March 30, 1943. L. E. LOVETT 2,315,265

MANUFACTURE OF ARTIFICIAL STAPLE FIBERS

Filed March 11, 1939 3 Sheets-Sheet 1

FLOW SHEET

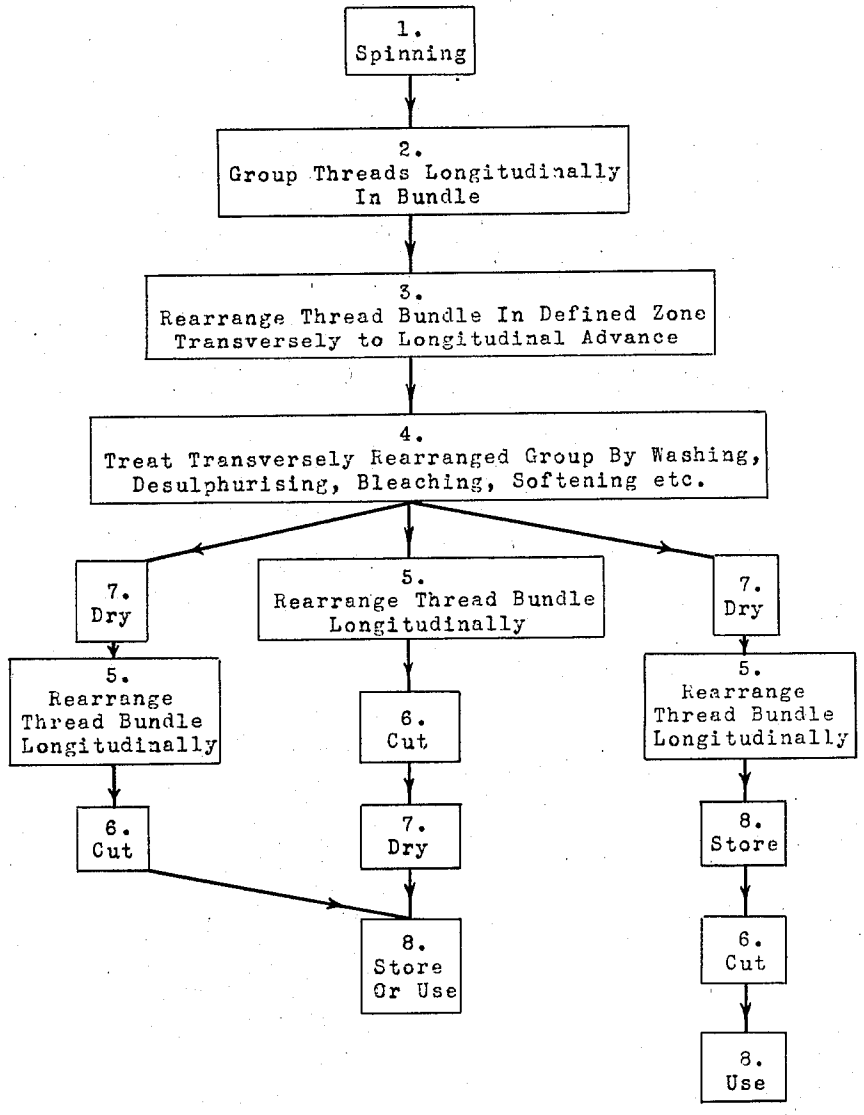

Fig. 1.

INVENTOR.
LOUIS E. LOVETT

BY Robert W. Wilson

ATTORNEY.

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MANUFACTURE OF ARTIFICIAL STAPLE FIBERS

Filed March 11, 1939 3 Sheets-Sheet 2

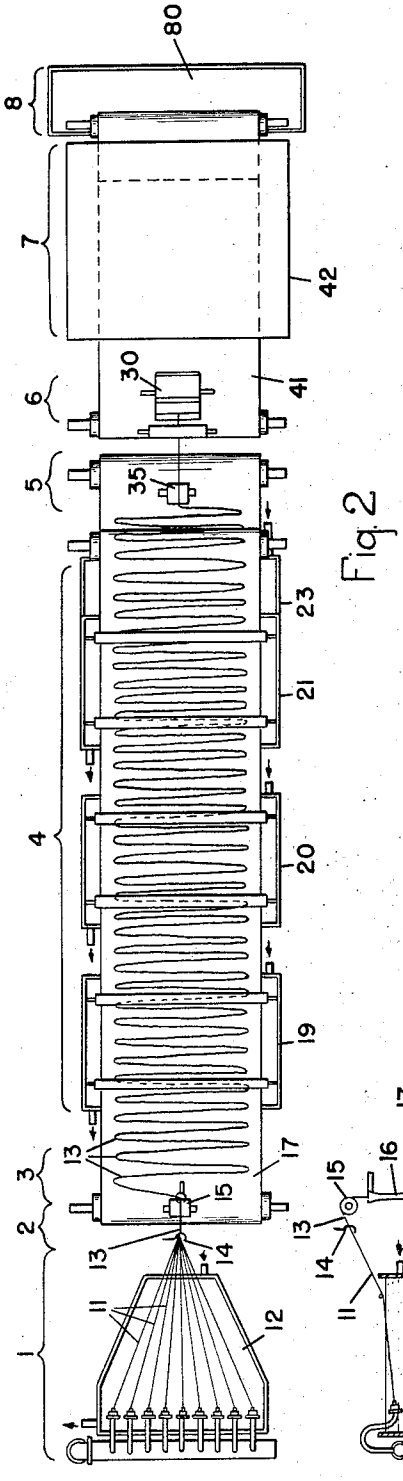

Fig. 2

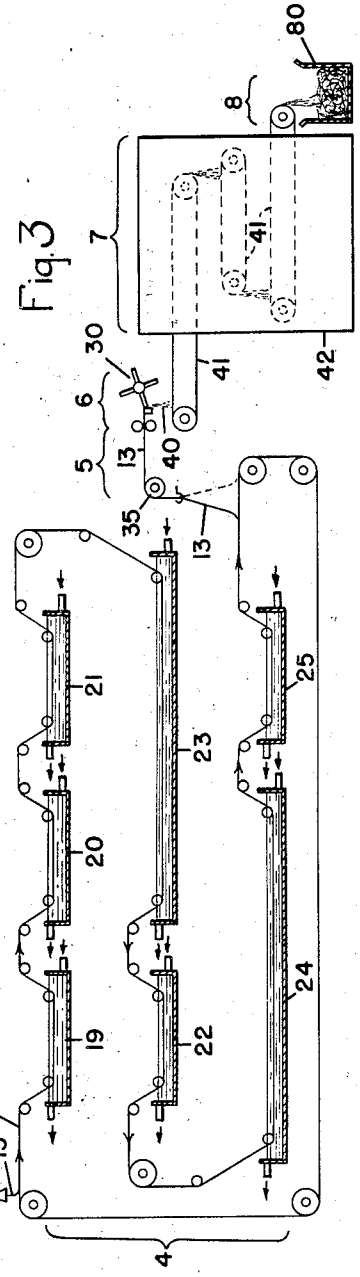

Fig. 3

INVENTOR.
LOUIS E. LOVETT

BY Robert W. Wilson
ATTORNEY.

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MANUFACTURE OF ARTIFICIAL STAPLE FIBERS

Filed March 11, 1939 3 Sheets-Sheet 3

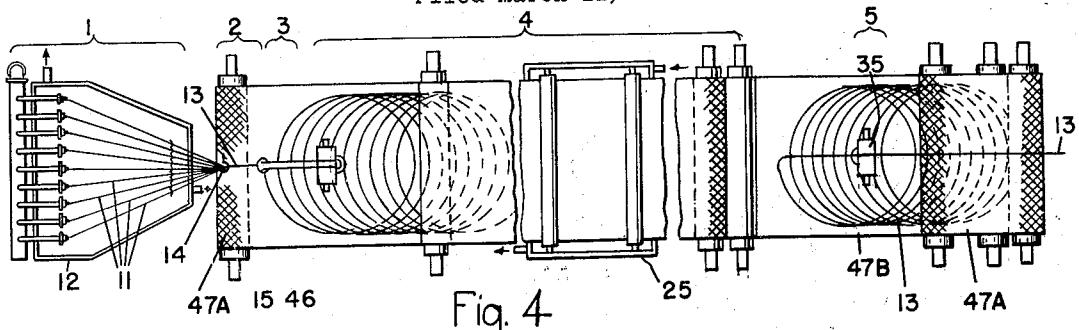

Fig. 4

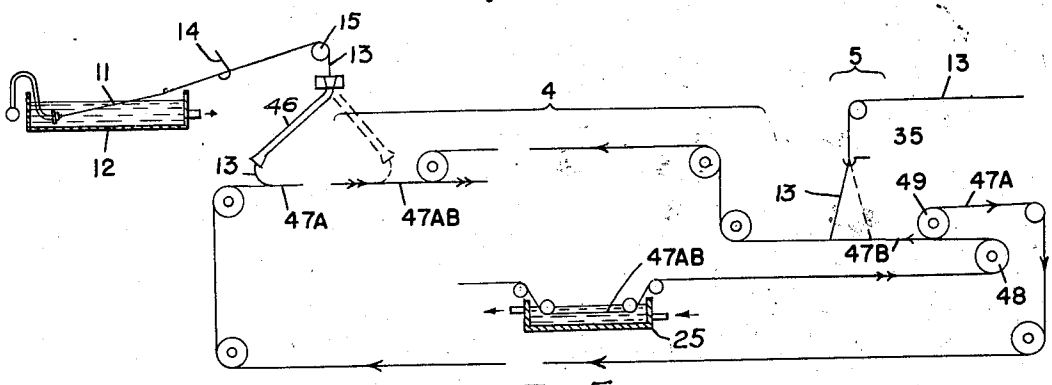

Fig. 5

INVENTOR.
LOUIS E. LOVETT

BY Robert W. Wilson
ATTORNEY.

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UNITED STATES PATENT OFFICE

2,315,265

MANUFACTURE OF ARTIFICIAL STAPLE FIBERS

Louis E. Lovett, Cleveland, Ohio

Application March 11, 1939, Serial No. 261,402

3 Claims. (Cl. 18—8)

This invention relates to a process and plant for the manufacture of staple fibers from artificial threads, more particularly artificial threads produced from viscose or other cellulose derivatives. In this process the filaments or threads are brought from the spinnerettes into a continuous bundle and the cutting of the threads to the desired staple length is carried out after the threads have been subjected to various after-treatments and either before or after drying. The thread bundle is subjected to the after treatments while mounted on a conveying means in a defined formation transversely to its longitudinal advance and extending practically the full width of the conveyor and with the thread bundles spaced only a few inches apart at each reversal of direction of the thread on the conveyor. The process is such that the drying may take place on comparatively short staples affording complete opportunity for shrinking and crinkling or in the continuous thread also with practically no tension or as much tension as may be desired. In one prior art process the cut staples may be subjected to any additional treatments by softening or curling agents before they are introduced into the dryer, while in another the continuous bundle of threads may be so treated before introduction into the continuous dryer.

An example of a process of the continuous type, known previously to my present invention but limited only to staple cut before drying, is one comprised of a series of two spaced generally cylindrical members rotatably mounted about inclined axis. By means of devices of this type a relatively long length of thread or bundle of thread or the like may be temporarily continuously stored in a relatively small space. While the thread or the like is so stored processing medium is applied thereto, wherefore thread store devices and groups of devices of this type find application in apparatus for the continuous processing of threads or bundles of threads or the like. In all of these cases cited, it is necessary that the machine either be equipped with a leader to guide the initial thread from one series of spaced cylindrical rotatably mounted members to the next set and also around the spaced generally cylindrical rotatable members themselves in a plane comprised of two straight sides and two generally cylindrical ends or the thread must be guided by hand for the complete winding of each individual group of two members and the transfer from one set of members to the next.

Among the objections to such prior art processes as described above is the limitation on time of treatment as controlled by the physical dimensions on the apparatus and also that the thread must be subjected to the after-treatments while under tension.

More particularly my invention relates to a process and plant in which the thread or bundle of thread after spinning is continuously laid either with or without tension in a definite zone transversely to its longitudinal advance on a conveying means for after-treatment and is thereafter either dried while still mounted on the conveyor or is continuously removed from said conveyor for cutting and drying. As contrasted with my present invention, most of the thread store devices known to the prior art must be threaded up by hand, e. g. the thread or the like must at the outset be wound by hand in a desired number of generally helical turns about the thread advancing members of a thread store device. However, in Patent No. 2,136,556, dated November 15, 1938, by Louis E. Lovett, the thread or thread bundle is started and advanced automatically in a plurality of generally spaced helical turns.

According to the method of the instant invention the thread or the like is initially and automatically laid on a thread advancing device comprising longitudinally moving conveyor members equipped with devices for holding the thread or thread bundle and upon which the thread is laid, as the conveyor advances, in zigzag or other defined formation but in substantially a single straight plane by any suitable means such as a reciprocating or rotating thread guide actuated by a suitable mechanism to move across from one side of the conveyor to the other in a fixed plane or planes laterally, or with combined lateral and longitudinal movement. Meanwhile, in one form of my invention, the longitudinal movement of the conveyor causes the engaging device on the longitudinally advancing members to engage the thread at the point of reversal of direction thus laying out a continuous zigzag pattern on the conveying means, and in another form of my invention the longitudinal movement of the conveyor permits the thread or thread bundles to be laid thereon continuously in an unlimited number of patterns such as zigzag, or overlapping spirals etc. The purpose of laying the thread or bundle of thread in this fashion is to form a band or belt of thread or the like in which the leading end of the thread or the like is contained. In this manner, it is possible, as an example, to lay up 100 feet of thread or thread bundle in a longitudinal distance of only about 1½ feet and with the defined formation extending laterally on the con-

veyor a distance of about 8 feet. the longitudinally moving conveyor then continuously receiving a thread or bundle of thread at the rate of for example 325 feet per minute, although the conveyor itself moves only very slowly, on the order of a few feet per minute. My process if, therefore, especially well-adapted for thorough liquid treating or after-treating of the continuously formed threads or thread bundles since the vats or treating tanks required for such thorough treatment need only be a few feet long and moreover, the process will permit an immersion treatment rather than spray or jet treatment of continuous threads or bundle of threads such as is known at present to the art. The thread bundle is removed after treatment at the same speed as the initial supply.

As to the operation of threading up, my method, in contradistinction to previous methods, including manual, of threading up thread store devices requires very little manipulation of either the thread or thread bundle or of the thread storage mechanism, and is especially well-adapted to threading up of the thread store device by wholly mechanical means. Furthermore, devices of my type may be threaded up without disconnecting them from the driving means or otherwise stopping them, thus providing, if desired, a substantially constant pick-up of the thread or the thread bundle or the like from its source of supply. Other advantages of the invention will be apparent from the succeeding descriptions thereof.

For the purposes of illustration the process above referred to of threading up such thread store device will now be compared with prior art thread store devices comprised of a rotatable generally cylindrical member having spaced from and inclined to the axis thereof one or more other members which may or may not be rotatable, each of said inclined members being inclined to the axis of said generally cylindrical member in a plane which is parallel to the axis of said generally cylindrical member. In devices of this kind the above-mentioned initially wound leader or belt or band or thread or the like may be discharged automatically from the free end of the device, provided it is of the cantilever type, after it has progressed longitudinally of the device but only if a leader has first been wound over the complete cycle by hand or if an automatic device such as referred to in Patent No. 2,136,556 by Louis E. Lovett is utilized. In contradistinction to the method, as described above, this invention relates to wholly automatic methods of laying up a thread or thread bundle in a defined zone transversely to its longitudinal advance. Moreover, in one form of my invention, no thread retaining mechanism is essential in the operation of this method beyond a means of support which may consist, for instance, of a woven wire conveyor belt to receive the thread or thread bundle laid on in a defined pattern as it is produced by the spinning means and held in place, for instance, by a superimposed screen-like belt which will permit the continuously stored up thread to be fed through various vats or troughs in the same manner as a conveyor belt and without danger of knotting up or displacing the thread bundle pattern as originally laid on the conveying means.

In the drawings which for the most part are of diagrammatic nature are shown illustrative embodiments of the process adapted to the practice of the present invention.

Fig. 1 is a flow sheet of my process;

Figs. 2 and 3 are plan and side elevation respectively of apparatus for performing the process, including the final stages;

Figs. 4 and 5 are plan and side elevation respectively of a specific form of apparatus for steps 1 and 2 of my process, whereby the bundle is distributed on and carried by and between endless screen-like belts.

In the drawings Fig. 1 is a flow sheet illustrating the steps of my process in various alternative sequences, as illustrated by the connecting lines. The steps are designated by numbers which do not in every instance indicate the sequence, but the same reference character, wherever used either in Fig. 1 or other figures of the drawings, indicates the same step. The flow sheet reference characters are used on subsequent figures of the drawings indicating the portions of the machinery in which the designated steps of the process occur.

In Figs. 2 and 3 the threads, as for example the threads **11** spun by the viscose process in spinning machine **12**, are formed into a bundle **13** by a guide **14** and led over a drawing or supply roll **15** and through a distributor **16** moving in a defined transverse zone to a conveying means **17** which thereafter carries the bundle, laid in a zigzaz pattern, into the after-treatment machinery. The after-treatment machine **18** is made up of trays or vats or tanks such as **19** to **25**, over or through which the conveyor **17** is continuously led. The after-treatment comprises, as is well known to those well versed in the art, a sequence of treatment steps, collectively designated as step 4. After treatment, in the sense used and claimed herein, includes such known steps as washing, desulphurizing, bleaching, etc., and is not considered to be limited in any way. The after-treatment liquids are fed into the vats or tanks **25A** in such a manner that the flow of the liquid is across the thread bundles either in a direction longitudinal to the conveyor but in a direction opposite to the conveyor travel, as indicated by the arrows in tank **19**, Fig. 3, or laterally thereto, as illustrated by arrows in tank **20**, Fig. 2. In either case the flow of liquid is opposed to the movement of the conveying means and, therefore, all liquid tends to thoroughly permeate the threads immersed therein while on the conveying means in a zigzag or other convenient continuous pattern. In this manner, particularly using the directly opposed flow as shown in tank **19**, the most effective treatment of the thread bundle **13** is obtained since the thread bundle about to emerge from any treating tank is exposed only to the purest treating liquid which becomes progressively less effective as it flows toward the opposite end of the tray into which new thread is being carried on the conveyor. Instead of treating the liquids by immersion in tanks, it is entirely practicable to treat them with sprays or jets of liquid in sequence of treatment steps, but the former method is preferred because of the greater effectiveness of immersion treatment.

From the last treating tank, the conveyor **17** carrying the thread bundle **13** continuously, still in zigzag or other defined formation, arrives at the cutting device **30** which may be any form of construction such as is known to those versed in the art, for example, in the form of squeeze rollers which serve to feed the thread between a stationary striker and radially mounted rotating cutting blades. Just before the cutter is shown

a means 35 for withdrawing the thread bundle 13 continuously from the conveyor at the speed at which it was delivered thereto by the supply roll 15 when it is desired to release said thread bundle for further manipulation. From the cutter 30 the cut material, in short lengths known as chips 40, hereafter discussed in some detail, is passed by suitable conveying means such as 41 through a dryer 42, from which they go to storage or to immediate use.

Various specific types of conveyors may be employed with my process. For example that of Figs. 4 and 5 is a web or network type of belt, through which the treating liquid in the tanks can readily reach the thread bundle. The belt 47 runs in two plies, lower 47A and upper 47B. Double arrows in Fig. 5 indicate where the two plies run together, with the thread bundle 13 between them, and single arrows show where the plies run separately, the arrows of course also indicating the direction.

The threads 11 are bunched at 14 into a bundle 13 fed to an uncovered area of the lower belt 47A by a distributor which might be 16 of Fig. 3, but in Fig. 5 is shown as 46 and swings in a circle instead of directly across the conveyor. Thus the thread bundle is laid in overlapping coils, closer or more widespread according to the relative speeds of the bundle supply and of the conveyor, so that in this sort of conveyor it is not necessary to synchronize the rate of supply of the thread bundle, or the speed of the arm 46 or 16, with the conveyor speed. The top ply 47B comes down on the coils and the two plies sandwiching the coils run together through the tanks of step 4, diagrammatically indicated at 25, Figures 4 and 5, through which liquid is circulated as for instance by entering at 25A and leaving at 25B, or by other appropriate arrangements. Thence the bundle may or may not go through a dryer, according to which of the paths of Fig. 1 the particular apparatus is built for. Just before unloading the conveyor is brought over a roller 48 and thereby inverted, followed by removal at 49 of the original bottom ply 47A, now on top, after which the thread bundle 13 is removed by a withdrawal roller 35, just as in Figs. 2 and 3. No counterpart of the delivery distributor arm 16 or 46 is required at the unloading end because the thread bundle is not fastened in any way.

My process may also be carried out by conveyors in which the thread bundle is fastened to the conveying means. Various modifications of such arrangements may be variously combined in a plant such as is characterized by Figs. 2 and 3.

Thereafter the conveyor is unloaded (step 5) in the same manner by which it was loaded, that is by narrowing it, from which it goes on to the further steps of the process.

The continuous thread bundle, after the treatment of step 4 and the straightening of step 5 is brought sooner or later to be cut by suitable apparatus such as 30 of Figs. 2 and 3. This operation, step 6, obviously may follow treatment by any of the conveyors typified herein, and it is the cutting which reduces the thread bundle 13 to staple in a form known as chips.

The staple fiber so produced usually consists of many thousands of parallel individual threads, which, as a result of their passage through the drawing rollers of the thread cutting mechanism, are usually in the form of a band from about one-quarter inch to several inches wide depending upon the size of the thread bundle 13. While it is entirely practicable to loosen these cut thread bundles by sprays or other means I prefer to maintain them in a thin chip form, since it has been found that by the use of the proper treatment in the last after treatment stage before cutting, the individual threads will, upon being subjected to the proper drying cycle, loosen themselves sufficiently so that they will shrink individually but still maintain the form of a chip in which they are most easily handled and are preferred by the trade to the matted construction otherwise obtained by the use of loosening jets, etc. (Fibers produced by the latter process are often seriously degraded by being broken when passed through the "opening" or "willowing" mechanism after drying.) In my preferred method it has been found that a much more rapid and thorough "opening" of the cut staple is provided than is the case where a web or wadding-like mass is formed. After cutting, the cut staple fiber is fed into any of the well known continuous types of dryers where it is spread uniformly by any suitable mechanism upon the carrying trays or conveyors of the dryer, all as indicated at step 7 in Figs. 2 and 3. From the dryer the material may be discharged into shipping packages as indicated at 80, for transport to the purchaser who can economically perform the operation of opening the fibers by suitable well known mechanism such as an opener or willow. Or the opening may be done immediately after drying and before packing, and so on.

It is obvious that the methods of initially laying up the thread or thread bundle or the like upon the thread storage device or conveying mechanism of the types above indicated may be modified in various ways and that the several forms of apparatus shown as adapted to the practice of this method or merely illustrative and capable of various modifications without departing from the spirit of the invention. Furthermore, the invention is not restricted to the initial winding of thread or thread bundles or the like upon the storage devices of the above type or the above process; the invention may be applied to the winding of lengths of any material capable of being so handled. The term "thread" or "thread bundle" in the appended claims is intended to include, beside thread, filar material generally.

It is intended that the patent shall cover by suitable expression in the appended claims whatever features of patentable novelty reside in the invention.

I claim:

1. A process of manufacturing rayon staple fibers which consists of continuously spinning such fibers, grouping the fibers into a thread bundle while advancing longitudinally, laying said fibers in overlapping spiral thread bundle formation on a conveying means, said conveying means having a forward speed reduced from the original spinning speed by the total amount of the lateral and forward length of application of the thread bundle, completing the processing of the fibers while so carried, turning the entire formation of fibers upside down so that the leading spiral is free of the following thread bundles and continuously removing said thread bundle from the carrying means for further processing.

2. Fiber treating apparatus including in combination spinning means, means for grouping fibers from said spinning means longitudinally into a thread bundle and for laying said thread bundle in overlapping spirals on a moving conveyor, a

series of treating tanks through which said conveyor travels, means for preventing flotation of said thread bundle on said conveyor in said tanks comprising secondary travelling members bearing down upon said thread bundle, and unloading means for said conveyor comprising guides for inverting the conveyor and for separating said secondary travelling members from the conveyor.

3. Rayon treating apparatus including in combination, spinning means, thread assembling means adapted to receive and assemble into a bundle threads from said spinning means, a foraminous conveyor in successive relation to said assembling means, a feed mechanism between said assembling means and said conveyor adapted to receive said bundle from said assembling means and deliver said bundle to said conveyor, said feed mechanism comprising a bundle guide adapted to move in predetermined path across and above said conveyor, thereby laying said bundle in substantially transverse formation on said conveyor, drive means for said conveyor and for said feed mechanism, said drive means including elements adapted to impart relative rates of movement such that the longitudinal speed of said conveyor plus the average lateral speed of said bundle guide equals the linear supply speed of said fiber bundle, devious guiding means at more than one level for said conveyor, whereby said conveyor is constrained to follow a devious path, a plurality of treating vessels through which said guide means are disposed, liquid supply and discharge means in said vessels, said vessels being provided with liquid-tight sides above the level of at least part of said guide means, holding means in juxtaposition to at least the entire submerged parts of said conveyor and adapted to contact said bundle on said conveyor at least below the level of liquid-tightness in said vessels, and removal apparatus at the discharge end of said conveyor means, said removal apparatus including a surface adapted to engage said bundle, and means for driving said surface at a speed equal to the linear supply speed of said fiber bundle.

LOUIS E. LOVETT.