April 23, 1940. J. W. ALLQUIST ET AL 2,198,448

CONTINUOUS FILAMENT FORMATION

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Fig. 1.

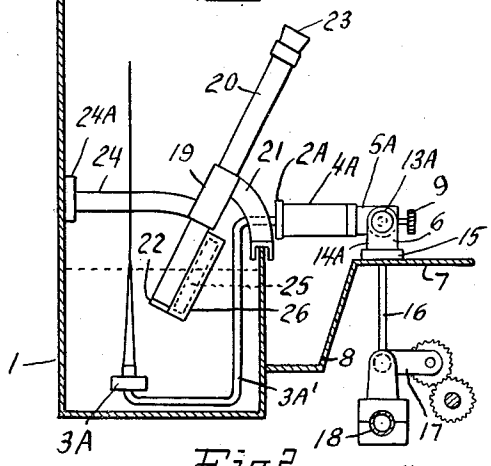


Fig. 3.

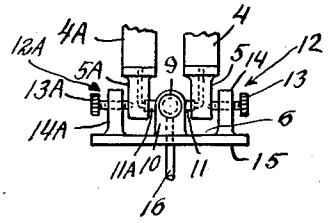


Fig. 8.

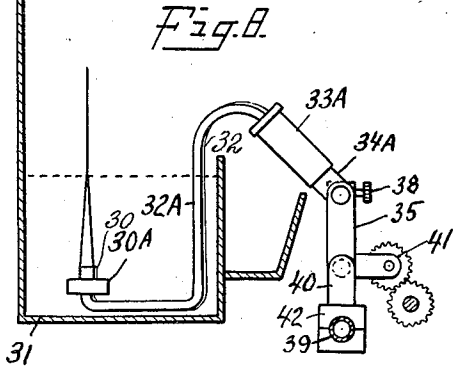


Fig. 2.

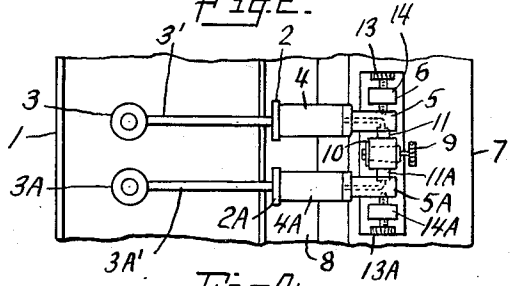


Fig. 4.

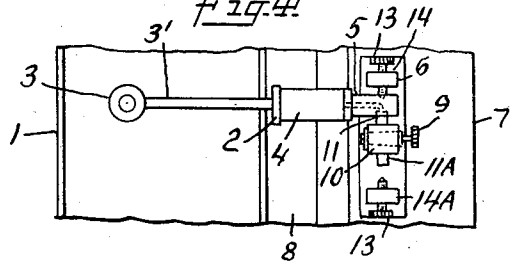


Fig. 9.

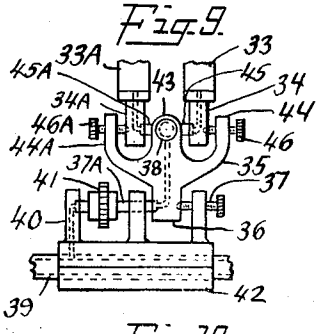


Fig. 5.

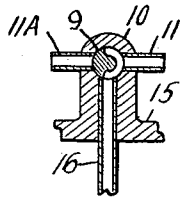


Fig. 6.

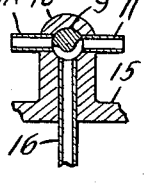


Fig. 7.

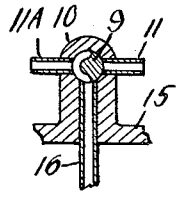
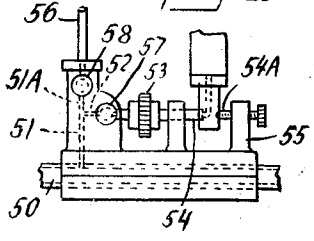


Fig. 10.



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Fig. 11.

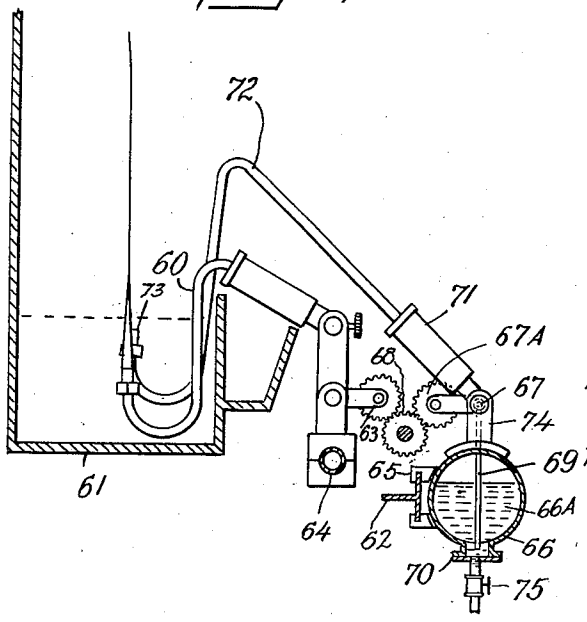
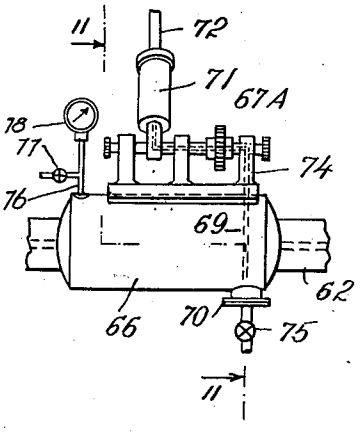


Fig. 12.



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UNITED STATES PATENT OFFICE

2,198,448

CONTINUOUS FILAMENT FORMATION

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Application March 18, 1937, Serial No. 131,598

8 Claims. (Cl. 18—8)

This invention relates to spinning of artificial silk and the like and is concerned with operations in which a viscous liquid is extruded through a small orifice in a spinnerette and immediately thereafter solidified to form a filament. The invention contemplates improvements whereby spinnerettes may be withdrawn from service temporarily for cleaning, testing, repairs, exchange, etc., without interrupting the formation of a continuous filament and therefore without interruption to spinning or to the subsequent operations to which the spun filaments are subjected. The invention may be employed to especially great advantage in processes of "continu" spinning, in which a strand of filaments is formed and subjected to all the customary treating operations to put it in marketable condition without interruption of the continuity of the strand.

In several of the known processes for making artificial silk a cellulosic spinning solution is forced through orifices in a spinnerette into a setting or solidifying medium, which in the case of dry spinning is an evaporative atmosphere and in wet spinning is a coagulating bath, and is thereby solidified to form one or more filaments. The freshly formed filaments are withdrawn continuously from the zone in which solidification occurs and passed to other operations such as, for example, stretching, washing, desulphurizing, bleaching, drying, lubrication and twisting before the product is completed.

Conventional apparatus employed in the above-mentioned wet spinning operation comprises an open tank to contain the coagulating bath, means for supporting the spinnerette below the surface of the bath, a conduit for supplying spinning solution to the spinnerette, a metering pump adapted to keep the solution flowing through the conduit at a predetermined and preferably uniform rate, and means for continuousiy withdrawing the freshly formed filaments from the bath. Preferably the conduit to which the spinnerette is affixed is removably mounted so that the spinnerette can be withdrawn from the bath. Thus in one common type of apparatus the spinnerette in spinning position discharges the solution upwardly into the bath, and the conduit to which it is affixed is in the form of an S or a gooseneck which is bent through about 180° at its lower end and extends upwardly to a point above the top of the tank. There it is attached to a candle filter which is mounted swivelly in a hollow arm bracket such that its long axis is perpendicular to the horizontal upper edge of the tank. The spinning solution is forced into the candle filter by the metering pump from a feed line disposed outside of the tank and flows through the hollow arm of the bracket and the candle filter into the gooseneck and thence through the spinnerette. Usually, the inlet end of the candle filter fits into a conical seat cut into the side of one of the hollow bracket arms and is made tight by compressing the candle filter inlet against said seat, but not so tight that the candle filter cannot be moved pivotally. When the spinnerette is to be withdrawn the candle filter and gooseneck assembly are tilted to raise the spinnerette up out of the tank.

When the artificial silk industry was in its infancy it was customary to make relatively coarse filaments, and a considerable lack of uniformity in filament size was tolerated. In consequence, orifices in spinnerettes were relatively large and clogging of the orifices and maintenance of constant flow rate through the spinnerettes did not present serious problems. It usually sufficed to clean the spinnerettes or to exchange them for cleaned ones during the weekend general shutdown which was then customary, and it was not necessary, except occasionally, to exchange the spinnerettes at other times.

In more recent years, however, spinnerettes have required more care and attention. Several changed conditions have combined to bring this about. There has been a demand for finer filaments with consequent smaller orifices in spinnerettes and an increase in the tendency for orifices to become clogged. It has become customary to introduce finely divided solid substances, such as pigments, into spinning solutions. Oversize particles or agglomerates of fine particles tend to lodge either in the spinnerette or in the candle filter which precedes it in the spinning assembly. It has become necessary to pay more attention to the rate at which solution is discharged from the spinnerette in order to insure greater uniformity in filament size.

Moreover, the weekly general shutdown which formerly afforded an opportunity to withdraw spinnerettes from service for testing, inspection, cleaning, exchange, etc., is no longer customary. Apparatus in the several operations of artificial silk manufacture has been so far improved that a general shutdown of the entire plant for an overhauling at fixed intervals is no longer required in commercial practice.

As a result of all these changed conditions, it has become customary to withdraw each spinnerette from its bath at fixed periodic intervals (ranging from a few hours to several days, depending upon the standard of excellence established for the particular artificial silk being made) and to inspect the condition of the orifices in the spinnerette by rubbing away the liquids with the thumb or with a dry soft piece of cloth, paper, or the like. Thus at relatively frequent intervals each spinning operation is interrupted. The interruptions represent a waste of material in the form of spinning solution and also of time consumed in threading the freshly coagulated

filaments through the various godets, guides, rollers, and other guiding, tensioning and conveying mechanisms which are associated with the spinning apparatus. This train of guiding, tensioning, and conveying mechanisms provided for handling the fresh filaments is complicated. Each time that spinning is interrupted and begun again, the filament ends must be threaded through the whole train, so that the time lost is considerable.

"Continu" spinning is conducted in such a way that as a continuous filament is formed by extrusion and solidification of a spinning solution, a portion of the same continuous filament which has been formed earlier is being stretched, while other portions of the same continuous filament which have been formed still earlier are being subjected successively to other finishing operations such as washing, desulphurizing, bleaching, drying and twisting. In principle, "continu" spinning presents many outstanding advantages, among them reduction in labor and increased efficiency of equipment, and there is a tendency at present to adapt "continu" spinning on a large scale. There is, however, a very serious obstacle to such adoption. Freshly spun filaments are extremely delicate and tend to break easily. A broken strand of filaments in a process of "continu" spinning is disastrous, usually necessitating an interruption of the entire train of processes and a laborious and costly operation of starting up again.

From the foregoing it will be clear that improvements are needed whereby spinning interruptions and the resulting difficulties may be avoided. Moreover, it is highly desirable that the improvements be of such character as not to necessitate the replacement or extensive alteration of present spinning equipment, which represents a large investment. As a result of our investigations we have developed improvements which substantially eliminate spinning interruptions with inexpensive changes to present spinning equipment and in a reliable manner.

In most artificial silk spinning operations, serious difficulties which bring about interruption may be anticipated for the most part by observing the surface conditions of the spinnerette and the character of the extruded material as it leaves the spinnerette. We have found that in wet spinning operations the observation preferably is made through a tube equipped with magnifying means, with one end submerged in the bath and its eye piece outside the coagulating bath. The space in the bath immediately adjacent the spinnerette should be illuminated either with a beam of light entering the tank from outside or by means of a submerged light. When such means are provided, it is relatively easy to anticipate difficulties that may cause spinning interruptions. It is seldom that the orifices in a spinnerette become clogged all at once or that other changes in spinning conditions occur suddently. Usually there is a gradual change in the size of one or more of the filaments at the point of their formation or some other manifestation which serves as an indication of incipient spining trouble. With a magnifying and illuminating unit (preferably portable), it is relatively easy to observe the surface condition of the spinnerette and of the filaments at the point of their formation at frequent intervals and thus determine when a spinnerette needs to be exchanged (instead of exchanging all of the spinnerettes at fixed intervals whether or not such exchange is necessary). This has the effect of reducing considerably the frequency of spinnerette replacement.

Freshly spun filaments attach themselves to each other if brought into contact with each other. The greater the length of filaments in contact with each other the firmer is the bond between them. The bonding together of the filaments may be due to the fact that they become entangled or entwined with each other, or to the fact that the filaments are still plastic and stick or cohere to each other, or to both of these causes. In any event, the bonding which results permits the filaments from one of a pair of neighboring parallel spinnerettes to be guided over and attached to the filaments issuing from the other spinnerette. Upon this fact depends that feature of our invention whereby spinnerettes may be withdrawn from the coagulating bath without spinning interruptions. The stream of spinning solution forced through one of a pair of parallel spinnerettes placed close together in a bath is continued while a stream of spinning solution is started through the second spinnerette. The stream from the second spinnerette forms loose-ended filaments which are guided over until they are in contact with the filaments issuing from the first spinnerette. Preferably the contact between the filaments is lengthwise and for a considerable distance and is made while the filaments are still plastic. (A firm bond between the filaments from the two spinnerettes results, however, due to the entangling action alone). The spinning solution is eventually cut off completely from the first spinnerette so that the spinnerette may be withdrawn from the bath, and the spinning of the filaments is taken up and continued on the second spinnerette. In this way there is no interruption of spinning to require re-threading, when a spinnerette is withdrawn from the bath for inspection, testing, exchange, etc.

These and other features of our invention will be more completely understood in the light of the following detailed description taken in conjunction with the following drawings, in which

Fig. 1 is a diagrammatic side elevation (partly in section) of a spinning assembly arranged for the practice of our invention;

Fig. 2 is a plan of the apparatus of Fig. 1 from which the observing device has been omitted;

Fig. 3 is a partial end elevation of the apparatus of Fig. 1;

Fig. 4 is a plan of the apparatus of Fig. 1 as it would normally appear during routine spinning;

Figs. 5, 6 and 7 are diagrams illustrating the valve settings at various times during the operation of the apparatus of Figs. 1, 2, 3 and 4;

Fig. 8 is a side sectional elevation of another type of spinning assembly arranged for the practice of our invention;

Fig. 9 is a partial end elevation of the spinning assembly of Fig. 8; and

Fig. 10 is a partial end elevation of still another modification of a spinning apparatus for the practice of our invention.

Figs. 11 and 12 illustrate a further modification of the apparatus of our invention.

The detailed description of our invention is made with particular reference to a wet spinning process in which the spinning solution is extruded into a coagulating bath. It will be understood, however, that the invention is also applicable to dry spinning processes.

Referring now to Figs. 1, 2, 3 and 4, it will be

seen that the apparatus comprises a spin bath trough or tank 1, which may be of any of the conventional forms and is adapted to retain the coagulating bath, and a pair of spinning assemblies 2, 2A, for extruding spinning solution into the bath through a pair of spinnerettes 3, 3A, of conventional construction. Each spinnerette is disposed in the bottom of the tank with its orifices pointing upward and is attached to the end of a conventional gooseneck 3', 3A', which is an S shaped conduit extending upwardly and out over the edge of the tank. At its upper end the gooseneck of each equipment is attached respectively to horizontally disposed candle filters 4, 4A, of well known form. The farther ends of each candle filter respectively communicate with and are attached to the ends of short conduits 5, 5A, which are closed at their other ends. These short conduits are removably and rotatably mounted in a manifold 6.

The manifold is mounted on a horizontal shelf 7 which is an extension of a drip trough 8 fastened along the side of the tank. The shelf is disposed at about the level of the top of the tank.

The manifold comprises a centrally disposed horizontal two-way plug cock 9 mounted in a block 10 in which are drilled horizontal outwardly extending passages at right angles to the axis of the plug cock. These passages open respectively into short pipes 11, 11A, mounted in or formed integrally with either side of the block. Facing each of these pipes and spaced from them along their axis are disposed a pair of clamps 12, 12A. These clamps are adapted to hold the conduits 5, 5A, respectively, against the ends of the pipes 11, 11A. The side of each conduit adjacent the respective pipe has a seat drilled partially through it to receive the pipe and a smaller hole drilled completely through the center of the seat. The other side of each conduit has a seat drilled partially through it to receive the end of tightening screws 13, 13A, of the respective clamps. The foregoing construction provides tilting means whereby the spinnerettes may be tilted from their normal operating position in the spinning bath to an inoperative position above the spinning bath. The clamps each have upright blocks, 14, 14A, through which the screws are threaded on a line with the pipes 11, 11A, projecting from the central block 10. The blocks 10, 14, 14A, are fastened rigidly to or formed integrally with a base plate 15 of the manifold, which in turn is mounted on the shelf 7.

In addition to the horizontal openings into the pipes 11, 11A, the block 10 has a downward extending channel which connects the plug cock to a riser pipe 16 that in turn communicates with a spin pump 17 or metering device of any convenient known type. The spin pump is connected to a spinning solution supply pipe 18, which may serve several spinning assemblies disposed on a single tank. The solution in the supply pipe is maintained under pressure by a means not shown.

When a spinnerette is submerged but slightly in a spinning bath, as is sometimes the case with horizontally disposed spinnerettes, it is relatively easy to observe with the naked eye the character of filaments at their point of formation and thereby observe indications by which it is possible to anticipate spinning interruptions. When, however, the spinnerette is submerged deeply (as in the case illustrated in Figs. 1, 2, 3 and 4) lack of clarity in the bath or ripples on its surface may preclude accurate observation with the naked eye. In such case an observing instrument 19 should be provided. This comprises a liquid tight and corrosion proof tube 20 mounted on a clip 21 which is adapted to fit over the wall of the tank and hold the tube with its axis pointing at the spinnerette outlet which is to be observed. The tube is equipped with magnifying means, preferably in the form of a lens 22 at its lower end and an eyepiece 23 at its upper end. If the instrument is to be portable, (and this is preferable) it is convenient to provide a brace 24 which will rest its padded outer end 24A on or against the farther side of the tank and thus increase the rigidity of the instrument when it is in position for making observations. A means for illuminating the outlet of the spinnerette is also required in most instances. Preferably this is a flashlight 25 in a liquid tight barrel 26 mounted along the tube so that it will throw a beam of light on the points to be observed.

To understand the operation of the apparatus illustrated in Figs. 1, 2, 3 and 4, reference should also be made to the valve positions illustrated in Figs. 5, 6 and 7.

It will be assumed that at first the filaments are being formed at spinnerette 3, in which case the plug cock 9 is in the position illustrated in Fig. 5. Spinning solution is being pumped through the riser and through the plug cock in the horizontal passage to the right, and thence through the short pipe 11, the conduit 5, the filter 4, the gooseneck and finally the spinnerette 3. The outlet in the block 10 leading to the other spinning assembly is closed.

Let it be assumed further that changes in the character of the freshly spun filaments such as lead one to suspect incipient difficulties have been observed. It is desired to withdraw spinnerette 3 from service, but without an interruption of spinning. This being the case, the companion spinning assembly 2A is clamped into spinning position in the manifold by means of the screw 13A of the clamp 12A, and the plug cock 9 is turned clockwise to the position shown in Fig. 6, so that the riser delivers a small amount of spinning solution to the second spinning assembly 2A. Fine filaments are thus formed at spinnerette 3A, and these are guided over manually (preferably with a rod dipped into the bath) until they come in contact with the filaments being formed by the spinnerette 3. The filaments from 3A attach themselves to those from 3 and filaments from both points are pulled out of the bath together by appropriate godets, etc., (not shown).

The plug cock is then turned slowly clockwise so that the amount of spinning solution supplied to spinnerette 3 gradually decreases to zero while the amount to the spinnerette 3A increases to the full stream. There results a gradual termination of filament formation at one spinnerette and a gradual assumption of the job of filament formation at the other. Eventually the plug cock is turned clockwise to the position shown in Fig. 7, and the filament formation continues at spinnerette 3A, while the spinning assembly 2 is shut off from a supply of spinning solution and may be withdrawn from the bath by loosening the clamp 12 and tilting the assembly backward. Accordingly, the plug cock or closing means is adapted to distribute progressively the flow of spinning solution to the spinning assemblies from complete and exclusive flow through one spinning assembly to complete and exclusive flow through the other spinning assembly. If desired, the entire spinning assembly may be removed from the manifold, as shown in Fig. 3. If at a later time it is

desired to replace the spinnerette assembly 2A, the procedure described hereinbefore is merely reversed. By gradually decreasing the flow through one spinnerette and increasing it through the other at a compensatory rate, the bundle of filaments from both spinnerettes becomes no greater in cross section than the bundle extruded from the first spinnerette during normal operation. This avoids the production of knots or bumps in the continuous bundle of filaments and is of advantage when it is not desired later to separate the products of the two spinnerettes.

In order to assure precise manipulation of the two-way cock, it is desirable to place stops and a finely graduated scale on the outside of the block 10.

Passing now to a consideration of Figs. 8 and 9, it will be seen that these figures illustrate a modified form of spinning mechanism adapted to promote uninterrupted spinning but which depends upon the principles discussed hereinbefore.

The principal difference between the modified assembly and that shown in Figs. 1, 2, 3 and 4, resides in the fact that the manifold is connected to the solution supply conduit at a lower point and by a rotatable joint. Changes in the shape of the goosenecks, of the position in which the candle filters rest, and in the shape of the manifold are brought about for this reason.

In the apparatus of Figs. 8 and 9, a pair of spinnerettes 30, 30A is disposed in the lower portion of a tank 31 as in the case previously considered, and are connected to a manifold by goosenecks 32, 32A, candle filters 33, 33A, and short conduits 34, 34A, corresponding respectively to the parts of the same names that are illustrated in Figs. 1, 2, 3 and 4. The goosenecks, however, are bent acutely at their upper ends and the candle filters slope downwardly from the edge of the tank to a fork-shaped manifold 35 at a lower position.

The manifold comprises a base 36 which is rotatably mounted on pivots 37, 37A. The pivot 37A is hollow and communicates with a right angled passage in the manifold which leads to the two-way plug cock 38. Spinning solution is delivered to the plug cock from a feed line 39 through a riser pipe 40, a spin pump 41, and the hollow pivot 37A. A suitable support 42 for feed line, riser, spin pump, and pivots is provided.

The rest of the manifold is similar to that shown in Figs. 1, 2 and 3. It comprises a center block 43 and a pair of end blocks 44, 44A, all mounted on the base or formed integrally therewith. The center block has an aperture to receive the plug cock and two horizontal channels at right angles to the plug cocks which lead into a pair of short pipes 45, 45A. The end blocks have horizontal threaded apertures in them to accommodate a pair of clamp screws 46, 46A. These clamp screws serve to hold the short conduits 34, 34A, of the two spinning assemblies against the respective short pipes of the manifold.

The operation of the apparatus illustrated in in Figs. 8 and 9 is similar to the operation of the apparatus of Figs. 1, 2 and 3. Spinning may be discontinued at one spinnerette and continued at the other without interruption.

The arrangement of feed line, spin pump, riser, pivots and support shown in Figs. 8 and 9 is a conventional one. In the heretofore customary practice, however, the short conduit of a single spinning assembly has been mounted between the two pivots. The advantage of the fork-shaped manifold illustrated in Figs. 8 and 9 resides in the fact that it permits the two spinning assemblies to be fed from the same spin pump with the results described hereinbefore but without altering any other portions of a conventional set-up.

All of the apparatus hereinbefore described operates on the principle of decreasing the flow at one spinnerette as the flow at a companion spinnerette is increased. However, in spinning filaments of a very fine denier it may be desirable to commence spinning at one spinnerette at the same rate which is progressing at the spinnerette which it is about to replace. The products of the two spinnerettes cohere in the bath and form a length of yarn which is greater in diameter than the regular product and may be detected by knot-catchers or similar devices placed in the train of yarn handling mechanisms which follow the spinning apparatus. The formation of this oversize length of yarn during the change-over period introduces a factor of safety against interruption of spinning due to breakage of the freshly formed filaments, and for this reason is desirable. It offers another advantage in that it permits the identification of yarn spun by any spinnerette.

The apparatus hereinbefore described is such that the whole assembly of the spinnerette, candle filter, gooseneck, or parts thereof, between the manifold and the point of discharge may be exchanged without interruption of spinning.

However, there may come an occasion when the spin pump also must be removed from service for cleaning or adjustment and a fresh one installed. Fig. 10 shows an arrangement whereby the pump or any other piece of equipment beyond it up to and including the spinnerette may be removed without interrupting the continuous formation of thread. This may be done by forming an interim product by means of an auxiliary spin set, comprising a spinnerette, gooseneck and accessories (including a candle filter if desired) attached to outlet 56 in Fig. 10.

Referring now to Fig. 10 it will be seen that a feed line 50 for spinning solution is connected to a riser 51 which in turn is connected through a horizontal conduit 52 to the intake of a spin pump 53. The spin pump has an outlet leading through a hollow pivot 54 into the short conduit of a spinning assembly of conventional form, i. e., including candle filter, gooseneck and spinnerette. A second pivot 54A is provided for clamping the end of the spinning assembly in place. Spin pump, pivots, etc., are supported in a conventional bracket 55. Up to this point the entire apparatus is conventional.

However, the riser 51 has a vertical extension 51A upon it. The upper end of the extension is threaded or otherwise adapted to make a tight joint with relatively long conduit 56 to the other end of which is attached a spinning assembly (not shown) that includes a spinnerette to be placed adjacent to the regular spinnerette in a coagulating bath.

Simple valves 57, 58 are disposed respectively in the riser extension 51A and the horizontal conduit 52 respectively so that either may be closed.

In normal operation the valve 58 is closed, the valve 57 is open and the auxiliary spinning assembly is not attached to the riser extension. Spinning progresses with the regular spinning assembly. If, however, difficulties are encountered with the spin pump or the regular spin-

ning assembly, the auxiliary spin set is placed in the bath with its spinnerette adjacent to and preferably parallel with the regular spin set. The valve 58 is then opened, and under the pressure maintained upon the feed line 50, spinning solution flows through the auxiliary spin set while the regular spin set continues to extrude full sized filaments. The ends of the freshly spun filaments from the auxiliary spinning assembly are guided over in the bath until they come in contact with and adhere to the filaments from the regular spinning assembly. After a sufficient length of the filaments have been joined together, the valve 57 is closed and spinning continues on the auxiliary assembly while the spin pump or the regular spinning assembly or parts thereof are exchanged. Valve 57 remains open when the spinning assembly is tilted back for checking and testing of spinnerette or spin pump delivery.

When the exchanges on the regular equipment have been completed, the valve 57 is opened again. The new ends of filaments from the regular spinning set are caused to come in contact with and adhere to the filaments issuing from the auxiliary assembly. Shortly thereafter the valve 58 is closed, and the auxiliary spin set detached and removed.

The apparatus illustrated in Fig. 10 is capable of producing an oversize filament (interim product) during the change-over period from the regular spinnerette to the auxiliary spinnerette or vice versa. Such oversize filament is produced by maintaining a full flow on the regular spinnerette through the spin pump 53 for a short time after the auxiliary spinnerette comes into operation and the filaments from both spinnerettes are joined. When changing from the auxiliary spinnerette back to the regular spinnerette a full flow is established on the regular spinnerette by completely opening the valve 57 and, after an appropriate interval, cutting off the full flow through the valve 58. The beginning and end of the interim product is then identifiable by the oversize portions, which may be caught with a knot or slub catcher.

If necessary, the flow through the auxiliary spinnerette may be such that the entire interim product is oversize, which permits the slub catcher infallibly to detect and break off the interim product.

The maintenance of a full flow at the regular spinnerette during change-over is of advantage when filaments of fine denier are spun in that the interim product is not so fine and delicate as to bring about accidental breakage during change-over, with consequent interruption.

It is often of advantage to produce an interim product of different color as well as different size, thus facilitating its identification. The apparatus shown in Figs. 11 and 12 is adapted to accomplish this result, although it may be employed conveniently when it is not desired to produce an interim product of different size or color.

Referring now to Figs. 11 and 12 it will be seen that along a battery of regular spin sets 60 operating in a single spin bath 61 there is mounted a horizontal slide rail 62. There may be a hundred or more such regular spin sets, each provided with a spin pump 63 and all fed from a solution main 64. The slide rail preferably is T shaped with the base of the T pointing toward the regular spin set and with the longitudinal axis of the rail lying parallel to the main. On the rail, by means of a clip 65, is mounted a horizontally disposed cylindrical tank 66 for an auxiliary supply 66A of spinning solution. The tank may be slid along the rail from spin set to spin set, or removed completely from the rail and carried to any desired position.

An auxiliary spin pump 67 is mounted on the top of the tank and provided with a gear 67A which can be dropped into mesh on driving gear 68 of the regular spin pump. Spinning solution is moved out of the tank 66 by means of a pipe 69 fastened to the inlet of the spin pump and extending into a well 70 in the bottom of the tank. On the outlet of the auxiliary spin pump is fastened an auxiliary spinning assembly comprising a candle filter 71, an extra long goose-neck 72 and a spinnerette 73.

Preferably the auxiliary spinning assembly and the auxiliary spin pump are mounted pivotally on a swivel bracket 74 (constructed along the lines of the brackets described in connection with Figs. 3, 9 and 10) fastened to the top of the tank so that the spinning assembly can be tilted up out of the spin bath and the gear of the auxiliary spin pump can be swung up out of contact with the driving gear 68.

The tank is provided with a valved inlet 75 for spinning solution, in which may be included a distinguishing dye. The inlet may be at any convenient point and, for example, may communicate with the tank through the well 70.

The tank has a gas inlet at a point near its top. The gas inlet is provided with a valve 77 and a pressure gauge 78.

The operation of the apparatus of Figs. 11 and 12 is simple. The tank 66 is filled with an appropriate spinning solution, such as one containing a distinguishing dye, and the apparatus is transported to a convenient position on the rail adjacent a regular spinnerette which is to be taken out of service. Compressed air is forced into the tank so that the somewhat viscous spinning solution tends to flow up the pipe 69 to the auxiliary spin pump. Air may be admitted either intermittently or continuously, but because of the viscous character of the spinning solution, the use of air pressure to force solution up to the auxiliary spin pump is strongly advised.

The gear 67A on the auxiliary spin pump is then swung down into engagement with the driving gear 68, so that solution is pumped to the spinnerette from the tank. The auxiliary spinnerette is then swung down into the spin bath at a point adjacent the spinnerette which is to be taken out of service. The resulting filaments are guided over with a rod or the like until they attach themselves to the filaments issuing from the regular spinnerette, and when a sufficient length of filament has attached, the formation of filaments at the regular spinnerette is interrupted, for example, by closing a valve (not shown) between the solution main 64 and the regular spin pump 63, or by withdrawing the regular spinnerette from the bath trough and swinging pump 64 out of engagement with driving gear 68. Repairs to or replacement of the regular spin pump or the regular spinning assembly may then be made. Thereafter, with the regular spinning assembly in good order and back in spinning position, formation of filaments at the regular spinnerette is resumed; these filaments are guided so as to attach themselves to the interim product; a firm bond is permitted to form, and then the flow of solution to the auxil-

iary spinnerette is interrupted by tilting it out of the bath trough and disengaging the gears 67A and 68. The apparatus may then be moved to another regular spinnerette and the process repeated.

As shown in Figs. 11 and 12 the auxiliary spin pump and the auxiliary gooseneck are pivotally mounted in the bracket, solution being supplied to the spin pump and from the spin pump to the end of the auxiliary spinning assembly through hollow axles. If desired, the auxiliary spin pump may be omitted, in which case solution is fed from the riser pipe 69 through a hollow axle of the bracket directly into the auxiliary spinning assembly. In such case it is convenient to provide a valve at some point between the pipe 69 and the auxiliary spinnerette so that the flow of solution from the tank 66 can be controlled.

By eliminating the auxiliary spin pump, the apparatus is considerably simplified. However, such elimination makes it difficult to control and maintain uniform the delivery of spin solution through the auxiliary assembly and the resulting character of the extruded interim product. We prefer, therefore, the use of an auxiliary metering pump in connection with the auxiliary spinning assembly.

We claim:

1. In a process involving the formation of filaments by extruding a cellulosic spinning solution through a first spinnerette into a zone in which solidification occurs and the continuous withdrawal of the filaments thus formed from said zone, the improvement which comprises disposing a second spinnerette in said zone adjacent to the first spinnerette, extruding spinning solution from the second spinnerette into the zone to form loose-ended filaments while continuing to extrude spinning solution from the first spinnerette, bringing the loose-ended filaments into contact within the zone with the filaments from the first spinnerette that are being continuously withdrawn from the zone and maintaining a length of filaments from both spinnerettes in contact with each other sufficient to permit them to attach to each other, withdrawing the filaments which have attached to each other substantially continuously from the zone, and interrupting the flow of solution to the first spinnerette while continuing to extrude solution from the second spinnerette and withdrawing the resulting filaments from the second spinnerette continuously from the zone, whereby the first spinnerette may be withdrawn from service without interrupting the continuous formation of filaments.

2. Process according to claim 1 in which the flow of spinning solution from the first spinnerette is gradually decreased while the flow of spinning solution from the second spinnerette is gradually increased at a substantially compensatory rate, and the resulting filaments from the two spinnerettes are brought into contact with each other so as to attach to each other within the zone, thereby forming a bundle of filaments of substantially the denier of the bundle which was being formed on the first spinnerette before the flow of spinning solution therethrough was decreased.

3. Process according to claim 1 in which the rate at which the total solution is extruded from both spinnerettes during the period when the filaments from both spinnerettes are being brought into contact with each other is greater than the rate at which the spinning between solution was extruded through the first spinnerette alone, whereby a bundle of filaments having denier greater than normal is formed.

4. Process according to claim 1 in which the spinning solution extruded from the second spinnerette is of such character as to form filaments of different appearance than those formed at the first spinnerette, whereby identification of the filaments produced at the respective spinnerettes is facilitated.

5. In an apparatus comprising a container for a coagulant, a first spinnerette disposed within the container, a conduit communicating with the first spinnerette, and means for forcing a spinning solution successively through the conduit and the spinnerette into the coagulant, the improvement which comprises a second spinnerette disposed in the container adjacent the first spinnerette, a pipe connecting the second spinnerette to the conduit, and closing means adapted to distribute progressively the flow of spinning solution through the conduit and the pipe from complete and exclusive flow through the conduit to complete and exclusive flow through the pipe.

6. In an apparatus comprising a container for a coagulant, a first spinnerette disposed within the container, a conduit connecting with the first spinnerette and means for forcing a spinning solution successively through the conduit and the spinnerette into the coagulant, the improvement which comprises a second spinnerette disposed in the container adjacent the first spinnerette, a pipe connecting the second spinnerette to the conduit, and a two-way stop cock disposed at the junction of the pipe and the conduit.

7. In an apparatus comprising a container for a coagulant, a first spinnerette disposed within the container, a conduit connecting with the first spinnerette, and means for forcing a spinning solution successively through the conduit and the spinnerette into the coagulant, the improvement which comprises a second spinnerette disposable in the container adjacent the first spinnerette, a pipe connecting the second spinnerette to the conduit, a two-way stop cock disposed at the junction of the pipe and the conduit, and tilting means disposed in the pipe connecting the second spinnerette to the conduit so that the second spinnerette can be tilted out of the container.

8. In an apparatus comprising a container for a coagulant, a first spinnerette disposed within the container, a conduit connecting with the first spinnerette, and means for forcing a spinning solution successively through the conduit and the spinnerette into the coagulant, the improvement which comprises a second spinnerette disposable in the container adjacent the first spinnerette, a pipe connecting the second spinnerette to a tilting means, a second pipe connecting the tilting means to the conduit, a two-way stop cock disposed at the junction of the second pipe and the conduit in the tilting means, and clamping means for holding the first pipe in the tilting means.

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