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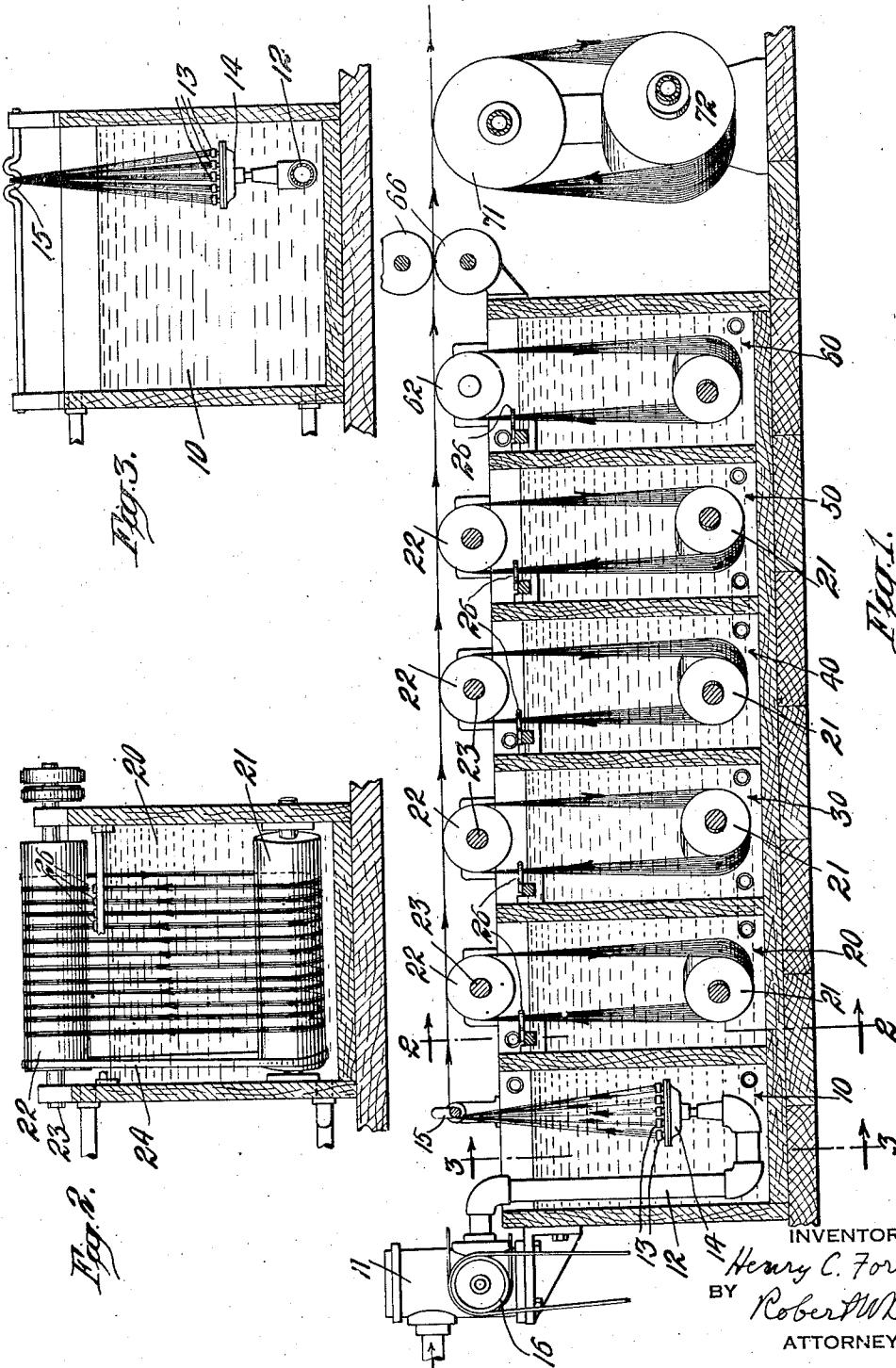
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2,108,285

METHOD AND APPARATUS FOR MAKING AND TREATING ARTIFICIAL FIBERS

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2 Sheets-Sheet 1



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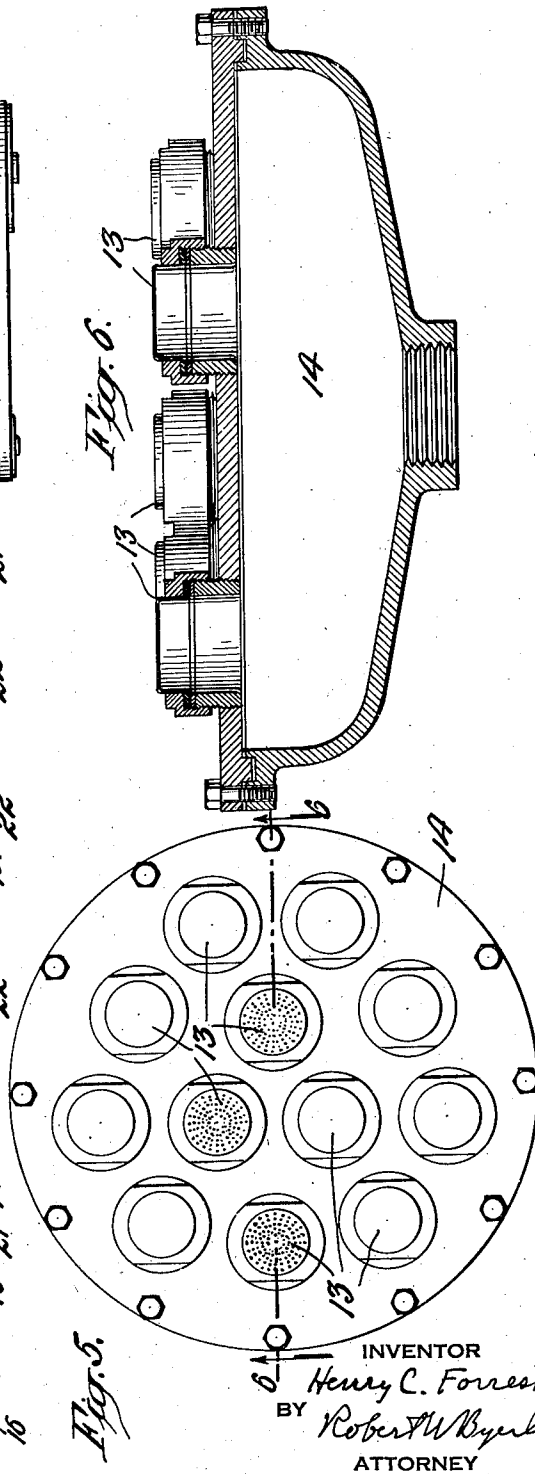
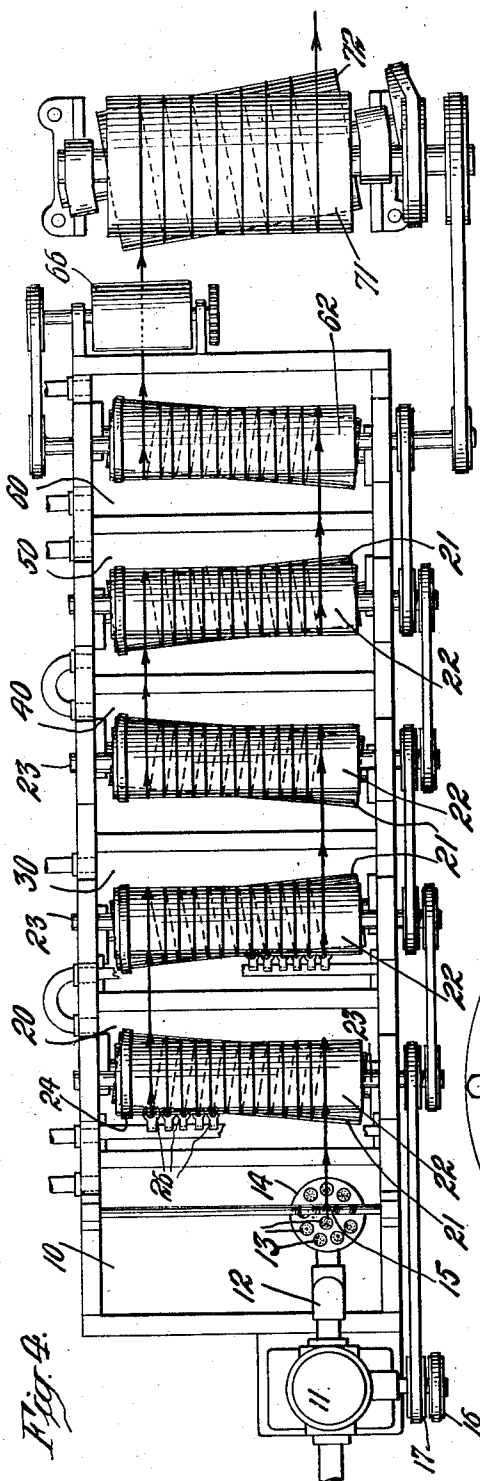
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UNITED STATES PATENT OFFICE

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METHOD AND APPARATUS FOR MAKING
AND TREATING ARTIFICIAL FIBERS

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8 Claims. (Cl. 18—8)

This invention relates to method and apparatus for making and treating artificial fiber, and aims to provide a continuous process for this purpose and a compact apparatus for carrying out the process.

The manufacture of artificial fiber, such as rayon fiber, is practiced by a number of different processes, all of which involve successive treatments of the fiber in a number of different liquids after the fiber has been formed by the extrusion from a spinneret. In commercial manufacture, these treatments have heretofore been effected by twisting the fiber into thread, forming the thread into skeins, and then immersing separate skeins successively into tanks containing the various treating liquids.

My invention effects a great saving in the manufacture of such fiber by providing for passing a continuous, constantly moved fiber into and out of each of a series of separate tanks, so that each portion of the fiber is successively immersed in the various treating liquids while the fiber is in a continuous form.

An important feature of the invention consists in forming a continuous traveling fiber into a series of continuously winding and unwinding coils, each of which is located partially in a separate tank. By this means, each portion of the fiber is repeatedly immersed in the liquid in each tank and repeatedly withdrawn therefrom as it travels around the coil which the fiber forms in that tank.

A further feature of the invention consists in bringing together the fibers extruded from a number of separate spinnerets into a single, continuous, untwisted rope or band which is passed through each of a series of separate tanks. The lack of twist in the rope of fibers and the spreading out of the rope into a flat band subjects each fiber to the effect of the liquids much more quickly and effectively than is the case with fibers which have been twisted together to form thread.

By forming a continuous and continuously moved untwisted rope of fibers into a series of constantly winding and unwinding coils located in separate tanks, I provide for the treatment of a large quantity of fiber in a small space.

The apparatus which I have invented for carrying out this method includes a series of tanks and a pair of rollers in each tank which are arranged to form the rope of fibers into continuously winding and unwinding coils in each tank, and to guide the winding-off end of the coil in each tank into the winding-on end of the coil in the next tank.

In order that my invention may clearly be understood, I will describe it in detail in connection with the specific embodiment of the apparatus features of the invention which is shown in the accompanying drawings in which:

Fig. 1 is a side elevation of the apparatus with the right-hand wall of the tanks removed and the driving belts omitted;

Fig. 2 is a transverse section of the apparatus taken on the line of 2—2 of Fig. 1;

Fig. 3 is a transverse section on the line 3—3 of Fig. 1;

Fig. 4 is a top view of the apparatus; and

Figs. 5 and 6 are enlarged views of the spinneret manifold, Fig. 5 being a face view, and Fig. 6 a diametrical section.

For the sake of illustration, I will describe the invention in connection with the cupro-ammonium process, although it will be understood that the main features of the invention are independent of the particular chemical treatment to which the cellulose is subjected before and after extrusion into fiber.

The apparatus illustrated includes a series of tanks 10, 20, 30, 40, 50 and 60. The first tank 10 contains the precipitating bath, while the other tanks contain the various treating baths. For practicing the cupro-ammonium process, the tank 10 contains a caustic soda solution, the tanks 20 and 30 contain acid, the tanks 40 and 50 contain wash water, and the tank 60 contains the soap solution.

Copper ammonia cellulose solution from a source not shown is forced by a gear pump 11 through a pipe 12 extending into the tank 10, and extruded through a large number of spinnerets 13 mounted in a manifold 14 attached to the end of the pipe 12 and directed upwardly. The spinnerets 13 lie in a common plane and are spaced apart, so that the liquid in the tank 10 has free access to the group of filaments extruded from each of them. The spinnerets may be of the usual form, each being adapted to extrude a multiplicity of (for example 500) filaments. In the form shown, the manifold contains 12 spinnerets, so that 6,000 filaments may be extruded simultaneously in the tank 10. The filaments are gathered together into a single bunch or rope of several thousand denier and passed over an open eye 15 above the tank 10.

The tank 20 is provided with a pair of rollers. The lower roller 21 is journaled in the tank near its bottom. The upper roller 22 has an axle 23 which is journaled at the top of the tank 20, so that the upper roller is located above the level of the liquid in the tank with its upper side above the walls of the tank.

The axes of the upper and lower rollers 22 and 21 are inclined at a small angle to one another. In the form shown, the axis of the upper roller is parallel to the front and rear edges of the tank, while the axis of the lower roller is so inclined that its right-hand end lies nearer the front end of the tank than does its left-hand end, as clearly shown in Figs. 1 and 4.

The untwisted rope of filaments which has been passed over the eye 15 is looped around the upper and lower rollers 22 and 21 in the form of a flat coil, as shown in Fig. 2. Once this coil has been formed, it maintains its form, the rope continually winding upon the upper roller near its right-hand end and continually winding off the upper roller near its left-hand end, as indicated by the dotted line in Fig. 4. The inclination of the axes of the two rollers causes the progressive advance of the turns of the coil along the two rollers, so that no means for guiding the separate turns is needed. Guiding means 26 may be provided for convenience in the threading operation later described. The rope of filaments is spread out in a flat band as it passes over the rollers. Each reach of the moving coil between the rollers is free, that is, it is not in contact with any support or guide, and each free reach moves directly upward through and out of the liquid in the tank or downward into and through the liquid in the tank. This causes a repeated and very effective treatment of each section of the rope by the liquid, and also serves to cause a circulation or stirring of the liquid in the tank. The effect is similar to that obtained by dipping a skein in a tank of liquid and moving it up and down in the tank. This has been found a very effective way of treating yarn with liquid, but it is not as effective as the moving coil which has been described, since the yarn in a skein is usually twisted, while, in the moving coil provided between the two rollers of my apparatus, the rope of filaments is untwisted and is spread out in a flat band, so that each filament is fully exposed to the liquid.

The tanks 30, 40, 50 and 60 each contain pairs of rollers similar to those of the tank 20, except that the axes of the lower rollers of successive tanks are inclined in opposite directions, so that, while the band advances progressively from right to left in the tank 20, it advances from left to right along the rollers in the tank 30 and from right to left in the tank 40, etc., as indicated by the dotted lines in Fig. 4. This permits leading the band from the winding-off end off each coil into the winding-on end of the succeeding coil in straight reaches between the upper rollers and above the upper edges of the tanks.

On the rear wall of the last tank 60 is mounted a pair of squeeze rolls 66. Beyond this tank is a pair of drying drums 71, 72, whose axes are inclined in the same manner as those with the rollers 21, 22. The drums are internally heated by steam which is brought in through their axes.

The band of filaments unwinding from the left-hand end of the upper roller 62 in the last tank passes between the squeeze rolls 66 and then around the heated drums 71, 72, progressing from left to right along these drums to form a winding and unwinding coil.

The band unwinding from the right-hand end of the drum 71 consists of filaments which have been completely treated and dried so that they are ready for use for many different purposes. The band may be led from the drum 71 to any sort of winding or packaging device.

In order that the band of filaments may be passed through the machine without friction or undue tension which might injure the filaments, all the tank rollers 21 to 62, the squeeze rolls 66 and the drying drums 71, 72 are mechanically driven at the same peripheral speed. For this purpose, the upper tank rollers 21 to 62, the squeeze rolls 66 and the drying drums 71, 72 may be connected by driving belts passing around pulleys on the axles of the rollers, as clearly shown in Fig. 4. With this interconnection, it is immaterial where the driving power is applied. In the arrangement shown in Fig. 4, the power is applied to a pulley wheel 16 on the axle of the gear pump 11, while another pulley 17 on this axle is connected by a belt to a pulley on the axle of the first upper tank roller 22. The lower tank rollers 21 to 61 may be driven in the same way as the upper rollers, but, in order to avoid the use of stuffing boxes which would be required if their axes were extended through the walls of the tanks, I prefer to drive each lower roller from the corresponding upper roller by means of a belt 24 passing around the rollers near their ends and lying within the tank.

It will be seen that the driving arrangement is such that every roller with which the band of filaments comes into contact in passing through the machine is driven at the same speed as the band, so that there is no friction or undue tension on the band. Furthermore, the connection between the gear pump and the rollers insures the constant ratio between the speed of extrusion and the speed of travel of the filaments so that a constant filament size is maintained. It will be understood that the filament size may be varied by changing the speed ratio between the gear pump and the rollers, as, for example, by changing the size of the pulley 17.

A circulation of liquid through each tank is maintained in order to keep the composition of the liquid in each tank approximately constant. A counter-current circulation is preferably maintained through the two acid tanks 20, 30, and through the two wash tanks 40, 50.

In placing the machine in operation, a cord is first led or threaded through the machine in the path which the filaments are to follow. The extruded filaments, after being passed through the eye 15, are then secured to the rear end of the cord so that the band of filaments follows the cord through the winding and unwinding coils to the end of the machine. The machine will then operate continuously without attention so long as a cellulose solution is supplied to the gear pump. The machine has a large capacity and is extremely compact. It produces finished cupro-ammonium filaments at the rate of 500 lbs. a day and occupies floor space not over 3 x 30 ft.

What I claim is:

1. The method of manufacturing artificial fiber, which comprises collecting a multiplicity of simultaneously extruded filaments into a flat band of several thousand denier and feeding the band continuously through a plurality of successive continuously winding and unwinding flat coils, each associated with a separate body of treating liquid, each coil having a multiplicity of free descending and ascending reaches extending into and out of the body of treating liquid associated with that coil.

2. The method of manufacturing cupro-ammonium fiber, which comprises extruding a copper ammonia cellulose solution in more than a thousand filaments in a caustic soda bath, collecting

5 said filaments into an untwisted rope and feeding the rope continuously through a plurality of successive continuously winding and unwinding flat coils, which are associated with separated acid, water, and softening agent baths, each coil having a multiplicity of free descending and ascending reaches extending into and out of the bath associated with that coil.

10 3. In the manufacture of artificial fiber, the steps of forming a multiplicity of simultaneously extruded filaments into an untwisted rope, and thereafter feeding said rope through a spiral path having a multiplicity of turns, each of which extends downward into an open body of treating liquid, downward and then upward within the body of liquid, and vertically upward out of the liquid, while supporting said rope only at points spaced above and below the surface of the liquid.

20 4. In the manufacture of artificial fiber, the steps of forming a multiplicity of simultaneously extruded filaments into an untwisted rope, and then feeding said rope through a spiral path having a multiplicity of turns, each of which has a curved portion located a substantial distance above the surface of a body of treating liquid, a curved portion in said body of liquid below its surface, and two straight vertical portions extending through the surface of said body of liquid.

30 5. In the manufacture of artificial fiber, the steps of forming a multiplicity of simultaneously extruded filaments into an untwisted rope, and then feeding said rope through a spiral path having a multiplicity of turns, each of which has a curved portion located a substantial distance above the surface of a body of treating liquid, a curved portion in said body of liquid below its surface, and two straight vertical portions extending through the surface of said body of liquid, and

forming said rope into a flat band in the curved portions of each turn while leaving it unrestrained in the straight portions thereof.

6. The method of manufacturing artificial fiber, which comprises collecting more than a thousand simultaneously extruded filaments into an untwisted rope, and feeding said rope through a plurality of successive continuously winding and unwinding flat coils, each of which has a multiplicity of free ascending and descending reaches, and maintaining separate bodies of treating liquids in contact with the lower portions of said coils with their surfaces between the upper and lower ends of said free reaches.

7. In an apparatus for manufacturing artificial fibers, a device for extruding a multiplicity of filaments, means for collecting the filaments into an untwisted rope, a tank, a pair of vertically spaced rollers in said tank, means for causing said rope to spiral about said rollers to form a multiplicity of vertical reaches between the rollers, and means for maintaining a liquid in said tank with its surface at a level between the upper and lower ends of said vertical reaches.

8. In apparatus for manufacturing artificial fiber, a device for extruding a multiplicity of filaments, means for collecting the filaments into an untwisted rope, a tank, a pair of vertically spaced rollers in said tank, means for causing said rope to spiral about said rollers to form a multiplicity of vertical reaches between the rollers, the axes of the rollers being at an angle to each other so as to maintain said reaches spaced from one another, and means for maintaining a liquid in said tank with its surface at a level between the upper and lower ends of said vertical reaches.

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