Nov. 8, 1938. W. WHITEHEAD 2,136,201

METHOD OF SPINNING ARTIFICIAL FILAMENTS

Filed Sept. 13, 1935

Fig. 1.

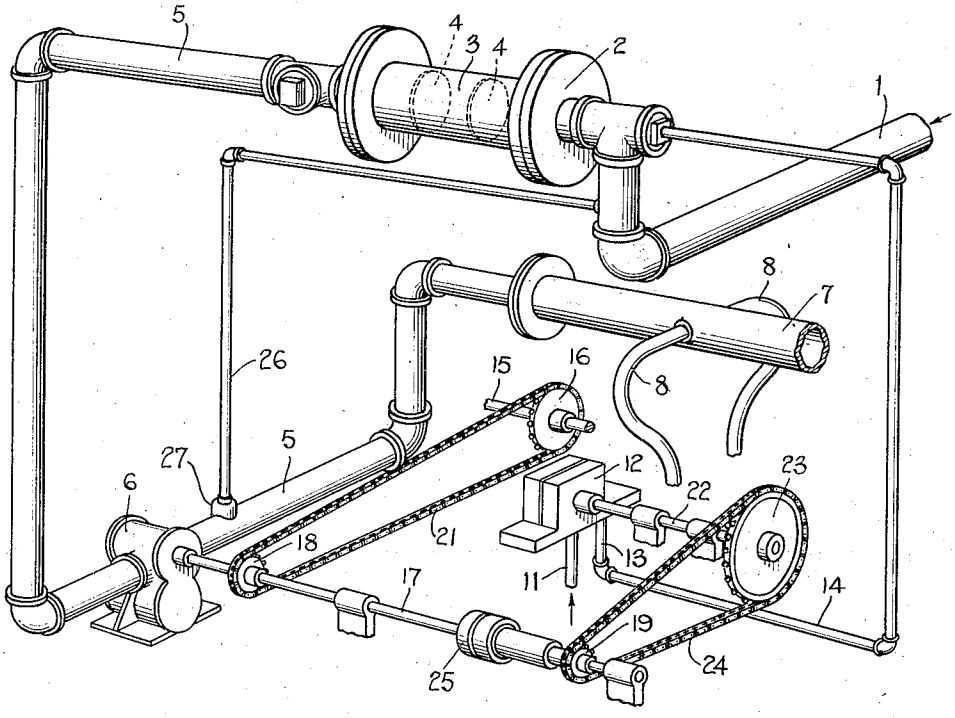
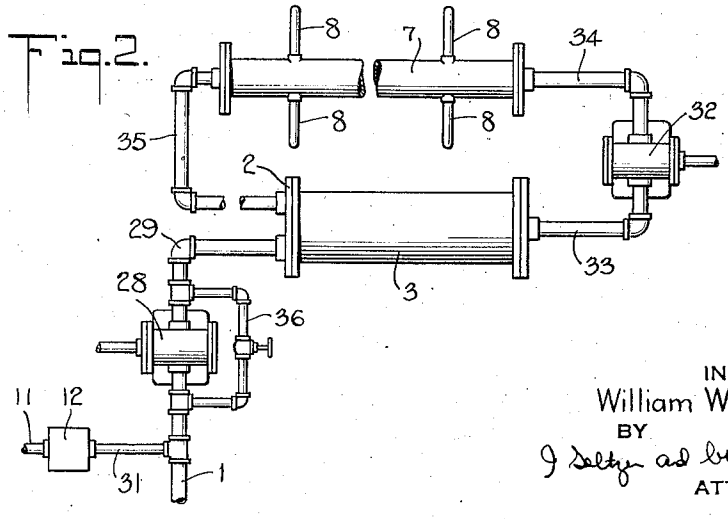


Fig. 2.



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METHOD OF SPINNING ARTIFICIAL FILAMENTS

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5 Claims. (Cl. 18—54)

This inventtion relates to the preparation of artificial filaments, yarns and other textile materials, and relates more particularly to a method of and apparatus for producing pigmented yarn in a commercially feasible manner.

An object of the present invention is the economic and expeditious production of artificial filaments or yarns having a pigment therein. Another object of the invention is the production of a device for forming pigmented filaments whereby a change from the use of one pigment to another pigment may be performed in an economical manner. Other objects of the invention will appear from the following detailed description and drawing.

In the drawing, wherein like reference numerals refer to the same or similar elements in the respective figures,

Fig. 1 is a perspective view of a part of a spinning system constructed in accordance with this invention, and

Fig. 2 is a plan view of a modified form of a part of a device for spinning filaments.

In order that yarns formed of artificial filament may stand up under the severe scourings of the types to which fabrics containing such yarns are subjected when soiled, and also to give the fabrics a good margin of fastness to light and acid fading, manufacturers of artificial yarn have resorted to the use of white or colored pigments, which pigments are incorporated in the yarn. The pigments are ordinarily incorporated in the yarn by adding them to the spinning solution from which the yarns are formed. The preparation and spinning of the pigmented solutions have not been satisfactory as the pigments cannot be obtained in a particle size such as is necessary to prevent separation during the large amount of handling required by batch processes including filtration, storage and charging of the spinning systems. Even slight separation of the pigment from the spinning solution results in the production of non-uniform yarns that cannot be woven into a fabric of uniform color. Another disadvantage of the method of adding pigments to spinning solutions employed prior to the present invention is that all of the mixers, tanks, filters, pumps and pipe lines require thorough cleaning after each batch was spun. This cleaning of the apparatus was absolutely necessary when filaments of different shade or color from the previous batch were to be made.

In attempting to overcome the disadvantages and difficulties of spinning pigmented artificial yarn, some of which are expressed above, it has been proposed to add the pigment to the spinning solution just prior to its reaching the spinnerets or spinning jets where the spinning solution is extruded in the form of filaments. While these attempts have been more or less successful, there was still the lack of proper mixing of the spinning solution and pigment, with the result that streaky yarn was produced. Further, the devices used in these attempts were so constructed that they were difficult to clean, thus increasing the cost of production of the filaments to such an extent that the use of the devices was not economically expedient, especially where it was necessary or desired to change from one pigment to another in consecutive batches. When, however, the method and device of the present invention is employed, a uniformly pigmented yarn is produced and a change in pigment may be economically made.

In accordance with my invention, I add a material that is suitable for use as a pigment to a spinning solution from which artificial filaments may be formed, immediately prior to its reaching the spinnerets or filament-forming jets of a spinning device. I mix the pigment with the spinning solution, spin a part of the mixed pigment and spinning solution and double a part of the mixed pigmented spinning solution back into the stream of spinning solution approaching the spinnerets or jets. The present invention also contemplates a simple and novel device for adding a pigment to the artificial filament spinning solution, mixing the pigment and spinning solution and making uniform the ratio of pigment and the spinning solution and the dispersion of pigment in the spinning solution. The device is also so constructed that the cleaning of the same may be performed in an economical manner.

The filaments made in accordance with this invention may be of fine size which may be associated together by twisting to form yarn, or the filaments may be heavier, such as bristles, artificial horsehair and straw. Such filaments may be made of reconstituted cellulose by the viscose, cuprammonium, Chardonnet or other process, but this invention is of particular importance in connection with filaments made of organic derivatives of cellulose such as organic esters of cellulose and cellulose ethers. Examples of organic esters of cellulose are cellulose acetate, cellulose formate, cellulose propionate and cellulose butyrate, while examples of cellulose ethers are ethyl cellulose, methyl cellulose and benzyl cellulose. The filaments containing the organic derivative of cellulose may be prepared by dissolving the or-

ganic derivative of cellulose in a volatile solvent such as acetone and extruding such solutions through fine orifices into an evaporative atmosphere as in dry spinning, or into a precipitating bath as in wet spinning.

As stated, I add a finely divided pigment to the spinning solution or dope. This pigment may be white 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, aluminum oxide, 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.

If desired, suitable colored inorganic pigment may be employed to obtain the desired color or shade. 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, 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. For shading, that is to get darker colors, lamp black, graphite or other dark pigment may be added. To obtain any other colors, the pigments may be mixed as is well understood in the paint art.

The pigment is preferably added to the dope or spinning solution containing the cellulosic compound in the form of a concentrated suspension in a cellulosic compound similar to that employed in the spinning solution or in the form of a concentrated suspension in a cellulosic compound that is compatible with the cellulosic compound of the spinning solution. The concentrated suspension of pigment in a cellulosic compound may be formed by adding the pigment to a rather viscous solution of the cellulosic compound and a plasticizer therefor in a volatile solvent for the cellulosic compound and ball milling, kneading or otherwise mixing the pigment with the viscous or plastic material, allowing at least a part of the volatile solvent to evaporate and then working the resulting plastic mass on malaxating rolls or the like. The milling, mixing and working of the plastic mass and pigment is preferably continued until the particle size of the included pigment is below .5 of a micron in size. After the pigment is thoroughly mixed into the plastic mass, the resulting material may be allowed to harden and then it may be broken into what is commonly known as lacquer chips or ground into a powder. However, other methods may be employed for incorporating the pigment with the cellulosic compound.

The amount of pigment suspended in the compound containing the concentrated pigment is preferably such that by adding 10%, based on the weight of the spinning charge, of the pigment-containing material to the spinning solution the desired ratio of pigment to base material will be found in the yarn. Greater or lesser amounts of pigment-containing material may be employed depending upon the results desired and upon the process and materials used in obtaining these results. Usually the ratio of pigment to base material in the yarn will range from .1% to 20%. However, larger or smaller amounts of pigment may be employed where required. When the pigment is in the form of lacquer chips or press-mass powder, it is preferable to form a solution of same prior to adding it to a spinning solution. The solution of the concentrated pigmented material may be formed by dissolving it in a solvent for the cellulosic base material that it contains.

As an aid in describing the invention, reference will be made to the accompanying drawing. In Fig. 1 of the drawing there is shown one form of a device constructed in accordance with this invention. This device may comprise a feed line 1 coming from a reservoir, mixing tank, plant filter or other source of supply of spinning solution. The pipe 1 may be connected to a header 2 of a homogenizer 3. The homogenizer may comprise a hollow cylinder having mounted therein at spaced intervals suitable baffle plates 4 having a plurality of holes, not shown, formed therein, which holes are so arranged that those in one plate vary in size from the holes in adjacent plates. A suitable conduit or pipe 5 runs from the homogenizer to a pump 6 and then to the spinning header 7. The spinning header may run across a series of compartments known as a metier. For each compartment of the metier there may be any suitable number of lead-in pipes 8 running from the header to candles and spinnerets or spinning jets normally employed in the formation of artificial silk. Any number of compartments may be supplied by the header 7, for instance, 1 to 100 or more.

A pipe or conduit 11 is provided for carrying the suspension of concentrated pigment to a pump 12. The pump is preferably so constructed that it will feed into its discharge line 13 a measured or predetermined quantity of material. The pump discharge line 13 is connected to a conduit or pipe 14 adapted to carry the material discharged by the pump 12 to the feed line 1 connecting therewith at a point near its entrance into the homogenizer header 2.

Suitably mounted in the main frame, not shown, of the device is a shaft 15 driven by any suitable source of power. Mounted on the shaft 15 is a sprocket wheel 16. Also suitably mounted on the frame is a shaft 17, on which are mounted sprocket wheels 18 and 19. A suitable chain or other driving means 21 is provided for rotating the shaft 17 from the shaft 15 through the sprocket wheels 16 and 18. The shaft 17 is adapted to rotate the pumping mechanism of the pump 6.

Mounted in suitable bearings of the main frame is a shaft 22 having fixed thereon a sprocket wheel 23. By means of the chain or other suitable power transmission means 24 the shaft 22 is adapted to be rotated by the shaft 17. A clutch and speed changing device 25 may be provided for the purpose of adjusting the speed of the shaft 22.

A conduit or pipe 26 connects the feed line 1 to the feed line 5 entering the header 7. This pipe or conduit 26 may be equipped with an automatic valve 27 adapted to be regulated by pressure such that upon an increase in the pressure in the header 7, the material carried by the pipe

line 5 will be forced through the line 26, back into the stream of material flowing towards the homogenizer 3 from the feed line 1.

In a modified form of my invention, as shown in Figure 2, there may be provided a feed line 1 connected to a suitable source of supply of a spinning solution. The feed line 1 may be connected to a pump 28. The discharge port of the pump 28 may be attached to a feed line 29 connecting the pump with the homogenizer 3. A feed line 11 suitably connected to a source of supply of pigment or pigmented material may be connected to a measuring pump 12 adapted to feed a desired quantity of pigment into the line 1 through the connecting pipe 31.

The discharge port of the homogenizer 3 may be connected to a pump 32 by means of the conduit 33. The discharge port of the pump 32 may be connected to the spinning jet header 7 by means of a conduit 34. The header 7 on the device shown in Figure 2 corresponds to the header 7 shown in Figure 1. The end of the header 7 opposite the feed end may be provided with a conduit 35 adapted to take any material, not discharged by the header 7 to the spinnerets, back to the homogenizer 3. There also may be provided a pipe or conduit 36 connected into the conduit 29 and the conduit 1 in such a manner that material may be by-passed around the pump 28.

In either of the devices the pumps 6, 28 and 32 may be of a type which maintain a given pressure of material on the discharge side of the pump and return any excess material to the entrance side of the pump. These pumps may be of the type employing meshed gears, eccentric rollers or other suitable means for maintaining a predetermined pressure of solution on the discharge line. The mechanism of the pump may act as a valve or auxiliary valves may be employed in connection with the mechanism of the pump to return any excess material to the feed line on the entrance side of the pump.

In place of the homogenizer 3 described above involving the use of a number of baffle plates 4 each of which is drilled with holes of different size there may be employed a homogenizer having baffle plates each of which are drilled with holes of varying size and/or shape so that the flow rate of spinning solution through each baffle plate is not uniform over the face of the plate and thus producing a mixing action in three dimensions. Other modifications of the homogenizer may be employed.

In operation of the device shown in Figure 1, a spinning solution under a constant pressure, for instance air pressure, is carried by the conduit 1 into the homogenizer 3. From a suitable source of supply the material containing a concentrated pigment is forced by the pump 12 into the stream of spinning solution just prior to its entrance into the homogenizer. In the homogenizer the pigmented material and the spinning solution are intimately mixed and the solution is carried through the line 5 and forced by the pump 6 through line 5 into the header 7. The pump 6 is preferably so regulated that it forces into the line 5 several times the amount of material used by the spinnerets attached to the lines 8. The excess material forced through the line 5 passes through valve 27 and line 26 back into the incoming stream of spinning solution being fed to the homogenizer. Thus, the pump 6 may be so regulated that it pumps five or more times that required by the spinneret or spinnerets, thus recirculating and blending the spinning solution and pigmented solution several times before finally being passed to the spinneret and formed into filaments.

The device shown in Figure 2 operates in a similar manner to that shown in Figure 1. However, all the material forced by the pump 32 enters the spinning header 7 and the excess material is carried from the further end of the header back into the homogenizer. If desired a combination of the devices shown in Figure 1 and Figure 2 may be employed. Such a device would contain the whole device shown in Figure 2 and the addition thereto of the line 26 and valve 27 of the device shown in Figure 1.

In changing the color of pigment of different batches, the device shown in Figure 2 is of particular importance in that there is no expensive cleaning step necessary. Between batches of differently colored pigments all that is necessary in order to clean the system is to force through the system for a short period of time a colorless spinning solution. The form of the device is such that the colorless solution will wipe clean of pigment all the lines, pumps, headers, etc. employed. In this system there are no dead ends or pockets in which the colored pigment will be retained to produce streaks or off-shade color in the filaments subsequently formed of a different colored pigment.

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

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

1. Process for improving the homogeneity of a mixture of pigment and spinning solution in the forming of pigmented artificial filaments or yarns, which comprises adding a pigment to a spinning solution and mixing the same together, feeding the pigment/spinning solution mixture to a spinning jet and passing a major proportion of the pigment/spinning solution mixture back to commingle with freshly mixed pigment and spinning solution.

2. Process for improving the homogeneity of a mixture of pigment and spinning solution in the forming of pigmented artificial filaments or yarns, which comprises adding a pigment to a spinning solution and mixing the same together, feeding the pigment/spinning solution mixture to a spinning jet, passing a major proportion of a pigment/spinning solution mixture back to the feed of unpigmented spinning solution and then causing the returned pigment/spinning solution mixture to commingle with freshly mixed pigment and spinning solution.

3. Process for improving the homogeneity of a mixture of pigment and spinning solution in the forming of pigmented artificial filaments or yarns, which comprises adding a pigment to a spinning solution having a basis of cellulose acetate and mixing the same together, feeding the pigment/spinning solution mixture to a spinning jet, passing a major proportion of the pigment/spinning solution mixture back to the feed of unpigmented spinning solution and then causing the returned pigment/spinning solution mixture to commingle with freshly mixed pigment and spinning solution.

4. Process for improving the homogeneity of a mixture of pigment and spinning solution in the forming of pigmented artificial filaments or yarns,

which comprises adding a pigment to a spinning solution and mixing the same together, feeding the pigment/spinning solution mixture to a spinning jet, passing at least 80% of the pigment/spinning solution mixture back to the feed of unpigmented spinning solution and then causing the returned pigment/spinning solution mixture to commingle with freshly mixed pigment and spinning solution.

5. Process for improving the homogeneity of a mixture of pigment and spinning solution in the forming of pigmented artificial filaments or yarns, which comprises adding a pigment to a spinning solution having a basis of cellulose acetate and mixing the same together, feeding the pigment/spinning solution mixture to a spinning jet, passing at least 80% of the pigment/spinning solution mixture back to the feed of unpigmented spinning solution and then causing the returned pigment/spinning solution mixture to commingle with freshly mixed pigment and spinning solution.

WILLIAM WHITEHEAD.