Nov. 25, 1941. G. T. HART, JR 2,263,681

TREATING RAYON CAKES

Filed Oct. 19, 1938

Fig.4.

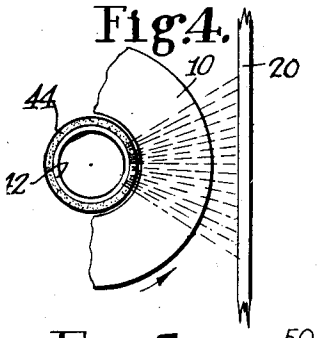


Fig.5.

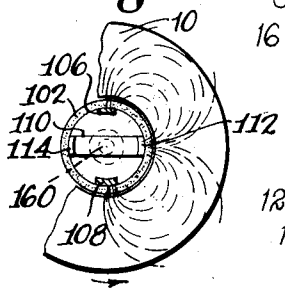


Fig.1.

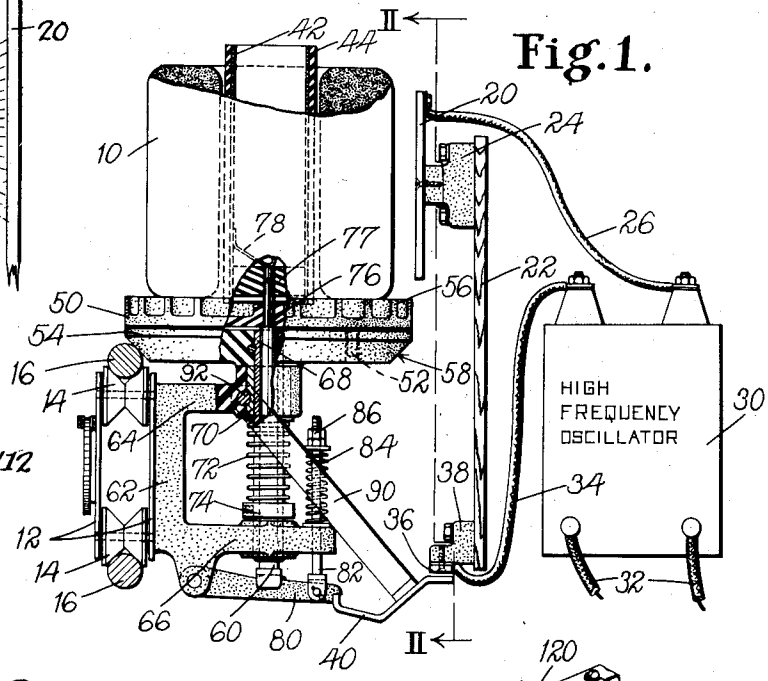


Fig.2.

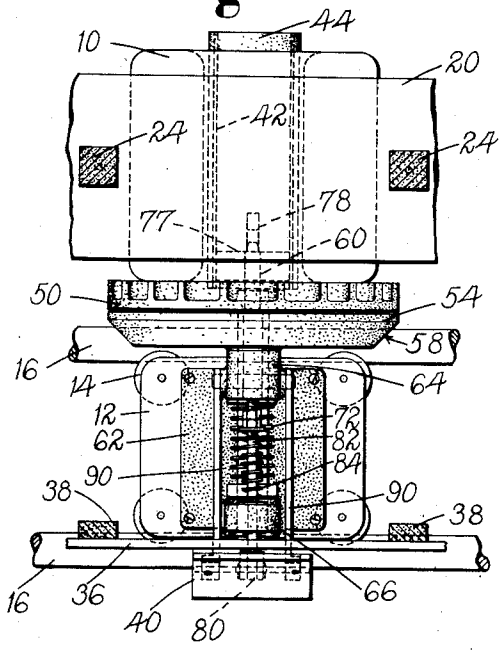
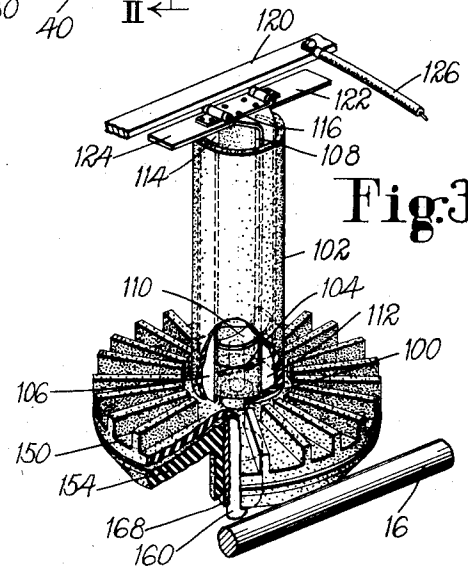


Fig.3.



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TREATING RAYON CAKES

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20 Claims. (Cl. 34—1)

This invention relates to methods of and apparatus for treating material, as, for example, to reduce the moisture content thereof. The invention is illustrated in its application to the drying of rayon cakes by a high-frequency electrostatic field.

In the production of artificial silk, the yarn of regenerated cellulose is commonly wound in an annular form, called a cake. While thus packaged, the yarn is subjected to numerous treatments involving liquid baths, after which the yarn is dried while still in the form of a cake. Most of the ordinary drying processes involve the subjection of the cakes, at some stage in the procedure, to either natural or forced currents of warm air. Quite obviously, this results in the drying of the outer layers of the cake prior to the inner layers and a decided disadvantage of this method of treatment lies in the nonuniform shrinking of the yarn. When the outer layers of the yarn, drying first, try to shrink, the shrinking is restricted by the support provided by the adjacent inner layers, whereas the layers at the inside of the annulus have an opportunity to shrink all they can. To overcome some of these disadvantages, it has been proposed to supply the heat essential for the drying by a high-frequency electrostatic field which, as is well recognized, causes the production of heat throughout the article and, therefore, is of material assistance in offsetting the uneven shrinking heretofore encountered. It has been found, however, that uniformity of drying action is dependent on uniformity in the field within the article, a state not readily obtained. With this in mind, one object of the invention is to provide an improved method of drying articles involving the subjection of successive portions of the article to the drying action of an electrostatic field.

In one aspect, the invention consists in providing relative rotation between the article and an electrostatic field to cause the field to pass through successive portions of the article so that uniform heating is secured and preferably so that the area of treatment is continually moving around the center of the article. This may be accomplished either by rotating the article with respect to the field or by setting up a rotating field within which the article is positioned. From another aspect, the invention involves the subjection of a plurality of articles to individual electrostatic fields and the automatic alteration of the intensity of the field of any individual article in response to the amount of moisture therein.

Another object of the invention is to devise an improved apparatus for carrying out the above method in its various aspects and by which substantial uniformity of drying action and of shrinkage is produced.

To this end and in accordance with a feature of the invention, electrodes are provided located one within the article and the other outside the article, with provision for relative rotation of the article and one electrode. Preferably and as shown, the outside electrode is in the form of an elongated plate positioned adjacent to the circumference of a plurality of the rayon cakes, mounted for rotation about individual electrodes to the end that the lines of force of the electrostatic field pass substantially radially through successive portions of each cake.

Experience shows that while the heating action is well distributed throughout the cake, a desirable result may be obtained by concentrating the heating on the inner periphery of the cake. In accordance with another feature of the invention, the inner electrode, which may be cylindrical, is covered with a layer of dielectric, such as Bakelite, thereby producing a concentration of the heating effect at this inner periphery of the rayon cake.

In a modified arrangement, an inner electrode is arranged to set up a series of stray fields which, by reason of relative rotation produced between these fields and the article, treat the article progressively around its center. As illustrated, this electrode is provided with two pairs of metallic strips running heightwise of the cake and the arrangement is such that alternate strips are energized from opposite sides of the source of high-frequency electric current, thereby to set up a field between adjacent strips. The direct field between these strips will be contained wholly within the electrode but, at the same time, a stray field will be produced between each pair of electrodes bulging outwardly through the thickness of the cake and producing a heating action the intensity of which is greatest at the interior of the cake, as is desirable.

In the practice of the invention, there is no assurance that the amount of moisture contained within a plurality of cakes will be uniform and if all the cakes are subjected to the treatment of the drying apparatus for an equal time, the consequence will be that the desired degree of moisture will be reached in some cakes sooner than in others, it being understood that

commonly it is not desired to remove all the moisture but rather to bring it down to a certain predetermined minimum at which the yarn may be handled to best advantage in later operations. To this end and in accordance with another feature of the invention, apparatus is provided which is responsive to the amount of moisture in the article and is designed to vary the intensity of the field when the moisture reaches a predetermined degree. A simple arrangement for this purpose is illustrated herein, in which the weight of each cake is balanced against the compression of a spring, the reaction of which is preferably made adjustable, and the arrangement is such that when the cake becomes light enough, the spring will lift it and, in so doing, will operate to interrupt the coupling between the inner electrode and one side of the source of electricity.

These and other features of the invention will be best understood from a consideration of the following specification, taken in connection with the accompanying drawing, in which:

Fig. 1 is an elevation, with parts broken away and in section, of apparatus for treating a single cake of rayon and including an automatic arrangement for breaking the coupling when desired;

Fig. 2 is a similar view, partly in section, along the line II—II of Fig. 1 and showing a conveyer arrangement for supporting a series of cakes for movement with respect to one of the electrodes;

Fig. 3 is an angular view with parts broken away and in section of a modified cake-supporting device having an inner electrode arranged to produce a plurality of stray fields;

Fig. 4 indicates diagrammatically an electrostatic field passing radially through a portion of an annular article which is rotated through this field, and

Fig. 5 indicates the action of a bulging field produced between adjacent electrode strips as relative rotation is produced between this field and an annular article.

It being assumed that it will be desired to treat simultaneously a plurality of hollow articles such as a rayon cake 10, provision is made for supporting each individual article on a carrier 12, provided with a plurality of grooved rolls 14 for mounting the carrier on parallel bars 16. It will be understood that the bars 16 extend a substantial distance along the drying chamber and that means, not illustrated, is provided for moving the successive carriers 12 along these bars. An arrangement suitable for the purpose is illustrated in Letters Patent of the United States No. 2,132,362, granted October 4, 1938, on an application of J. E. Regan.

Extending parallel to the conveyer bars is an electrode plate 20 mounted on a suitable support 22 by an insulator 24 and connected at 26 to one side of a high-frequency oscillator 30, to which electric current of low frequency is supplied through the terminals 32. The other side of the oscillator is connected at 34 to a narrow power rail or bus-bar 36 mounted on the support 22 by an insulator 38. Associated with the bar, to form a coupler acting electrostatically, is a pick-up 40 which is connected to an inner electrode 42. The pick-up 40 and the bar 36, acting as parts of a condenser, transfer the current electrostatically. This inner electrode is cylindrical and is surrounded by a layer of dielectric 44, such as Bakelite or the like. By this arrangement each individual cake is positioned in an electrostatic field, such as is illustrated diagrammatically in Fig. 4, which passes radially through the hollow article 10 between the inner electrode 42 and the electrode plate 20.

It will be understood that once the cakes have become heated, they do not cool immediately, even if the electric field does not traverse them continuously. Trials, for example, have been conducted in which the temperature ranged from 126° F. on the inside of the cake to 88° F. on the outside and the oscillator was operated at a frequency of about fifteen megacycles. Under these conditions, it is not essential that the electrode 20 extend the whole length of the conveyer because the drying action will continue in the heated cakes for some time after they pass out of the field.

A conveyer arrangement is also desirable in that it facilitates the rotation of work supports comprising an upper table 50 loosely joined by a pin 52 to a lower table 54. The upper table is provided with a plurality of radial ribs 56 to permit a free circulation of air and the escape of moisture. The lower table has a conical surface 58 resting against one of the conveyer bars 16 so that rotation is effected by this frictional contact as the carriers 12 are moved. These table supports are preferably made of dielectric material, such as Bakelite, and are supported for rotation about a spindle 60 held in upright position in a bracket 62 attached to the carrier 12, with its axis parallel to the surface of the electrode 20. This bracket has an upper arm 64 and a lower arm 66, with the spindle 60 extending through both arms. Surrounding this spindle is a sleeve 68 attached to the lower table 54 and rotatable within a bushing 70 in the upper arm 64. A spring 72 surrounding this sleeve 68 bears against a washer at the under side of the upper arm 64 and against a collar 74 held on the sleeve by a set screw thereby, by its expansion, holding the conical surface 58 of the table 54 in firm frictional contact with the upper bar 16. The upper table 50 is supported on a shoulder 76 of the spindle 60 and the reduced upper end of the spindle is pinned to a block 77 at the bottom of the inner electrode 42 and is arranged to contact with a spring 78 attached to said electrode 42. The lower end of the spindle is forked and rests on a spring-operated latch arm 80 pivoted in the lower arm 66 of the bracket, the outer end of this arm 80 being notched to contact one end of the pick-up 40. Pivoted to the outer end of the arm 80 is a rod 82 extending upwardly through the outer end of the arm 66 and surrounded by a spring 84, the compression of which may be adjusted by nuts 86. When the weight of the rayon cake 10 is reduced to a certain point by evaporation of moisture therefrom, the spring 84 will lift the arm 80 and, with it, the spindle 60 and the upper table 50, on which the cake is supported. This movement of the latch arm 80 will disengage the end of the arm from the pick-up 40. The latter is mounted at the lower end of a pair of swinging arms 90 mounted on a pivot 92 which passes through the upper arm 64 of the carrier bracket and is in electrical contact with the bushing 70. The bushing 70 contacts with the sleeve 68 and the sleeve 68 contacts with the spindle 60, thereby providing an electric circuit from the pick-up 40 to the spring 78 on the inner electrode 42. When the arm 80 is raised by the spring 84, the pick-up 40 is allowed to swing downwardly about the pivot 92, thus breaking the electrostatic cou-

pling with the bar 36. It thus appears that when the rayon cake reaches the desired degree of dryness, the electrostatic field passing between the electrode 42 and the plate electrode 20 will be removed, permitting a cessation of the drying action.

In the modified electrode arrangement illustrated in Fig. 3, a table 150 is movable with a lower table 154 which rests against a conveyer bar 16 and, having a sleeve 168, is freely rotatable about a spindle 160 which is supported in a carrier 12 just as is the spindle 60 in Fig. 1. This spindle 160 is connected to one side of the oscillator through a pick-up 40 in nontouching but adjacent relation to a power rail 36 which is joined to one side of the oscillator. It will be understood that the current is transferred from this rail to the pick-up 40 by electrostatic coupling.

Supported within a recess 180 in the table 150 is an electrode arrangement involving a cylinder 102 of Bakelite or the like having at its lower end a Bakelite block 104 fastened by a transverse pin to the spindle 160 and in which are supported a pair of upstanding electrode bars 106, 108. These are connected electrically to each other and to the spindle 160 by a metal connector 110. Spaced by 90° from these electrodes 106 and 108 are other electrode bars 112 and 114 having a common plate 116 which underlies a power rail 120 joined by a wire 126 to one side of an oscillator. To insure a proper pick-up by electrostatic, i. e. condenser, coupling with the power rail 120, the plate 116 is provided with extensions 122 and 124 elongated in the direction of the length of the power rail and hinged to the plate 116, thereby to facilitate the application or removal of cakes of rayon as they are threaded over the cylinder 102 at some point beyond the end of the rail 120. Between each two adjacent electrodes 106 and 112, 112 and 108, etc., there is set up an electrostatic field. The direct field passing through the shortest distances between these adjacent electrodes will have practically no effect on the cake surrounding the electrode cylinder 102. On the other hand, stray fields (Fig. 5) bulging out between each two adjacent electrodes will act on the annular cake which, for uniformity of drying action, will be rotated with respect to the successive stray fields to produce a complete drying by the resultant integrating action of the stray fields. The intensity of these fields will be, as desirable, greatest at the inner periphery of the annular cake and of lessening intensity toward the outer periphery thereof.

In the use of the apparatus in carrying out the novel method, rayon cakes will be positioned on the tables and the arms 80 will be latched over the pick-up 40, these having been swung into the position illustrated in Fig. 1. It is assumed that the compression of the springs 84 has been adjusted to the desired degree by turning the nuts 86. A series of cakes having thus been positioned on the tables mounted on the conveyer, electric current will be supplied to the oscillator and a drying action set up which will be continued so long as may be necessary, until all the cakes have been reduced in weight to such a degree that the springs 84 have been able to lift the upper tables 50, allowing the pick-ups 40 and their supporting arms 90 to drop to a substantially vertical position away from the live rail 36.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. That method of treating a hollow article by subjecting it to an electrostatic field existing between two electrodes which consists in positioning the article to surround one of the electrodes, and then causing relative rotation between the article and the inner electrode.

2. That method of treating a hollow article by subjecting it to an electrostatic field existing between two electrodes which consists in positioning the article to surround one of the electrodes, and causing relative rotation between the article and the outside electrode.

3. That method of treating a hollow article which consists in rotating the article about an axis thereof and passing an electrostatic field substantially radially through one side only of the hollow article.

4. That method of drying hollow rayon cakes which consists in creating an electrostatic field between the interior of the cake and the outside thereof, and in rotating the cake to cause the field to act on successive portions of the same.

5. That method of treating a hollow article which consists in producing a stray electrostatic field bulging toward and intersecting a side of the article, and causing relative rotation between the field and the article.

6. That method of drying a plurality of rayon cakes which consists in passing an electrostatic field through at least a portion of each cake, and automatically shutting off the field through any individual cake in response to change in the weight of the same.

7. In an apparatus for drying articles of annular shape, electrodes positioned within and without said annular article, means for producing an electrostatic field between said electrodes, and means for producing relative rotation between the article and one of said electrodes.

8. In an apparatus for drying annular rayon cakes, a conveyer for a series of cakes, an electrode common to a plurality of cakes and positioned beside the conveyer, a series of electrodes positioned one within each cake whereby electrostatic fields are set up which pass radially through the cakes, means for rotating said cakes upon the conveyer, and means for connecting said series of electrodes to one side of a source of high-frequency current and said common electrode to the other side thereof.

9. In an apparatus for drying an article of annular shape, a substantially flat plate electrode positioned adjacent to the outer circumference of the article, an electrode positioned within the article, means for producing an electrostatic field between said electrodes, and means for rotating the article with respect to one electrode.

10. In an apparatus for drying rayon cakes, a conveyer, cake supports rotatably mounted on said conveyer, means for rotating said supports as the conveyer moves, an electrode common to a plurality of cakes and positioned beside the conveyer adjacent to the periphery of the cakes, a series of electrodes positioned one within each cake whereby electrostatic fields are set up which pass radially through the cakes, and means for energizing said electrodes.

11. In an apparatus for drying articles by an electrostatic field, a conveyer for supporting a series of said articles, a bus-bar alongside said conveyer, means for electrically connecting said bus-bar to one side of a source of current, a plate electrode elongated in the direction of movement

of the conveyer and positioned alongside the latter, means for electrically connecting said plate electrode to the other side of said source, an electrode on the conveyer, a depressible article support for positioning an article on the conveyer in the field set up between the latter electrode and said plate electrode, an individual coupler movably supported on the conveyer and interposed between the electrode on the conveyer and the bus-bar, a latch holding said coupler in operative relation to the bus-bar, a spring for releasing the latch and hence the coupler to permit the coupling provided thereby to be broken irrespective of the position of the conveyer, and a connection between said depressible article support and said spring.

12. In an apparatus for drying moist articles by an electrostatic field, a conveyer for supporting a series of articles, individual electrodes on the conveyer for at least some of the articles thereon, means for transmitting energy from one side of a source of current to said electrodes including individual pick-up devices carried by the conveyer with said electrodes, another electrode connected to the other side of said source and cooperating with said first electrodes to pass a field through each article, and spring-upheld means supporting one of said articles on said conveyer and operated, as a result of the loss of moisture in the article, to render an associated pick-up device inoperative to transmit energy when a predetermined degree of moisture is obtained.

13. In an apparatus for drying a series of articles, an electrode common to a plurality of said articles, means for connecting the common electrode to one side of a source of electricity, individual electrodes for said articles, displaceable individual coupling devices for connecting said latter electrodes to the other side of said source, yieldable means supporting an article in an electrostatic field produced between said common electrode and an individual electrode, and means operated by said supporting means as a result of the loss of moisture from the article to act upon the displaceable coupling device to electrically disconnect said individual electrode for said article from said source.

14. In an apparatus for drying rayon cakes, a conveyer having a plurality of supports for said cakes, electrodes on the supports and positioned within the cakes, means for rotating said supports, a plate electrode extending beside the conveyer and adjacent to the peripheries of the cakes, means for connecting said plate electrode to one side of a source of high-frequency current, a bar extending along the conveyer and spaced a substantial distance from the plate electrode, means for connecting said bar to the other side of said source, and means for conducting current between said inner electrodes and said bar including individual pick-ups displaceably mounted on the conveyer.

15. In an apparatus for drying rayon cakes, a conveyer, a plurality of supports thereon for said cakes, an electrode on each support and positioned within its cake, a plate electrode extending beside the conveyer and adjacent to the peripheries of the cakes, means for connecting said plate electrode to one side of a source of high-frequency current, a bar extending parallel to said electrode and spaced a substantial distance therefrom, means for connecting said bar to the other side of said source, individual pick-ups between said inner electrodes and said bar, and means for rotating the individual supports as the conveyer moves.

16. In an apparatus for drying rayon cakes, a conveyer, a plurality of supports thereon for said cakes, an electrode on each support and positioned within its cake, a plate electrode extending beside the conveyer and adjacent to the peripheries of the cakes, means for connecting said plate electrode to one side of a source of high-frequency current, a bar extending parallel to said electrode and spaced a substantial distance therefrom, means for connecting said bar to the other side of said source, individual pick-ups between said inner electrodes and said bar, and means associated with each support responsive to the weight of the cake carried thereby for rendering inoperative the connection between its pick-up and the bar when the moisture content of a cake reaches a predetermined amount.

17. In an apparatus for drying rayon cakes, a support for a cake, a plurality of electrodes positioned within a cake, and means for connecting alternate electrodes to opposite sides of a source of high-frequency electric current.

18. In an apparatus for drying rayon cakes, a rotatable support, a cylindrical member of dielectric material separately supported adjacent to the center of said support, metallic strips extending heightwise of the cylinder, and means for connecting alternate strips to opposite sides of a source of high-frequency electric current.

19. In an apparatus for drying annular rayon cakes, a support, electrodes positioned adjacent to said support and within a cake, means for connecting alternate electrodes to opposite sides of a source of high-frequency electric current, and means for causing relative rotation between the support and the electrodes.

20. In an apparatus for drying annular rayon cakes, a support provided with transversely extending ribs, an electrode positioned at a mid point of said support and over which a cake may be threaded to position it on the support, and means co-operating with said electrode to create an electrostatic field passing substantially radially through at least a portion of the cake.

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