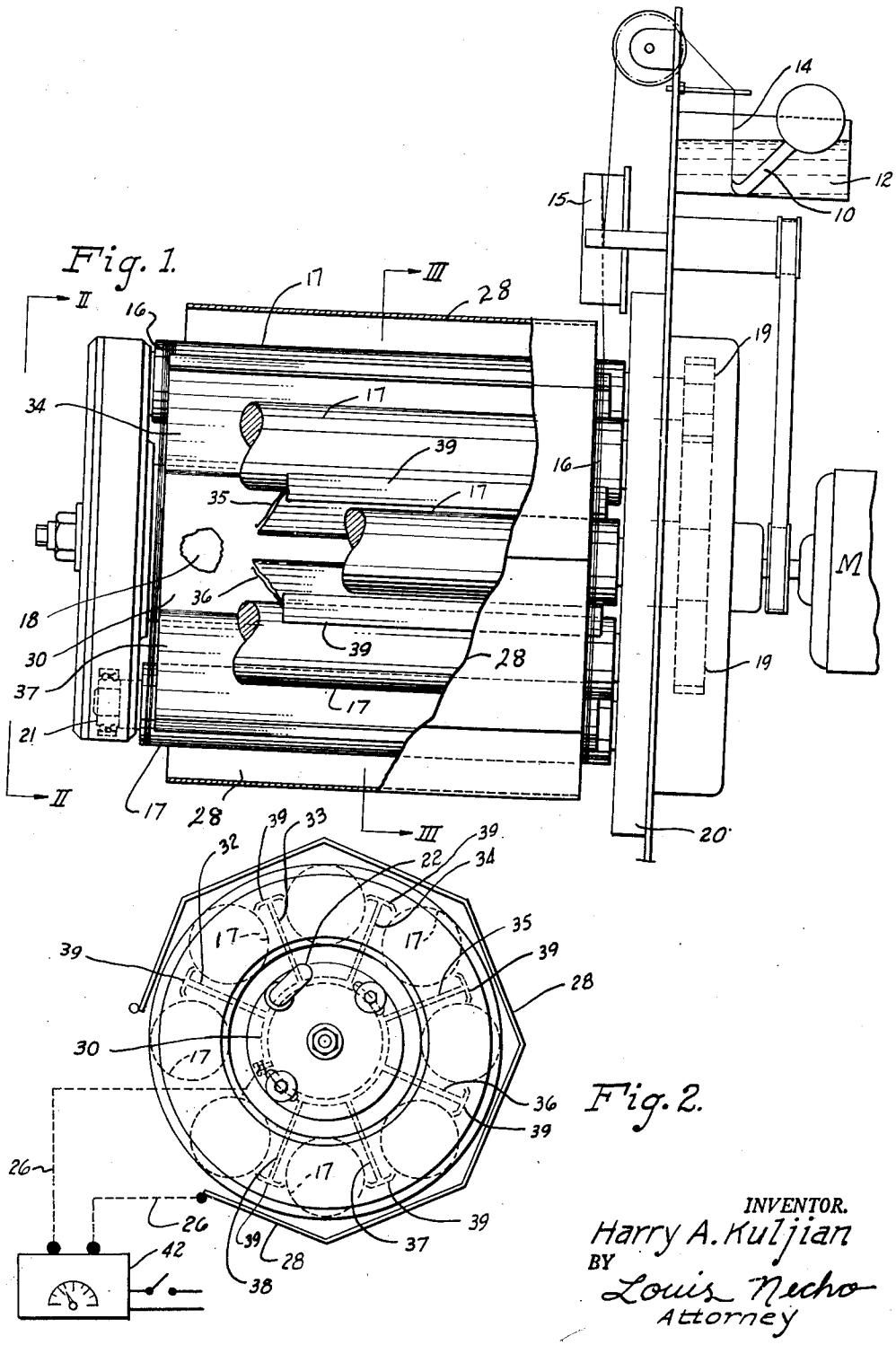
March 28, 1950 H. A. KULJIAN 2,501,776

METHOD OF AND APPARATUS FOR DRYING

Filed July 17, 1947 2 Sheets-Sheet 1



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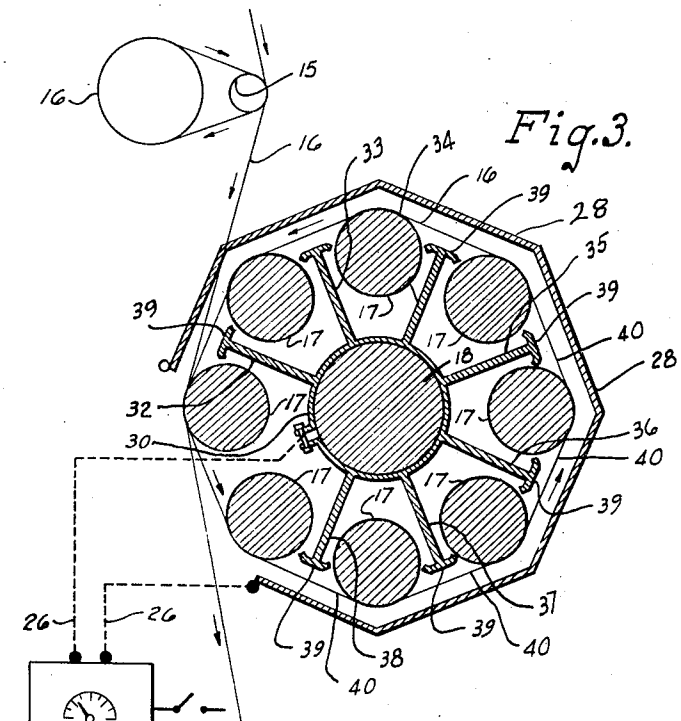


Fig. 3.

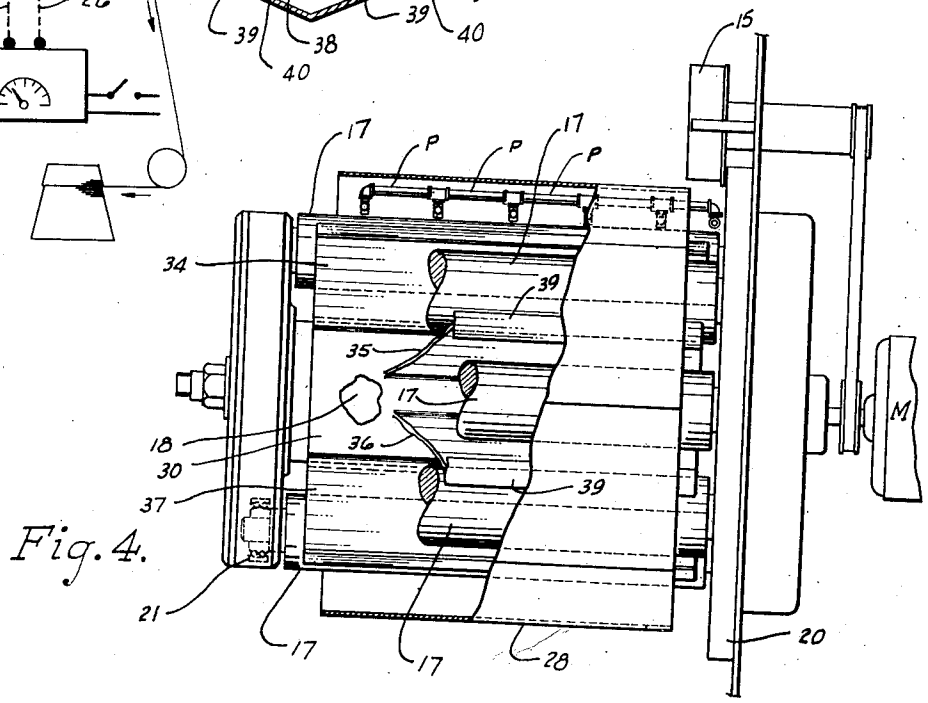


Fig. 4.

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METHOD OF AND APPARATUS FOR DRYING

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My invention relates to a drying apparatus of the type which employs the heating effect which results when a material having a considerable dielectric loss characteristic is placed in a high-frequency electric field.

One object of the invention is to produce an improved apparatus for, and an improved method of, drying or otherwise treating a dielectric material by the use of dielectric heating.

A further object of the invention is to produce an improved apparatus for, and an improved method of, drying or otherwise treating natural or synthetic yarns, textiles or other materials having relatively high dielectric loss characteristics.

A still further object of the invention is to produce an improved apparatus for, and an improved method of, drying or otherwise treating dielectric materials, whereby the material to be dried or treated is fully exposed to the action of a controlled high-frequency electric field and whereby the means which support the material is substantially wholly excluded from the high-frequency field, thereby assuring adequate heating of the material and insuring against heating of the supporting means by the action of the high-frequency electric field.

A still further object of the invention is to produce an improved apparatus for, and an improved method of, drying or otherwise treating yarn, whereby a controlled portion or portions of the yarn may, simultaneously or successively, be subjected, for controlled periods of time, to constant or variable, but controlled, action of a high-frequency electric field.

A still further object is to produce an improved apparatus for, and an improved method of, drying or otherwise treating a yarn, with the yarn moving, single-file, through a high-frequency electric field, as distinguished from subjecting a spool or cake of yarn to the action of a high-frequency electric field.

A still further object of the invention is to produce an improved apparatus for, and an improved method of, drying or otherwise treating yarn, whereby the principle of dielectric heating is employed in conjunction with a thread-storing and advancing device of the type which includes two or more spaced rolls, the axis of at least one of which is skewed, and at least one of which rolls is rotated about its axis, whereby the device causes a yarn wound thereabout to move, in the form of a helix having a plurality of spaced convolutions, axially of the device.

A still further object of this invention is to

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produce an improved apparatus which can be used for drying only or for subjecting the material to heat while such material is being liquid-treated, set or cured.

These and other objects are effected by the invention as set forth in the following specification and as illustrated in the accompanying drawings in which:

Fig. 1 is a fragmentary and diagrammatic view in side elevation showing the application of my invention to the drying of a synthetic thread.

Fig. 2 is a fragmentary end elevational view looking in the direction or line 2—2 on Fig. 1.

Fig. 3 is a fragmentary vertical sectional view taken on line 3—3 on Fig. 1.

Fig. 4 is a view, similar to Fig. 1, showing another application of the invention.

In the particular application illustrated in the drawings, there is shown, in a highly diagrammatic manner, an apparatus for continuous manufacture of synthetic yarn, which apparatus includes a spinnerette 10 which extrudes an appropriate solution into a coagulating bath 12 to form a filament 14. The filament 14 passes over suitable stretching and guiding devices 15, and onto a thread-storing and advancing device which is adapted to receive and advance the thread, in the form of a helix having a plurality of spaced convolutions 16, from one end of said device to the other.

The thread-storing and advancing device, as such, does not form part of the present invention and is, therefore, not shown or described in detail. It is sufficient to state that the thread-storing and advancing device is formed of a plurality of spaced rotary rolls 17, with the axis of one or more of the rolls skewed with respect to the axis of a central, fixed roll 18, and with one or more of the rolls rotated about its individual axis. By this structure, a thread wound about one end of said device, will travel, axially of the device, in the form of a helix having more or less closely spaced convolutions 16 until it reaches and leaves the other end of the device. One or more of the rolls may be rotated by a suitable gear arrangement 19 driven by a motor M, and the entire thread-storing and advancing device is mounted, in cantilever fashion, on a frame 20. The ends of the rolls 17 are provided with ball bearings 21, and the axis of one or more of the rolls may be skewed, by rotation of a handle 22 which is arranged to move the left-hand ends of the rolls, as viewed in Fig. 1, to cause the thread to move longitudinally of the rolls as above set forth. It will be understood that the

spacing of the convolutions 16, and the rate of their movement axially of the rolls, can be varied by increasing or decreasing the skew of the rolls. Since the manner in which the axes of the rolls may be skewed is not part of the present invention and since there is one, or more, well-known methods of skewing the axes of the rolls, further illustration and description of this mechanism are unnecessary.

In carrying out my invention, I produce a controlled high-frequency electric field between the electrodes of an electrostatic circuit, and I cause the thread on the thread-storing and advancing device to move, in a controlled manner, through said field. Also, I so arrange the electrodes as to exclude the thread-storing and advancing device from the high-frequency electric field.

The high frequency electric field is created between an outer electrode 28 and an inner electrode 30, said electrodes being connected by means of wires 26 to the control device 42 of a conventional electrostatic circuit not shown. The outer electrode 28 is preferably arcuate in form so as to encompass a major portion of the circumference of the thread-advancing device, and the inner electrode 30 is in the form of an annulus which encloses the central fixed roll 18. The inner electrode 30 is provided with radial, generally T-shaped, extensions 32, 33, 34, 35, 36, 37 and 38 which are disposed between the rolls 17, as best shown in Fig. 3. Also, as shown in this figure, the extensions 32, 33, 34, 35, 36, 37 and 38 are circumscribed by a yarn circumscribing the rolls 17. By this arrangement, the heads 39 of the extensions 32, 33, 34, 35, 36, 37 and 38 are in juxtaposition with corresponding portions of the outer electrode 28, so that a high-frequency electric field is created therebetween. Again referring to Fig. 3, it will be seen that, as the yarn moves through the spaces 40 between adjacent rolls, it will pass between the electrode 28 and the corresponding, juxtaposed, electrode extensions 32 to 38 or through the high-frequency electric fields created between said electrodes.

In the drawings, I have shown seven extensions 32, 33, 34, 35, 36, 37 and 38, so as to create a high-frequency field across the spaces 40 which intervene between all but two of the rolls 17, and I have shown the electrodes as coextensive, longitudinally considered, with the rolls 17. However, it will be understood that the electrodes may be made short enough to cover any desired fraction of the length of the rolls, that they may also be made to cover any desired fraction of the circumference of the thread-advancing device, and that any desired number of extensions 32 to 38 may be used. For example, if it is desired to confine the heating to one portion or another of the thread on the rolls, the electrode 28 and the extensions 32 to 38 can be so arranged to create a high-frequency field in a selected limited location. Likewise, if it is desired to subject the thread to the heating action of a high-frequency field only while it is passing from one or more given rolls onto adjacent rolls, only the corresponding extensions of the inner electrode 30 will be used, and the other extensions will be omitted or deenergized, thus limiting the high-frequency electric field to any given segment of the thread-storing and advancing device.

In addition to controlling the location, extent and intensity of the high-frequency field in the manner above set forth, the drying operation can be further controlled by varying the spacing of the convolutions 16 of the helix and by regulating the rate of movement of the thread axially of the thread-advancing device. This, as above stated, can be done by varying the degree to which the axis of one or more of the rolls is skewed and by varying the rate of rotation of the rolls.

While, as shown and described, the rolls 17 are not exposed to the various high-frequency electric fields created, so that such rolls can be made of any desired material, I prefer to make the rolls from some material having a low dielectric loss characteristic, so that, even if such rolls were exposed to the high-frequency electric field, they will not become overheated. In practice, I prefer to make the rolls from a derivative of acrylic acid, such as methyl methacrylate or similar plastic.

It will, of course, be appreciated that evaporation of moisture from the yarn absorbs most, if not all, of the heat generated, so that the yarn does not begin to heat sensibly until it has reached the delivery end of the thread-storing and advancing device. Likewise, any sensible heat which tends to develop in the rolls 17 will also be used up in evaporating the liquid in the yarn or on the rolls. Thus, by properly timing the control factors above outlined, undesirable heating of the yarn or of the rolls can be eliminated or controlled.

If desired, instead of using a single pair of electrodes 28 and 30, which are substantially coextensive, longitudinally and circumferentially, with the thread-storing and advancing device, I can use a plurality of separately operable electrodes and I can selectively energize one or more of said electrodes.

In certain cases, it is desirable that a thread or other material may be washed, or liquid-treated in the presence of heat. This is diagrammatically illustrated in Fig. 4, in which a series of controlled pipes PP are provided for delivering one or more kinds of liquid with which it is desired to treat the thread. In this construction, the thread will be subjected to the liquid treatment and to the heating action of the high-frequency electric field at the same time.

What I claim is:

1. The method of subjecting a thread to heat, which method includes winding said thread about a thread storing and advancing device formed of a plurality of elongated, spaced rolls, placing one electrode of an electrostatic circuit within the area circumscribed by said thread but in registration with a selected number of the spaces which intervene between adjacent rolls, placing the other electrode of said circuit outside of said area but in registration with said spaces, energizing said electrodes, and causing said thread to move across said space and between said electrodes.

2. The method of subjecting a thread to controlled heat, which method includes winding said thread about a thread storing and advancing device formed of a plurality of spaced, elongated, substantially parallel rolls with said thread circumscribing all of said rolls, placing a plurality of electrodes connected to one side of an electrostatic circuit within the area circumscribed by said thread, with said electrodes in registration with a corresponding number of the spaces intervening between said rolls, placing corresponding electrodes, which are connected to the other side of said circuit, outside of said area but in registration with said spaces, energizing said electrodes, and causing said thread to move across said spaces.

3. Apparatus for carrying out the method disclosed, said apparatus including a plurality of

spaced, substantially parallel, elongated rolls adapted to have a thread wound about, and circumscribing all of, said rolls, a first electrode connected to one side of an electro-static circuit and positioned inwardly of the outer peripheries of said rolls but in registration with a selected number of the spaces intervening between adjacent rolls, a second electrode connected to the other side of said circuit and placed outwardly of the peripheries of said rolls but in juxtaposition with the first mentioned electrode, means for causing the thread to move across said space and between said electrodes, and means for energizing said electrodes.

4. Apparatus for carrying out the method disclosed, said apparatus including a plurality of elongated, spaced, substantially parallel rolls adapted to have a thread wound thereon with said thread circumscribing all of said rolls, a plurality of electrodes connected to one side of an electrostatic circuit and placed inwardly of said thread but in registration with selected spaces between said rolls, an electrode placed outwardly of said thread and arranged to register with said electrodes, means for energizing said electrodes, and means for causing said thread to move across said spaces.

5. The combination with a thread storing advancing device formed of a plurality of spaced, elongated, substantially parallel rolls, and including means for causing thread wound about

said device to move in a spiral path, transversely of said rolls and axially of said device, of an electrode connected to one side of an electrostatic circuit and located inwardly of a line which encompasses all of said rolls, but in registration with a selected space intervening between said rolls, and an electrode connected to the other side of said circuit and located outwardly of said line but in registration with said space.

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