Feb. 19, 1952 R. H. HAGOPIAN 2,586,328

DIELECTRIC HEATING ESPECIALLY FOR SPOOLS OF RAYON THREAD

Filed Jan. 29, 1948

Fig. 1.

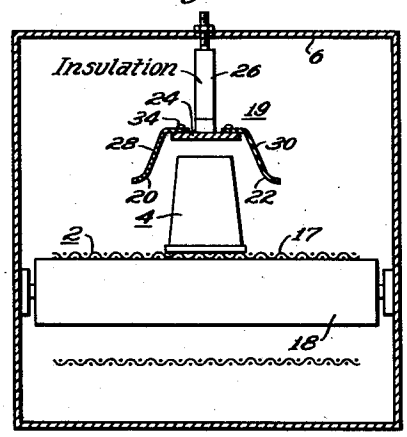



Fig. 2.

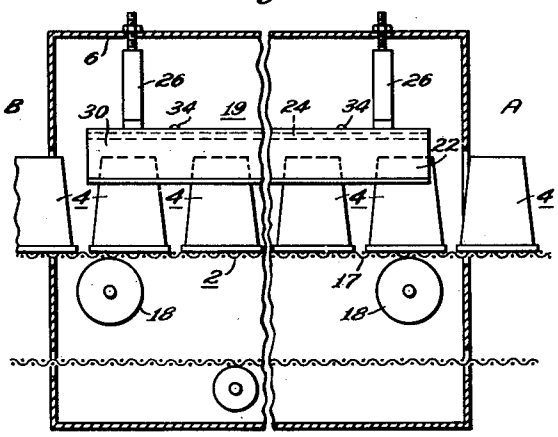



Fig. 3.

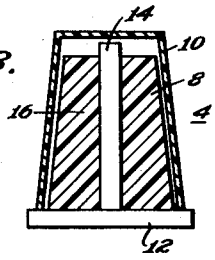



Fig. 5.

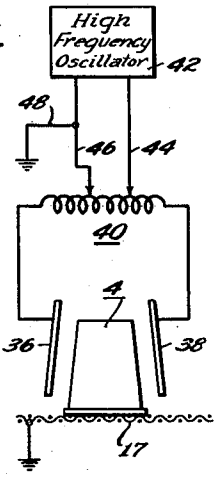



Fig. 4.

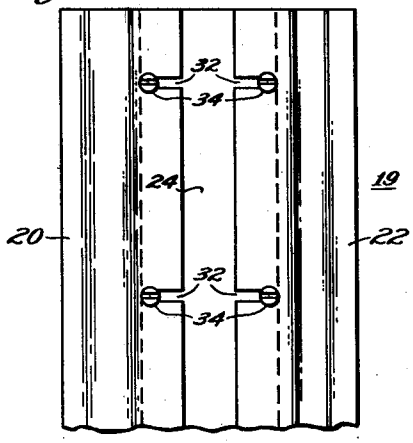
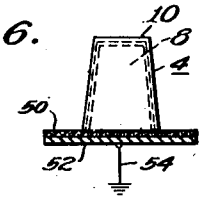



Fig. 6.




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## DIELECTRIC HEATING ESPECIALLY FOR SPOOLS OF RAYON THREAD

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3 Claims. (Cl. 219—47)

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This invention is directed to improvements in the field of dielectric heating, and is more particularly directed to the dielectric heat-treatment of partially cured plastic material for the purpose of further setting or curing the material. Preferably, but not necessarily, the material is filamentary rayon-material wound into a compact annular-like bundle or shape known more commonly as a reel, bobbin, spool, cake, cone or by some other designation, all of which I hereinafter embrace in the term "spool."

In a stage of a process for making rayon, filamentary material is wound into a spool usually having flat ends; by filamentary material meaning thread, cord, etc. The spool undergoes a curing treatment which includes a heat-treating step intended to set the twist of the filamentary material so that it will be of more consistent strength and size. During such a step, it is desirable to keep all of the filament-portions throughout the spool at the same treatment-stage at all times in order to obtain a final product which will have the desired characteristics of tolerably uniform strength and size throughout. More recently, dielectric heating processes have been proposed for heating and curing plastic materials of a type described. Such processes are typified by way of example in such patents as the Hart Patent 2,263,681 of November 25, 1941, Bierwirth Patent 2,373,374 of April 10, 1945, Brown Patent 2,388,824 of November 13, 1945, Brabander Patent 2,402,609 of June 25, 1946, and Hoyler Patent 2,403,800 of July 9, 1946. For twist setting with high-frequency heating, it has been the practice to individually wrap each spool in cellophane, wax paper, or in some other material in which it remains during its twist-setting heat-treatment as disclosed, for example, in the Kline et al. Patent No. 2,421,334 of May 27, 1947. The wrapping limits surface-evaporation from the spool so that the spool will cure more uniformly throughout.

An object of my invention is to provide an improved system which will save time and wrapping material in prior processes where a plurality of spools are heat-treated while wrapped.

Another object of my invention is to provide a system for dielectrically heat-treating rayon spools or similar articles in an apparatus which can continuously receive the spools so that a high rate of production can be obtained.

In accordance with my invention, I provide a conveyor on which the spools are successively carried between a plurality of relatively insulated heating-electrodes which are connected to a high-

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frequency power source. Each spool is covered by a closely-fitting hood so that the rate at which moisture evaporates from the spool is under control and humidity conditions within the hood are more uniform. The hood should be of a material which does not shield the electric field from the spool to an undesirable extent. In furtherance of our invention, the heating-electrodes are so arranged and shaped and are so electrically connected to the high-frequency source of power that a more uniform generation of heat is obtained in each spool.

Other objects, features, innovations and methods introduced to the art by my invention will be discernible from the following description of preferred embodiments thereof, to which embodiments, however, my invention is not limited. In the description, details are omitted which are not necessary to an understanding of my invention to one skilled in the art. The description is to be taken in conjunction with the accompanying diagrammatic drawing, not to scale, in which:

Figs. 1 and 2 are sectional views, at right angles, of apparatus embodying my invention;

Fig. 3 is a sectional view of a spool of rayon thread and covering hood therefor;

Fig. 4 is a plan view of a heating-electrode structure which is used in the apparatus;

Fig. 5 is a simplified view of a modified form of my invention for the apparatus of Figs. 1 and 2; and

Fig. 6 is a simplified view, along the lines of Fig. 3 of another modified form of my invention.

A preferred form of my invention, to which I am not limited, comprises a conveyor-means carrying a plurality of hood-covered rayon spools between relatively insulated heating-electrodes that are connected to a high-frequency source of power, such as a tube oscillator. Referring to the specific form of my invention shown in the drawing, a conveyor means **2** carries a plurality of units **4** through a protective metal housing **6**. As the units pass through the housing **6**, they are subjected to a high-frequency electric field provided by suitably arranged heating-electrodes in the housing **6**.

Each unit **4** comprises a spool **8** and a hood **10**. The spool **8** comprises a base **12**, a core **14**, and rayon filamentary material **16** on the core **14**. The base **12** may be of any suitable size, and can be smaller than the base of the spool. The base **12** and core **14** are of any suitable dielectric material having a loss-factor that is, preferably, less than that of the material being heat-treated,

and a material such as stiff paper, wood, or a suitable plastic is satisfactory.

The conveyor means 2 comprises an endless metal mesh belt 17 which passes around a suitable metal driving drum and return drum; and its upper run is supported on intermediate metal rollers 18 which are electrically grounded so that the belt 17 is also at ground potential. The conveyor-belt extends beyond both ends of the housing 6 so as to provide a work-loading zone A at one end of the housing and a work-unloading zone B at the other end. At the loading zone, the spools 8 can be placed on the conveyor-belt and a hood 10 for each spool may be added after the spool is on the conveyor-belt or before. Preferably, the spools are substantially equally spaced along the conveyor-run which carries them through the housing and between the heating-electrodes therein for dielectric heat-treatment. After such treatment, the hoods are removed from the spools reaching the unloading zone B, and the spools then removed from the conveyor-belt, but obviously the spools and hoods can be removed from the conveyor-belt in one operation and at any suitable point.

The filamentary material 16 comprises elongated partially cured plastic thread or cord wound in layers on the core 14. The hoods 10 are made of some suitable dielectric material having good electrical insulation properties and able to stand the temperatures to which the spools are heated. Thermoset resins are usually satisfactory for processes requiring a temperature of about 200° F. Inexpensive materials such as waxed paper, a good grade of dried paper, or wood can frequently be used.

In order to save time in loading and unloading the heating equipment and to more effectively heat the material 16, it is desirable to have the hoods 10 conform to the shape as the spools 8, but slightly larger in size. The hoods are open at their bottoms so that they can easily be slipped over and from the spools. Preferably, the hoods should have enough rigidity and stiffness to permit them to be used a considerable number of times without losing their shapes. The walls of the hoods need not be very thick and as little as $\frac{1}{16}$th inch, or less, is satisfactory if the walls have the necessary stiffness. Usually, each spool 8 will be either of a cylindrical shape or of a frusto-conical shape having its large base at the bottom. Hence, the bottoms of the hoods for such spools will usually be open circles.

I have found that an arrangement of heating-electrodes, such as shown in the drawing, is exceptionally satisfactory for twist-setting the filamentary material of a spool with a high degree of uniformity. Referring more particularly to Figs. 1–5, an elongated heating-electrode-means 19 comprises a pair of elongated angular heating-electrode portions 20 and 22 and a third heating electrode portion 24 in the form of a plate which carries the portions 20 and 22. The electrode-means is adjustably carried by the housing 6 through a plurality of spaced insulators 26, so that it can be raised or lowered in the housing 6.

The electrode-portions 20 and 22 provide facing angular sections 28 and 30. The electrode-portions 20 and 22 are adjustably fastened to the electrode-portion 24 through a plurality of slots 32 and screw means 34, so that the distance between the facing bent sections 28 and 30 of the electrode-portions 20 and 22 can be controlled.

In the preferred form of my invention, high-



frequency power is connected across the conveyor-belt 2 and the electrode-means 19 which provide a work-receiving space therebetween. I have found that better results are obtained in operation by locating the heating-electrode portions 20 and 22 so that their bent sections 28 and 30 are opposite only to the upper parts of the units 4, after the fashion indicated in the drawing. The symmetrical or balanced arrangement results in the sides of the spools 8 being heated substantially alike.

In the embodiment shown in Fig. 5, an even heating of the spools is obtained by arranging a pair of elongated relatively insulated heating-electrodes 36 and 38 parallel to opposite upstanding sides of the units 4. If the spools and hoods of the units are tapered, then the heating-electrodes 36 and 38 should be slanted. If the spools and hoods of the units are cylindrical, then the heating-electrodes would be vertical.

The heating-electrodes 36 and 38 are energized through a balanced circuit which includes a voltage-providing means in the form of a coil 40. The coil has end points to which the electrodes are connected. A high-frequency tube-oscillator 42 energizes the coil 40 through conductors 44 and 46 connected to intermediate tap-points on the coil 40. One of the conductors, 46 in this instance, is grounded as indicated at 48. As a consequence, direct electrical field-lines are provided across the facing heating-electrodes 36 and 38. Electric field-lines are also provided between each heating-electrode and the metal conveyor-belt 17, so that the conveyor-belt also constitutes a heating-electrode. Accordingly, the region including the space between the heating-electrodes 36 and 38 and the space between them and the underlying portion of the conveyor-belt form a work-receiving space in which the spools are heat-treated.

In the foregoing arrangement, haphazard or stray heating because of stray capacity-currents from the insulated heating-electrodes to ground is reduced. By properly adjusting the connections and points of the conductors 44 and 46 to the coil 40, or through circuit adjustments, or both, the voltage with respect to ground of each of the heating-electrodes 36 and 38 can be made substantially one-half of the voltage across them. If one of the heating-electrodes 36 or 38 had been grounded and the other insulated the stray capacity currents to ground would cause one side of a spool to heat more than the other.

Using apparatus of the type described in Figs. 1–4 and a frequency of between 10 and 30 megacycles, I have satisfactorily and evenly cured rayon thread for the purpose of setting its twist when the thread was wound in spools of different sizes ranging from 6 to 12 inches high and 4 to 9 inches in diameter. Occasionally I have had to try several adjustments of the heating-electrodes 20 and 22 in order to obtain satisfactory results.

While I have described my invention in connection with an electrically grounded metallic belt for the conveyor, it is obvious to one skilled in the art that an equivalent can be obtained by using an insulating belt riding on a grounded metal plate which functions as the heating-electrode. An embodiment of this kind is shown in Fig. 6 in which the conveyor-belt 50 is of canvas and carries units 4 in a direction perpendicular to the plane of the drawing. The work-carrying portion of the conveyor-belt in the work-receiving zone rides on a plate-type metal heating-electrode 52 which is electrically grounded by a

conductor 54. In this embodiment the units 4 rest directly on the conveyor-belt.

While I have described my invention in forms which I now prefer, it is obvious that the principles and teachings of my invention are subject to embodiments in different forms and modifications.

I claim as my invention:

1. Dielectric heating apparatus of a type described comprising an electrode-means including a pair of spaced upstanding heating-electrode portions, a conveyor means providing a conveyor-belt and a further heating-electrode insulated from said pair of heating-electrode portions, a plurality of articles which have substantially greater length than breadth arranged in upstanding position on said conveyor-belt with said further heating-electrode therebelow, and arranged in such a manner that the upper portions of the articles only are successively passed between said portions.

2. An invention including that of claim 1 but further characterized by said electrode-means having a generally horizontal electrode-portion, and by said upstanding heating-electrode portions extending from opposite edges of said generally horizontal portion.

3. Dielectric heating apparatus of a type described comprising an electrode-means including a pair of spaced upstanding heating-electrode



portions, a conveyor means providing a conveyor belt and a further heating-electrode insulated from said pair of heating-electrode portions, a plurality of spools of filamentary thread arranged on said conveyor belt with said further heating-electrode therebelow, and arranged in such a manner that the upper portions of the spools only are successively passed between said portions, and a hood of stiff plastic placed over each spool, said hoods being shaped to correspond to the shape of the spools, but slightly larger and having an open side whereby they can be readily placed over and removed from the said spools.

RICHARD H. HAGOPIAN.


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