

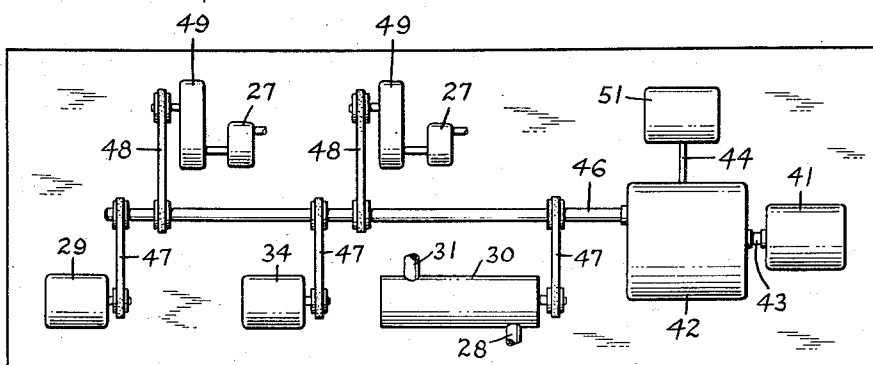
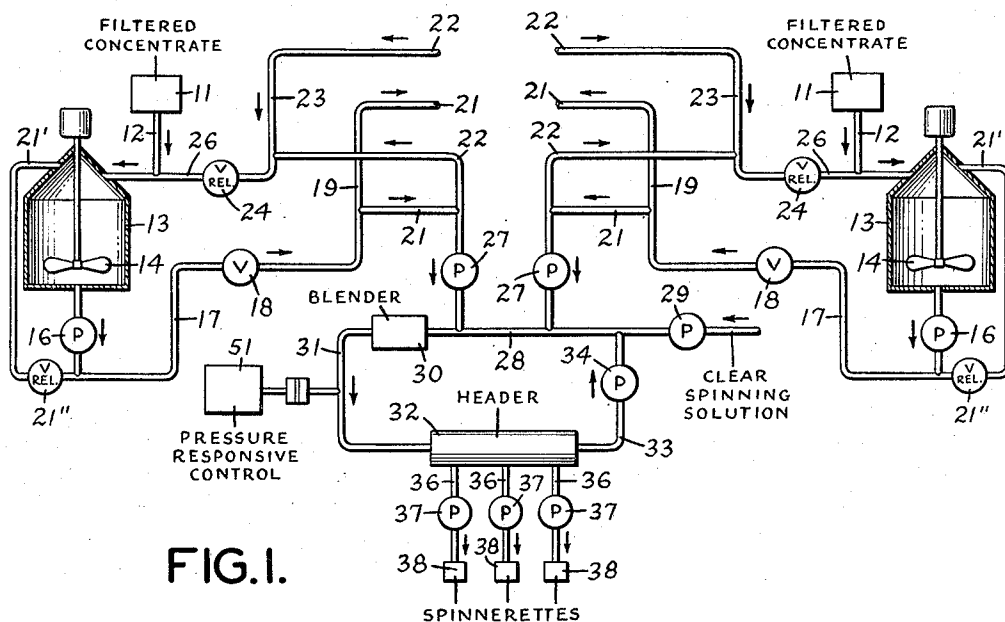
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PRODUCTION OF FILAMENTS

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2,838,792

PRODUCTION OF FILAMENTS

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This invention relates to the incorporation of effect materials into spinning solution and relates more particularly to the manufacture of pigmented yarns.

It is an object of this invention to provide a new and improved process and apparatus for the incorporation of effect materials into spinning solutions.

A further object of this invention is the provision of a new and improved process and apparatus by which effect materials may be incorporated continuously and uniformly into a spinning solution.

Still another object of this invention is the provision of a new and improved process for preparing uniformly colored cellulose acetate yarns.

Other objects of the invention will appear from the following detailed description and claims.

In accordance with this invention, a blend of an effect material and a spinning solution is extruded in filamentary form, as by means of spinnerettes. For the preparation of the blend the effect material or materials employed are added to the spinning solution in the form of flowable concentrates which travel in streams from storage containers to a blending zone. These concentrates are prepared in any suitable manner. Generally they are dispersions of the effect materials in carrying liquids. A minor portion of each concentrate stream is pumped into, and thoroughly blended with, a stream of the spinning solution flowing to the spinnerettes, while a major proportion of the concentrate stream is recirculated back to the storage container. This recirculation maintains the concentrate in a thoroughly mixed condition and prevents separation or sedimentation in any part of the system.

Preferably a plurality of concentrates are led from their respective storage containers to the blending zone and a minor portion of one or more of the concentrate streams is pumped into, and thoroughly blended with, a stream of the spinning solution flowing to the spinnerettes, while a major proportion of each concentrate stream is recirculated back to the storage container. By this method it is possible to obtain great flexibility of operation. For example, a plurality of circulating streams of different color concentrates may be supplied to the blending zone and any one or more of these color concentrates may be blended, as desired, with the spinning solution in any desired proportion, so that a full range of colors and shades of the spun filaments may be produced at will.

A problem which frequently arises in the spinning of pigmented yarn is the fact that during the spinning operation the color value of the yarn becomes progressively lighter. We have found that this problem may be overcome by a pretreatment of the concentrate before it is supplied to the stream of concentrate which circulates between the storage container and the blending zone. In the pretreatment operation, the pigmented concentrate is passed first through a clean filter and then recycled through the same filter until practically all of the larger particles or agglomerates of pigment, e. g. the particles

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or agglomerates whose diameter is larger than 5 microns, are removed from the pigmented concentrate. The pigmented concentrate is then supplied to the storage container. It is found that by the use of this pretreatment a substantially constant color value of the yarn may be obtained throughout the spinning operation. This substantially constant color value is not attained when the pigmented concentrate is pretreated by passing it successively through a plurality of clean filters instead of recycling it through one filter.

The apparatus of this invention includes pumps which supply the concentrate and the spinning solutions to a blender under pressure, means for driving these pumps at a fixed speed ratio and means responsive to the pressure of the blend for varying the speed of the driving means. This arrangement insures a constant blend of concentrate and spinning solution and also a constant pressure on the blend. If one of the spinnerettes becomes disabled or is otherwise taken out of service there is an instantaneous increase in the pressure of the blend and in the spinning pressure, since the supply pumps are still operating at their original speeds. This instantaneous increase in pressure operates a control device which slows down the driving means for the pumps so as to reduce the pressure to its original value, whereby the constant pressure is maintained regardless of the number of spinning pumps in operation.

A great variety of spinning solutions may be employed according to this invention. For example, there may be used solutions of organic derivatives of cellulose, such as cellulose esters and ethers, more particularly cellulose acetate, cellulose propionate, cellulose butyrate, cellulose acetate butyrate, cellulose acetate propionate, methyl cellulose, ethyl cellulose or benzyl cellulose, viscose, cuprammonium cellulose, or other filament forming high polymers, e. g. polyacrylonitrile, copolymers of acrylonitrile with other monomers such as vinyl acetate, vinyl chloride or vinyl pyridine, and copolymers of vinyl chloride and vinyl acetate.

The effect materials employed in the process of this invention may be chosen from a wide range of materials including pigments, dyes, fire retardants, filling materials, softening agents, sizes, resinous materials, catalytic reagents and lubricants.

The effect material may be a white pigment to obtain subdued luster and increased opacity. Examples of white inorganic pigments are tin oxide, tin phosphate, antimony oxide, titanium dioxide, barium sulfate, lead sulfate, calcium sulfate, zinc oxide, zinc carbonate, silicon dioxide, barium borate, calcium borate, or silicates such as china clay or other clays, talc or mica. The pigment may be of organic nature, such as diacetyl benzidine, diacetyl toluidine, dibenzoyl benzidine, naphthyl urea, or suitable synthetic or natural resins.

To obtain colored yarns, suitable color pigments may be employed. For a yellow color, ochre, sienne, chrome yellow, tin bronze, etc. may be employed. For a red color, Venetian red, red lead, vermillion, etc. may be employed. For a blue color, ultramarine, Prussian blue, Milori blue, etc. may be used. For green Guignet's green, verdigris or chrome green may be employed. For brown, raw umber, burnt umber or Vandyke brown may be used. Lakes containing aluminum, tungstic acid, etc. may be employed with advantage as pigments in the obtaining of colored yarns of extreme general fastness to commercial processing and domestic use. To obtain metallic effects, finely divided or colloidal metals may be employed. Nacreous effects may be obtained with pearl essence, such as fish scales, nacreous mercurous chloride, nacreous lead iodide. For shading, that is to get darker colors, lamp black, graphite or other dark pigment may

be added. To obtain any other color, suitable pigments may be mixed as is well understood in the paint art.

Concentrates of fire retardants and softening agents may also be used. Examples of fire retardants are beta chloronaphthalene, trichlor ethyl phosphate, triphenyl phosphate and tricresyl phosphate. Among the softening agents which may be employed are glycol and glycerol oleates and stearates and triethanolamine oleate or stearate.

The concentrate of the effect material may be prepared by mixing the latter with a carrying medium or diluent. For example, when the effect material is a solid which is insoluble in the spinning solution, e. g. a pigment, the concentrate may be a suspension of finely divided effect material in a liquid which is compatible with the spinning solution. Preferably, this liquid is the same as the solvent used in the spinning solution. It is desirable that such a suspension contain, dissolved in the liquid, a thickening and suspending agent which is the same as, or is compatible with, the material employed as the filament-forming material of the spinning solution. For example, when the spinning solution comprises cellulose acetate and acetone we may employ a concentrate of 10 parts of pigment in a solution of 10 parts of cellulose acetate and 80 parts of acetone. In one method of making such a suspension, the effect material is kneaded, milled or otherwise mixed with a rather viscous solution of the filament-forming material in a volatile solvent, with or without a plasticizer, at least part of the solvent is allowed to evaporate, and the resulting plastic mass is worked on malaxating rolls until the particle size of the effect material is reduced to the desired value and the mixture is uniform. The resulting mixture is then allowed to harden and is broken into so-called lacquer chips or is ground into a powder. To produce the final suspension or flowable concentrate these chips or powder are added to a solvent for the filament-forming material. The pigmented concentrate is passed through a clean filter and then recycled a plurality of times, e. g. five or more times, through the same filter.

When the effect material is soluble in the spinning solution, for example, when the effect material is a soluble dye, the concentrate may be a solution of the effect material in a solvent which is the same as, or miscible with, the solvent employed in the spinning solution. Emulsions of liquid effect material may also be employed as concentrates.

In the drawing, wherein a preferred embodiment of this invention is shown,

Fig. 1 is a diagrammatic view of the novel system for blending an effect material into a spinning solution, and

Fig. 2 is a plan view showing the novel arrangement for driving the pumps for blending the effect material and spinning solution.

Like reference numerals indicate like parts throughout both views of the drawing.

In the drawings, reference numeral 11 designates a source of a filtered concentrate, such as a suspension of effect material. Two such sources 11 are shown, each source being for a different concentrate. If it is desired to add more than two different concentrates to the spinning dope the number of sources 11 is increased accordingly. Identical arrangements are used for supplying the two or more concentrates to the spinning dope as described below.

Each concentrate is fed from its source 11 through a pipe 12 into a storage vessel 13, where it is agitated by a stirrer 14 and where solvent is removed or added as desired. From the storage vessel 13 the concentrate is forced, by a pump 16, through a pipe 17, provided with a valve 18, to a supply header 19 and into supply pipes 21. It is desirable to recirculate a large portion, for example over 50%, of the concentrate supplied by pump 16 back to the storage vessel 13 through a pipe

21' and a relief valve 21''. This assists in the mixing cycle and maintains the desired pressure. A major portion of each concentrate flowing to the supply header 19, preferably at least 75% thereof, is recirculated back to the storage vessel 13 through return pipes 22, return header 23, pressure relief valve 24 and pipe 26. From supply pipe 21 a gear pump 27, or other positive displacement pump, forces each concentrate under pressure into a stream of spinning solution flowing in a pipe 28 supplied under pressure by gear pump 29, or other positive displacement pump. The resulting non-uniform mixture of concentrates and spinning solution flows under pressure to a rotary blender 30 where the ingredients are thoroughly and uniformly mixed. From the blender 30 the mixture flows through a supply pipe 31 into a spinning header 32. A portion of the mixture, preferably at least 50% thereof, is recirculated back through a pipe 33, to pipe 28 and blender 30 by means of a gear pump 34, or other positive displacement pump. This recirculation keeps the blend thoroughly mixed and avoids any settling. From the spinning header 32 a plurality of pipes 36 lead to gear pumps 37 which force the uniform mixture through a candle filter (not shown) and a spinnerette filter (not shown) and then through spinnerettes 38. Although Fig. 1 of the drawing omits, in the interest of clarity, the connections for the supply and return pipes 21 and 22 in the upper portion of the drawing, it is to be understood that the arrangements provided for these pipes are identical with those shown for the supply and return pipes 21 and 22 in the lower portion of the drawings.

Blender 30 and gear pumps 34 and 29 are driven by a motor 41 through a main positive infinitely variable transmission 42 of conventional structure. This main transmission is connected to the shaft 43 of motor 41 and carries a control connection 44 by means of which the speed ratio may be varied in a continuous manner, so that between its maximum and its minimum speed ratios the transmission can provide an infinite number of intermediate speed ratios. This main variable transmission 42 drives a main shaft 46, which in turn drives belts 47 connected with blender 30, recirculating pump 34 and spinning solution supply pump 29. The concentrate supply pumps 27 are also driven by the main shaft 46, through belts 48 and individual positive infinitely variable transmissions 49, of conventional structure, similar to main transmission 42.

In operation the speed ratio of each of the individual variable transmissions 49 is adjusted to produce the desired ratio of the concentrate supplied by its corresponding pump 27 to the spinning solution supplied by pump 29. After such adjustment the speed ratio of each individual transmission 49 is kept constant so as to insure a constant mixture of each concentrate with the spinning solution.

The speed ratio in the main variable transmission 42 is controlled, through control connection 44, by means of a pressure responsive control 51, of conventional design, which is connected with the supply pipe 31. Any variation from the desired normal pressure in spinning header 32 and supply pipe 31 causes the control 51 to vary the speed ratio in the main transmission 42. This, in turn, changes the speed of all of the pumps 27, 29 and 34 in order to bring the pressure in spinning header 32 and supply pipe 31 back to normal. For example, when the pressure in supply pipe 31 increases, the control 51 varies the speed ratio in the main transmission 42 so as to decrease the speed of main shaft 46 and its connected pumps 27, 29 and 34.

When a plurality of pigmented concentrates are used and it is desired to change the color of the yarn being spun, it is only necessary to change the speed ratios of the appropriate positive infinitely variable transmissions 49. If it is desired to eliminate one pigment from the blend being spun, it is sufficient to stop the positive

infinitely variable transmission for that blend, as by disconnecting its belt 48.

Example

In the spinning of uniform olive drab pigmented cellulose acetate yarn there are employed two concentrates of pigments dispersed in solutions of cellulose acetate in acetone. One concentrate contains carbon black while the other contains a green gold pigment. Before it is admitted to the storage vessel 13 each concentrate is first filtered by forcing it under pressure through a filter press carrying a fresh cloth dressing and recycling the filtered concentrate 19 more times through the same filter press. Each concentrate is circulated by its pump 16, with a major portion of each concentrate passing through said pump being returned to the storage vessel 13 through the pipe 21'. A minor proportion of each concentrate passing through pipes 17 and 21 is drawn off by the pumps 27 and blended with clear spinning solution in the blender 30. About half of the resulting blend is recirculated to the blender 30 by the pump 34. The resulting olive drab yarns are uniform in color value.

It is to be understood that the foregoing detailed description is given merely by way of illustration and that many variations may be made therein without departing from the spirit of our invention.

Having described our invention, what we desire to secure by Letters Patent is:

1. Apparatus for the spinning of filaments, which comprises a blender, a positive displacement pump for introducing a concentrate of an effect material under pressure into said blender, a positive displacement pump for introducing a spinning solution under pressure into said blender, whereby a blend of concentrate and spinning solution is produced, a spinnerette for the extrusion of said blend in filamentary form, conduit means connecting said spinnerette to said blender, means for driving said pumps at a fixed speed ratio, and means operatively connected to said conduit means and responsive to the pressure of said blend in said conduit means for varying the speed of said driving means and, accordingly, of said pumps to maintain the pressure of the blend constant in said conduit means.

2. Apparatus for the spinning of filaments, which comprises a blender, a positive displacement pump for introducing a concentrate of an effect material under pressure into said blender, a positive displacement pump for introducing a spinning solution under pressure into said blender, whereby a blend of concentrate and spinning solution is produced, a spinnerette for the extrusion of said blend in filamentary form, conduit means connecting said spinnerette to said blender, means for driving said pumps at a fixed speed ratio, means for varying the speed of said driving means and said pumps and means operatively connected to said conduit means and responsive to the pressure of said blend in said conduit means for controlling said speed-varying means to maintain the pressure of the blend constant in said conduit means.

3. Apparatus for the spinning of filaments, which comprises a blender, a positive displacement pump for introducing a concentrate of an effect material under pressure into said blender, a positive displacement pump for introducing a spinning solution under pressure into said blender, whereby a blend of concentrate and spinning solution is produced, a spinnerette for the extrusion of said blend in filamentary form, conduit means connecting said spinnerette to said blender, rotating shaft means for driving said pumps at a fixed speed ratio, a prime mover, a transmission having a continuously variable speed ratio connected to said prime mover and to said rotating shaft means and means operatively connected to said conduit means and responsive to the pressure of said blend in said conduit means for controlling the speed ratio of said transmission and the speed of said pumps to maintain the pressure of the blend constant in said conduit means.

4. Apparatus for the spinning of filaments, which comprises a blender, a positive displacement pump for introducing a concentrate of an effect material under pressure into said blender, a positive displacement pump for introducing a spinning solution under pressure into said blender, whereby a blend of concentrate and spinning solution is produced, a spinnerette for the extrusion of said blend in filamentary form, conduit means connecting said spinnerette to said blender, a rotating shaft means for driving said spinning solution pump, a transmission having a continuously variable speed ratio operatively connecting said rotating shaft means to said concentrate pump, a prime mover, a main transmission having a continuously variable speed ratio operatively connecting said prime mover to said rotating shaft means, and means operatively connected to said conduit means and responsive to the pressure of said blend in said conduit means for controlling the speed ratio of said main transmission to maintain the pressure of the blend constant in said conduit means.

5. Apparatus for the spinning of filaments, which comprises a blender, a positive displacement pump for introducing a concentrate of an effect material under pressure into said blender, a positive displacement pump for introducing a spinning solution under pressure into said blender, whereby a blend of concentrate and spinning solution is produced, a spinning header, a conduit leading from said blender to said spinning header, a spinnerette for extruding said blend from said spinning header in filamentary form, pump means for recirculating a major portion of said blend from said spinning header to said blender, rotating shaft means for driving said pumps at a fixed speed ratio, a prime mover, a transmission having a continuously variable speed ratio connected to said prime mover and to said rotating shaft means and means responsive to the pressure of said blend in said spinning header for controlling the speed ratio of said transmission and the speed of said pumps to maintain the pressure of the blend constant in the conduit between said blender and said header.

6. Apparatus for the spinning of filaments, which comprises a storage vessel for holding a concentrate of an effect material, a blender, a conduit for feeding said concentrate toward said blender, a conduit for recirculating a major portion of said concentrate from said first conduit back to said storage vessel, a pump for introducing said concentrate from said first conduit under pressure into said blender, a pump for introducing a spinning solution under pressure into said blender whereby a blend of concentrate and spinning solution is produced, a spinnerette connected to said blender for the extrusion of said blend in filamentary form, means for driving said pumps at a fixed speed ratio and means, responsive to the pressure of said blend flowing from said blender to said spinnerette, for varying the speed of said driving means and, accordingly, of said pumps to maintain constant the pressure of the blend flowing from said blender to said spinnerette.

7. Apparatus for the spinning of filaments, which comprises a storage vessel for holding a concentrate of an effect material, a blender, a conduit for feeding said concentrate toward said blender, a conduit for recirculating a major portion of said concentrate from said first conduit back to said storage vessel, a pump for introducing said concentrate from said first conduit under pressure into said blender, a positive displacement pump for introducing a spinning solution under pressure into said blender, whereby a blend of concentrate and spinning solution is produced, a spinning header, a conduit leading from said blender to said spinning header, a spinnerette for extruding said blend from said spinning header in filamentary form, pump means for recirculating a major portion of said blend from said spinning header to said blender, rotating shaft means for driving said pumps at a fixed speed ratio, a prime mover, a transmission hav-

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ing a continuously variable speed ratio connected to said prime mover and to said rotating shaft means and means responsive to the pressure of said blend in said spinning header for controlling the speed ratio of said transmission and the speed of said pumps to maintain the pressure of the blend constant in the conduit between said blender and said header.

8. Process for the continuous production of filaments, which comprises preparing a concentrate of a finely divided solid material in a solution of a filamentary-forming material, passing said concentrate through a clean filter, and then recycling said concentrate at least five times through said filter, feeding a stream of said recycled filtered concentrate from a storage zone to a blending zone, continuously passing a major portion of said stream back to said storage zone, continuously blending a minor portion of said concentrate with a spinning solution in said

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blending zone, and continuously spinning the resulting blend of concentrate and spinning solution into filamentary form while maintaining the pressure of the blend constant in the region between the blending zone and the point of spinning.

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