June 7, 1955 A. W. HUNTER ET AL 2,709,856

DRYING APPARATUS FOR WOUND FILAMENTARY PACKAGES

Filed Dec. 3, 1952

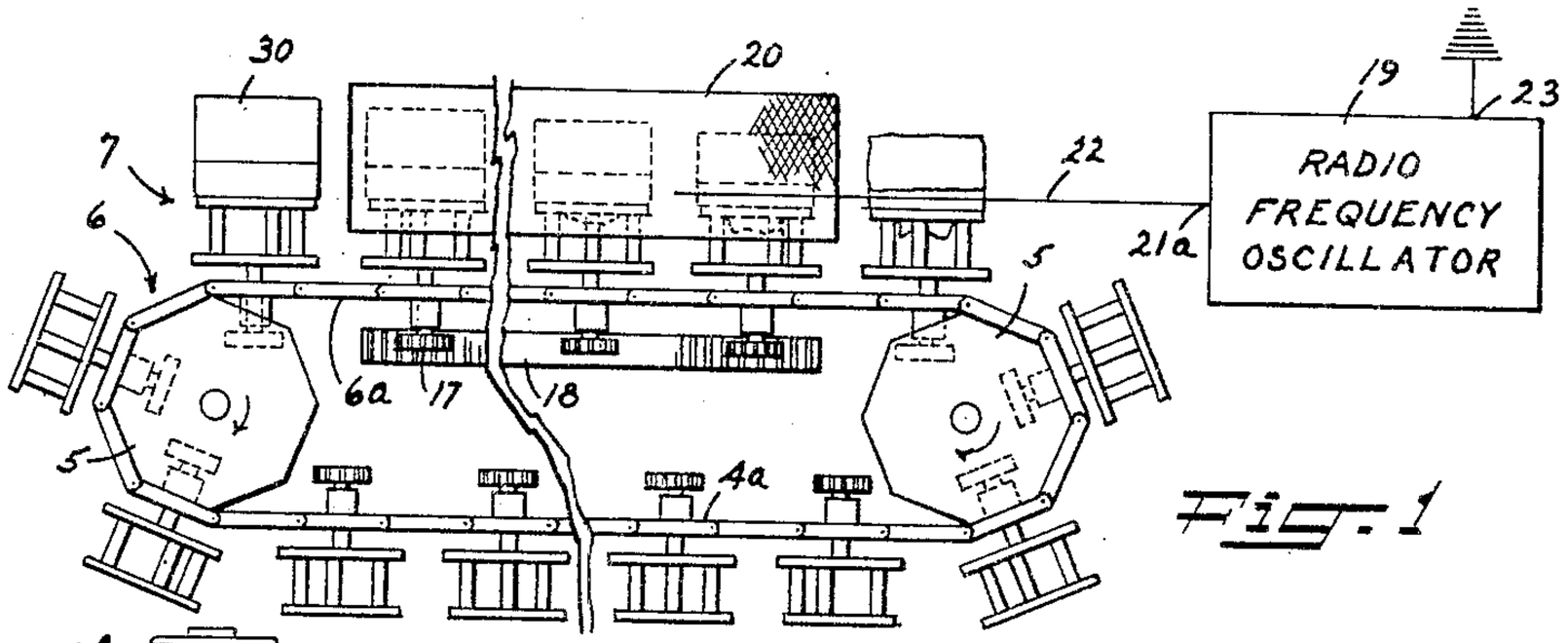

Fig. 1

Fig. 2

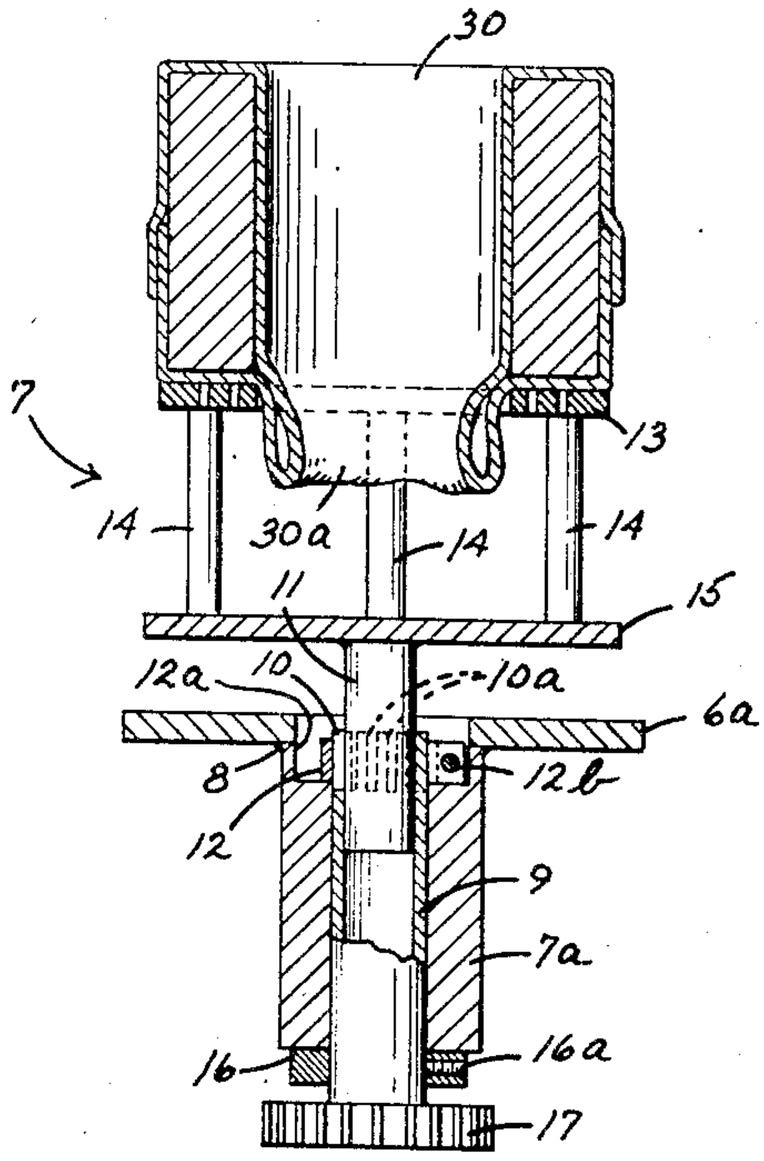

Fig. 4

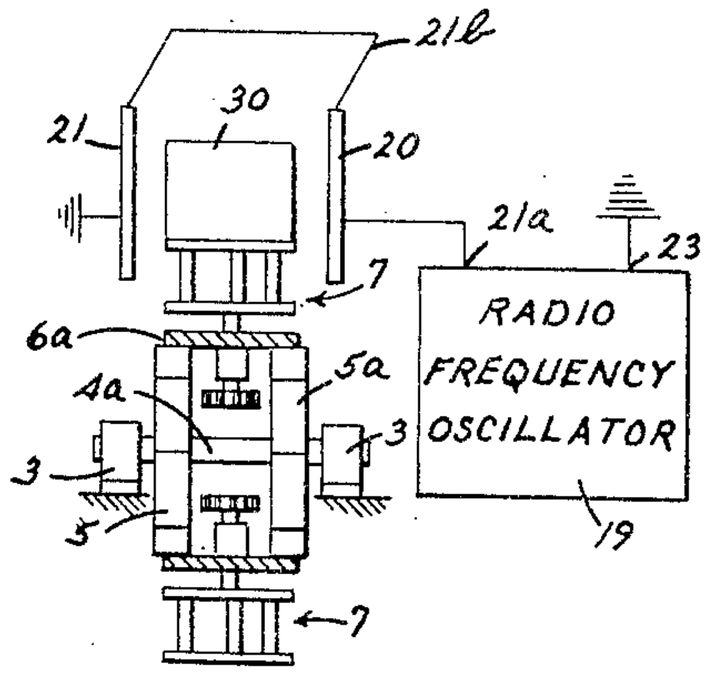

Fig. 3

INVENTORS
ALFRED W. HUNTER
JOHN E. PHILLIPS

BY Thomas R. O'Malley
ATTORNEY.

United States Patent Office

2,709,856

Patented June 7, 1955

2,709,856

DRYING APPARATUS FOR WOUND FILAMENTARY PACKAGES

Alfred W. Hunter and John E. Phillips, Chester, Pa., assignors to American Viscose Corporation, Philadelphia, Pa., a corporation of Delaware

Application December 3, 1952, Serial No. 323,912

5 Claims. (Cl. 34—1)

The present invention relates to apparatus for drying moisture-laden wound packages of filamentary material and the like. More particularly it relates to apparatus for drying annular packages of filamentary material which reduce in size and shrink considerably during the moisture-removal operations. In the specification and claims hereof it is to be understood that the term "moisture" is intended to refer to any suitable treating liquid or the like and it is therefore not restricted to water.

In the liquid treatment of filamentary materials in package form it is ordinarily necessary to first wrap the package with a suitable protective permeable covering or the like so that during the subsequent liquid treating operations, deformation of the package and entanglement of its component convolutions is substantially prevented. After the various liquid treating operations have been completed, it is then necessary to properly dry the filamentary packages as quickly and as efficiently as possible. So as to minimize the possibility of damage to the yarn, no attempt is ordinarily made to remove the protective covering prior to the completion of the drying operation. Accordingly the filamentary packages which are still wrapped in their respective protective coverings are ordinarily deposited in that condition on a suitable conveyor device and delivered to the drying apparatus. In drying apparatus, which has been suggested heretofore in the art, the filamentary package support members which are secured to and spaced along the conveyor device are ordinarily perforated so as to improve the circulation of convection currents about the packages during the drying operation. However, inasmuch as the packages often contain 40% or more moisture by weight (and it is quite common to contain 100 to 200% by weight of moisture even after the extraction of excess liquid in a centrifuge) it has been found that the liquid removal or drying operation of the package is ordinarily accompanied by marked shrinkage. Consequently, considerable difficulty has been experienced in the past when the protective coverings, which become increasingly loose about their associated filamentary packages during the marked shrinkage thereof, droop downwardly to cover the perforations in the package support members and thereby obstruct and impede proper circulation of the drying convection currents.

It is a principal object of the present invention to provide novel and improved apparatus for drying annular packages of filamentary material and the like with greater speed and efficiency.

A further object of the invention is to provide an improved yarn cake support in apparatus of the class described.

Other objects and advantages of the present invention will be apparent from the following description.

In the drawing which is illustrative of the invention,

Figure 1 is an elevational view of a yarn cake drier incorporating present invention;

Figure 2 is a top view of the apparatus shown in Figure 1;

Figure 3 is a section along reference line III—III in Figure 2; and

Figure 4 is an enlarged sectional view of our improved yarn cake support.

In general, the improved apparatus of the present invention includes an endless conveyor, perforated annular package support members which are positioned about the periphery of the conveyor in a spaced relation thereto, and means disposed adjacent a portion of the path followed by the support members for drying filamentary packages positioned thereon. It has been found that the conventionally wrapped annular wound filamentary packages may be dried more quickly and more efficiently in such apparatus.

Although it is to be understood that other types of conventional drying apparatus could also be employed in connection with the present invention, it has been found that relatively high voltage radio frequency drying apparatus provides particularly satisfactory results. More specifically it has been found that the heretofore mentioned marked shrinkage of the filamentary packages causes considerable trouble when conventional drying procedures are employed since the outer windings of the packages tend to dry more rapidly than the inner windings thereof. This gives rise to a so-called strained yarn wherein the residual shrinkage of the inside and outside windings of the yarn varies considerably and oftentimes causes a barré effect when the yarn is subjected to subsequent processing and/or treating operations such as dyeing or the like.

In order to reduce these effects to a practical minimum it has been necessary, when other conventional drying apparatus has been employed, to carefully control various aspects and/or conditions of the drying operation such as the humidity, the temperature, and the like. With the use of relatively high frequency drying appartus however (i. e., apparatus which operates within or substantially within the radio frequency range), improved results have been obtained whereby drying times have been materially reduced and the need for control over the above mentioned humidity and temperature conditions and the like has been practically eliminated. Consequently it is often preferable to employ radio frequency drying apparatus at least until approximately 75% by weight of the original moisture in the yarn has been removed therefrom. Since at approximately that point in the drying operation it has been found that the subsequent shrinkage in the yarn is practically negligible and therefore unimportant and that thereafter a relatively abrupt increase in the expenditure of electrical energy is necessary to maintain a constant rate of drying, it is generally expedient and desirable to use the other conventional types of drying apparatus to remove the remaining 25% of the moisture in the yarn. It is to be again emphasized, however, that the methods and apparatus of the present invention can be used advantageously with other conventional drying apparatus as well as with the radio frequency equipment disclosed herein.

A preferred embodiment of the present invention is illustrated in Figures 1 through 4 of the drawing. As shown therein the journal or bearing members 3 rotatably support the substantially parallel shafts or the like 4 and *4a*. The sprocket members 5 and *5a*, which are secured to each of the shafts as shown, cooperate with and guide the endless apron conveyor or the like 6 which is positioned thereabout. Any suitable means such as the motor or the like *4b* is connected to one or both of the shafts and provides a means for driving the conveyor 6 at a predetermined rate.

As best shown in Figures 1 and 4, a plurality of filamentary package support assemblies which are generally designated by the reference numeral 7 are preferably

regularly spaced about the periphery of the conveyor or the like 6. More specifically the journal members 7*a* are preferably secured to the individual sections or links 6*a* of the conveyor in any suitable manner such as by the welding shown at 8 and extend outwardly and transversely therefrom. The tubular members 9 which are rotatably positioned in each of the journal members 7*a* are preferably vertically slotted as at 10 adjacent one extremity to form the resilient fingers 10*a*. The shaft 11 which is positioned in the slotted extremity of the tubular member 9 is preferably secured thereto by clamping means comprising a split resilient ring 12 which surrounds the resilient fingers 10*a* and may be tightened thereabout by a screw 12*b* to bring the fingers into frictional engagement with the lower end of the shaft 11. The clamp is preferably disposed within an annular recess 12*a* of the journal member as shown.

The corrosion resistant plate members or discs 15 which are secured to the opposite extremities of each of the shafts 11 together with the upright members or posts 14 which extend upwardly therefrom are adapted to support the perforated annular platforms or the like 13 above and generally parallel to the discs 15 as is best shown in Figure 4 of the drawing. As will be more apparent hereinafter the numerous perforations in the annular platforms 13 are preferably provided to permit the circulation of natural and/or forced convection currents through the package support platforms 13. The material out of which the upright members or posts 14 and the annular platforms 13 which are positioned thereon are made preferably has a relatively low dielectric constant so as to minimize the absorption of electrical power therein during the drying operation. More specifically, various synthetic resin materials such as Rexolite #1422 which is a copolymer of styrene and divinylbenzene and which has a dielectric constant of approximately 2.4 to 2.5 and a power factor of .0007 up to 3000 megacycles have been found particularly useful. For reasons which will be more apparent hereinafter, the inner diameter of each annular platform 13 is preferably substantially equal to the inner diameter of the annular filamentary package 30 which is positioned thereon during the drying operation. Similarly the outer diameter of each annular platform is preferably substantially equal to the outer diameter of the package 30. As will also be more apparent hereinafter the length of the upright members or posts 14 is preferably made sufficient to properly insulate the annular platforms 13 from the discs 15 as well as to insure good circulation into the center of the packages 30 even when the protective coverings 30*a* droop downwardly.

The collar member 16 which is secured in any suitable manner such as by the set screw or the like 16*a* to the periphery of the tubular member 9 adjacent the outer extremity of the journal member 7*a* together with the clamping member 12 limit the vertical movement of the tubular member therein. The gear 17 which is secured to the lower extremity of the tubular member 9 is adapted to engage a stationary rack or the like 18 disposed below the upper course of the conveyor apron 6 so as to cause rotation of the support assemblies 6 and the various filamentary packages 30 positioned thereon in the various respective journal members 7*a* during the drying operation.

As indicated heretofore the drying apparatus which is used in conjunction with the present invention preferably includes a relatively high voltage radio frequency generator or oscillator which is diagrammatically designated in the drawing by the reference character 19. The output circuit of the oscillator 19 preferably includes the generally parallel vertically disposed electrodes 20 and 21 between which the filamentary packages 16 are adapted to pass. More specifically the output terminal 21*a* of the radio frequency oscillator is connected by means of the conductor 22 to the electrode 20 whereas the terminal 23 of the oscillator is connected by way of ground to the other electrode 21. In this way a relatively intense radio frequency field is set up about the rotating filamentary packages as they progress along the upper course of the conveyor apron 6.

The electrodes 20 and 21 are preferably formed from a suitable screen-like material or the like such as a woven metallic wire screen. It has been found that when the electrodes are constructed in such a manner substantially reduced amounts of moisture precipitate and collect thereon during the drying operation. Moreover, the screen or grid-like electrodes of the present invention serve to improve still further the circulation of convection currents about the filamentary packages.

As shown in Figure 2 of the drawing a shorted stub or the like 21*b* may be provided to obtain an approximately constant potential along the electrodes. Accordingly the stub is preferably positioned at a point approximately one third the length of the screen-like electrodes 20 and 21 from the extremities thereof between which the filamentary packages enter, and the feed lines or conductors from the oscillator 19 are preferably connected to the electrodes 20 and 21 at a point approximately one third their length from the extremities thereof between which the packages leave the drying region. Due to the varying amount of residual moisture in the filamentary package or cakes during the drying operation and therefore the change of the load along the length of the electrodes 20 and 21, it has been found that the characteristic impedance of the system can be more nearly approached and a relatively constant voltage potential along the length of the electrodes can be better maintained in such a way.

It is to be understood, however, that if it were desirable to control the voltage potential along the length of the electrodes 20 and 21 in any other fashion the position of the stub 21*b* and the feed lines could be accordingly varied without departing from the spirit or scope of the present invention.

It is to be understood that any suitable conventional oscillator circuit could be employed to generate the desired high frequency current. The voltage of the high frequency field between the electrodes 20 and 21 could vary anywhere from 3,000 up to 25,000 volts and its frequency could range from one to 50 or more megacycles, it being understood that, in general, the higher voltage and frequency, the higher the rate of heat input and drying.

In operation the annular filamentary packages 30 which are to be dried in accordance with the present invention and which have been wrapped in their conventional fabric coverings or sleeves 30*a*, suitably liquid processed, centrifuged in order to preliminarily remove the excess treating liquid absorbed thereby and worked or kneaded into a relatively loose condition are first properly positioned on the perforated annular platforms 13 of the support assembly 7. Although this operation is preferably performed manually as the assemblies 7 progress with the conveyor 6 from the upper periphery of the sprocket member 5 toward the adjacent extremities of the electrodes 20 and 21, it is to be understood that this operation could be performed in any conventional, automatic, or semiautomatic manner without departing from the spirit or scope of the present invention. As the filamentary packages 16 then pass between the electrodes of the drying apparatus, the gears 17 of each of the package support assemblies 7 engage the stationary rack 18 and thereby cause the associated packages 16 to rotate at a predetermined rate during the drying operation. As the packages 16 then proceed to shrink in size the resulting oversized protective fabric coverings 30*a* droop downwardly into the annular openings of the platforms 13 as shown in Figure 4 of the drawing. In this way none of the apertures or perforations in the support platforms are covered or blocked up and improved circulation of the drying convection currents results. Finally upon completion of at least a major part of the drying operation, the packages are removed from

the conveyor 6 either manually or automatically in any suitable manner.

The following example is illustrative of a typical drying operation wherein the apparatus of the present invention was employed. Annularly wound regenerated cellulose rayon cakes approximately six inches in height having an outside diameter of about seven inches and an inside diameter of 3½–4 inches were centrifuged after being conducted through the various conventional liquid treating operations. In the wet condition as removed from the centrifugal device the overall weight of each cake was approximately 1750 grams including approximately 900 grams of water. Each cake was then dried in the apparatus of the present invention for approximately 3 minutes. The juxtaposed electrodes of the said apparatus and therefore its effective radio frequency drying field were approximately ten feet long and the filamentary package support assemblies were spaced along the conveyor such that about fourteen cakes were exposed to the field at a given time. The voltage along the length of electrodes was maintained substantially constant at about 9000 or 10,000 volts. During the three minute period approximately 100,000 to 200,000 calories of heat energy were generated per minute in each cake and the moisture content thereof was reduced to about 25% by weight of the rayon on the wet basis.

Although it has been found unnecessary in connection with the above disclosed drying apparatus when using dielectric heating, it is to be understood that the air which is circulated about the filamentary packages 30 during the drying operations either by dielectric heating or otherwise could be heated and/or humidified without departing from the spirit or scope of the present invention.

While preferred embodiments of the invention have been disclosed, the description is intended to be illustrative only and it is to be understood that changes and variations may be made without departing from the spirit and scope of the present invention as defined by the appended claims.

We claim:

1. Apparatus for removing moisture from annularly wound packages of filamentary material wrapped with a permeable protective fabric covering comprising a pair of substantially parallel shafts; an endless conveyor; means for driving one of the shafts at a predetermined rate; a bracket secured to the conveyor; a tubular sleeve rotatably positioned in the bracket; a rod secured to one extremity of the sleeve and extending axially therefrom through said bracket; a flat disc-like member having one surface secured to the opposite extremity of the rod; a plurality of posts positioned about the periphery of the opposite surface of the disc-like member; an annular perforated package support positioned on the posts, the inner and outer diameters of the annular support being substantially equal to the inner and outer diameters of the filamentary packages from which moisture is to be removed; and a drying device through which the annular support is conducted during a predetermined portion of each revolution of the conveyor.

2. Apparatus for removing moisture from annularly wound packages of filamentary material wrapped with a permeable protective fabric covering comprising a pair of substantially parallel shafts; an endless conveyor; means for driving one of the shafts at a predetermined rate; a bracket secured to the conveyor; a tubular sleeve rotatably positioned in the bracket; a rod secured to one extremity of the sleeve and extending axially therefrom through said bracket; a flat disc-like member having one surface secured to the opposite extremity of the rod; a plurality of posts positioned about the periphery of the opposite surface of the disc-like member; an annular perforated package support member positioned on the post members, the inner and outer diameters of the annular support member being respectively substantially equal to the inner and outer diameter of the filamentary packages from which moisture is to be removed; a pair of separated substantially parallel elongated screen-like plates through which the annular support passes during a particular portion of each revolution of the conveyor; means including a radio frequency generator for producing an electrostatic field between the plates; and means secured to the other extremity of the tubular sleeve for rotating the annular support as it passes between the plates.

3. A yarn cake support for yarn cake driers and the like comprising a bracket having a substantially vertical bore, a shaft journaled in said bore, means on the shaft for preventing relative axial movement thereof, a plate mounted on one end of said shaft, means including a pinion secured to the opposite end of the shaft for rotating the shaft in the bracket, a perforated annular disc supported above and in spaced relation to said plate, and a plurality of non-conductive posts supporting the disc on the plate, the inside diameter of the disc being substantially the same as the inside diameter of a yarn cake.

4. Apparatus in accordance with claim 3 in which the disc and the post are of a synthetic plastic material.

5. Apparatus in accordance with claim 4 in which the outside diameter of the disc is substantially equal to the outside diameter of a yarn cake.

References Cited in the file of this patent

UNITED STATES PATENTS

2,263,681	Hart	Nov. 25, 1941
2,589,400	Koster et al.	Mar. 18, 1952
2,599,360	Batink et al.	June 3, 1952
2,604,665	Bosomworth et al.	July 29, 1952
2,635,352	Phillips, Jr.	Apr. 21, 1953