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L. E. PETERSON ET AL

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PRODUCTION OF ARTIFICIAL FIBERS

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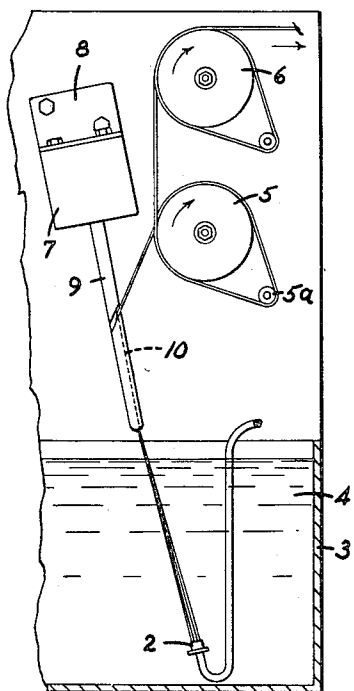


Fig. 1

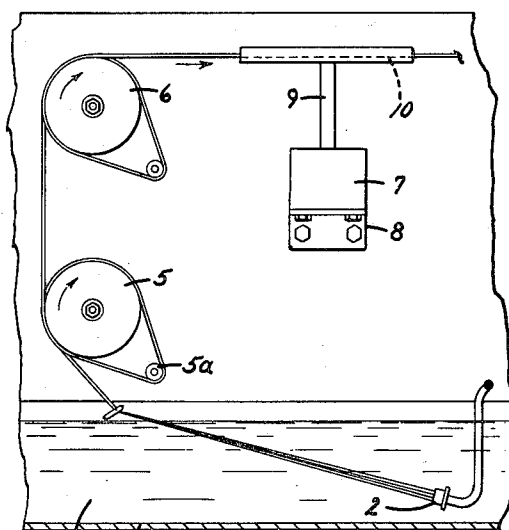


Fig. 2

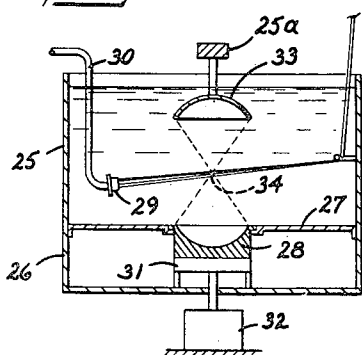


Fig. 3

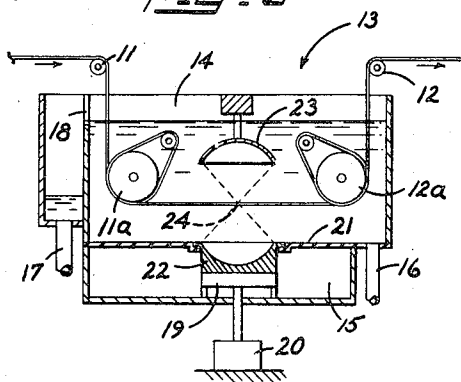


Fig. 4

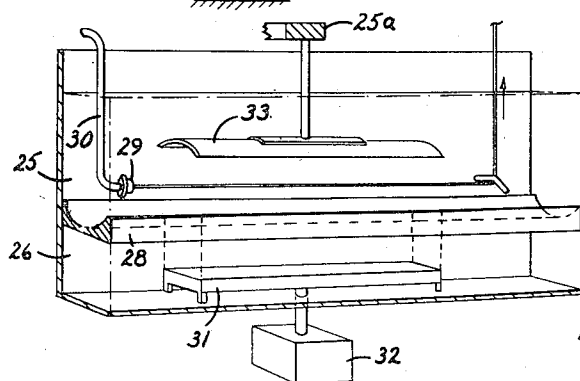


Fig. 5

INVENTORS.
LEROY ERIC PETERSON
SIDNEY LEONARD DART

BY *Thomas R. O'Malley*

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PRODUCTION OF ARTIFICIAL FIBERS

Leroy Eric Peterson and Sidney Leonard Dart,
Chester, Pa., assignors to American Viscose
Corporation, Wilmington, Del., a corporation of
Delaware

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20 Claims. (Cl. 18—54)

1 This invention relates to improvements in the manufacture of artificial fibers from solutions of fiber-forming materials.

While the invention may be practiced with advantage in connection with the manufacture of artificial fibers from solutions of fiber-forming materials of various types, it will be described in detail in connection with the manufacture of regenerated cellulose fibers from viscose by the wet spinning method, by way of specific exemplification.

Cellulose, as shown by Meyer (Brochemische Zeitschrift, 214,253-281, 1929) is a linear superpolymer, i. e., a superpolymer in which the crystalline regions or micelles comprising molecular chains or bundles of molecular chains show a high degree of orientation along fiber axis. Although in viscose, the crystallites or micelles are randomly dispersed and oriented in all directions or agglomerated into small gel-like masses, they tend to reorient themselves in the direction of the fiber axis during spinning. According to modern concepts, the physical strength of fibers of regenerated cellulose depends upon the ratio of crystalline portions to amorphous portions, homogeneity at all portions of the fibers, and the degree to which the crystalline portions are reoriented with respect to the fiber axis. It is known that stretching of freshly spun fibers comprising partially regenerated cellulose improves the crystallinity and orientation of the crystallites along the fiber axis, with improvement in the tenacity of the fibers. However, regenerated cellulose fibers obtained by conventional procedures are not homogeneous and do not show maximum uniform crystallite orientation consistent with good extensibility, even after being subjected to strong stretching while in the gel state in which they are initially obtained.

In accordance with conventional procedures, the fibres are manufactured by extruding viscose through a spinneret into an acid coagulating and regenerating bath, and continuously withdrawing the fibers formed by the action of the bath away from the spinneret face and to the exterior of the bath for eventual after-treatment and purification.

During the spinning operation and concomitantly with conversion of the freshly formed highly plastic or gel-like fibers to the form in which they are finally set up, the fibers undergo a series of changes due to various chemical processes such as dehydration, dexanthation of the cellulose xanthate, etc., which proceed more

2 or less simultaneously. While the fibers are undergoing such changes, and the molecules are more or less in a state of flux, a number of factors arise which interfere with the freedom of the crystallites to satisfy their natural tendency to reorient themselves in the direction of the fiber axis, as for instance, the stresses and strains which tend to develop in the molecular structure during the spinning operation, the difficulty of controlling the rate at which dexanthation proceeds at all portions of the fiber cross-section, and at all points along the fiber length, with regeneration of the cellulose, and doubtless other factors, as well.

15 Under usual manufacturing conditions, the fibers are withdrawn from the bath in the form of a gel comprising partially regenerated cellulose, dependence being placed upon diffusion of the acid carried from the bath through the skin initially set up on the fibers in the bath about a still fluid core to effect complete regeneration of the cellulose at all portions of the fiber cross-section. The rate of diffusion of the adhering acid to the interior of the fiber, and the uniformity of such diffusion controls the rate at which the xanthate groups are split off and the uniformity of the dexanthation at any given moment, which in turn controls the speed with which the fibers are finally set up, with formation of hydroxyl-to-hydroxyl bonds between the cellulose molecules. Apparently, the speed with which the hydroxyl-to-hydroxyl bonds are formed effects the degree to which the molecules are reoriented with respect to the fiber axis, since, obviously, when such bonds have been formed, the crystallites are less free to undergo molecular rotations and align themselves along the fiber axis.

20 Under usual spinning conditions, it is difficult, if not impossible, to control the rate at which dexanthation proceeds at all portions of the fiber-cross-section and along all portions of the fiber length. At some portions of the freshly spun fibers, a greater number of xanthate groups appear to be split off, with more rapid complete regeneration of the cellulose, in a given time period, than occurs at other portions, which apparently is one factor leading to lack of homogeneity in the final fibers and their failure to show the maximum uniform crystallinity and crystallite orientation consistent with good extensibility, which theoretically should be effected by the stretching to which the fibers are subjected during their production.

25 One object of the present invention is to pro-

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vide a method of manufacturing artificial fibers which exhibit a high degree of micellar orientation with respect to the fiber axis. Another object is to provide a method of manufacturing regenerated cellulose fibers from viscose characterized by maximum uniform tenacity consistent with sufficient extensibility to render the fibers suitable for commercial purposes. A further object is to provide a method of manufacturing regenerated cellulose fibers from viscose which permits a greater measure of control over the changes which take place in the freshly formed fibers, before they are finally set up, to yield more homogeneous and uniform fibers, and the delivery of the fibres in the more homogeneous condition to the after-treatment stages.

In accordance with the present invention, freshly formed artificial fibers are passed, at any time prior to final setting up thereof, that is, while they are in the highly plastic condition in which they are obtained initially and before final setting of the molecular structure, in the case of regenerated cellulose fibers, while they are in the form of a gel comprising partially regenerated cellulose, through a pulsating field of sound waves having a frequency in the range of about 1000 to several billion cycles per second, herein called high frequency sound waves. The pulsations may be of varying duration, and the pulses may be of varying width. For example, when the transducer employed for transmitting the sound waves to the fibers, is energized through a pulsed oscillator, in accordance with this invention, the oscillations may have a frequency of, say, 500 kc. and the periods of operation and non-operation of the oscillator may be of 0.001 second duration each, to produce, during each second, 500 pulses consisting of 500 vibrations, or 250,000 cycles, each pulse having a width of 0.001 second.

In the preferred embodiment of the invention the fibers are exposed to the pulsating sound waves in a liquid medium which may be the spinning bath or a stretching bath or cascade, and a converging compressional wave lens of plano-concave type is disposed in the path of the compressional wave beam produced by the transducer. The concave face of the converging lens may be either cylindrical or spherical depending on whether it is desired to focus the waves along lines or at points. The lens may be formed of any suitable homogeneous solid material, for example, a plastic such as cellulose acetate butyrate, isobutyl methacrylate, vinyl chloride, etc. Further, a reflector is provided and so positioned with respect to the transducer and to the lens that the wave trains are returned and reinforce each other back through the lines or points of focus of the waves, whereby the intensity of the sound wave vibrations to which the fibers are exposed as they pass through the focal point or along the lines of focus of the beam, is increased. The reflector may be made of any suitable metal, for example stainless steel.

By subjecting the freshly formed highly plastic or gel-like fibers to the pulsating high frequency sound waves, it is possible to exercise control over the various processes which take place prior to final setting up of the fibers, and to radically influence the molecular structure of the final fibers, with material improvement in their physical properties. Thus, under the influence of the extremely rapidly alternating waves of compression and rarefaction to which fibers comprising partially regenerated cellulose are subjected,

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in accordance with the invention, either in the spinning bath or soon after their withdrawal from the bath and while they are in the acid-moist condition, it is possible to control the rate of diffusion of the acid through the fibers so that it is uniform at all portions of the fiber, with consequent uniform control of the rate at which dextranation and regeneration of the cellulose proceeds to completion, thus insuring that, before final setting up of the fibers, the crystallites are uniformly free to align themselves in the direction of the fiber axis. The high frequency sound wave radiations have the effect of accelerating the rate of diffusion of the bath to the interior of the fibers. However, although the diffusion rate is accelerated as compared to the rate at which it proceeds normally, it is uniform at all portions of the fiber, and under the conditions of the invention, by appropriate choice of the frequency and magnitude of the waves, the duration of exposure of the fibers to the pulsating field and the stage in the manufacture at which the sound wave radiations are applied, the rate of dextranation may be controlled to the extent that the fibers are stretched while the cellulose is only partially dextranated under which conditions optimum orientation of the crystallites is realized. In addition to the jet stretch to which the fibers are subjected incidental to withdrawal thereof from the spinning bath, the fibers may be given a predetermined after-stretch, as measured, for example, by differential in godet speeds, and acceleration of dextranation may be so controlled that, during the after-stretching step, the cellulose is only partially dextranated, the dextranation being completed, however, soon after the fibers leave the after-stretching zone, and the after-stretched fibers being in a condition for immediate processing and purification, without requiring a period of storage to permit complete regeneration of the cellulose, or only a shortened storage period for that purpose. By uniformly controlling the rate of diffusion of the acid to all portions of the fiber cross-section, and the rapidity with which the fibers are finally set up, it is possible to control the degree of reorientation of the crystallites with respect to the fiber axis within the limits in which maximum uniform increase in the tenacity of the fibers is obtained without embrittlement of the fibers.

The sound waves may be applied either directly or indirectly to the fibers, threads, or yarns, at all stages in their manufacture, from the time of their formation to just prior to subjecting them to the usual after-treating processes, or at any one or more of such stages. Further, it is within the scope of this invention to subject the fibers, while they are in the form of a gel comprising partially regenerated cellulose, simultaneously or successively to the action of a pulsating field of sound waves having different frequencies within the range stated and of different magnitudes.

The fibers may be subjected to the action of the pulsating sound waves concurrently with their formation in the spinning bath, as they proceed through the bath, before, during, or after subjecting them to after-stretching, after collection in the form of a wound package or other thread mass and during storage of the mass to permit complete regeneration of the cellulose by the adhering spinning bath, as they proceed to a thread storage, thread-advancing reel, which may also be a stretching reel, or as they are advanced over

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such a reel. When the pulsating high frequency sound wave field is established in the path of a thread proceeding from one stage to another, as from the spinning bath to a stretching zone, or from one thread handling device to another, as between godets or between a thread handling godet and a stretching reel, the waves may be applied in any direction, with respect to the direction of travel of the thread, as for instance in a direction parallel to the direction of travel, or transversely thereof. Preferably, however, the sound waves are applied to the fibers in a direction at right angles to the direction of travel of the fibers.

The freshly spun fibers may be passed through the pulsating high frequency sound wave field prior to final setting up thereof, set up, with or without after-stretching thereof, and, at a subsequent stage, brought to unplasticized condition and after-stretched, if desired.

The transducer may be of the piezo-electric crystal, magnetostrictive, or electromagnetic type.

The accompanying drawing will serve to illustrate various specific embodiments of the invention. In the drawing,

Fig. 1 is an elevation, partly in section, of apparatus suitable for carrying out one modification of the invention;

Fig. 2 is an elevation, partly in section, of apparatus suitable for carrying out another modification;

Fig. 3 is an elevation, partly in section, of apparatus suitable for carrying out another modification of the invention;

Fig. 4 is a cross-section through a spinning tank of a horizontal spinning machine, the tank being divided into a plurality of compartments or cells, each constituting an individual unit of the spinning machine, one cell being shown; and

Fig. 5 is a perspective view of a different embodiment of the invention.

Referring to Figure 1, viscose is extruded through spinneret 2, positioned in vessel 3 containing the spinning bath 4, the spinneret being arranged to spin generally vertically upwardly to the godets 5 and 6, which are driven (by means not shown) at different peripheral speeds for imparting a predetermined stretch to the fibers. A pulsed generator 7 (which may be of conventional type) is supported above the level of the bath, in a bracket 8, secured to the side of the spinning machine, and associated with the generator is a transmission tube 9, which may itself be a transducer of the type aforesaid, or provide a support for the transducer. The tube is provided with a slot or groove 10 through which the thread travels to the godets, the tube thus serving not only to transmit the pulsating high frequency sound vibrations to the threads or fibers, but also as a guide for controlling the thread as it proceeds to the lowermost godet, and for removing excess coagulating liquid from the thread. The thread is passed around godet 5, over a guide 5a, and thence over godet 6. The fibers, threads or yarns leaving the spinning bath are thus subjected to the pulsating high frequency sound waves as they enter the stretching zone.

In Figure 2, a different arrangement is illustrated, the pulsed generator 7 supported in bracket 8 being mounted on the side of the spinning machine so that the thread is subjected to the pulsating sound waves as it proceeds from the stretching zone. In Figure 2 the spinneret 2 is positioned for horizontal spinning.

Figure 3 illustrates an embodiment of the in-

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vention in accordance with which the fibers or yarns are subjected to the pulsating compressional waves simultaneously with stretching thereof. As shown, there is provided a trough 13 comprising a compartment 14 and a compartment of reduced length 15, the compartments being separated from one another by a liquid-tight diaphragm 21, a portion of which comprises a plano-concave compressional wave lens 22 the curved face of which is a spherical surface. Compartment 14 is supplied with a plasticizing liquid for the fibers, for instance, hot water or hot dilute acid, through pipe 16. The liquid discharges through pipe 17 from the overflow chamber formed adjacent one end of compartment 14 by the overflow 18. Compartment 15 contains a body of oil in which is supported a transducer 19 of the piezo-electric crystal type, the crystal being energized by a pulsed generator 20 supported below the trough. A reflector 23 is supported in compartment 14 below the level of the bath, and the crystal, spherical lens, and reflector are spaced away from each other at relative distances such that the system is tuned in resonance. The beam of compressional waves travelling from the crystal is directed by the lens 22 and converged to a focal point 24, as shown in dotted lines. The rays passing through the focal point impinge upon the spherical reflector 23 and are turned back by the reflector to their point of convergence, so that the wave energies are concentrated at the point of focus 24. The fibers are passed into the liquid in compartment 14 over the guide roll 11, wrapped one or more times around the driven roller 11a, immersed in the liquid, and then around the driven roller 12a and are withdrawn from the bath over the guide roll 12. Rollers 11a and 12a are driven at different peripheral speeds to impart a predetermined stretch to the fibers passing therebetween. The fibers travelling from roll 11a to roll 12a pass through the focal point 24 and are thus simultaneously stretched and exposed to the action of the concentrated pulsated sound waves.

It will be readily understood that one or both of rolls 11a and 12a may be replaced by thread-advancing reels.

With reference to Fig. 4 which is illustrative of an arrangement for subjecting the fibers to the effects of pulsed high frequency sound waves concurrently with their formation, there is shown one unit of a spinning machine comprising a spinning tank or other similar container for the spinning bath which, it will be understood, is divided into a plurality of compartments or troughs separated by partitions and each accommodating a single spinneret and provided with suitable means for introducing fresh spinning bath into each trough and removing the spent liquid, each compartment or cell being provided with at least one associated compressional wave producing and directing system comprising a sound producer, a compressional wave lens, and a compressional wave reflector. As shown in Fig. 4, each spinning cell is divided into two chambers 25 and 26 by means of a liquid-tight diaphragm-like member 27, having inserted therein a plano-concave compressional wave lens 28 the curved face of which is a spherical surface. The spinning bath is contained in chamber 25, and a spinneret 29 attached to a rounder 30, in turn connected with a spinning pump (not shown) is positioned in the chamber, viscose or other spinning solution being extruded horizontally into the bath through the spinneret. Chamber 26 contains a body of oil in which is supported a transducer 31 of piezo-

electric crystal type, the crystal being adapted to translate high frequency electric oscillations produced by a generator 32 into compressional waves as will be understood. A spherical compressional wave reflector 33 is supported in chamber 25 by means of a bracket 25a. The beam of high frequency compressional waves is directed by lens 28 to a focal point 34. The focal point may be immediately adjacent the face of the spinneret or at a distance removed therefrom, or the spinneret may be positioned in the point of focus of the concentrated pulsating sound waves. The rays, passing through the focal point are returned, by the reflector 33, as they impinge thereon, and concentrated at the focal point 34, through which the freshly formed fibers pass as they are drawn through the spinning bath. It will be understood that more than one compressional wave producing and directing system, each comprising a transducer, a compressional wave lens, and a compressional wave reflector may be provided at spaced points along the length of the cell, so that the freshly formed fibers are drawn through more than one point of focus of the concentrated pulsating high frequency sound waves as they are drawn through the bath.

The arrangement illustrated in Fig. 5 differs from that shown in Fig. 4, in that the plano-concave compressional wave lens 28 has a concave face of cylindrical shape and itself constitutes the liquid-tight partition between compartments 25 and 26 of the spinning cell. The reflector 33 is also cylindrical. In this embodiment of the invention, the compressional wave beam is focused and concentrated along a line in the path of travel of the fibers or threads through the spinning bath. Again, more than one compressional wave directing and concentrating system comprising a transducer, a cylindrical compressional wave lens, and a cylindrical compressional wave reflector may be provided, to provide a plurality of lines of focus and concentration of the sound waves.

The invention is not limited to the manufacture of fibers of regenerated cellulose from viscose, or to the manufacture of fibers from fiber-forming solutions by wet spinning methods, but may be practiced in the manufacture of fibers of different chemical constitution from various fiber-forming materials. Thus, fibers of regenerated proteins may be subjected to pulsating high frequency sound waves while they are in the plastic condition in which they are initially obtained, to assist in the agglomeration of polypeptide chains into parallel bundles, as occurs in the manufacture of fibers from solutions of casein, for example.

The invention is also of advantage in the manufacture of fibers from solutions of cellulose esters, such as cellulose acetate, by either the dry or wet spinning methods. Cellulose acetate fibers obtained by spinning the solution of the ester into an evaporative atmosphere, such as heated air or other fluid medium, and while still in the plastic condition in which they are obtained initially, or such fibers obtained by spinning the solution into a setting bath which may comprise, for instance, an aqueous salt solution, hydrocarbons, or oils, etc., may be subjected to the pulsating high frequency sound waves, for the obtention of fibers having enhanced tenacity by virtue of improved micellar orientation.

Modifications and variations may be made in the specific procedures described herein, without

departing from the spirit and scope of the invention as defined by the appended claims.

We claim:

1. A method of manufacturing artificial fibers from an organic polymeric fiber-forming material capable of being formed into fibers which exhibit crystallinity, which comprises extruding a solution of the fiber-forming material into a setting medium to form initially plastic fibers, advancing the fibers, at some time between extrusion of the fiber-forming material and final setting of the fibers, in a predetermined path and through a focused beam of pulsating sound waves having a frequency of at least 1000 cycles per second, said beam of waves being focused in a definite, predetermined direction on the path of the fibers.

2. A method of manufacturing artificial fibers from an organic polymeric fiber-forming material capable of being formed into fibers which exhibit crystallinity, which comprises extruding a solution of the fiber-forming material into a setting medium to form initially plastic fibers, advancing the fibers, at some time between extrusion of the fiber-forming material and final setting of the fibers, in a predetermined path and through a focused beam of pulsating sound waves having a frequency of at least 1000 cycles per second, said beam of waves being focused in a definite predetermined direction to a single point on the path of the fibers.

3. A method of manufacturing artificial fibers from an organic polymeric fiber-forming material capable of being formed into fibers which exhibit crystallinity, which comprises extruding a solution of the fiber-forming material into a setting medium to form initially plastic fibers, advancing the fibers, at some time between extrusion of the fiber-forming material and final setting of the fibers, in a predetermined path and through a focused beam of pulsating sound waves having a frequency of at least 1000 cycles per second, said beam of waves being focused in a predetermined definite direction to a line on the path of the fibers.

4. The method of claim 1, wherein the fiber-forming material is viscose.

5. The method of claim 2, wherein the fiber-forming material is viscose.

6. The method of claim 3, wherein the fiber-forming material is viscose.

7. Method of manufacturing artificial fibers from viscose which comprises extruding the viscose through a spinneret into a focused beam of pulsating sound waves having a frequency of at least 1000 cycles per second maintained in an acid setting bath for the viscose, and drawing the fibers thus formed through the setting bath, the beam of sound waves being focused in a definite predetermined direction on the path of the fibers through the bath so that the sound wave rays pass transversely through the fibers.

8. Method of manufacturing artificial fibers from viscose which comprises extruding the viscose through a spinneret into a focused beam of pulsating sound waves having a frequency of at least 1000 cycles per second maintained in an acid setting bath for the viscose, and drawing the fibers thus formed through the setting bath, the beam of sound waves being focused in a definite predetermined direction to a single point on the path of the fibers through the bath so that the rays of the sound wave beam pass transversely through the fibers.

9. Method of manufacturing artificial fibers

from viscose which comprises extruding the viscose through a spinneret into a focused beam of pulsating sound waves having a frequency of at least 1000 cycles per second maintained in an acid setting bath for the viscose, and drawing the fibers thus formed through the setting bath, the beam of sound waves being focused in a definite predetermined direction to a line on the path of the fibers through the bath so that the rays of the sound wave beam pass transversely through the fibers.

10. Method of manufacturing artificial fibers from viscose which comprises extruding the viscose through a spinneret into a focused beam of pulsating high frequency sound waves having a frequency of at least 1000 cycles per second maintained in an acid setting bath for the viscose, adjacent the spinneret, and drawing the fibers thus formed through the setting bath, the beam of sound rays being focused in a definite predetermined direction on the path of the fibers and reflected back to the site of focus so that any given ray of the sound wave beam passes repeatedly through the same point on the path of the fibers and perpendicularly through the fibers.

11. Method of manufacturing artificial fibers from viscose which comprises extruding the viscose through a spinneret into a focused beam of pulsating high frequency sound waves having a frequency of at least 1000 cycles per second maintained in an acid setting bath for the viscose, adjacent the spinneret, and drawing the fibers thus formed through the setting bath, the beam of sound rays being focused in a definite predetermined direction on a single point on the path of the fibers and reflected back to the site of focus so that any given ray of the sound wave beam passes repeatedly through said point on the path of the fibers and transversely through the fibers.

12. Method of manufacturing artificial fibers from viscose which comprises extruding the viscose through a spinneret into a focused beam of pulsating high frequency sound waves having a frequency of at least 1000 cycles per second maintained in an acid setting bath for the viscose, adjacent the spinneret, and drawing the fibers thus formed through the setting bath, the beam of sound rays being focused in a definite predetermined direction in a line on the path of the fibers and reflected back to the site of focus so that any given ray of the sound wave beam passes repeatedly through the same point in the line on the path of the fibers and perpendicularly through the fibers.

13. A machine for manufacturing artificial fibers comprising, in combination, a vessel containing a setting medium for a fiber-forming material, means for extruding a fiber-forming material into the setting medium, means for drawing the fibers formed in the setting medium through the medium in a predetermined path, means for producing a pulsating beam of sound waves having a frequency of at least 1000 cycles per second in the setting medium, and a compressional wave lens disposed between the means for producing the beam of sound waves and the fibers, for focusing the beam of sound waves in a definite, predetermined direction on the path of the fibers through the setting medium.

14. A machine for manufacturing artificial fibers comprising in combination a vessel containing a setting medium for a fiber-forming material, means for extruding a fiber-forming material into the setting medium, means for drawing the fibers formed in the setting medium

through the medium in a predetermined path, means for producing a beam of sound waves having a frequency of at least 1000 cycles per second in the setting medium, and a plano-concave compressional lens the curved face of which is a spherical surface disposed between the means for producing the beam of sound waves and the fibers, for focusing the beam of sound waves in a definite predetermined direction to a single point on the path of the fibers through the setting medium.

15. A machine for manufacturing artificial fibers comprising in combination a vessel containing a setting medium for a fiber-forming material, means for extruding a fiber-forming material into the setting medium, means for drawing the fibers formed in the setting medium through the medium in a predetermined path, means for producing a beam of sound waves having a frequency of at least 1000 cycles per second in the setting medium, and a plano-concave compressional lens the curved face of which is a cylindrical surface disposed between the means for producing the beam of sound waves and the fibers for focusing the beam of sound waves in a definite predetermined direction to a line on the path of the fibers through the setting medium.

16. A machine for manufacturing artificial fibers which comprises in combination a container, a plano-concave compressional wave lens extending longitudinally of the container and separating the container into two liquid-tight compartments, a setting medium for a fiber-forming material in one of the compartments, a body of oil in the other of the compartments, a piezo-electric crystal supported in the body of oil, means for energizing the crystal to produce a beam of pulsating high frequency sound waves, a compressional wave reflector tuned in resonance with the lens and crystal and supported in the setting medium, means supported in the setting medium for extruding a fiber-forming material into the medium, and means for drawing the fibers formed in the medium in a predetermined path through the medium between the lens and reflector and in a direction at a right angle to the beam of sound waves produced by the crystal, and through the site of focus of the focused and reflected sound waves.

17. A method of manufacturing artificial fibers from an organic polymeric fiber-forming material capable of being formed into fibers which exhibit crystallinity, which comprises extruding a solution of the fiber-forming material into a setting medium to form initially plastic fibers, advancing the fibers, at sometime between extrusion of the fiber-forming material and final setting of the fibers, in a predetermined path, and through a beam of pulsating sound waves having a frequency of 250,000 cycles per second, each pulse having a width of 0.001 second, said beam being focused and reflected back in a definite predetermined direction to a focal site on the path of the fibers.

18. A method of manufacturing artificial fibers from an organic polymeric fiber-forming material capable of being formed into fibers which exhibit crystallinity, which comprises extruding a solution of the fiber-forming material into a setting medium to form initially plastic fibers, advancing the fibers, at sometime between extrusion of the fiber-forming material and final setting of the fibers, in a predetermined path, and through a beam of pulsating sound waves having a frequency of 250,000 cycles per second, each pulse having a width of 0.001 second, said

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waves being applied in a direction transverse to the direction of travel of the fibers and focused and reflected back to a focal site on the path of the fibers.

19. A method of manufacturing artificial fibers from an organic polymeric fiber-forming material capable of being formed into fibers which exhibit crystallinity, which comprises extruding a solution of the fiber-forming material into a setting medium to form initially plastic fibers, advancing the fibers, at some time between extrusion of the fiber-forming material and final setting of the fibers, in a predetermined path, and through a beam of pulsating sound waves having a frequency of 250,000 cycles per second, each pulse having a width of 0.001 second, said waves being applied transversely of the fibers and the sound wave beam being focused and reflected back to a single point on the path of the fibers so that each ray of the beam passes repeatedly through said point and transversely through the fibers.

20. A method of manufacturing artificial fibers from an organic polymeric fiber-forming material capable of being formed into fibers which exhibit crystallinity, which comprises extruding a solution of the fiber-forming material into a setting medium to form initially plastic fibers, advancing the fibers, at some time between ex-

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trusion of the fiber-forming material and final setting of the fibers, in a predetermined path, and through a beam of pulsating sound waves having a frequency of 250,000 cycles per second, each pulse having a width of 0.001 second, said waves being applied at a right angle to the fibers and the sound wave beam being focused and reflected back to a line on the path of the fibers so that each ray of the beam passes repeatedly through the same point on said line and perpendicularly through the fibers.

LEROY ERIC PETERSON.
SIDNEY LEONARD DART.

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