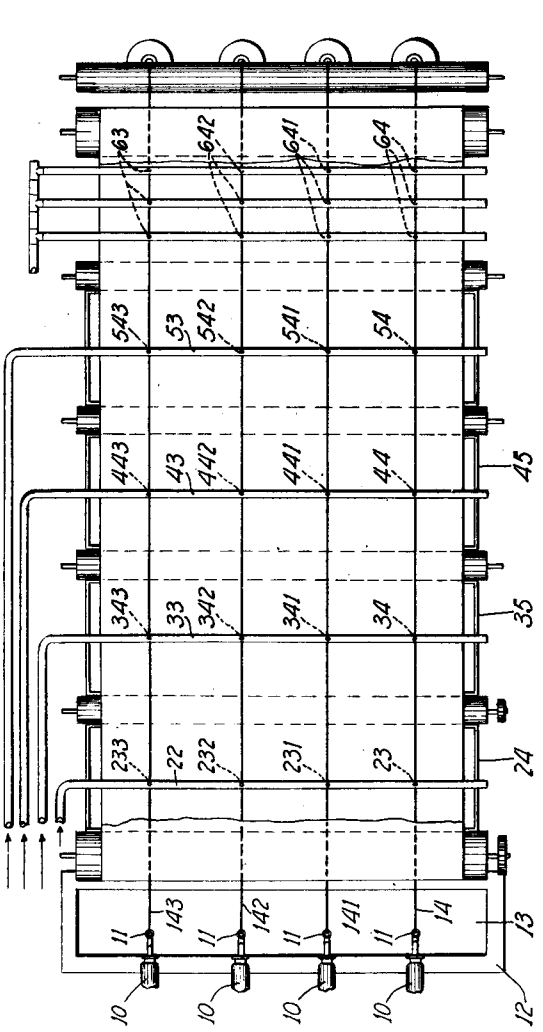
May 19, 1936. P. E. HARRISON 2,041,338

CONTINUOUS RAYON SPINNING AND PROCESSING MACHINE

Filed Aug. 8, 1934



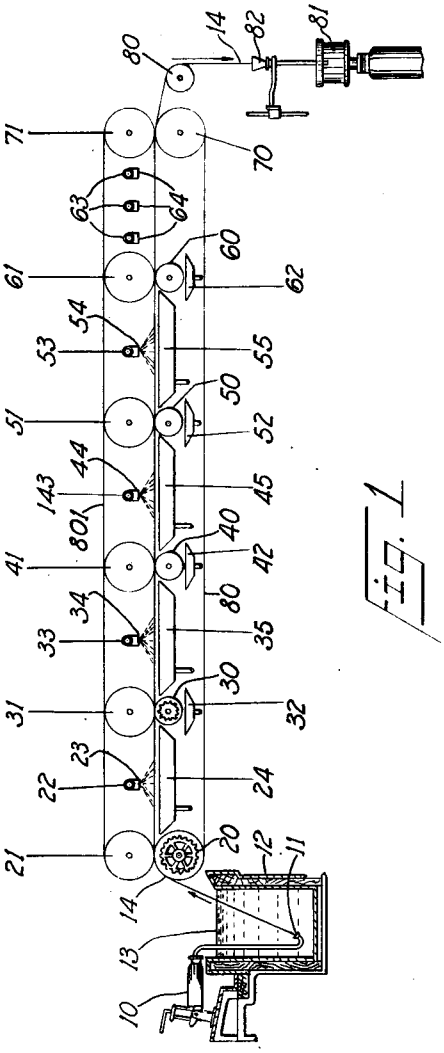


FIG. 1

FIG. 2

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CONTINUOUS RAYON SPINNING AND PROCESSING MACHINE

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7 Claims. (Cl. 18—8)

This invention relates to the manufacture of rayon. More particularly the invention relates to a continuous method of manufacturing rayon. The invention has particular applicability to the viscose process of manufacturing rayon and it will be described in connection with that process. It is to be understood, however, that that description is exemplary, not limitative.

Heretofore the manufacture of rayon by the viscose process has been carried out by extruding a viscose solution into a regenerating (within which term is included both coagulation and regeneration) bath, withdrawing it from the bath in the form of a continuous thread, collecting the thread in the form of an annulus on the surface of a bobbin or within a centrifugal bucket, and subjecting the annulus to washing, desulfuring, bleaching, and to the other processes which serve in the production of thread of good quality. After the liquid treatment of the thread annulus has been completed, the thread is dried, unwound, and is rewound in packages which are sold to manufacturers of cloth.

The prior art methods of manufacturing viscose rayon have several grave disadvantages, not the least of which is the tendency of regenerated cellulose thread, when dried in a cake or on a bobbin, to shrink unevenly and form a thread of non-uniform denier. Various methods have been invented to eliminate this defect of the prior art processes but, while some of them have produced a thread having a more uniform denier, each of them has involved the addition of a step to the process, have increased the cost of the process, and have failed to eliminate fully the disadvantages.

It is an object of my invention to produce a thread of rayon and particularly of viscose rayon, having improved characteristics. Another object of my invention is to produce a satisfactory rayon thread by a new process. Another object of the invention is to overcome disadvantages inherent in older processes. Yet another object of the invention is to produce an apparatus capable of efficiently contributing to the practice of the new process. Other objects of the invention will be in part apparent and in part hereinafter set forth.

The objects of the invention are accomplished, broadly speaking, by forming a gel regenerated cellulose thread by any approved process of the prior art but preferably by regeneration in a bath containing regenerating liquid, withdrawing the thread from the bath, supporting it upon the surface of a moving support which is preferably permeable to liquids, successively treating it, while thus supported, with the materials and reagents which contribute to its proper formation, drying the thread, twisting it, and gathering it in a convenient form. The objects of the invention are also accomplished in a greater or less degree by the details of process and the details of apparatus hereinafter more fully described.

In the drawing, which diagrammatically illustrates a preferred form of my invention, Figure 1 is a diagrammatic side view of an apparatus embodying my invention. Figure 2 is a plan view, with the upper rollers removed, of the apparatus shown in Figure 1.

Referring to the numerals in the drawing, 10 are filters of a type known to the prior art through which a viscose solution passes before being extruded into a regenerating medium; 11 are spinnerets of a type known to the prior art through which a thread is extruded in the form of a single filament, or in the form of a plurality of filaments; 12 is a tank; 13 is a regenerating liquid contained in the tank; 14, 141, 142, 143 are threads; 20—21 are pressure rollers which serve to draw the thread from the regenerating bath at a rate which permits its substantially complete regeneration, and which exert only enough pressure to expel from the thread liquid carried with it from the said bath, and not enough to damage the filaments; 22 is a pipe which extends across the machine; 23, 231, 232, 233 are nozzles located in a position such that fluid forced through them will bathe the thread as it is drawn through the machine; 24 is a pan beneath the shower and thread to collect the liquid with which the thread is bathed; 80 is an endless belt, preferably made of liquid-permeable fabric, which is carried and moved by the lower rollers to support the thread and to carry the thread through the various steps of the process; 801 is an endless belt carried about the upper series of rollers; 30—31 are pressure rollers of which roller 30 is of smaller size than roller 31; 32 is a trough for collecting fluid expressed from the belt and thread between pressure rollers 30—31; 33 is a pipe capable of carrying fluid; 34—341—342—343 are nozzles through which fluid from the pipe 33 may be directed upon the thread; 35 is a trough or pan to collect used liquid; 40—41 are pressure rollers; 42 is a trough to collect liquid; 43 is a pipe; 44—441—442—443 are nozzles to direct the liquid in pipe 43 upon the upper belt at a point just above the thread; 45 is a drip trough; 50—51 are pressure rollers; 52 is a drip trough; 53 is a pipe to contain fluid; 54—542—541—543 are nozzles to

direct fluid from the pipe 53 under the thread; 55 is a drip tank to collect used fluid; 60—61 are pressure rollers; 62 is a drip trough; 63 are pipes to contain drying fluid, such as warm air; 64—642—643 are nozzles to direct the drying fluid against the threads; 70—71 are pressure rollers; 80 is a guide roller; 81 is a twisting and collecting means, in this instance illustrated as a centrifugal bucket; 82 is a reciprocable guide which serves to lay the thread in successive helices against the interior of the centrifugal bucket.

The apparatus in a preferred form of the invention functions as follows: The viscose, or other regenerable cellulose solution, is ejected into the regenerating bath, which usually contains sulfuric acid as the regenerating medium. The thread is formed by the regeneration of the viscose solution in the form of a plurality of continuous filaments, and is drawn between the protecting belts and the pressure rollers 20—21. The belts are driven at a rate which permits the substantially complete regeneration of the thread during its travel in the regenerating bath. The belts carried by the upper and lower series of rollers are preferably fabric belts having an open weave which permits liquids to pass readily through them but which serve to support the thread, to carry it through the apparatus, and to protect it against damage from the force of the showers. As the thread leaves the rollers 20—21, carried upon the surface of the belt 80, it passes beneath shower 23 (or, if advisable, a series of showers) which is preferably of water in order to remove the regenerating fluid. The fluid from the nozzle washes the regenerating fluid from the thread and the majority of it passes through the fabric and is caught in the receiver 24 and is returned to be used again or to be regenerated. Of course, a regenerating fluid shower could be inserted before the washing shower if regeneration were not completed in the bath.

The thread as it leaves the shower contains a considerable quantity of water which would dilute the next solution. However, the pressure rollers 30—31, which are driven, expel from the thread and from the belts liquid which would otherwise dilute the treating solution in the next step. Much of this liquid is carried down the surface of roller 30 and is collected in the receiver 32. The rollers 30—40—50—60 are of smaller size than the end rollers 20—70 in order to permit the collection of the expelled liquid. These smaller rollers 30—40—50—60 are driven at the same peripheral speed as their companion rollers 31—41—51—61.

Having lost excess water between the pressure rollers the thread is carried by the belt and the rollers to a position beneath the next nozzle, which showers it with a desulfuring solution. This solution desulfurs by reacting with the material of the thread to free sulfur and then washes the freed sulfur out of the thread, a function which is but poorly performed by the immersion bath typical of the prior art. In this step of the process a certain amount of shrinkage occurs in the thread, but the rollers 30—31, 40—41 grip the thread with even tension and propel it with uniform speed, so that each portion of the thread is subjected to uniform shrinkage for a period of time equal to that of every other portion. This is a great improvement over the prior art, wherein all shrinkage took place against opposition which varied according to the thickness of the windings beneath it.

In order that the shrinkage of the thread shall be uniform in this step of the process, it is desirable that a uniform viscose solution shall be sent through the spinneret into the coagulating bath, and that the regenerating bath or baths and the desulfuring solution shall each be of uniform concentration and content.

Excess desulfuring solution is squeezed out of the thread and belt by the rollers and the thread is carried on to be treated in a similar manner with other necessary and desirable fluids. In the drawing there have been illustrated in separate steps washing, bleaching, and drying. In addition to these steps a washing step could follow the bleaching step, a soaping step follow the washing step, a washing step follow the soaping step, a dyeing step follow the washing step, and a washing and drying step follow in order. It will be understood by persons skilled in the art that any treatment which has heretofore been carried out in an immersion or batch process can be carried out by my invention and that the order of treatment need not be altered.

In the drying step wherein the greatest shrinkage occurs particular care should be taken that the temperature of the air which is blown through the nozzle 64 is constant, that the moisture content of that air shall be controlled closely, and that each portion of the thread shall be exposed to the heated air for equal periods of time.

After the drying the thread is twisted and collected in a package. I have illustrated in the drawing a centrifugal bucket and customary reciprocating mechanism to accomplish this function. It is not necessary to use this bucket, however, for any standard method of twisting and packaging can be used. For instance, the thread can be collected on bobbins with twisting or it can be twisted and collected on a cap spinner. When removed from the collecting device the thread is ready for sale. On the other hand, if the manufacture of staple rayon is intended the twisting and collecting step will be omitted, the thread will be run without twisting to a chopping machine which will cut it in the lengths satisfactory for use in spinning threads.

No driving mechanism has been illustrated because such mechanisms are well known and widely used, are many in number, and are of approximately equal efficiency. Suffice it to say of the driving that it is desirable that all rollers shall have the same peripheral speed. This can be obtained by driving both sets of rollers, or by mounting the upper rollers freely to be driven by friction from the lower rollers.

The manufacturing apparatus can be made of size sufficient to take only one thread or it can be made of size sufficient to take a large number of threads. In actual practice in my invention the spinnerets would be spaced close together.

In the drawing the means for collecting and draining the used liquids is disclosed as a very simple one. Other methods will occur to persons skilled in the art.

The upper belt may be omitted under certain circumstances but generally its use is preferred. That modification of the invention which omits the use of any belt is not recommended for general purposes.

An advantage of this invention is in the production of thread more highly uniform than thread heretofore known. Another advantage of the invention is in an improved and simplified process of producing a regenerated cellulose thread. Another advantage of the process is in an apparatus which lends itself to the efficient working of the

new process and to the production of the new product.

Many changes may be made in my process and apparatus, but such changes as fall within the claims are mere expedients within the ability of any mechanic.

I claim:

1. An apparatus for manufacturing rayon thread comprising means for regenerating a viscose solution in the form of a thread, means for twisting and collecting the dried thread, a series of nozzles between the regenerating means and the collecting means, means for transporting the thread from the regenerating means to the collecting means beneath the said series of nozzles and for protecting the thread from the force of the showers comprising a pair of movable, liquid-permeable, endless belts between which the thread is carried, means to supply to each nozzle of the series a separate fluid whereby the thread may be successively bathed by processing liquids, pressure rollers between adjacent nozzles to expel excess liquid from the thread and belt, means to collect the liquid which passes through the belt and means to collect liquid expelled by the rollers.

2. An apparatus for manufacturing rayon thread comprising means for regenerating a viscose solution in the form of a thread, means for twisting and collecting the dried thread, a series of nozzles between the regenerating means and the collecting means, means for transporting the thread from the regenerating means to the collecting means beneath the said series of nozzles comprising a pair of movable, liquid-permeable, endless belts between which the thread is carried, pressure means between adjacent nozzles to expel excess liquid from the thread and belt, and means to collect the used processing liquids.

3. An apparatus for manufacturing rayon thread comprising means for regenerating a viscose solution in the form of a thread, means for twisting and collecting the dried thread, means between the regenerating means and the collecting means to successively bathe the thread in various processing fluids, means for transporting the thread through the said baths comprising a plurality of permeable webs between which the thread is carried, pressure means between successive baths to expel excess fluid from the thread, and means to collect the used processing fluid.

4. The method of making viscose rayon which comprises drawing regenerated thread from a regenerating bath without deviation to the wind-up, spraying the thread with washing, desulfuring, and drying fluids, maintaining the temperature, concentration and constitution of each bath constant throughout the process, protecting the thread from the force of the baths, maintaining uniform temperature, flow, and humidity of the drying medium, and substantially preventing lengthwise contraction of the thread during any step of the process.

5. The method of making viscose rayon which comprises drawing regenerated thread from a regenerating bath without deviation to the wind-up, spraying the thread with washing, desulfuring, and drying fluids, maintaining the temperature, concentration and constitution of each bath constant throughout the process, protecting the thread from the force of the baths, maintaining uniform temperature, flow, and humidity of the drying medium, and substantially preventing lengthwise contraction of the thread during desulfuring and drying.

6. In the method of manufacturing rayon thread which includes forming a regenerated cellulose thread from viscose and drawing it successively through baths of water, desulfuring fluid, water, bleaching fluid, water, dyeing fluid, water, and a current of hot air, the steps which comprise drawing the thread without deviation through the steps of the process, and pressing the thread gently with sets of rollers located between steps whereby to expel absorbed liquids therefrom and to oppose shortening by shrinking.

7. In the continuous method of manufacturing rayon wherein the thread is drawn from a regenerating bath and passed through successive processing steps, the steps which comprise moving the thread without deviation through the baths of the process between moving permeable fabric belts, and by gripping and pressing the thread between steps to express liquid therefrom, prevent longitudinal contraction thereof, and apply tension thereto.

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