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ELECTRODE STRUCTURE FOR HIGH FREQUENCY DRIER

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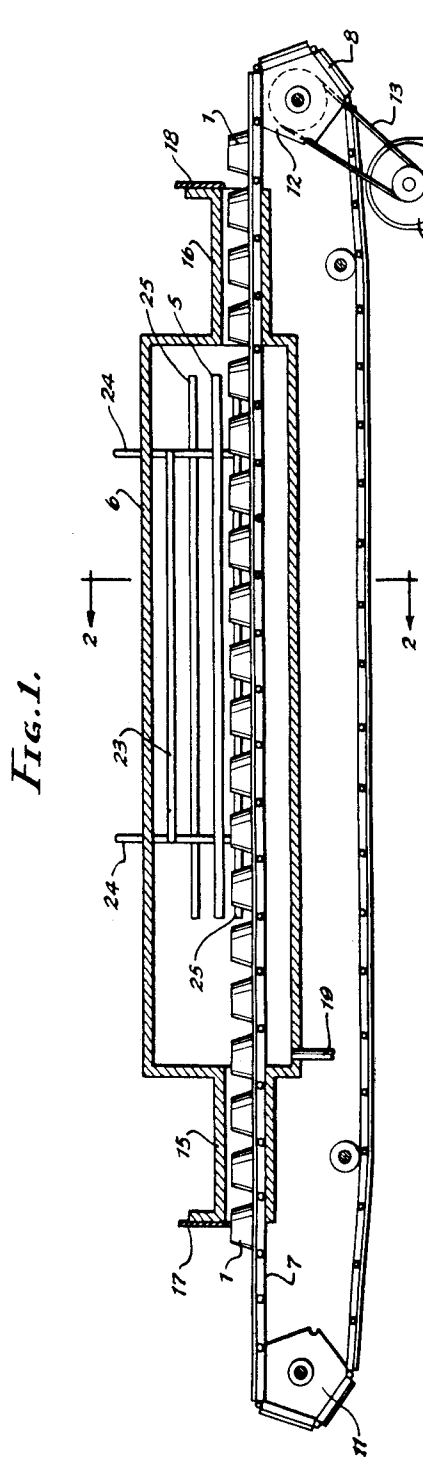


FIG. 1.

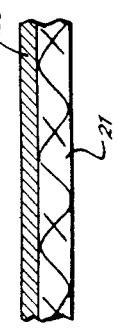


FIG. 3.

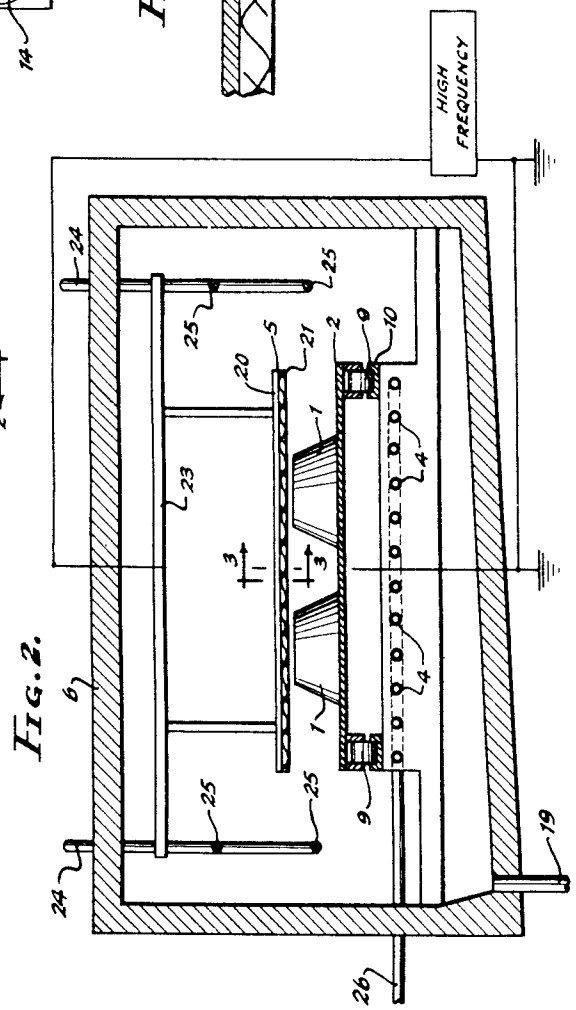


FIG. 2.

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ELECTRODE STRUCTURE FOR HIGH FREQUENCY DRIER

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3 Claims. (Cl. 219—10.69)

This invention relates to improvements in apparatus for the high frequency heating of textile materials, such as wound packages of rayon or thread.

In the manufacture and processing of rayon yarn it is necessary to vaporize relatively large amounts of water when drying the yarn after the various wet treatments. It is well known that high frequency electrical heating may be used to vaporize water from textile materials, such as wound packages of rayon yarn or thread, rapidly and economically.

It has been found that during the drying of cakes of rayon yarn or the like by high frequency heating between spaced electrodes some of the water vaporized from the yarn packages condenses on the relatively cool electrode surfaces, especially on the under surface of the upper electrode, which the water vapor strikes as it rises from the yarn package. The water condensing on the under surface of the upper electrode tends to form drops which often fall onto the cake. These drops of water carry dirt from the electrode surface, which discolors the yarn, and they may cause arcing as they fall, which will burn the yarn and sometimes causes shut down of the high frequency generator.

Various methods have been proposed for avoiding the condensation of water on the surface of the high frequency electrode. The methods proposed may be divided into two groups: (1) those which involve heating the electrode to such a temperature that water no longer tends to condense on its surface and (2) those which involve placing an impervious barrier around the electrode.

A high frequency electrode may be heated so as to prevent condensation on its surface by means of suitably placed lamps, by means of steam coils placed adjacent to the electrode, by the introduction of steam or other heating fluid into a hollow space provided in the electrode itself, or by passing heated air or gas over the electrode surface. These methods are wasteful of energy for the quantity of heat used to assure the desired result is in excess of that actually required to prevent condensation on the electrode surface, and they require that the structure of the high frequency drying apparatus be complicated by the addition of the heating units. Furthermore, when these methods of preventing condensation on the electrode surface are used one advantage of high frequency electrical drying is lost because the heat supplied to prevent condensation on the electrode surface tends to cause the yarn packages to dry prematurely on the outside. Such non-uniform drying sets up localized strains within the packages which cause the dried yarn to possess undesirable non-uniform shrinkage characteristics.

A high frequency electrode may be enclosed within a suitable impervious barrier which will of course prevent condensation on the electrode surface, but such structures are difficult to construct, especially when flat electrodes of large surface area are used.

It is therefore an object of the present invention to

provide an improved high frequency electrode structure adapted to prevent condensation on the electrode surface.

It is a further object of this invention to provide a high frequency electrode structure adapted to provide the heat required at the electrode surface to prevent condensation on said surface.

According to the present invention power absorbing material, placed adjacent to the under surface of the upper electrode of a high frequency heater, is heated by high frequency current, thus providing heat at the electrode surface to prevent condensation on said surface. According to the preferred embodiment of the invention the material placed adjacent to the under surface of the electrode is one which absorbs power in considerable quantity only when it is wet. Such a device is practically self-regulating for power is consumed to heat the electrode surface only when water or other liquid starts to condense in the neighborhood of said surface, and then only to the extent required to evaporate the water or other liquid.

Plastics, such as urea-formaldehyde resin, laminated with glass fabric, if desired, to provide a support, and pressed fiberboard are examples of the first type of power absorbing material. A layer of such material placed adjacent to the under surface of the upper electrode is heated by the high frequency current during the drying operation and provides heat to prevent condensation on the electrode surface.

Cellulose pulp, textile fabrics, including those made of glass fiber, silica gel, natural sponge, and cellulose sponge are examples of another type of power absorbing material. These materials possess the common property of adsorbing or absorbing amounts of water or similar liquids significant for the present purpose. Since these materials are not heated to any great extent by high frequency current unless they are wet, energy is consumed to heat them only when water or a similar liquid is condensing thereon. This device is therefore not only self-heating but also self-regulating. Since heat is provided only as needed to prevent excessive condensation on the electrode surface, the yarn packages are not dried prematurely on the outside.

The power absorbing material may be attached by any suitable means to the under surface of the upper electrode as a coating, or it may be positioned below the electrode so that there is a space between the power absorbing material and the electrode. In either case, moisture condensing on the adsorbent or absorbent material will be evaporated and does not cause drops to fall to the rayon cakes. Such electrode structures are extremely simple, for it is not necessary to construct an impervious barrier around the electrode, nor is it necessary to provide auxiliary means for supplying heat to the electrode from an outside source.

An embodiment of the high frequency electrode structure of the invention is shown in the drawing, in which:

Fig. 1 is a view, principally in longitudinal section, of apparatus in which the electrode structure of this invention is used for the continuous high frequency drying of yarn packages;

Fig. 2 is a transverse sectional view of the apparatus of Fig. 1 taken along the line 2—2 thereof; and

Fig. 3 is a transverse sectional view of the electrode structure, per se, taken along the line 3—3 of Fig. 2.

The drier shown in the drawing is of the type shown in Patent No. 2,428,615 granted to Alfred S. Brown on October 7, 1947, and will not be described in full detail. Fig. 3 of Patent No. 2,428,615 is a view similar to Fig. 1 of the present application.

In Fig. 1 the yarn packages 1 are supported on a metal screen 2 which in turn is supported by a framework 3, the screen 2 comprising one electrode in a high frequency circuit. The screen 2 is preferably maintained at a tem-

perature of at least about 212° F. by means of a heating coil 4 to which steam or other suitable heating fluid is supplied. The upper electrode structure 5 in the high frequency circuit is shown spaced above the yarn packages 1 although it may, if desired, rest directly on the packages. The electrodes are connected to a suitable source of high frequency power.

The yarn packages 1, to be dried, are carried through the chamber 6 by an endless conveyor generally indicated at 7, which is made up of a plurality of panels 8, preferably of metallic construction, so that the conveyor may serve as the lower electrode in addition to its function as a conveying means. Wheels or rollers 9 traveling in tracks 10 minimize friction in the movement of the conveyor and determine the path of the conveyor 7 through the drying chamber 6. Adjacent to the entrance end of the chamber 6 the conveyor 7 passes around a pair of idler roller sprockets 11, suitably shaped to accommodate the particular type of conveyor used. Somewhat similar sprocket members 12, mounted adjacent to the exist end of the chamber 6, are driven by a flexible belt or driving chain 13 from a suitable driving means 14, which may provide either continuous or intermittent movement.

In order that the desired atmospheric conditions may be readily maintained within the drying chamber 6, the entrance and the exit ends 15 and 16 of the chamber are relatively constricted. If the conveyor 7 is caused to advance intermittently, doors 17 and 18, provided at the entrance and exit ends of the chamber, respectively, may be closed during the dwell periods to further minimize any disturbing inflow of air currents. Any water which collects in the drying chamber 6 may be removed by means of the drain pipe 19.

The upper electrode structure 5 is shown in cross section in Figs. 2 and 3. This particular structure consists of the electrode 20, shown in the form of an electrically conducting flat plate, with a fabric 21 positioned adjacent to the under surface of the electrode 20. The fabric 21 may consist of any of the materials described above, that is, plastics such as urea-formaldehyde resin, laminated with glass fabric, cellulose pulp, textile fabrics including those made of water resistant materials, such as, glass fiber, silica gel, natural sponge and cellulose sponge. This fabric may be attached to the electrode 20, by any suitable means or a space may be provided between the electrode and the fabric. When water starts to condense in the relatively cool neighborhood of the under surface of the upper electrode, the glass fabric or other material 21 absorbs the condensed water in its capillary structure, and the moist fabric is then heated by the high frequency current so as to vaporize the water. Since the material 21 is heated only when water is present to be vaporized, the amount of power consumed to heat the electrode is reduced to a minimum, the device is made self-regulating and the electrode structure does not become heated to such an extent that the yarn packages are caused to dry prematurely on the outside. The upper electrode 20, shown here as a flat plate, may be of any desired size and shape. The upper electrode structure may be further simplified by supporting the glass fabric or other power absorbing material by a suitable framework and simply placing the electrode plates on it. If the power absorbing material is impregnated with a suitable resin and cured such a structure will possess considerable stability.

The electrode structure 5 may be suspended, as shown in Figs. 1 and 2, from the roof of the chamber 6 by supports 22, suitably insulated, carried by a frame 23, which is in turn carried by upright members 24 that pass through the roof of the drying chamber 6. The members 24 carry the tuning stubs 25 for adjusting the radio frequency circuit. The source of high frequency power and the electrode grounds are shown diagrammatically in Fig. 2.

The lower electrode, shown in Figs. 1 and 2, is heated by means of a heating coil 4 which is connected to a supply of steam or heating fluid by pipes such as 26. The bottom of the cakes of rayon yarn or thread passing through the drier are so wet that this method of heating the electrode conveyor is convenient and economical. Relatively few constructional difficulties are encountered in providing for such heating of the lower electrode and control of the heating is facilitated by the fact that the bottoms of the cakes are so wet that portions of the electrode conveyor may preferably be maintained at a temperature of about 212° F. to assure satisfactory drying.

The electrode structure of this invention has been shown in connection with a high frequency drier of a specific type, but it will be recognized that such an electrode structure may be used in other types of high frequency driers or heaters to prevent the condensation on the electrode surface of water or any other liquid which is vaporized during high frequency drying or heating. It has been found desirable, for example, to use such an electrode structure in a high frequency drier in which the yarn is dried in an atmosphere of steam of 212° F. for, when starting up such a drier, before the top electrode is heated to 212° F. by the steam which surrounds it, there may be considerable condensation on the relatively cool electrode surface.

While we have described the preferred embodiment of this invention in detail, it is, of course, understood that we do not desire to limit this invention to the exact details described and illustrated except in so far as those details are defined by the claims.

We claim:

1. Apparatus for drying rayon yarn cakes impregnated with a substantially aqueous liquid comprising a generator for generating high frequency electrical energy, a housing, a conveyor for conveying a plurality of water-logged rayon yarn cakes positioned side by side thereon into said housing, said housing having a highly humid atmosphere approaching saturation therein, an electrode supported in said housing above and spaced from said rayon cakes so that said rayon yarn cakes may be moved under said electrode without rubbing contact therewith, means for connecting said electrode to said generator for producing a high frequency electric field through said rayon yarn cakes for heating said rayon yarn cakes and driving out the moisture therefrom in the form of vapor into said highly humid atmosphere, a sheet of porous, highly water-vapor absorbent fabric containing a water-resistant material of the class consisting of glass fibers, silica gel, natural sponge and cellulose sponge, and means for supporting said sheet adjacent to the bottom face of said electrode, said fabric sheet being adapted to trap substantial quantities of said vapor given off during heating of said rayon yarn cakes by the high frequency electric field, said sheet of fabric being highly water-vapor absorbent in order to prevent water drops from forming on the bottom of said sheet and dropping from said sheet and drawing electric arcs to said rayon cakes, said materials having a low dielectric constant compared to that of water so that said fabric sheet remains substantially at ambient temperature until it traps water vapor which substantially increases the absorption of high frequency electric energy thereby, the high frequency electric energy functioning to vaporize the water out of said fabric before drops of water form and fall to said cakes and draw electric arcs thereto.

2. Apparatus for drying rayon yarn cakes impregnated with a substantially aqueous liquid comprising a generator for generating high frequency electrical energy, a housing having therein a highly humid atmosphere approaching saturation, means for supporting a rayon yarn cake in such highly humid atmosphere in said housing, an electrode supported above and spaced from said rayon cake so that said rayon yarn cake may be moved under said electrode without rubbing contact therewith, means for connecting said electrode to said generator for producing a high frequency electric field through said rayon yarn cake for heating said rayon yarn cake and driving out the moisture therefrom in the form of vapor into

said highly humid atmosphere, a sheet of porous, highly water-vapor absorbent fabric containing a water-resistant material of the class consisting of glass fibers, silica gel, natural sponge and cellulose sponge, and means for supporting said sheet adjacent to the bottom face of said electrode, said fabric sheet being adapted to trap substantial quantities of said vapor given off during heating of said rayon yarn cake by the high frequency electric field, said sheet of fabric being highly water-vapor absorbent in order to prevent water drops from forming on the bottom of said sheet and dropping from said sheet and drawing electric arcs to said rayon cakes, said materials having a low dielectric constant compared to that of water so that said fabric sheet remains substantially at ambient temperature until it traps water vapor which substantially increases the absorption of high frequency electric energy thereby, the high frequency electric energy functioning to vaporize the water out of said fabric before drops of water form and fall to said cake and draw electric arcs thereto.

3. Apparatus for drying rayon yarn packages impregnated with a substantially aqueous liquid comprising a generator for generating high frequency electrical energy, a housing having therein a highly humid atmosphere approaching saturation, a conveyor for supporting a plurality of rayon yarn packages side by side in said highly humid atmosphere in said housing, an electrode supported above and spaced from said rayon yarn packages so that said rayon yarn packages may be moved under said electrode without rubbing contact therewith, means for connecting said electrode to said generator for producing a high frequency electric field through said rayon yarn packages for heating said rayon yarn packages and driving out the moisture therefrom in the form of vapor

into said highly humid atmosphere, a sheet of porous, highly water-vapor absorbent fabric containing a water-resistant material of the class consisting of glass fibers, silica gel, natural sponge and cellulose sponge, and means for supporting said sheet adjacent to the bottom face of said electrode, said fabric sheet being adapted to trap substantial quantities of said vapor given off during heating of said rayon yarn packages by the high frequency electric field, said sheet of fabric being highly water-vapor absorbent in order to prevent water drops from forming on the bottom of said sheet and dropping from said sheet and drawing electric arcs to said rayon cakes, said trapped water vapor increasing the absorption of high frequency energy by said sheet so as to drive off said vapor and prevent it from forming drops of liquid falling to said packages and drawing electric arcs thereto.

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