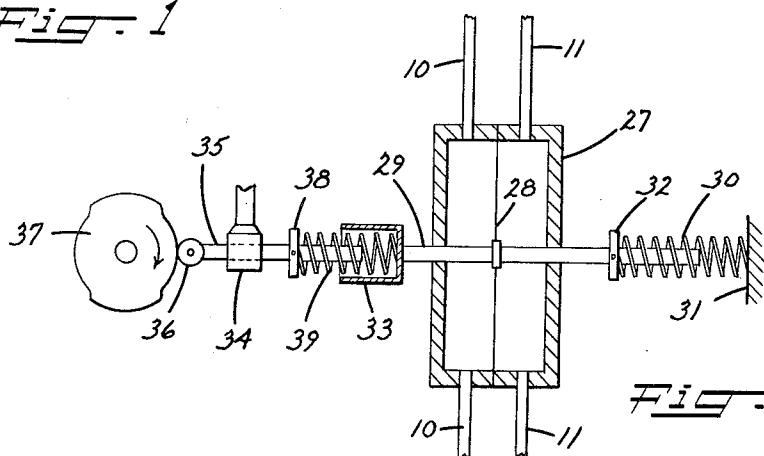


Fig. 3

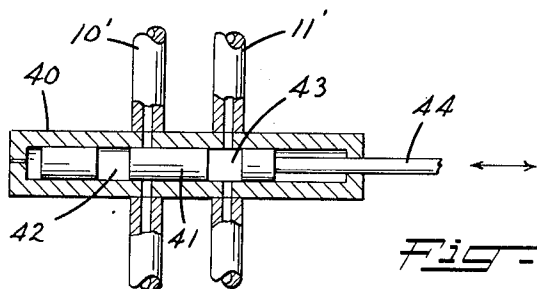


Fig. 4

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PROCESS OF MAKING SPACE-DYED YARN

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1 Claim. (Cl. 18—54)

This invention relates to artificial textile yarn having contiguous segments of alternating colors, and more particularly to an improved method for producing such a yarn.

In the production of artificial or synthetic yarns it is now a common practice to introduce coloring matter into the spinning solution so that the resultant filaments and yarn strands formed of the filaments have the color locked in as an integral part of the yarn. It is also known to produce artificial yarns having alternating colored segments but it has heretofore not been practicable to produce such yarns wherein the different colors are sharply divided, there generally being an appreciable length between adjacent differently colored segments wherein the different colors are mixed together.

It is an object of the present invention to provide an improved method for spinning space-dyed yarn.

It is a further object of the invention to provide a method for spinning a space-dyed yarn wherein the zone of intermixing between the separate colors is cut to a minimum so as to provide an apparent sharp line of demarcation between the different colors.

Other and further objects, features and advantages of the invention will become apparent as the description of a preferred embodiment thereof proceeds.

Referring now to the drawings:

FIG. 1 is a diagrammatic view of the overall apparatus,

FIG. 2 is a sectional view of one form of conjugate spinneret or jet of the type employed in carrying out the invention,

FIG. 3 is a diagrammatic sectional view of one form of apparatus for controlling the flow of the different colored spinning solutions, and

FIG. 4 is a sectional view of a different form of flow regulating device.

The new method of spinning a space dyed-yarn wherein the mixing of the two colors between adjacent differently colored segments is minimized contemplates the use of what is known as a conjugate jet or conjugate spinneret, several examples of which are illustrated in the patent to Kulp et al., No. 2,386,173. In such a spinneret the area immediately back of the face containing the orifices through which the spinning solution is extruded to form the filaments is divided into substantially separate regions, each of which is in communication with the orifices. In the usual method of spinning with a conjugate jet, spinning solutions of different compositions are introduced into the separate regions and extruded simultaneously through one or more common orifices or jet holes to produce filaments having a composite composition whereby the filaments have physical characteristics differing from those formed of a single composition. In the present invention, which is of equal value in the spinning of viscose, acetate, or other wet or dry spun synthetic fibers, spinning solutions having different colors are led to the separate regions of the conjugate jet, and by sharply varying the pressures or rates of flow of the two solutions, as by increasing the pressure of one of the solutions while decreasing the pressure of the other, the solutions are made to flow alternately through the orifices of the jet. The use of a conjugate jet prevents any

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intermingling or mixing of the differently colored spinning solutions right up to the very point of extrusion and thereby enables the production of filaments having what appear to be sharp lines of demarcation between the alternate colors thereof.

A preferred form of apparatus will now be described in part in detail and in part in general terms, since certain elements of the apparatus may take various forms.

The overall arrangement as shown in FIG. 1 comprises two separate conduits 10 and 11 leading from two separate and differently colored supplies of spinning solution. Pumps 12 and 13 in the conduits operate at constant rates, the rates being equal or unequal depending upon whether equal or unequal lengths of the alternate colors are desired. After leaving the pumps 12 and 13, the spinning solutions pass through candle filters 14 and 15 located in the conduits 10 and 11 respectively, and thence to a device 16, presently to be described in greater detail, which controls the flow or pressure of the two spinning solutions. Downstream from the device 16 the conduits 10 and 11 are connected to a spinning head generally indicated at 17.

The head 17 comprises a coupling member 18 into which the conduits are threaded, said coupling being provided with passages 19 and 20 communicating with the bores of the conduits 10 and 11 respectively. The spinneret or jet 21 having an orifice 22 is connected to the coupling 18 by means of a collar 23, a gasket 24 being positioned between the flange of the spinneret and the coupling 18 to insure a tight seal. A cup-like member 25 is positioned in the space between the spinneret and the coupling 18 and said cup-like member is provided with a septum or wall 26 extending transversely of the orifice 22. The edge of the septum is located very closely adjacent the face portion of the spinneret to effectively divide the space back of the face into two separate regions, each of which is in equal communication with the orifice 22. With a conjugate jet such as above described, if spinning solutions are supplied at the same pressure to the separate regions of the jet, equal amounts of the two different spinning solutions will be extruded through the orifice 22. However, by sharply increasing the pressure on the solution in one of the regions of the jet while decreasing the pressure in the other region, only that solution in the region of highest pressure will be extruded and thus by alternately simultaneously increasing the pressure of one of the solutions while decreasing the pressure of the other, the differently colored solutions will be forced alternately through the filament-forming orifice and since there is no opportunity for the differently colored solutions to intermingle up to the very point of extrusion, the filament will have a sharp line of demarcation between the adjacent different colors. For simplicity of illustration and ease of understanding, a spinneret having a single orifice is shown in the drawing but it is to be understood that said spinneret may take various forms such as some of those shown in the above referred to patent to Kulp et al. and that in practice the spinneret will have more than a single orifice. The orifices may be arranged in straight or curved rows, the important feature being that the septum or septums extend to a point close to the orifices to prevent intermingling of the differently colored spinning solutions.

Since various means may be employed for controlling the pressures within the different regions of the spinneret, two suitable devices for accomplishing this will be briefly described. Referring first to FIG. 3, the conduits 10 and 11 are intersected by a common chamber or reservoir 27 having therein a flexible diaphragm 28 which maintains the two spinning solutions separate during their passage

through the chamber. An operating shaft 29 is connected to the diaphragm and extends outwardly through suitable seals in opposite sides of the chamber. A spring 30 surrounds one end of the shaft 29 and operates between a fixed stop 31 and a collar 32 on the shaft 29 to urge said shaft and the diaphragm 28 toward the left as viewed in the drawing. On the opposite side of chamber 27 the shaft 29 has secured to the end thereof a cup-shaped member 33. Slidable within a fixed guide 34 is a rod 35 having a cam following roller 36 adapted to cooperate with the stepped periphery of a rotatable cam 37. The rod 35 is provided with a collar 38 and a spring 39 is arranged to operate between said collar and the cup-shaped member 33. The spring 39 is of such force that when the follower 36 is half way between the high and low surfaces of the cam 37, and the diaphragm is in its undeflected position, the force of the spring 39 is exactly equal to the force of the spring 30. When the follower is on the high portion of the cam, the force of the spring 39 will overcome the spring 30 and tend to deflect the diaphragm 28 toward the right, and when the follower is on the low surface of the cam the spring 30 will tend to deflect the diaphragm to the left. Because of the relative incompressibility of liquids and the high resistances to flow downstream of device 16, the deflections of the diaphragm will be very small and the springs, in their alternate positions, will act chiefly by exerting alternating forces, now on one side of the diaphragm and now on the other, which forces will be transformed into hydrostatic pressures by the diaphragm itself. The cam 37 may be operated from any suitable source of power and is rotated rather rapidly so as to alternate the direction of the net force upon the diaphragm 28 very quickly and at brief intervals of time. The contour of the cam is designed to reduce to a minimum the periods of transition during which there is equal pressure and equal flow in the two regions of the spinneret because, as previously mentioned, when this balanced condition exists, equal amounts of the two solutions will be extruded through the orifice of the spinneret and this would of course result in a filament having two colors throughout its entire length rather than the desired alternating colors. The chamber 27 and associated operating mechanism constitute one form of pressure regulating device generally indicated at 16 in FIG. 1.

The flow of spinning solution to the different regions of the spinneret may also be effectively controlled by a suitable valve arrangement such as illustrated diagrammatically in FIG. 4. Since very small increments of volume of the differently colored spinning solutions are involved, it is desirable when using a valve arrangement to provide conduits having very small passageways and such conduits are indicated in FIG. 4 at 10' and 11'. It will be understood that the conduits 10' and 11' correspond to the previously referred to conduits 10 and 11 and that the spinning solutions are supplied to these conduits by pumps such as the pumps 12 and 13 and they terminate in the conjugate jet 17. These conduits 10' and 11' lead to and from a common valve member which regulates the flow through the two conduits and constitutes another form of regulating device indicated generally at 16 in FIG. 1. Said valve comprises a body portion 40 and a slidable partition 41 having openings 42 and 43 therein adapted to be alternately aligned with the passages in the conduits 10' and 11' respectively. The partition 41 is provided with a stem 44 by means of which said partition may be reciprocated by any suitable reciprocatory motion producing arrangement such, for example, as a cam or crank shaft. If the openings 42 and 43 are round and of substantially the same size as the passageways of the conduits, the pulses of pressure of the two supplies will be nearly sinusoidal and there will be appreciable periods during which both conduits are partially open. By making the openings 42 and 43 substantially larger than the passageways of the conduits, the intervals during which one or the other supply line is open and the other

closed will be of considerably longer duration than the intervals during which one is opening and the other closing and the effect will be to produce quite sharp lines of demarcation between the differently colored segments of the resultant filaments.

As previously mentioned, the particular construction of the flow regulating device 16 is not of the essence of the present invention and the particular forms shown are intended to be merely illustrative examples of two possible forms that such device may take.

While this invention now appears to have its greatest utility in connection with the spinning of yarn strands having alternating segments of different colors and has therefore been so particularly described, it will be apparent that the uses of the invention are not so limited. Thus the alternating segments could be caused to have distinguishing characteristics other than color, for example, the spinning solutions may be polymers which are the same color but differing either in molecular weight or copolymeric composition within the range of compatibility of the copolymers involved. Still other types of longitudinally alternation of properties or characteristics will occur to those skilled in the art once the means for attaining this purpose, provided in the present invention, is made known.

Furthermore, the description of this invention set forth above has discussed in detail means for producing an alternate flow of two solutions through a conjugate jet. The principle of the conjugate jet, as set forth in the above referred to Kulp patent, is not limited to the spinning of two solutions but may by appropriate means be extended to the spinning of three, four or more. The production of fibers possessing three, four or more sets of characteristics in longitudinal alternation, with sharp transition zones, may be accomplished by means essentially similar to those described in detail above with respect to two solutions. The method of achieving alternation of fiber characteristics in the case of three or more sets of characteristics is the same basic method described in detail with respect to two sets; the pressures of the several solutions are caused to vary in a coordinated manner in time in such a way that one solution is, at any one time, under a substantially higher pressure than the others and flows through the jet hole at that time to the exclusion of the others. As in the case of two solutions, the control of pressure of the individual solutions may be accomplished by mechanical means which operate directly to produce an increase or decrease of pressure, as by the extension of force upon a diaphragm, or alternatively by mechanical means which vary the delivery rates of the individual solutions to the conjugate jet assembly.

Moreover, while the description above of means for producing fibers having lengthwise alternation of characteristics has specified that the pressures on both spinning solutions should be varied in such a way that one is raised while simultaneously the other is lowered, it will be apparent that the effect of alternation could be achieved by maintaining the pressure of one spinning solution at a constant value and varying pressure of the second spinning solution from a value well below the pressure of the first to a second value well above the pressure of the first. In that way the solution supplied at constant pressure would issue from the orifice at those times when the pressure upon the second solution had its lower value, but when the pressure upon the second solution was raised to its higher value, that solution would flow through the orifice to the exclusion of the first. While this method would achieve the desired lengthwise alternation of fiber properties it would possess the disadvantage with respect to the method of operation described in detail above that the polymeric solutions issuing from the orifice would do so at two different levels of pressure so that the cross-sectional area and weight per unit length of the fibers produced would tend to

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vary in accordance with the variations of spinning pressure.

It is to be understood that the scope of the invention is to be determined only by the following claim:

Having thus described the invention, what is claimed is:

The method of spinning a constant denier filament having alternating segments of differing characteristics comprising introducing two differently characterized spinnable filament-forming solutions to two different compartments of a conjugate jet which has a septum 10 separating the compartments and a downwardly directed jet opening located directly and closely below the septum, alternately raising the pressure of one of the solutions to

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a particular level while simultaneously reducing the pressure of the other solution, and maintaining the pressures of the solutions such that the sum of the two pressures remain constant.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

August 14, 1962

Patent No. 3,049,397

Marion T. O'Shaughnessy

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 3, line 59, for "condits" read -- conduits --;
column 4, lines 21 and 22, for "longitudinally alternation"
read -- longitudinal alteration --; line 45, strike out
"of", second occurrence; column 6, line 10, for "2,790,833"
read -- 2,780,833 --.

Signed and sealed this 18th day of December 1962.

(SEAL)

Attest:

ERNEST W. SWIDER
Attesting Officer

DAVID L. LADD
Commissioner of Patents