

April 18, 1961

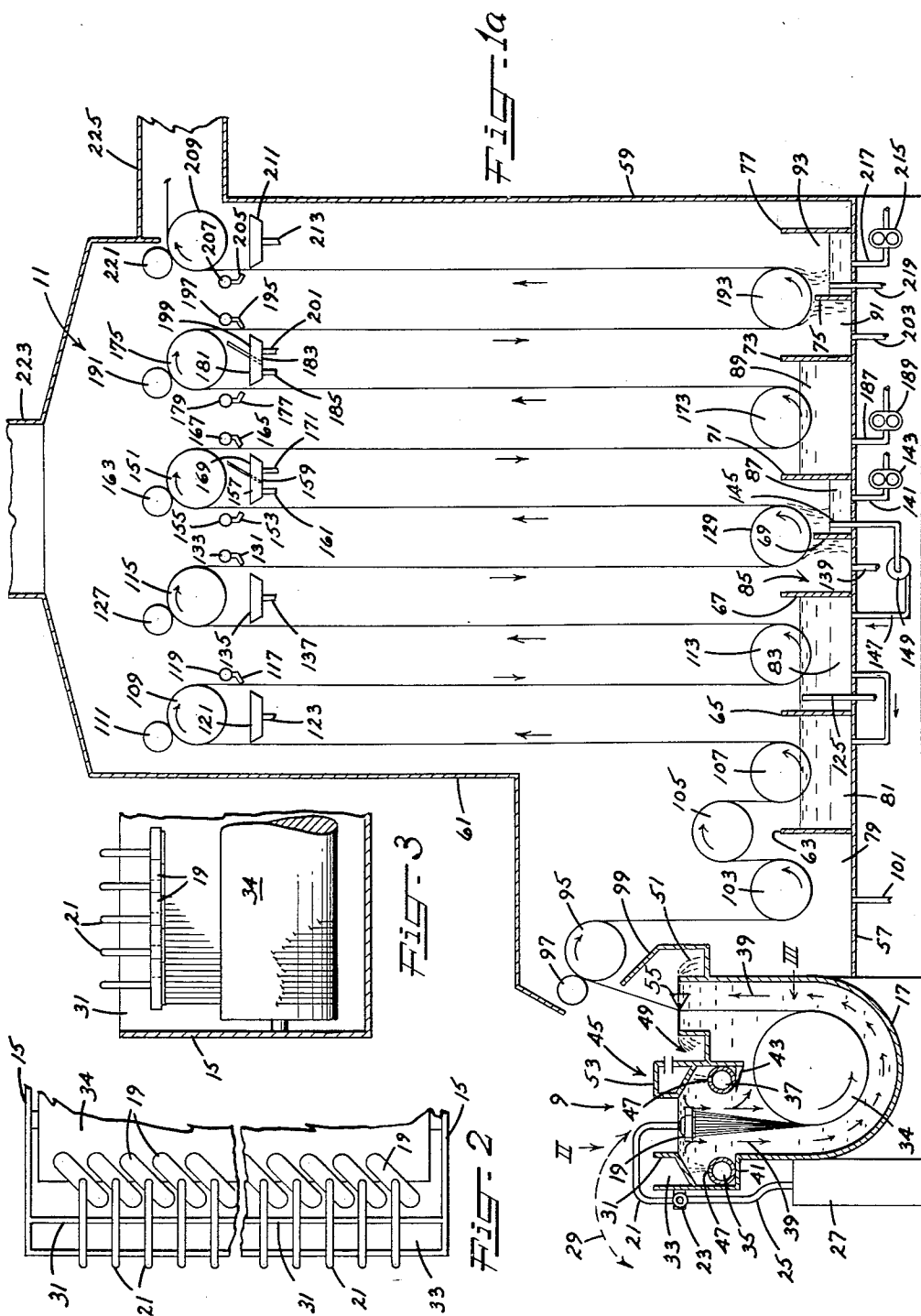
H. P. FRY, JR

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FILAMENT FILM SPINNING AND PROCESSING MACHINE

Filed June 12, 1956

2 Sheets-Sheet 1



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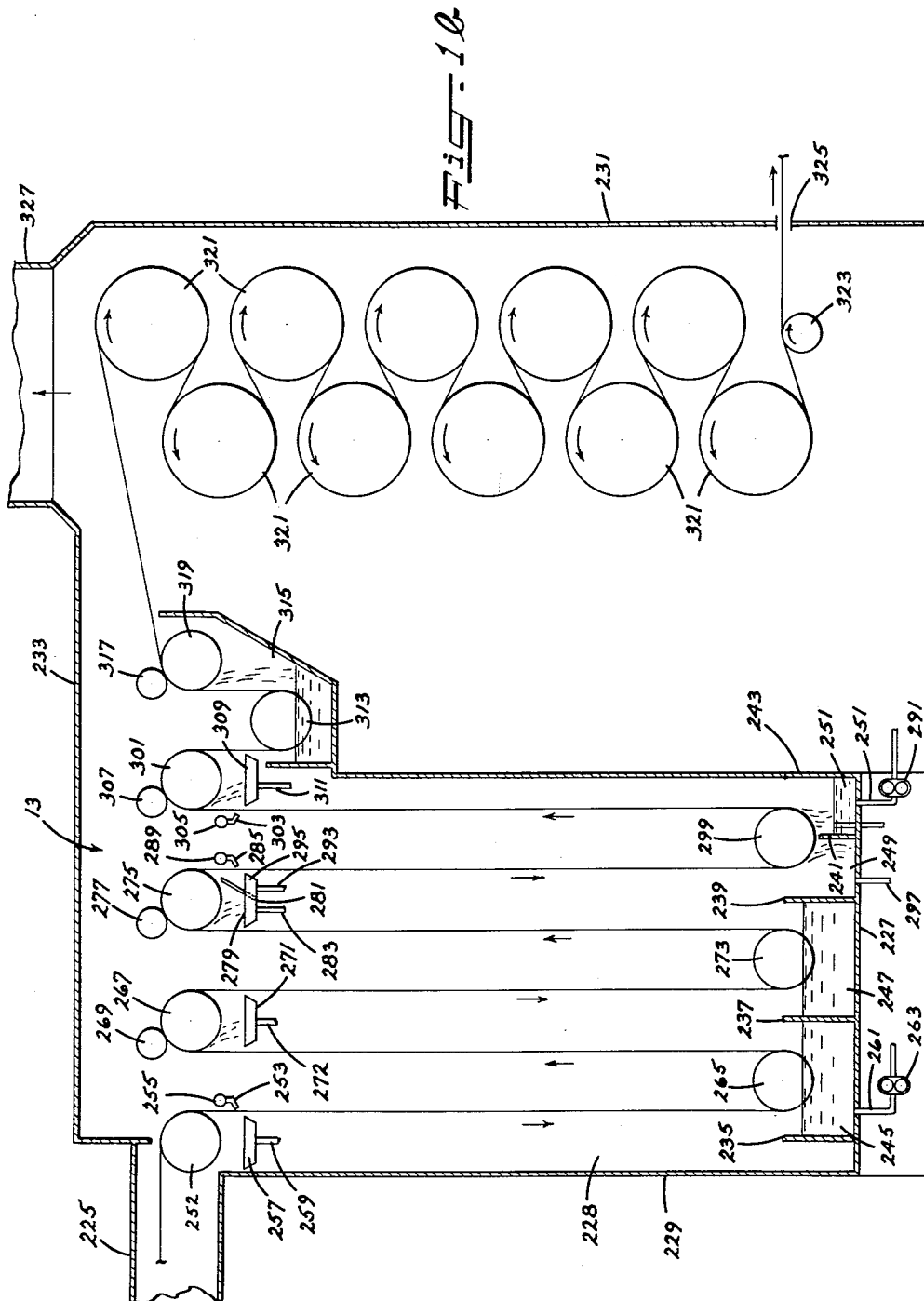
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FILAMENT FILM SPINNING AND PROCESSING MACHINE

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10 Claims. (Cl. 18—8)

The invention relates to the manufacture of artificial filaments, and particularly to the spinning and processing of a web or sheet of artificial filaments.

In the conventional manufacture of artificial filaments, a plurality of jets are normally employed, each producing a small compact tow of filaments. These individual tows are in turn gathered into a large compact tow or bundle involving several hundred thousand filaments. Since a very large number of the filaments remain buried within the center of the resulting large bundle, equal treatment, both in degree and time, of all the filaments during the various processing stages is not possible. Various means have been proposed and employed in an attempt to spread the bundle sufficiently as it is passed through the different necessary treatments but have not offered a satisfactory solution to the problem. Accordingly, a primary object of this invention is to provide a new or generally improved and more satisfactory method and apparatus of spinning and processing artificial filaments.

Another object is the provision of spinning a plurality of artificial filaments in a manner as to provide a web or sheet-like tow in which all the filaments are exposed.

Still another object is to provide a method and apparatus by means of which a tow of filaments, after spinning, is passed through its various treating and drying stages as a substantially flat web or sheet.

A further object is to provide an arrangement of spinning jets which are together adapted to cast a plurality of filaments into a substantially flat web or sheet, and which are individually capable of being removed from spinning position without disturbing the operation of the remaining jets.

A still further object is the provision of a method and apparatus in which a traveling web or sheet of artificial filaments is passed through a heated humidifying chamber during certain stages of its processing and can be subjected to either or both concurrent or countercurrent flow of treating fluids during certain desired stages of the processing.

A still further object is to provide a method and apparatus for producing artificial filaments with the use of relatively simple and efficient equipment which requires a minimum of care and supervision and which will produce a satisfactory product of consistently uniform character.

These and other objects and advantages of the invention will be apparent from the following description and accompanying drawing in which:

Figure 1a is an elevation of a portion of the apparatus of the present invention illustrating the spinning end of the machine and the arrangement for treating a web of artificial filaments during its early processing stages;

Figure 1b is an elevation of the remainder of the apparatus of the present invention illustrating the manner in which the final treating and drying stages of the traveling web of filaments is effected;

Figure 2 is a plan of a portion of the spinning end of the apparatus as viewed in the direction of the arrow

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II in Figure 1a showing the spinning jet arrangement; and

Figure 3 is a vertical section through a portion of the spinning end of the apparatus as viewed in the direction of the arrow III in Figure 1a.

Generally, the invention is directed to the spinning and processing of a plurality of filaments in a substantially flat web or sheet so as to effect equal treatment of all the filaments. The spinning of filaments into a web or sheet-like form is accomplished by a plurality of spaced diagonally or angularly disposed jets, each of which provides a flat tow of filaments. The apparatus and the manner of treatment of the web of filaments are such as to permit the traveling web to pass sinuously through a heated humid area during certain stages of the processing, have certain of its reaches subjected to either or both concurrent or countercurrent flow of treating fluids during any desired stage of its processing with a minimum of intermixture of treating fluids, and be dried efficiently and uniformly.

Preferably, viscose is employed as the basic material from which the filaments are formed. Further, the various baths, hereinafter referred to, employed in the process of present invention may be the same as those normally utilized in the known and conventional manufacture of artificial filaments formed of viscose, or may be of any desired components and concentrations found best suited for the particular material being extruded and the qualities of the filament desired.

With reference to the drawings, the apparatus of the present invention includes a filament spinning area 9, a first chamber 11 in which the filaments undergo treatment in a heated and humid atmosphere, and a second chamber 13 in which the formed filaments undergo finishing and drying treatments.

At the spinning area of the apparatus, a pair of laterally spaced side walls 15 (see Figure 2), which extend the length of spinning area and the chamber 11, and a U-shaped member 17 extending therebetween together form a spin bath trough into which the filaments are initially extruded by a series of jets 19. The jets 19 are carried on the free ends of rounder brackets 21, each of which is pivotally connected at 23 to a conduit 25 leading from a suitable supply source generally indicated at 27. By means of the pivot connection 23, any or all of the jets 19 may be individually moved into their operative or inoperative position by swinging the respective rounder brackets 21 along a path as shown by the double headed arrow 29. An angulated member 31, extending between the walls 15, is connected to one end of the member 17 and forms therewith a trough 33 into which the viscose or other filament forming material is discharged from any of the jets which are in inoperative or elevated position. The trough 33 conveys the material received therein to a suitable collection unit, not shown.

As best seen in Figure 2, the jets 19 are of oblong construction and are each disposed with its longitudinal or main axis in a diagonal or angled position relative to the vertical plane of its rounder bracket 21. In this manner any of the jets may be individually moved into inoperative or elevated position without disturbing the operation of the remaining jets. The jets 19 are preferably each formed with a rectangular pattern of extrusion openings or orifices so as to cause a web of filaments to be formed as the filament forming material is extruded therethrough. Further, it will be noted that the jets 19 are positioned in partially overlapped relationship, as viewed in Figure 2, so that the web of filaments produced by each jet overlaps in part with the webs formed by the adjacent jets and thus provide an unbroken web substantially across the whole width of the apparatus.

An immersion roll 34 is rotatably mounted within the

spin bath trough and is adapted to maintain the filaments spread out in the desired web form as they pass thereunder, see Figures 1a and 3. Preferably, an acid resistant material, such as porcelain, is employed in the construction of the roll 34. The spin bath or coagulating acid is introduced into the trough 17 through conduits 35 and 37 extending transversely between the side walls 15 and connected to a suitable source, not shown. The conduits 35 and 37 are located on opposite sides of the filament paths as they leave the jets 19 and thus subject both sides of the web to equal acid application in addition to creating a streamline flow of acid through the spin bath trough as illustrated by the arrows 39. The conduit 35 is supported by a ledge or shelf 41 formed in the member 17, while the conduit 37 is carried by brackets 43 secured to a transversely extending support member 45. With both conduits 35 and 37, it will be noted that acid discharge openings 47 are directed upwardly toward the jets so that the extruded streams of filament-forming material are subjected to fresh acid immediately upon their entry into the spin bath trough without any risk of the initially formed filaments being broken or damaged by the force of the entering spin bath acid.

As indicated by the arrows 39, the spin bath acid is being continuously discharged into troughs 49 and 51, both of which extend transversely of the apparatus, with the trough 49 forming a part of the support member 45. The acid receiving troughs 49 and 51 preferably have inclined bottom walls to insure that the acid flow is directed to one end of the apparatus for collection and recirculation. Fumes and vapors emanating from the spin bath are collected and carried away by an exhaust conduit 53 which also forms a part of the support member 45. A doctor blade may be provided to insure that the web of filaments does not wrap around the immersion roll 34, but is not necessary for proper operation since the washing action of the spin acid across the top of the roll satisfactorily accomplishes this function. As the web of filaments leaves the spin bath, it is engaged against a guide bar 55 which is positioned at approximately the acid level and is preferably bowed to insure proper filament spreading.

Upon leaving the spinning area 9, the web of filaments enters the chamber 11 where it travels through a sinuous path during which time it undergoes various fluid treatments. The chamber 11 includes a bottom wall or base 57, an end wall 59, and a cover or hood 61. A plurality of longitudinally spaced transversely extending partitions 63, 65, 67, 69, 71, 73, 75 and 77 separate the lower portion of the chamber 11 into a number of troughs 79, 81, 83, 85, 87, 89, 91, and 93, certain of which serve as containers for the different treating fluids. At the entrance of the chamber 11, the web of filaments passes over a roll 95 which is engaged by a squeegee roll 97 for expressing the spin acid from the filaments. The acid so removed is deflected by a plate 99 into the trough 79 from which it is conveyed to a reclamation unit by a pipe 101. The passage of the web of filaments about the roll 95 and subsequent rolls 103 and 105 enable a good nip on the filaments to be attained prior to the stretching of the filaments as hereinafter described.

In the stretching phase of the process, the web of filaments is first immersed by a roll 107 within the stretch bath contained within the trough 81, which is preferably provided with steam coils (not shown) for maintaining the stretch bath at a desired temperature. Since the filaments are all exposed during their travel through the stretch bath, they are adequately heated during this relatively short immersion period. The stretching of the filaments actually occurs as they travel from a roll 107 to the elevated roll 109. During this period the filaments are preferably maintained in a heated condition, for example by steam introduced into the chamber 11

under low pressure. If desired, a squeegee roll 111 may be provided to cooperate with the roll 109 for removing the excess stretch bath fluid from the filaments.

Regeneration of the filaments occurs as they travel from a roll 109 about a roll 113, and then upwardly to a roll 115. If desired, a spray of regenerating fluid may be impinged against the web filaments by nozzles 117 which are supplied from a suitable source, not shown, through a conduit 119. Any fluid passing through the web of filaments or sprayed in the absence of a web is received within a transversely extending trough 121 from which it is delivered by the pipe 123 to the regenerating bath contained within the trough 83. Intermediate the regenerating stage, the roll 113 causes the web to be immersed within the regenerating bath which may also be heated by steam coils, not shown. An overflow drain 125 is provided for removing the excess fluid from the trough 83. A squeegee roll 127, similar to the roll 111, may be used to remove the excess regenerating fluid from the web as it passes over the roll 115.

After passing through a regeneration stage, the web of filaments travels into a wash zone which includes both a soak wash and a countercurrent wash of the filaments. The soak wash is accomplished as the web of filaments travels from the upper roll 115 to a lower roll 129 by means of a plurality of nozzles 131 which are supplied with water from the conduit 133. Any of the water passing through web is received within a trough 135 and is conveyed to the regenerating bath by a drain 137. Since the wash water flows downwardly along the web, the filaments remain somewhat soaked with the washing fluid. The effluent running off the roll 129 is in part received within the trough 85 from which it is discharged as waste by a pipe 139, while the remainder of the effluent drains into the trough 87 and is recirculated by a conduit 141 and pump 143 to the nozzles 131. The excess fluid in the trough 87 is removed therefrom by an overflow pipe 145 and delivered to the regenerating bath through conduit 147 and pump 149.

The countercurrent wash occurs while the web travels from the roll 129 to a roll 151, during which time it is subjected to a spray of fresh wash water from nozzles 153 which are supplied by a conduit 155. The wash water passing through the web is received in the left side compartment 157 of a partitioned trough 159 from which it is delivered by a pipe 161 to the regenerating bath, while the wash water received by the web flows downwardly therealong, in a direction opposite to the filament travel, and finally discharged into the trough 87. As the web travels over the roll 151, it is preferably acted upon by a squeegee roll 163 to remove the excess wash water from the filaments.

Following the above described wash treatment, the web undergoes the usual process steps in which various solutions are applied according to the type of treatment needed. If desired certain of the fluid treatments may be omitted or varied without departing from the scope or spirit of the invention. Thus, as shown in Figure 1a, as the web leaves the roll 151, nozzles 165 spray the same with a desulphurizing solution supplied by conduit 167. Here the solution passing through the web is received within a compartment 169 of the trough 159 and discharged through a pipe 171 into the desulfurizing bath contained in the trough 89. Desulfurizing of the web occurs as the same travels under a roll 173 and upwardly to a roll 175, with an immersion of the filaments in the desulphurizing bath taking place intermediate its travel. Steam coils, not shown, may be provided in the trough 89 to maintain the bath at a desired temperature. In a manner similar to the wash zone, the filaments, as they approach the roll 175, are subject to a spray of desulphurizing solution from nozzles 177 which are supplied by a conduit 179. The solution here applied travels downwardly along the web and thus is a countercurrent sulfide treatment. The left side compart-

ment 181 of a partitioned trough 183 receives the solution passing through the web and is conveyed therefrom to the desulphurizing bath by a pipe 185. Both the nozzles 165 and 177 are supplied from the trough 89 by means of a conduit 187 and pump 189. A squeegee roll 191 expresses the excess desulphurizing solution as the filaments pass over the roll 175.

The desulphurizing solution is removed from the web by a soak and a countercurrent wash treatment in a manner similar to that following the regeneration stage. As the web travels from the roll 175 to a roll 193, nozzles 195, supplied by the conduits 197, spray wash water against the web, with the portion passing therethrough being collected in the right side compartment 199 of the trough 183 and ultimately sewered through a pipe 201 or sent to the regeneration bath. The wash water thus applied to the filaments moves downwardly along the filaments so as to soak the same and drains therefrom into the trough 91 from which it is returned to the desulphurizing bath by a conduit 203. A countercurrent flow of fresh water is applied to the web by nozzles 205 and conduit 207 as the web travels to a roll 209. A trough 211 collects the water passing through the web and conveys the same by pipe 213 to a recirculating tank. As the countercurrent flow of wash water drips from the roll 193, it is received in the trough 93 from which it is recirculated by pump 215 and conduit 217, to the nozzles 195, while the overflow is sewered through a pipe 219. A squeegee roll 221 removes the excess wash water from the web as it passes over the roll 209. Since the chamber 11 is being continuously supplied with a heated and moist atmosphere due to the heating coils in the stretch, regenerating, and desulphurizing bath, and preferably also by low pressure steam introduced directly to the chamber itself, it is desirable to exhaust the chamber 11 through a duct 223 by any suitable means, not shown.

Once the processing in the chamber 11 is completed, the web of filaments travels through a duct or passageway 225 which separates the chambers 11 and 13, the latter of which is not intentionally supplied with a heated or humid atmosphere. In effect, the web undergoes a preliminary cooling in the passageway 225 before entering a bleach zone. The chamber 13 is similar to the chamber 11 and includes a bottom wall 227, side walls 228, end walls 229, and 231, a cover or hood 233, and a plurality of partition walls 235, 237, 239, 241 and 243. The wall 243 extends transversely between the side walls and separates the chamber 13 into a liquid treating area and a drying area. The walls 235, 237, 239, and 241 provide containers or troughs 245, 247, 249 and 251 for purposes as hereinafter described.

The web, upon its entry into chamber 13, is passed over a roll 252 where it is sprayed by nozzles 253 supplied with bleach through a conduit 255. A trough 257 receives the bleach passing through the web and conveys the same by a pipe 259 to the bleach bath in the trough 245, while a conduit 261 and pump 263 continuously supply the nozzles 253 with bleach. The bleach on the web at this stage travels with the web and thus soaks the filaments until they are finally immersed within the bleach bath by a roll 265. During upward travel of the web toward a roll 267, the fluid carried thereon continues the bleaching action until the bleaching solution is expressed by the action of roll 269. A trough 271 collects the bleach so removed and returns the same to the bleach bath through a pipe 272.

After this bleaching zone, the web is immersed, by a roll 273, within the bleach acid bath in the trough 247, from which it is moved over a roll 275. A squeegee roll 277 causes the excess bleach acid to drain into the left side portion 279 of a partitioned trough 281 and be returned by a pipe 283 to the bleach acid bath.

By means of nozzles 285, the web is sprayed with

water supplied from the trough 251 through conduits 287 and 289, and pump 291. A pipe 293 conveys the wash water received in the left side compartment 295 of the trough 281 to trough 251. This portion of the wash serves as a soak wash treatment and the water draining from the web is received in the trough 249 and finally sewered through a pipe 297. A final and countercurrent wash is given the web, as it travels upwardly from a roll 299 to a roll 301, by nozzles 303 supplied with fresh water by a conduit 305. The excess spray of wash water and the water expressed from the filaments by a roll 307 is received in a trough 309 and delivered to the trough 251 by a pipe 311 for reuse.

The final liquid treatment of the web is accomplished by immersing the same, by a roll 313, within the soft finish bath contained within a compartment 315. One or more rolls 317 may cooperate with a roll 319 for removing the excess soft finish solution from the web and the filaments are then sinuously passed about heating drums 321 for final drying still in the web form. A guide roll 323 assists the web in its exit travel from the chamber 13 through an opening 325. Vapors resulting from the liquid and drying operations are expelled from the chamber 13 through an exhaust duct 327.

For design purposes, it is preferred to have the various rolls and drums of the apparatus supported at each end with any suitable means, not shown, being employed for rotating the same at the proper speeds and in the directions as indicated by the arrows in Figures 1a and 1b. Further, it will be understood that the troughs positioned beneath the elevated rolls serve the three-fold purpose of receiving the liquid passing through the web as it is sprayed by the adjacent nozzles, to collect the liquid dripping from the particular roll beneath which it is located, and to collect liquid sprayed in absence of a web. Nozzles are recommended for applying the liquids to the web since the liquid direction can be more easily controlled, a uniform liquid distribution is attained, and any voids in the web, as for example when one of the jets is elevated, in no way disturbs the spraying procedure. The various rolls are preferably formed of porcelain and, if desired doctor blades may be used to prevent the web from traveling around the rolls.

The filaments, once dried, may be collected in various ways. For example, the web may be cut into staple and baled, collected on a beam or beams as two or more small webs or as one large web as it comes from the dryer drums. When cut into staple, the cutting of the web in a dried condition provides a more desirable product as compared to a conventional wet cut staple in view of the clean cut ends.

From the above description, the method of the present invention can be easily followed from start to finish. In practicing the above described method, it is merely necessary to extrude the filament forming material through one of the jets and to secure the partially formed filaments to a tape laced through the apparatus along the desired path. The other jets are then placed in operation and the partially formed filaments extruded therefrom are merely laid upon the web of filaments already laced and are thereby carried through the desired path. It will be noted that the festoon arrangement of treating the web of filaments permits an efficient countercurrent treatment of the web with a minimum of parts. Further, the regeneration, desulfurizing, and bleaching time is inexpensively acquired by virtue of the long vertical heights in the respective zones through which the web travels. It will of course be understood that the process stages described above can be varied for the particular filaments desired without departing from the scope of the invention or in any way effecting the quality of the resulting product.

It is seen from the above description that the objects of the invention are well fulfilled by the method and apparatus described. The description is intended to be illus-

trative only and it is to be understood that changes and variations may be made without departing from the spirit and scope of the invention as defined by the appended claims.

I claim:

1. A method for producing artificial filaments having uniform characteristics including the steps of extruding along side of each other and into a coagulating bath a plurality of individual and substantially parallel streams of filament-forming material to form a continuous flat web of individual partially formed filaments, continuously delivering coagulating medium into the bath adjacent to opposite sides of the web of filaments as it enters the bath, removing the web of filaments from the bath and passing the same through a series of fluid-treating stages, and continuously removing coagulating medium from the bath at opposite sides of the web of filaments as it leaves the bath whereby opposite sides of the web of filaments are equally and uniformly treated with coagulating medium which travels concurrently therewith.
2. A method as defined in claim 1 wherein the series of fluid-treating stages include the steps of passing the web of filaments along a vertical sinuous path, impinging the web of filaments with streams of treating liquids at certain upper portions of its sinuous path to provide concurrent and countercurrent flow of treating liquid along selected reaches of the web of filaments, and immersing the web of filaments within liquid-treating baths at certain lower portions of its sinuous path.
3. A method as defined in claim 2 wherein adjacent reaches of the web of filaments are treated with different treating liquids at certain upper portions of its sinuous path.
4. A method as defined in claim 1 wherein the web of filament is passed through a hot and humid atmosphere during initial portions of the fluid-treating stages and a cool atmosphere during the remainder of the fluid-treating stages, and further including the step of drying the fluid-treated filaments in their web formation.
5. A method as defined in claim 1 wherein the web of filaments is formed of a series of smaller webs of filaments combined into a single flat web of filaments as they enter the coagulating bath, with no spacing between adjacent of said smaller webs of filaments.
6. Apparatus for use in producing artificial filaments having uniform characteristics including a trough for containing a coagulating medium, means disposed along one side of said trough for extruding a plurality of individual filaments in side-by-side relation which together form a flat web of filaments extending across the width of the apparatus, a roller disposed within said trough for guiding the web of filaments along an arcuate path through the coagulating medium contained in said trough, means for delivering coagulating medium at opposite sides of the path of the web of filaments as it enters said trough, means for removing coagulating medium from said trough

at opposite sides of the path of the web of filaments as it leaves said trough, and means for liquid-treating the web of filaments to complete the formation thereof.

7. Apparatus as defined in claim 6 wherein said means for extruding said web of filaments includes a series of individual jets each mounted for independent swinging movement into and out from said trough, said jets being positioned so that the adjacent webs of filaments extruded by said jets partially overlap each other.
8. Apparatus as defined in claim 6 wherein said means for extruding said web of filaments includes a series of individual jets each mounted for independent swinging movement along vertical planes into and out from said trough, said jets each having a rectangular perforated face and being spaced relative to each other so that the webs of filaments extruded by adjacent jets partially overlap each other, the longitudinal axes of said jets extending diagonally relative to said vertical planes of swinging movement whereby each jet may be individually withdrawn from said trough without disturbing the operation of adjacent jets.
9. Apparatus as defined in claim 6 wherein said liquid-treating means includes a series of vertically spaced and horizontally staggered rolls over and about which the web of filaments travels as it moves along a sinuous path, means for impinging streams of treating liquids against the web of filaments as it approaches certain of the elevated rolls of said series of rolls, and means for impinging streams of liquid against the web of filaments as it leaves certain of said elevated rolls.
10. Apparatus as defined in claim 9 further including a series of troughs within which certain of the lower rolls of said series of rolls are disposed, and means for delivering treating liquids to said troughs.

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