Nov. 21, 1939. L. S. FRYER 2,181,052

APPARATUS FOR THE MANUFACTURE OF ARTIFICIAL FILAMENTS

Filed July 18, 1935 3 Sheets-Sheet 1

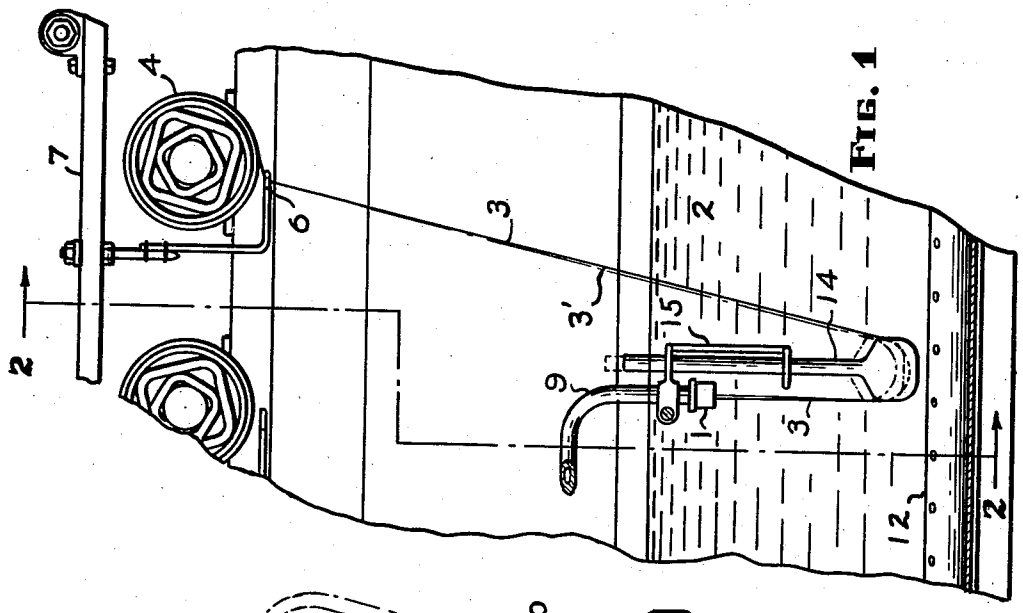


FIG. 1

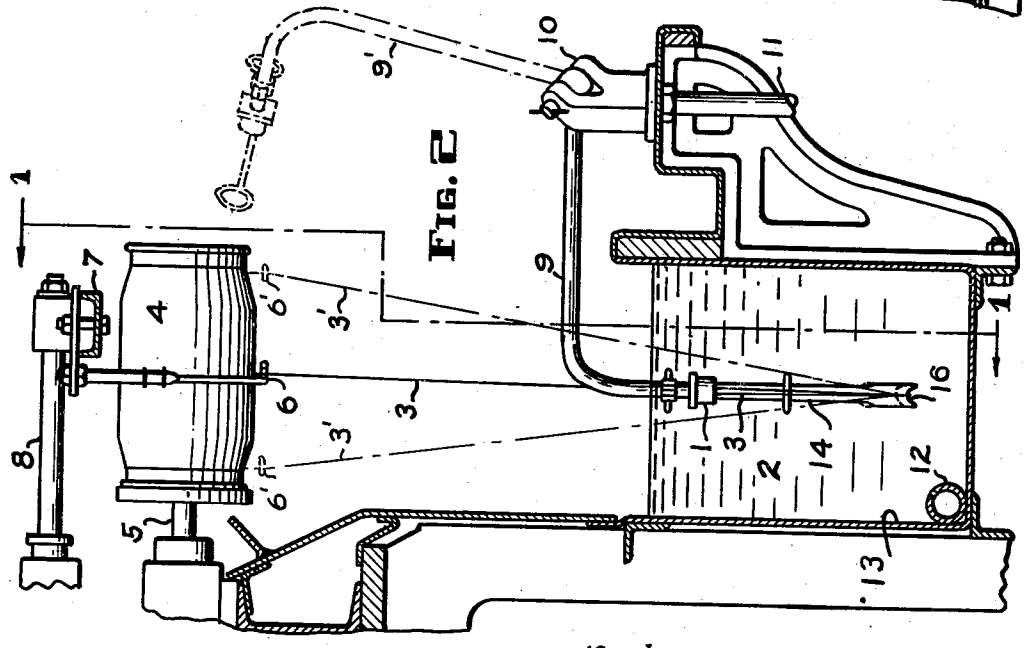


FIG. 2

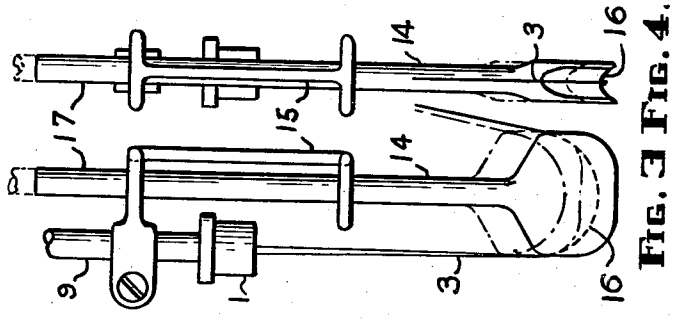


FIG. 3 FIG. 4.

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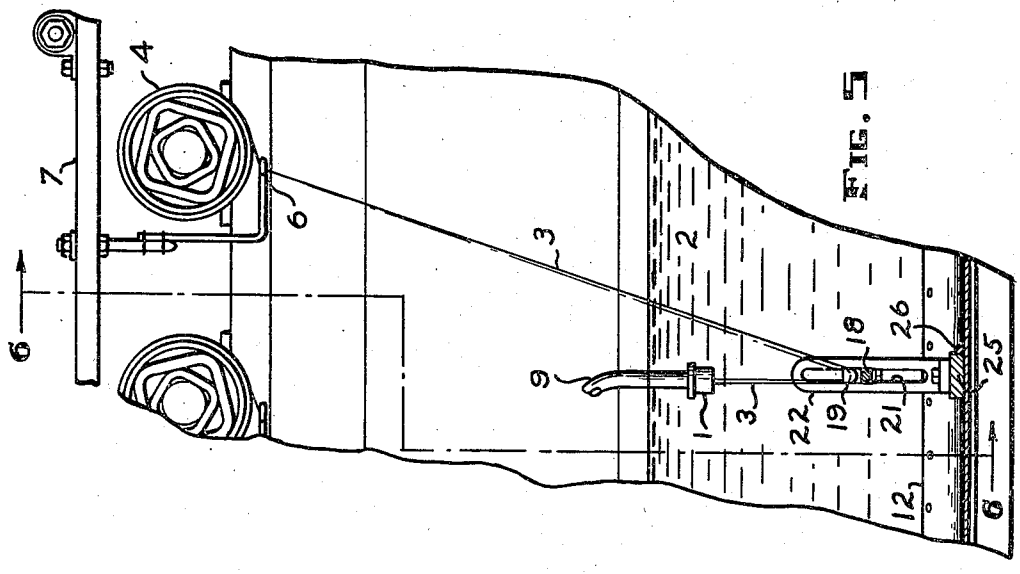


FIG. 5

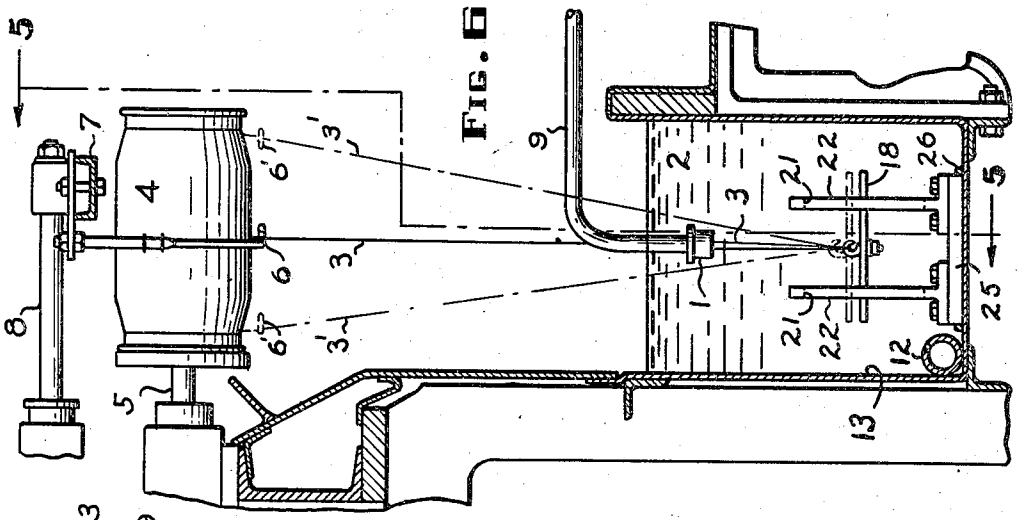


FIG. 6

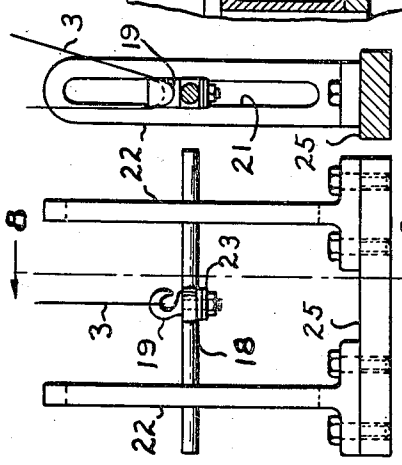


FIG. 7

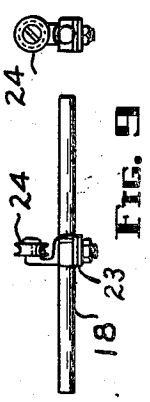


FIG. 9

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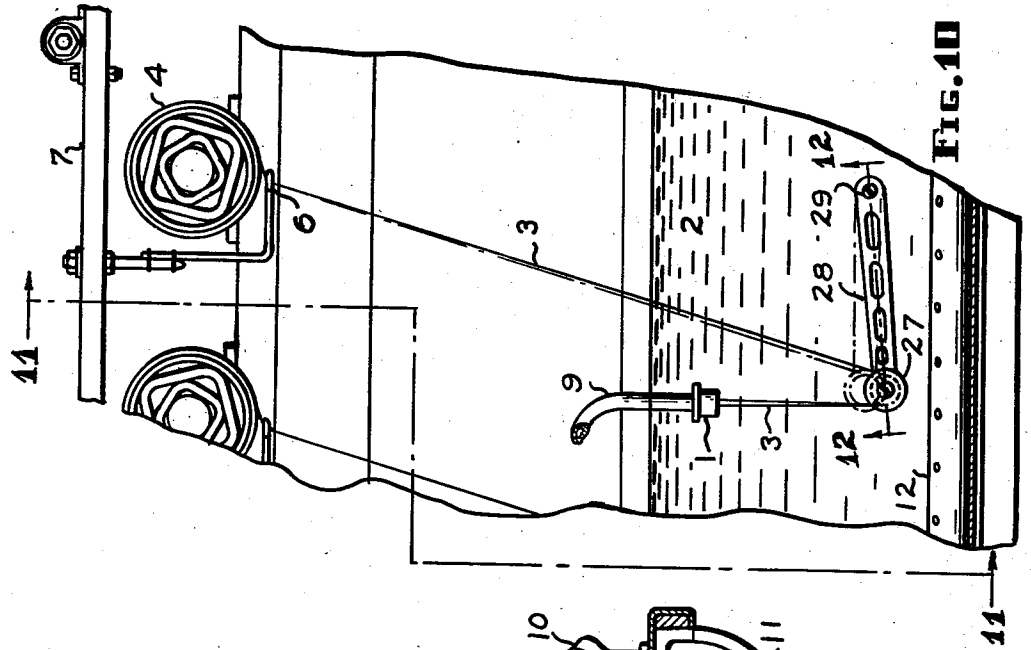


FIG. 10

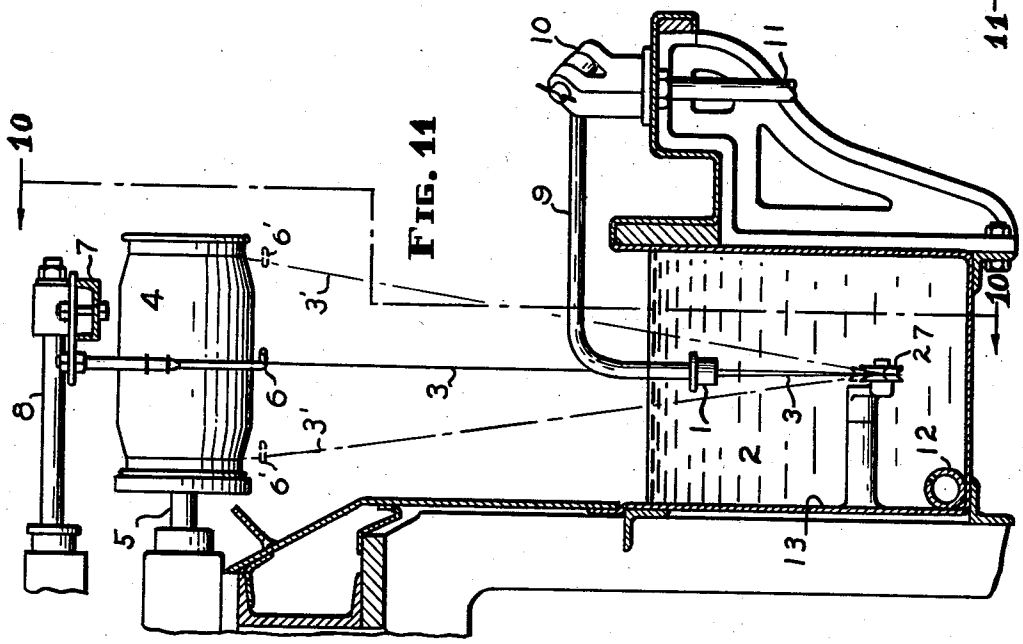


FIG. 11

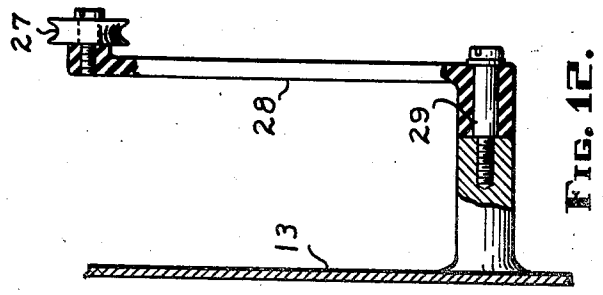


FIG. 12

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UNITED STATES PATENT OFFICE

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APPARATUS FOR THE MANUFACTURE OF ARTIFICIAL FILAMENTS

Louis S. Fryer, Cleveland, Ohio, assignor to Industrial Rayon Corporation, Cleveland, Ohio, a corporation of Delaware

Application July 18, 1935, Serial No. 32,059

4 Claims. (Cl. 18—8)

This invention relates to the manufacture of artificial filaments, threads, ribbons, or the like, and more particularly to methods of an apparatus for eliminating tension variations in said filaments, threads, or ribbons during the process of their manufacture. The invention in its broader aspects is applicable to any system of manufacture of artificial filaments or threads or similar articles, regardless of their nature; but is especially useful in connection with processes employing coagulating baths, as, for example, the production of rubber threads from natural or artificial latices, the fabrication of ribbons, artificial straw, artificial horsehair, etc., from solutions of cellulose derivatives, and the manufacturing of rayon.

For convenience, the invention will be described as employed in the manufacture of multiple filament threads of rayon.

In present processes of manufacturing rayon, the filaments are extruded from a spinneret and, after passing through suitable fixing means, such as a coagulating bath, are collected on some form of collecting device. In the spool spinning process, this collecting device consists of a rotating bobbin on which the filaments are wound. To spread the filaments evenly on the bobbin, a traverse guide reciprocating longitudinally of the bobbin is commonly used, but sometimes the bobbin is reciprocated longitudinally of the guide, the guide remaining stationary. In the former method, the path of the filaments between the spinneret and reciprocating guide is least when the guide is midway of its stroke and increases as the guide moves toward the extremities of its stroke, being greatest at the ends of the stroke. Inasmuch as the delivery of the pumps remains substantially constant, this tends to introduce irregularities into the product.

Also, in both methods the filaments are often wound with a considerable helix to provide an open-work winding for the purposes of washing, desulphurizing, etc. The filament turns are then at an appreciable angle to the axis of the bobbin over the greater part of the reel, but at the ends at least a portion of a turn is at right angles to the axis; wherefore less material is wound per revolution on the ends of the bobbin than is wound on other portions thereof. Thus the filaments tend to be drawn faster from the spinneret when it is being wound on the central portions of the bobbin than when it is being wound on the ends.

It is also common practice to distribute the windings on the bobbins so that one or both of the ends of the full bobbin are conical, introducing another difference between the amounts wound per revolution on the central portion of the bobbin and the amounts wound at the ends.

Since the spinneret from which the filaments are extruded supplies spinning solution at a substantially constant rate while for certain or all of the above reasons the speed at which the filaments are being wound varies from time to time, objectionable variations in tension in the filaments occur. The filaments are not completely set up or regenerated either while in the coagulating bath or immediately after leaving it and therefore these tension variations between the spinneret and bobbin result in variations in denier. These denier variations are especially objectionable when the filaments are twisted into threads and woven into fabrics. They result, among other things, in a lack of levelness in dyeing, in barre effects, and other irregularities.

It is an object of this invention to eliminate these tension variations and the attendant defects in the filaments by providing devices which will maintain the tension substantially constant during spinning. It is a further object of this invention to make these devices simple in operation and self-acting. Further objects of the invention will in part be obvious and will in part appear more fully hereinafter. With these objects in view, the invention may be explained with the aid of the drawings, in which:

Figure 1 is an elevation, partly in section, along line 1—1 of Figure 2 of a conventional spool-spinning apparatus equipped with one embodiment of the invention;

Figure 2 is another sectional elevation of the same, taken substantially on the line 2—2 of Figure 1;

Figure 3 is an enlarged side view of the above invention;

Figure 4 is an enlarged end elevation of the same device;

Figure 5 is an elevation, partly in section, along line 5—5 of Figure 6 of a conventional spool-spinning apparatus equipped with another embodiment of the invention;

Figure 6 is a sectional elevation of the same apparatus taken on the line 6—6 of Figure 5;

Figure 7 is an enlarged side elevation of the tension-equalizing device of Figure 5;

Figure 8 is an elevation along line 8—8 of Figure 7;

Figure 9 is a modification of a part of this same device;

Figure 10 shows a third embodiment of the in-

vention as applied to a similar conventional spool-spinning apparatus, this sectional elevation being taken on the line 10—10 of Figure 11;

Figure 11 is a sectional elevation of the same along line 11—11 of Figure 10, and

Figure 12 is an enlarged detail, partly in section, of the device of Figures 10 and 11 taken substantially on the line 12—12 of Figure 10.

In the drawings, in which like reference characters refer to like parts throughout, the spinneret 1 is disposed in the coagulating bath 2, in which are formed filaments 3. Filaments 3 are collected by the rotating bobbin 4, mounted on the shaft 5 which is rotated by suitable means (not shown), and are guided on the bobbin by a traverse guide 6. Traverse guide 6 is movable longitudinally of and parallel to the axis of the bobbin by the traverse bar 7, which is actuated by some means as the rod 8. The mass tube 9 is adapted to be lifted out of the bath when not in use and is pivoted at its outer end at the swivel joint 10 through which the spinning solution is supplied from the pipe 11 connected to suitable pumps (not shown). Perforated tube 12 at the bottom of the trough 13 supplies fresh bath liquor. In machines of this type, there is a plurality of units, each consisting of a spinneret with its winding bobbin and auxiliary apparatus, extending the whole length of the machine. Only one such unit is shown in the drawings.

In Figures 1 and 2 one embodiment of the invention is shown as applied to a machine of this type. It consists of a member 14 positioned immediately adjacent to the spinneret and freely supported on the filaments and guided by some means as a guide 15 to move in a vertical direction. The shape of member 14, which is shown enlarged in Figures 3 and 4, may be modified in various ways, but that illustrated in the drawings is considered preferable. The lower portion may be enlarged and rounded and formed with a groove 16 to aid in keeping the member 14 positioned on the filaments 3. The weight of member 14 should be such that, when supported as shown, it produces a slight initial tension in the filaments 3. In preferred construction, member 14 is made light enough to float in the bath liquor if it were not weighted at the lower end. With this weighted construction, since the upper portion 17 of member 14 is lighter than the bath liquor, the member 14 remains upright and does not bear appreciably on the guide 15.

If desired, the member 14 may be made hollow and the upper stem 17 made long enough to project above the surface of the bath liquor even at the lowermost position of the member 14. The top of the stem 17 in this case can be open, and the weight of the member 14, and consequently the tension in the filaments, adjusted as desired by dropping in or removing from member 14 weight material, such as lead shot. Obviously, member 14 need not be weighted at the lower end, but may be made of construction light enough so that it is of only slightly greater density than the bath liquor. Any suitable material, such as Celluloid, cellulose acetate, Bakelite, hard rubber, glass or metal resistant to the action of the chemicals in the bath, may be used, though Celluloid is preferable. Likewise a rotatable roller may be substituted for the groove portion 16 at the lower end of the member 14 without departing from the spirit of this invention.

Guide 15 is made of some such form as shown of chemical resistant material, such as nickel, stainless steel or the like, and may be fastened directly to the mass tube 9 in the manner indicated. With this construction, when the tube 9 is swung back out of the trough 13, to some position 9' as shown by the dotted lines in Figure 2, the guide 15 goes with it and is thus out of the way when it is desired to clean the trough, etc. Likewise this construction makes it a simple matter to insert the member 14 into the guide 15, as well as insuring that the guide 15 will always be in correct relationship with regard to the spinneret. Of course it is possible to support the guide 15 in other ways, as from the trough walls or floor.

In the operation of this device, when the speed at which the thread is collected as it is wound on the bobbin varies, as for any one of the above mentioned reasons, change in the length of the filaments between the spinneret and traverse guide is permitted by vertical movement of the member 14. This action can be illustrated in connection with Figures 1 and 2 where the effect of the change in this length caused by the longitudinal movement of the traverse guide 6 is illustrated. As can be seen when the traverse guide 6 is at either of its extreme positions 6', the filaments take some such position as 3'. If there were no compensating means as provided for by this invention, the length of the filaments at the end positions of the traverse guide between the guide 6 and spinneret 1 would, because of the angularity, be greater than that for the mid-position, resulting in increased tension and stretch in the filaments. This would result in a consequent decrease in denier of the filaments. Likewise, when the guide 6 is at its mid-position, less free length of the filaments would be required and thus less tension and a consequent increase in denier would result. Thus, from the movement of the traverse guide, as from the other factors explained above, variation in tension and denier results in ordinary spool spinning practice. With this device, a certain predetermined amount of initial tension, which may be very slight, is set up by that part of the weight of the member 14 which is not buoyed up by the liquid. As the length of filaments between the bobbin and spinneret changes as the filaments are being wound for any of the above reasons, the member 14 moves up or down accordingly as the length decreases or increases, and the original tension is unchanged. Thus no variation in denier can result.

In Figures 5 and 6 another embodiment of the invention is shown applied to a similar filament spinning apparatus. The tension equalizing apparatus in this case, shown to better advantage in Figures 7 and 8, consists of a rod-like member 18 supported by the filaments 3 by means of a guide 19, which is fastened to member 18. Rod 18 is guided by the slots 21 in the parallel members 22. The operation is similar to that of the previous device; i. e., as the length of filaments 3 between the spinneret 1 and bobbin 4 varies for any of the previously mentioned reasons, the resulting stretching effect and tension variation is eliminated by the movement of the rod 18 in the guide slots 21. Thus the tension in the filaments is constant and denier variations cannot result.

The device can be made of any material resistant to the action of the chemicals in the bath liquors; Bakelite, hard rubber, Celluloid, cellulose acetate, and stainless steel are examples. The weight of the parts suspended from the thread; i. e., the rod 18 and the guide 19, must not be

so great as to cause excessive tension in the filaments 3. This weight can be adjusted, if desired, in the construction shown by some such means as by the addition or removal of suitable washers 23 from the rod member 18. The rod 18 can also be provided with a rotatable roller 24, as shown in Figure 9, instead of a grooved guide 19, if so desired. The slotted members 22 can be mounted in the trough in any manner desired, but it is preferable that they be fastened to a base of metal such as 25, the weight of which serves to firmly position the apparatus in the bath. Ridges 26 may be provided by welding or otherwise on the bottom of the bath trough to locate the base 25 when it is placed in the bath. With this construction, the apparatus can easily be removed for cleaning of the trough, etc., and easily and accurately positioned when replaced.

The third form of the invention is shown applied to similar spool spinning apparatus in Figures 10, 11 and 12. In this case it consists of a roller 27, preferably grooved as shown, rotatably mounted on an arm 28 which is pivoted about a pin 29. The weight of the roller and part of the weight of the arm 28 is supported on the filaments 3. When the length of filaments between the spinneret and filament-collecting means varies for any reason, the arm 28 swings about the pivot 29 and thus allows the roller 27 to adapt itself by movement to the change in length. Thus a substantially constant tension is maintained in the filaments and denier variations resulting from tension variations are eliminated.

This apparatus, as the others, can be made of some material resistant to the action of the bath chemicals. The weight of the arm 28 and roller 27 should not be great enough to cause undue tension of the filaments 3, and, if desired, any one of various methods of adjusting said weight can be provided. For instance, means for adding to or removing weight from the arm 28 may be incorporated in the design. A guide or grooved portion might also be substituted for the roller 27, if desired. The pivoted pin 29 and corresponding end of the arm 28 may also be positioned so that they are above the level of the bath liquor, while the roller or guide 26 is submerged, if this method of mounting is desired.

Certain advantages reside in the location of the tension equalizing devices in the bath. Of these, the chief is that a longer bath travel for the filaments is obtained and thus more time is secured for the action of the bath liquor in setting up or regenerating the filaments with the corresponding improvement in physical properties of the filament. Another is that a certain portion of the weight of the equalizing device is supported by the bath liquor, and thus the parts supported on the filaments need not be of such light construction as would otherwise be necessary. A third advantage lies in the fact that the devices when located in the bath allow a longer free length of filament between the bobbin and the tension equalizer guide or roller and thus any effects of the angular position of the tension on the filaments are minimized.

It is apparent that this invention is equally applicable to other types of apparatus for manufacturing rayon, as, for example, pot-spinning apparatus. It can be applied advantageously to any of the various processes of manufacturing rayon, as, for example, the viscose, cuprammonium, cellulose nitrate, and cellulose acetate processes. It is clear that numerous modifications can be made without departing from the spirit of the invention. It is intended that the patent shall cover, by suitable expression in the appended claims, whatever features of patentable novelty reside in the invention.

What is claimed is:

1. Apparatus for manufacturing thread or the like comprising a coagulating bath; thread-forming means disposed in said coagulating bath; thread-receiving means disposed in proximity to said coagulating bath; a freely movable thread guide which is heavier than the liquid of which the coagulating bath is composed immersed in said coagulating bath in close proximity to said thread-forming means in a position to bear against and form a bend in the thread or the like; and means confining movement of said thread guide to a fixed substantially vertical path to cause it to maintain a substantially constant tension on the thread or the like by gravitational force.

2. Apparatus for manufacturing thread or the like comprising a coagulating bath; thread-forming means disposed in said coagulating bath; thread-receiving means disposed in proximity to said coagulating bath; a freely movable thread guide which is heavier than the liquid of which the coagulating bath is composed immersed in said coagulating bath in close proximity to said thread-forming means in a position to introduce a bend into the thread or the like, the weight of said thread guide, taking into account the buoyancy of the liquid of which the coagulating bath being composed, is supported by the thread or the like; and means confining movement of said thread guide to a fixed vertical path to cause it to maintain a substantially constant tension on the thread or the like by gravitational force.

3. Apparatus for manufacturing thread or the like comprising a coagulating bath; thread-forming means disposed in said coagulating bath; thread-receiving means disposed in proximity to said coagulating bath; a freely movable thread guide which is heavier than the liquid of which the coagulating bath is composed immersed in said coagulating bath in close proximity to said thread-forming means, said thread guide being at least partly supported by the thread or the like between said thread-forming means and said thread-receiving means; and means confining movement of said thread guide to a fixed substantially vertical path to cause it to maintain a substantially constant tension on the thread or the like by gravitational force.

4. Apparatus of the character described in claim 3 in which the thread guide comprises an elongated member having at one end thereof a portion adapted to contact with the thread or the like in a manner permitting the thread guide to rest thereon in a substantially vertical position.

LOUIS S. FRYER.

CERTIFICATE OF CORRECTION.

Patent No. 2,181,052. November 21, 1939.

LOUIS S. FRYER.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 3, second column, line 41, claim 2, for the words "being composed, is" read is composed, being; line 43, same claim, before "vertical" insert substantially; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 2nd day of January, A. D. 1940.

(Seal)

Henry Van Arsdale,
Acting Commissioner of Patents.