

Feb. 12, 1957

R. H. BRAUNLICH
APPARATUS FOR THE PRODUCTION OF
ARTIFICIAL SLUBBED FILAMENTS
Filed June 11, 1952

2,780,833

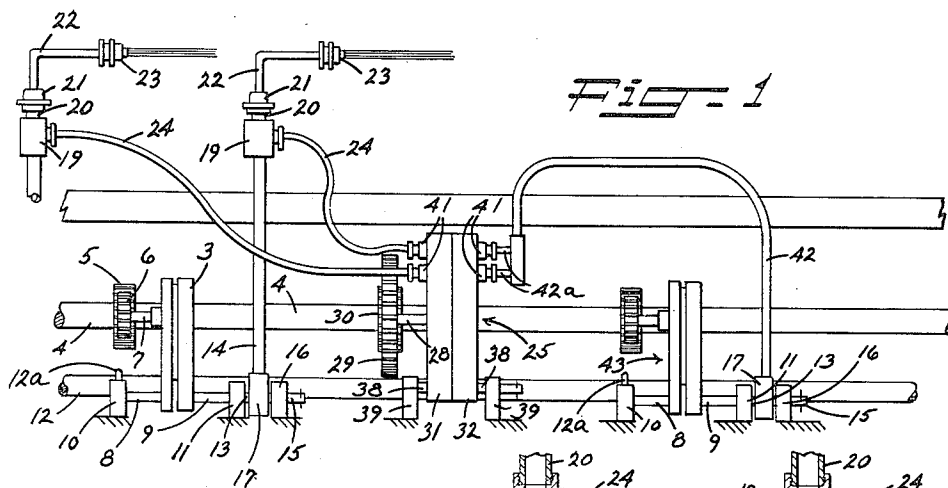


Fig. 1

Fig. 2

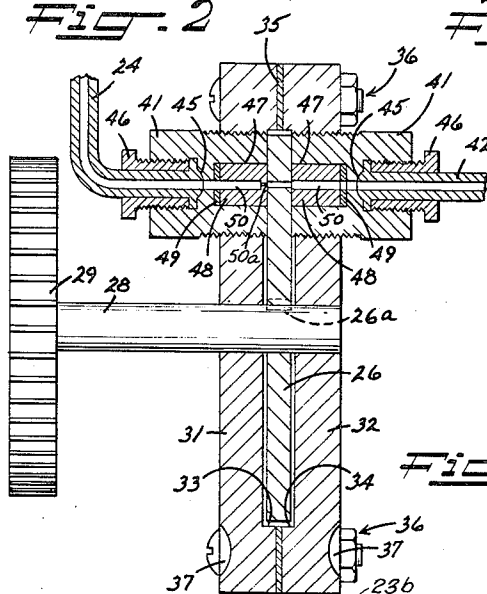


Fig. 1a

Fig. 1b

Fig. 3

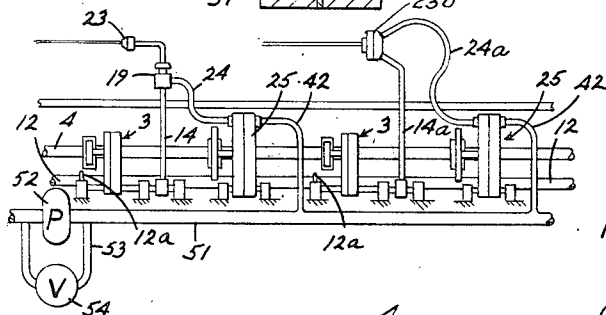
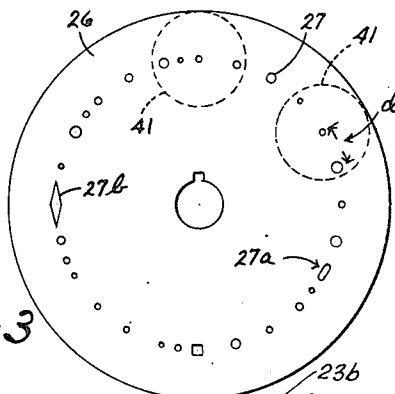


Fig. 4

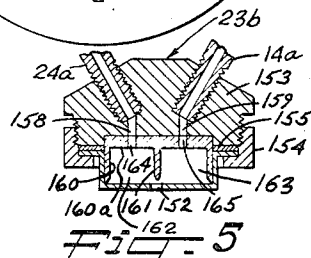


Fig. 5

INVENTOR.
RICHARD H. BRAUNLICH
BY

Carl A. Castellan

ATTORNEY.

1

2,780,833

APPARATUS FOR THE PRODUCTION OF ARTIFICIAL SLUBBED FILAMENTS

Richard H. Braunlich, West Chester, Pa., assignor to American Viscose Corporation, Philadelphia, Pa., a corporation of Delaware

Application June 11, 1952, Serial No. 292,929

10 Claims. (Cl. 18—8)

This invention relates to artificial filaments and methods and apparatus for the production of artificial filaments and particularly to the production of filaments having irregular denier.

The principal object of the present invention is to provide an improved method and form of apparatus adapted to produce filaments having varying denier along their length by the extrusion of the filament-forming material through one or more spinnerets. An ancillary object of the present invention is to provide apparatus for this purpose which is of extremely simple construction having relatively few parts requiring accurate machining and having relatively few moving parts which are liable to get out of order. Other objects and advantages of the invention will be apparent from the drawing and the description thereof hereinafter.

In the drawing, which is illustrative of the invention,

Figure 1 is a plan view of one embodiment,

Figure 2 is a sectional view through the control valve,

Figure 3 is a side view of the valve disc,

Figure 4 is a plan view of a modification, and

Figure 5 is a section through a form of spinneret that may be used in the embodiment of Figure 4.

In general, the invention comprises for each spinning station a primary or base denier pump, which may be the conventional spinning pump and may be associated with the usual supply and discharge connections for the filament-forming material. In addition, supplementary spinning material is injected or introduced into the discharge line of the primary or main pump at some point in advance of or right at the spinneret orifices and the introduction of this supplementary material is controlled by a valve comprising a rotating disc having transverse apertures of various diameters disposed at various distances apart around the circumference of a circular zone of the disc concentric with its axis of rotation.

In the embodiment of Figures 1 to 3, each primary or main pump 3 associated with the individual spinning stations is driven from the main drive shaft 4 which may run lengthwise alongside the spinning machine which may comprise a plurality of vertical spinning cells in which the filament-forming streams, such as of cellulose acetate or vinyl resins, proceeding from spinnerets disposed at the top may be coagulated and set by a heated evaporative medium, such as hot air. Alternatively, the spinning cells may be provided with a cooling medium, such as cold air, when the spinning material is of the type, such as nylon, which can be melt spun. The system may also be employed in wet spinning processes used for producing rayon from viscose, other artificial filaments from protein solutions, such as casein, or any other spinning material in which event, the drive shaft 4 may extend longitudinally alongside a trough or a series of individual containers for the liquid coagulating medium which may be for example, in the case of viscose, a solution of sulfuric acid and sodium sulfate with or without additional salts and materials such as zinc sulfate, magnesium sulfate, glucose, and the like, which coagulating bath may in the

2

case of viscose also serve to regenerate the cellulose from the xanthate.

A gear 5 is mounted on the drive shaft 4 and during spinning a gear 6 fixedly mounted on the pump shaft 7 is in mesh with gear 5 and serves to drive the pump 3 which is preferably of the positive displacement type, such as a conventional gear pump. The pump 3 may be swivelly mounted on the axis of the suction and discharge conduits 8 and 9 respectively so that the gear 6 may be withdrawn from engagement with gear 5 or swung into such engagement, as desired, in conventional fashion. The conduits 8 and 9 communicate with the suction and discharge ports of the pump 3 and also with suitable supply and discharge passages in the stationary brackets 10 and 11 respectively. The supply passage in bracket 10 is connected with a header 12 for the spinning material by a suitable branch conduit 12a. The passage in bracket 11 which communicates with the conduit 9 communicates with a pipe or conduit 13 with respect to which a conduit 14 is swivelly mounted in conventional fashion. An adjustable pin 15 screwed in and extending through the fixed bracket 16 cooperates with the conduit 13 in this swivel action and the passages provided in the elbow-fitting or lug 17 direct the entry of spinning material into the conduit 14. The spinning material is discharged through a T-fitting 19, a nipple 20, coupling 21, a "rounder" pipe 22 and the spinneret 23.

At each spinning station, the supplementary spinning material is introduced into the side connection of the T 19 by means of a secondary supply system comprising a conduit 24 connected to a discharge port of the control valve assembly 25 which (as shown in Figures 2 and 3) has a perforated disc 26 keyed at 26a to a shaft 28 on which there is fixedly secured a gear 29. The gear 29 is adapted to be meshed with a drive gear 30 on the drive shaft 4. The control valve comprises a housing formed of two plates 31 and 32 recessed on their opposed faces at 33 and 34 respectively to provide a hollow interior chamber for the rotating disc 26. A gasket 35 may be interposed between the two plates and the unit held together by suitable bolts and nuts 36. The outer faces of the plates may be provided with recesses 37 to receive the complementarily shaped ends of the fulcrum pins 38 secured in brackets 39. By this arrangement, the control valve may be swung on the axis of pins 38 to disengage the gears 29 and 30 or engage them at will.

The plates 31 and 32 are provided with threaded bores which receive the fittings 41 therein. The spinning material may be supplied to one or a plurality of fittings 41 on one side of the disc in the control valve through individual conduits connecting each fitting 41 separately to individual pumps. An alternative system that may be used when there are a plurality of fittings 41 is that shown in Figure 1 in which a conduit or header 42 and branch conduits 42a are fed by means of a single auxiliary pump 43 which may be mounted for swivel motion and provided with driving gears connecting it to the shaft 4 for operation thereby in a manner similar to the pump 3.

The fittings 41 on the other side of the disc 26 may be one or plural in number. They correspond in number and disposition to the first-mentioned fittings 41 and are preferably spaced apart along the circumference of a common circle through their centers which has the same center as the shaft 28 so that one row of orifices 27 controls the supply and discharge through all of the fittings 41. However, if desired, concentric circular rows of orifices 27 may be provided and the fittings may be radially, or radially as well as angularly, displaced with respect to each other.

The supply and discharge conduits 42 and 24 respectively are firmly secured in the fittings 41 against com-

plementarily shaped seats at 45 therein by means of nuts 46 which are threaded into the bores which receive the conduits. The plugs or fittings 41 are recessed also at 47 for receiving packing elements 48 and 49. Preferably, one or both of these packing elements are of resilient character so as to urge the elements 48 against the face of the disc 26. A preferred construction uses polytetrafluoroethylene for the packing elements 48 and suitable felts for the elements 49. The compressed felts 49 urge the elements 48 against the face of the disc 26 and because of the slippery character of the polytetrafluoroethylene, the disc 26 is readily rotated between the glands 48 without excessive power consumption while successfully sealing off the escape of spinning material into the recesses 33 and 34. This construction is particularly important when a material like viscose is being spun since any viscose escaping into the free space in recesses 33 and 34 would stagnate and harden and thereby provide increased resistance to rotation of the disc 26. Aligned passages 50 are provided through the packings and the fittings 41 to provide direct communication between the supply conduit or conduits 42a and one face of the disc 26 and between the discharge conduit or conduits 24 and the opposite face of the disc 26. The discharge element 48 is desirably provided with a restriction 50a to maintain the required pressure in the conduit.

The disc 26 is provided with an annular row of apertures 27 which as shown may be of various sizes or diameters. The distance *d* between adjacent apertures in the disc may also vary widely as shown. When the fittings 41 are spaced apart radially, two or more concentric rows of apertures 27 would be provided. The various conduits should be rigid and free of air pockets.

In operation, when the driving gears of the pumps 3 and 43 and of the control valve 25 are in mesh, the spinning material supplied by the pump 3 provides the base denier which predetermines the minimum diameter of the filaments and the supplementary spinning material is supplied at intervals when the apertures 27 are successively in registry with a pair of the aligned passages 50, 50 in the control valve. Since all mechanical parts are in continuous motion, the system is characterized by almost complete freedom from vibration. Since the disc 26 is rotated at constant speed, the spacing between thickened sections in the filaments will be proportional to the spacing between adjacent apertures. The diameter of the filaments at the enlarged sections will taper to a maximum proportional to the diameters of the apertures 27. The apertures 27 may be of circular, square, rectangular, elliptical, or any other contour. Some of the apertures may be arcuate slots as shown at 27a.

The ratio between gears 29 and 30 can be widely varied. By rotating the disc 26 more slowly, as by increasing the diameter of the gear 29 relative to gear 30, the pattern unit determined by a single rotation of the disc may readily be made to amount to a distance of 500 to 1000 yards or more along the length of the filaments produced. Besides changing the gear ratio between 29 and 30, the aperture pattern of the disc 26 may be changed, or a larger diameter disc having apertures disposed on a circle or circles of larger radius may be used. The control valve unit 25 may be readily replaced at will to get a different pattern with a unit having the same or different size of gear 29 and/or disc 26 which may have the same or a different pattern. Avoidance of too frequent repetition can also be effected by omitting one or more teeth from the gear 30. Also, a continuously varying speed drive may be provided for the control valve 25. Thus, the individual spinning station or end is extremely versatile. When it is desired to produce a group of packages with offset denier variations, it is easily done by providing control valve units at the several spinning stations in which the discs 26 are operating in out-of-phase relationship. When it is desired to produce tow

which is subsequently to be converted to spun yarns by the "Perlok" stretch-breaking system, the large denier portions of each end in the tow, i. e., in the group of filaments derived from each spinneret, may be staggered with relation to the large denier sections of the other ends by appropriate angular orientation of the several discs, or of the fittings 41 about a common disc, taking into consideration the space between the spinnerets and the rate of travel of the filaments through the spinning system.

Figure 4 shows a modification in which the supplementary spinning material is supplied through a high pressure header 51 into which the material is fed by means of the single pump 52, the pressure in the header 51 being controlled by providing the by-pass pipe 53 and the relief valve 54 which allows return of excess spinning material when the pressure desired in header 51 is exceeded. In this embodiment, the supply conduits 42 connected to the control valves 25 are connected directly to the header 51. The main pumps 3 and the control valves 25 for each spinning station are mounted and driven in the same manner as in the embodiment of Figure 1. This system has the advantage of eliminating the individual pumps 43 required at each spinning station or each small group of such stations supplied by a single valve 25 in Figure 1 to supply the supplementary material to the main pump system associated with each individual spinning station. In this system, also, the separate header 51 may be supplied with a different spinning material than that supplied by the header 12 to the main pumps 3, although both headers 12 and 51 may be supplied with the same material, if desired. When supplying two different materials in this manner, either one of the two may be delustered while the other is of the same filament-forming material but contains no delustrant. Similarly, the two spinning materials may differ only in the lack of a dye by one, or by providing differently colored dyes in the two systems. When spinning viscoses, one of them may be of different age or temperature, or of such different cellulose and/or caustic content that it crimps more highly than the other when the coagulating bath used is of proper character.

In the embodiment of Figure 4, the main filament-forming stream and the stream of the supplementary material may be joined in a T 19 to feed to a spinneret 23 as in the embodiment of Figure 1. This is shown in the left portion of Figure 4. However, the juncture of the two streams of filament-forming materials may be effected right at the point of filament-formation within the spinneret or at the orifices of the spinneret by employing the type of spinneret shown in any of Patents 2,386,173, 2,398,729 or 2,428,046. In this embodiment, each control valve 25 may be connected to several spinnerets as in Figure 1.

Figure 5 shows a cross-section of the simplest form that such a spinneret may take, being the same as Figure 1 in 2,386,173. However, any of the spinnerets shown in the several patents mentioned may be substituted. In this arrangement which is shown at the right in Figure 4, the T 19 is omitted and the main filament-forming stream proceeds to the spinneret assembly 23b through conduit 14a while the supplementary material is supplied through the conduit 24a. As shown in Figure 5, the spinneret has a plurality of holes 152 spaced apart in a row extending diametrically across the face of the spinneret in the line of sight of the observer of Figure 5. The spinneret is attached to a spinning solution supply head 153 by the coupling 154. A gasket 155 is positioned between the flange of the spinneret and the supply head to insure a tight seal. The different spinning solutions are delivered to the spinneret through holes 158 and 159 in the supply head. A cup-like member is positioned in the space between the spinneret and the supply head with its cylindrical side wall 160 in engagement with the side wall of the spinneret and with its disc-like base 160a in engagement

5

6

with the supply head. Passages 164 and 165 are formed in the base 160a of the cup-like member in line with the passages 158 and 159 in the supply head. A septum or rib-like partition member 161 extends diagonally across the space back of the spinneret face and projects from the base 160a of the cup-like member into contact with the back face of the spinneret so that its edge extends transversely of the orifices 2 therein. The edge of the septum in contact with the back face of the spinneret is preferably sharpened or V-shaped and preferably bisects the entrances of the orifices 152. The septum divides the space back of the orifices in the spinneret into two separate regions such as chamber 162 which communicates with the passages 164 and 158 and feed pipe 24a and chamber 163 which communicates with the passages 165 and 159 and the feed pipe 14a. The chamber 162 communicates with one-half of each hole 152 in the spinneret adjacent one side of the septum and the chamber 163 communicates with the other half of each hole 152 adjacent the other side of the septum.

In Figure 1a, a cross-section of T 19 is shown in which the lateral pipe 24 feeds the supplementary material to one side at the juncture of the streams. In Figure 1b, the lateral 24 extends into midstream of the main supply. These two systems are particularly useful when the supplementary material is of different character than the main stream. For example, it may be colored and the other not or the two streams may be of different colors. The distribution of the two materials may thus be predetermined to produce specialty yarns. For example, if the contrasting filaments are placed along one or several sides of the yarn, they form a candy-stripe effect after twisting of the yarn. If located centrally or eccentrically inside the yarn bundle as would result from the distribution of the supplementary material to one or several points within the main stream as in Figure 1b, the filaments may lend an opacity to the yarn while being not visible at the surface of the yarn. If the outer filaments are clear and transparent while the inner group are delustered or dark-colored, the result is an opaque yarn having an external lustrous appearance. The effect varies lengthwise of the yarn depending on the frequency of the apertures in the control valve disc 26. To be certain that the supplementary material is not sucked into the main stream even in the intervals corresponding to the blanks between apertures 27 in the disc 26, it may be necessary to reverse the rotation of the auxiliary pump momentarily during each such interval.

The abruptness of the transition from the base or minimum denier to the enlarged denier occurring at each aperture 27 can be varied by proper selection of the volume of the conduit extending from the auxiliary pump 43 to the juncture of line 24 with the T 19 or with the supply head 153. The smaller this volume for a given yarn denier, the more pronounced the transition.

Tapered filaments of the type disclosed in U. S. Patent 2,370,112 may be obtained by using apertures shaped like 27b (Figure 3) and the out-of-phase or staggered relationship between their maxima and minima (diameters) may be obtained by combining into a single yarn the product of several spinnerets each of which is producing the tapered filaments.

When using any embodiment of the present invention, and especially the system shown at the right of Figure 4 and in Figure 5, any of the different filament-forming materials suggested in the following patents may be used: 2,386,173, 2,398,729, 2,428,046, 2,439,813-5 and 2,440,761. For example, any of the filament-forming materials or solutions including viscoses, proteins, such as caseins and soya bean proteins, cellulose derivatives such as cellulose acetate and ethyl celluloses, and resins such as nylons, the vinyl resins, especially the copolymers of vinyl chloride and vinyl acetate and the vinylidene halides, may be employed. When different cellulose xanthates or viscoses are used, they may differ as to either age, cellu-

lose content, sodium hydroxide content, carbon disulphide content, as to the type of cellulose from which they are made, such as wood pulp or cotton pulp, or as to any two or more of these factors. When other cellulose derivatives, such as the esters or ethers, are used they or their solutions may differ as to viscosity, cellulose content, or as to degree of polymerization or substitution of the cellulose chains therein. When resin solutions are used, the solutions may differ as to kind of resin, viscosity, and the degree of polymerization of the resin. Two spinning materials of different classes may be combined, such as a protein with a viscose, a protein with a cellulose acetate, or a cellulose acetate with a vinyl resin. It is only necessary that the materials in the form employed (fused or in solution) do not mutually precipitate each other and that they adhere together in the final filaments.

The invention, and especially the embodiment shown at the right in Figure 4 (and in Figure 5) lends itself to include processes in which the two spinning materials may comprise the same or different spinning substances, but differ in that one of the two contains incorporated therein, either suspended therein or dispersed therein, such as by true or colloidal solution or by emulsification, at least one substance which is not of itself a filament-forming substance. Alternatively, both spinning materials can contain one or more of such additions in different concentrations. Such additions can be solid, liquid or gaseous, for example, pigments, roughening agents, softening agents, agents for improving the feel, fats, oils, soaps, resins, dyestuffs, fungicides, medicinal substances, phosphorescent substances, and substances which can react chemically with the spinning substance in the solution or during the precipitation. In particular, those additions which are used to modify the properties of the filaments and have hitherto involved unavoidable disadvantages when applied to homogeneous fibers can be restricted to that zone of the filament where they are desired.

When the process is carried out with two spinning solutions which contain different spinning substances in solution, the two spinning substances can be chemically related, as, for example, two different cellulose esters, or a cellulose ester and a cellulose ether, or two different albuminous substances. Two spinning substances may, however, be used which belong to quite different classes of materials, such as cellulose and an albuminous substance, or a cellulose ester of ether and an artificial resin or rubber produced by polymerization.

By using two spinning materials which shrink to a different extent during precipitation, drying or after-treatment, there may be obtained, for example, strongly crimped threads. Also, one or both spinning materials or solutions may consist of or comprise mixtures of two or more filament-forming substances insofar as this is permitted by the compatibility of the particular substances.

The invention may be used for producing a novelty filament in which the thickened portions may be crimped and the thin portions not or vice-versa or both portions may be highly crimped. For example, in producing filaments having thickened portions which are relatively highly crimped and intervening portions having little or no crimp, the system at the right of Figure 4 may be employed and, after production of the filaments by the conversion of the dual-material streams to a plastic condition in the setting medium, they are subjected to an after-stretch while plasticized or not, thereafter relaxed in a plasticized condition and the plasticizer is removed while in relaxed condition to set the crimp therein. The plasticizer employed depends on the materials of which the filaments are composed. Water, whether hot or cold, is adequate for regenerated cellulose. Heat or swelling agents may be employed with thermoplastics such as the cellulose esters and ethers, vinyl resins, nylons, and the like. One particularly advantageous method of producing crimped filaments from thermoplastic components is to use two such components which have different shrink-

age temperatures or which have different shrinkage characteristics at a given temperature. Merely by subjecting the final composite filaments of such character to the given temperature, a differential shrinkage occurs, one component of the filament either not shrinking at all or much less than the other with the result of a substantially permanent crimp therein.

It is to be understood that changes and variations may be made without departing from the spirit and scope of the invention as defined in the appended claims.

I claim:

1. Apparatus for producing artificial filaments comprising first means including a spinneret, second means including a conduit connected to the spinneret, means for supplying primary filament-forming material to the conduit, auxiliary means for adding a secondary quantity of a filament-forming material to said primary filament-forming material comprising a control valve and a conduit connecting the discharge port of the valve to one of said first and second means, said valve comprising a rotatable apertured disc and passages extending from opposite faces of the disc to the inlet and outlet ports respectively of the valve, the apertures in the disc extending through the disc between the opposite faces thereof, and means for rotating the disc to align the apertures with the passages in succession.

2. Apparatus as defined in claim 1 in which a pump and a conduit connecting the pump to the inlet port of the valve are provided to supply the secondary quantity of filament-forming material.

3. Apparatus as defined in claim 1 wherein the supply means for the primary filament-forming material is separate from the supply means for the secondary filament-forming material, thereby preventing intermixture of the two materials until just prior to extrusion.

4. Apparatus of claim 1 wherein the means for rotating the disc comprises a gear mechanism permitting convenient engagement and disengagement of the disc with its driving means.

5. Apparatus of claim 1 wherein the shape and spacing of the apertures on the rotatable disc are varied so as to produce a filament of irregularly varying denier.

6. Apparatus for producing artificial filaments comprising a spinneret, a conduit connected to the spinneret, means for supplying a filament-forming material to the conduit, and auxiliary means for supplying an additional quantity of a filament-forming material to the conduit comprising a control valve and a conduit connecting the discharge port of the valve to the first-named conduit, said valve comprising a rotatable apertured disc and passages extending from opposite faces of the disc to the inlet and outlet ports respectively of the valve, the apertures in the

disc extending through the disc between the opposite faces thereof, and means for rotating the disc to align the apertures with the passages in succession.

7. Apparatus of claim 6 wherein the means for rotating the disc comprises a pinion and gear combination, the gear being mounted coaxially with the disc and normally in mesh with the pinion but adapted for simple disengagement from the pinion, whereby the control valve may be readily shifted into and out of operation.

8. Apparatus for producing artificial filaments comprising a plurality of spinnerets, individual conduits connected to the spinnerets, individual pumps for supplying a filament-forming material to the conduits, a branch conduit connected to each individual conduit, a common control valve having several discharge ports connected to the several branch conduits respectively; said valve comprising inlet port means, a rotatable apertured disc, a plurality of passages extending from one face of the disc to the several discharge ports, a plurality of passages extending from the opposite face of the disc to the inlet port means, and means for rotating the disc.

9. Apparatus as defined in claim 8 in which the several discharge ports are spaced angularly from one another about the axis of the disc.

10. Apparatus for producing artificial filaments having varying denier along their length comprising a spinneret, a first and second conduit connected directly to the supply head of the spinneret, a source of supply of filament-forming material to the first conduit, means for supplying a continuous stream of said filament-forming material to the first conduit, a separate source of supply of filament-forming material for the second conduit and a rotary disc valve controlling the flow of filament-forming material through the second conduit from its source of supply, said valve comprising inlet port means, a rotatable apertured disc, a plurality of passages extending from one face of the disc to the several discharge ports, a plurality of passages extending from the opposite face of the disc to the inlet port means, and means for rotating the disc.

References Cited in the file of this patent

UNITED STATES PATENTS

2,142,597	Allen	Jan. 3, 1939
2,219,504	Willis	Oct. 24, 1940
2,386,173	Kulp et al.	Oct. 2, 1945
2,476,293	Hall et al.	July 19, 1949
2,571,457	Ladisch	Oct. 16, 1951
2,584,226	Pool	Feb. 5, 1952

FOREIGN PATENTS

176,323	Switzerland	July 1, 1935
---------	-------------	--------------