MOBILE DIELECTRIC DRYING APPARATUS WITH ENERGY SOURCE COUPLING MEANS

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This application is a continuation of the applicant's co-pending application Ser. No. 435,196 filed Feb. 25, 1965, and now abandoned, and Ser. No. 440,210 filed Mar. 16, 1965 and now abandoned.

This invention relates to the treatment of material by high frequency electric fields and more particularly to the controlled drying of materials, including paper, in continuous web form by subjecting such materials to the effects of high frequency electric fields.

In the drying of materials in continuous web form, conventional techniques employ the passage of webs to be dried over, around and between steam heated drying rolls. Such drying devices suffer from many obvious defects inherent in the steam approach. Firstly, there is a great deal of time and cost involved in the generation of the steam; steam generation must be begun long before the drying process is to start. The steam must be made as dry as possible so as to be able to absorb moisture from the web and not add moisture to the web. All drying rolls, pipes and other equipment involved must be quite strong to withstand the pressures and heat. There must be provisions made to absorb or otherwise remove the moisture driven from the web so that efficient drying can take place.

Further, control of the degree of drying is difficult for it takes many hours to bank the steam generator to cool the steam. Also, control between the temperature of individual drying rolls is difficult to maintain due to the heat loss increase as the distance from the steam generator is increased. Additionally, the presence of steam at high temperatures and pressures presents a constant danger to those who must work on or about such drying devices.

One approach suggested in the prior art is that of the so-called "dielectric" drying technique. Electrodes are placed to either side of the web, as the web is advanced and the electrodes are subjected to high frequency electric fields. A first electrode group is grounded while the second group, above the web is coupled to the "hot" side of the high frequency generator. The air space, the web and the moisture in the web serve to complete the electric path. This approach serves quite well under certain restrictive conditions. The thickness of the web must be uniform, such that the proper electrode spacing can be set and the high frequency generator size determined. Too large a generated field may cause arcing to occur without the presence of the web, thus destroying the electrodes. Or, if the web is present, causing it to char or burn. The web must be maintained at a prescribed minimum moisture so that the path for the high frequency generator is completed. Any change in the thickness of the web would result in a change in the electrode spacing and the requirement that the spacing system be re-established for the new electrode spacing.

The present invention overcomes the defects of prior art steam drying systems as well as the defects of previous dielectric drying devices. A drying device constructed according to the novel concepts of the invention employs a plurality of intermixed grounded and hot electrodes, all mounted to a single side of the web. The grounded electrodes are coupled to the supporting structure of the dryer while the hot electrodes are insulated from the supporting structure and coupled to the hot side of the high frequency generator. The web to be dried is passed above or below the electrodes and is employed to form part of the conductive path between individual grounded and hot electrodes. The remaining portion of the conductive path are the capacitors which are formed between the electrodes and the web. The amount of the field is controlled by these capacitors (controlled by spacing) and the moisture of the web. Thus when the web becomes dryer, the resistivity of the path through the web becomes higher and limits the field. Due to the presence of the electrodes to one side of the web, no adjustment of electrode spacing must be made for changes in web thickness. Due to the limiting characteristics of the web moisture no alteration of the high frequency generator is required. The drying unit will only pull the power it actually needs from the high frequency generator.

The drying device of the present invention also includes certain features of mounting, mechanical adjustments and connections which further increase its flexibility and use.

A first of these mounting features resides in the mounting of the electrode assembly, called the applicator and the high frequency generator, called the generator upon a single supporting member and providing a roller-track arrangement whereby the entire drying device may be moved and positioned in or away from the path of a moving web. This facilitates the removal and replacement of the drying device without the need for shutting down the remainder of the web handling system. A second feature resides in the mounting of the applicator upon rollers arranged to move along rails mounted upon the supporting member permitting the rapid change of the applicator.

In this manner all applicators of different heights, and sizes may be employed with a single generator to meet the needs of the web being dried. The supporting frame for the applicator is also made adjustable to operate with the varying web heights of different web handling system or particular manner of handling the web. The applicator is also pivotally mounted upon its supporting frame to permit 360° of rotation relative to the path of the web as dictated by the drying needs of the web.

Finally, a unique rigid coupling is provided for the ground and hot connections between the applicator and generator which permits an easily assembleable connection to be made regardless of the height of the applicator or its rotational position. The coupling further provides proper connections to be maintained as the applicator is rotated with respect to the web. The coupling is composed of concentric members, the inner members serving to couple the hot electrodes of the applicator to the hot output of the generator, providing constant shielding therefore.

It is, therefore, an object of this invention to provide an improved form of material treating device.

It is another object of this invention to provide an improved form of dielectric drying device.

It is yet another object of this invention to provide an improved form of dielectric drying device for drying webs of material, such as paper.

It is still another object of this invention to provide an improved form of dielectric dryer mounted in such a manner as to permit rapid positioning with respect to a moving web of material without disrupting the movement of such web.

It is yet another object of this invention to provide an improved form of dielectric dryer, composed generally of an applicator and a generator, wherein the applicator can be positioned with respect to the generator and a moving web of material without disrupting the movement of such web or affecting the position of its associated generator.

Another object of this invention is to provide an im-
proven form of dielectric dryer, composed generally of an applicator and a generator wherein the applicator can be rotated with respect to a web of material to be dried. Still another object of this invention is to provide a form of rigid coupling between the generator and applicator of an improved form of dielectric dryer which coupling can be adjusted for different applicator heights or different applicators and which coupling can be maintained regardless of the rotational position of said applicator with respect to the web to be dried.

Another object of the invention resides in the provision of a drying machine of this nature which is very easy to set up originally and which is likewise easy to move out of the line of the traveling web and which can be rotated to any position through 360° on an axis parallel to the plane of the web but transverse thereof, so that the web can be traveled in any direction, horizontal, vertical, or at any angle therebetween, while being operated upon by the drying apparatus.

A further object of the invention resides in the provision of a drying unit as described which has a rigid, detachable energy and ground connection with respect to the RF or energy source so that the drying unit per se can be quickly and easily detached from the energy source which can be mounted just to the side of the path of the web, so that the drying unit can be moved therefrom for cleaning, etc., or completely moved out of the way of the whole line. When the unit is returned to operative position it makes contact with the RF stage and the ground connection, thus eliminating cables or movable lines. Through the use of such a fixed or rigid connection, power losses and drops are avoided, these losses being inherent in installations where flexible power leads are utilized for high frequency electric fields. The invention also contemplates that the connection for the electric energy as aforesaid is centrally located with respect to the drying unit which can be turned around it as an axis through 360° without disturbing the connections, and without the loss of power or energy.

A still further object of the invention is to provide a drying unit of the class described which is modular in nature so that a series of units can be set up side-by-side or in any combination of vertical stacking or horizontal arrangement, the units being in general in a rectangular form so that they are easily aligned and utilize a minimum amount of space, but at the same time the transformer and power supply is provided elsewhere in a cooler spot, i.e., in the basement of the factory building, etc., and wherein all of the overall dimensions of the units are flat to carry out the stacking and alignment noted above and also to make use of the same in the smallest possible factory space.

Other objects and features of the invention will be pointed out in the following description and claims and illustrated in the accompanying drawings, which disclose by way of example, the principles of the invention, and the best mode which has been contemplated for carrying it out.

In the drawings:

FIG. 1 is a perspective view of the new dryer;

FIG. 2 is an end view thereof looking generally in the direction of arrow 2 in FIG. 1;

FIG. 3 is a view in side elevation, parts being broken away and in section;

FIG. 4 is a top plan view of the dryer unit per se, parts being broken away and parts being broken away;

FIG. 4a is a schematic diagram of the theory of operation of the dryer with a web in place over the dryer unit; and

FIG. 5 is an enlarged section through the coupling between the dryer unit and the RF cabinet.

Similar elements are given similar reference characters in each of the respective figures.

Referring now to the drawings which show the preferred embodiment of the invention employed to dry a traveling web, such as paper, the reference numeral 10 indicates the floor line in FIGS. 2 and 3 and on the floor 10 there are preferably provided permanently installed rails at 12. These rails are trianularly arranged with respect to the proposed line of the path of the web which is indicated at 14 (see FIG. 2). These rails 12 can extend to the exterior of the plant housing the drying apparatus if this should be desired to provide for movement of the entire drying apparatus, to be described, in an easy and efficient manner and to locate it exactly where it is wanted.

There is a relatively simple supporting framework of rectangular form generally indicated at 16 and on this supporting framework there are provided wheels 18, 18 arranged to mate with the tracks 12. This supporting framework 16 mounts the entire drying apparatus to be described.

The supporting framework 16 is also preferably provided with a pair of rails 20, 20, these being parallel to those at 12 and extending along the supporting framework 16 in a fore-and-aft direction. On these rails 20 there are provided two sets of wheels 22, 22 in pairs and these wheels movably support parallel yokes 24 and 26 arranged in spaced relation with respect thereto. The two yokes 24 and 26 may be connected by any kind of framework such as beams at 28 or the like to connect them together in a rigid manner. Each yoke is provided with legs such as at 29, these legs supporting a main cross member which has a circular recess at the uppermost portion thereof. The recess 30 in the yoke 24 is smaller than the recess 32 in the yoke 26, but these recesses are axially aligned. The legs 29 may be unitary or may be formed in sections to accommodate an adjustment device, such as a jack screw, whereby the length of the legs 29 may be varied.

The legs 29 may be lengthened or shortened, depending upon the application, i.e., the desired distance of the web from the floor, without disturbance to the electric connection shown in FIG. 5, and later to be described.

There is a rectangular housing 34 mounted on the yokes 24 and 26. In general, this housing has a closed bottom member 36, closed side walls at 38, and closed end walls 40 and 42. On the end wall 42 there is an extending cylindrical element 44 which has a relatively large insulated sleeve 46 thereon and this is received in the recess 30 of yoke 24 (see FIG. 2).

The end wall 40 of the housing 34 is provided with a rather enlarged, hollow, annular member generally indicated by the numeral 48 (see FIG. 5) and aligned with it in the end wall 40 there is a relatively large opening 50. The annular member 48 is beveled at its forward edge portion as at 52 (see FIG. 5) and concentrically therewith there is mounted an electric energy conducting rod 54 by any kind of proper insulative means. This rod 54 extends through the center of the opening 50 and has a short "cable" 56 secured thereto. The opposite end of rod 54 is threaded. The member 48 forms a ground connection for the apparatus to be described and the rod 54 is the energizing or hot connection through which the high frequency electric current is led to the electrodes to be described.

The housing 34 is provided with a removable cover 58. This is comprised essentially of a rectangular open framework with a screen 60 across it to act as a shield. This cover may be suspended from above or it may be hinged in any way desired (not shown) with respect to any of the walls of the housing 34.

Mounted to extend across the housing 34 and insulated therefrom are a series of alternate energized electrodes 61, 61 and these electrodes are connected at their ends as at 62, 62 to a plate 64. This plate is the RF plate and it energizes the electrodes 61. The ground electrodes indicated at 66, 66 alternating with electrodes 61 are connected to the housing 34, to which the annular member 48 is also coupled thus forming a ground connection as
aforesaid. All the electrodes extend in parallel relation across the path of the web.

The cable 56 is connected to a plate 70 which acts to couple the high frequency energy from the generator to the electrodes 61 via the plate 64. The plates 64 and 70 make a huge capacitor permitting the intensity of the field applied to the electrodes 61 to be varied. The variation of the field is accomplished by altering the spacing between the plates 64 and 70. To accomplish this the plate 70 may be coupled directly to an insulated device for raising or lowering it or the plate 70 may be coupled to a further plate such as 74 which in turn is connected to an uninsulated device for raising or lowering the plate 70. The plate 70 is mounted by means of insulated standoffs or insulators 72,73 to the plate 74. The plate 74 in turn is raised or lowered relative to plate 64, thus also raising or lowering plate 70 with respect to plate 64 by any desired or convenient means such as air cylinders, pneumatic jacks or jack screws as shown at 76, 76. The jack screws 76 are operated via a worm gear arrangement 78 from a motor 89 or the like in order to adjust the intensity of the field as set out above. Capacitors 82,82 are coupled between the plates 70 and 74. The plate 74 will thus act as a constant ground plane for the plate 70 and will provide a fixed capacitive loading based upon the size of the plates 70 and 74, their spacing and the capacitors 82. In the form where the plate 74 is not employed, variations in the height of the plate 70 with respect to the housing will provide variations in the field which might cause overloading of the generator.

The web in the path at 14 runs through a slot as at 86 in the cover 59 of the housing 34 as shown in FIG. 3. The web 19 is maintained at a relatively constant spacing from the electrodes 61 and 66 so that relative differences in intensity and drying speeds can be achieved merely by the adjustment of plate 70 and from plate 64 by the means described above.

Also mounted upon the supporting framework 16 and at one end thereof is the generator unit 98 which provides high frequency currents to the electrodes 61. The generator unit 98 may take the form of any well known oscillator and forms no direct part of the present invention. Connected to the side wall of the generator closests to the housing 34 are a set of vertical ways 102 in which a sliding panel 100 is arranged for movement with respect to the supporting framework 16. The area of the side wall between the vertical ways 102 is shown entirely to facilitate a connection between the output of the generator and the electrodes 61 as will be described below. Attached to the sliding panel 100 is an extending hollow, open rotatable collar 94, having its remote end 96 tapered to unite with the beveled end 52 of the annular member 48. The rotatable collar 94 thus serves to complete the ground connection from the generator 98 to the electrodes 66 via the collar 94, and the annular member 48. Mounted within the collar 94 and insulated therefrom is the rod 90. The rod 90 is coupled at a first end to the hot output of the generator 98 by a cable (not shown) extending within the housing 34 (as shown) between the vertical ways 102. This permits the maintenance of a contact between the rod 90 and the list output of the generator regardless of the position of the sliding panel 100 with respect to the supporting framework 16. The opposite end of rod 90 is threaded and is arranged to mate with the threaded collar 92. The collar 92 is coupled to the collar 94 by means of spacers such as 93. The collar 92 serves to couple the rod 90 to the threaded end of the rod 54, whereby the hot connection between the generator 98 and the electrodes 61 is completed. As will be described below the collars 92 and 94 are arranged for rotation with respect to the sliding panel 100 and will concurrently cause the contacting and coupling of rods 90 and 54 and collar 94 with annular member 48. Due to the collar 92 coupling can be maintained between rods 90 and 54 for a substantial number of rotations.

Coupling between the rotatable collar 94 and the annular member 48 is made as soon as the yokes 24 and 26 are advanced along the rails 28 and physical contact is achieved. The rotatable collar 94 and annular member 48 are securely fastened by means of a threaded annular sleeve 108 coupled to collar 94 by an annular ring 104 arranged to engage with a threaded sleeve 106 connected to the annular member 48. Thus as the rotatable collar 94 is rotated thus rotating annular sleeve 108 collar 94 and annular member 48 are clamped together via the annular sleeve 108 and the sleeve 106 and the rods 50 and 54 are clamped by means of collar 92 rotated with collar 94. Due to the extent of the threaded areas of the collar 92, the rods 90 and 54, the annular sleeve 108 and sleeve 106 contact and clamping between the individual elements can be maintained despite a number of rotations of the housing 34 moving annular member 48 and rod 54 with it.

The transformers, rectifiers and other heat generating equipment of the generator 98 is generally indicated at 110. This equipment may be located at a remote position as for instance in a cool spot as in the basement of the factory and is connected by proper cables to the generator 98. In turn the generator can also be connected by cables to a control panel or the like 112 which can be situated anywhere convenient. The control panel 112 can be provided with such controls as the operator will need in order to operate the machine as desired.

Now that the various components of the drying apparatus constructed according to the inventive concepts disclosed herein have been set forth, the operation of the drying apparatus can now be set forth with reference to FIGURE 4A. For illustrative purposes a portion of the web 14 and a single hot electrode 61 and a single grounded electrode 66 will be considered. FIGURE 4A is a schematic representation of the electrical characteristics of the apparatus. Generator 98 is shown coupled via rod 90 to the adjustable plate 70, which in turn is capacitively coupled to plate 64. The hot electrode 61 is directly coupled to plate 64 and capacitively coupled via an air dielectric to the web 14. The current path continues within the web 14 to the portion adjacent electrode 66. Again the web 14 and electrode 66 are coupled by an air dielectric capacitor. The capacitance due to the separation of the web 14 and electrodes 61 and 66 and the relative potentials applied to them. The electrode 66 is coupled to the collar 94 and to ground.

As can be seen from the foregoing, a complete current path exists through the web 14. It is well known that liquids and materials containing liquids will conduct currents depending upon the amount of liquid present. The measure of the resistance to current flow is identified as resistivity. The more saturated with liquid the material the lower its resistivity and the better its ability as a conductor. The resistivity will go up, impeding the flow of current as the material becomes dryer. The presence of the field which exists between web and electrodes and the current which flows as a result cause the drying of the web and its decrease in conductivity. Thus as the web becomes dryer the demand for power becomes less reducing less output from the generator. Therefore only that power needed to supply the forth coming currents is made available. Unlike steam devices which provide substantially constant heating, the present device will only draw the power it requires.

The mechanics of the heating operation is not precisely known, but it is believed that it is due to the flow of currents through the wet areas of the web and also due to the excitation of the molecules of the web by the field. The excitation of the molecules of the web causes them to move more rapidly and generate thermal energy within the web itself. It is also believed some skin effect heating takes place. Due to the insulation of the center of the web from the exposed surfaces the center of the web will dry first permitting greater uniformity of drying. In conventional devices the contact surfaces dry first, and if the
center of the web is to be dried there is a danger of charring the contact surfaces.

It will be seen that the present invention has a great many advantageous aspects. In the first place there is a fixed ground and energy connection with respect to the generator 98, the source of the high frequency current. This is made on a center line of the swiveling action of the housing 34 so that it makes no difference where the housing 34 is positioned on its axis, there is a good solid electric connection provided at all times. Flexible connections could be used, but these result in rather heavy power losses and by the use of the rigid connection of this invention, power losses are minimized.

The housing 34 can be swiveled throughout 360° and can actually be located upside down or in any position desired, depending upon the requirements of the web. By the use of the modular apparatus described, the web handling apparatus can be made modular, i.e., there can be several of these units arranged side-by-side or stacked vertically, depending upon supports as from the ceiling, struts, side walls or the like, as will be clear to those skilled in the art. The field intensity adjustment is arranged inside the housing 34 where it is completely concealed and protected; and as described the transformer 110 and other equipment can be placed at a remote point so that the generator 98, which is comparatively of very light weight, can be located to move on the supporting framework 16 so that the entire unit is completely and easily movable not only out of the paper line but out of the building if this should be required for any purpose.

The control panel 112 can be located close to the machine; it can be used for controlling several of them, or it can be put at the rear end of the line.

Furthermore, in an existing paper line, the present unit can be used and tilted in any direction as for instance as is indicated in FIG. 1 as it often happens that one part of the apparatus is at a low level and another part to which the web is to be traveled is in a higher elevation. This tilt is also useful to run the web to a higher unit in the next stack, or from unit-to-unit in the same stack.

It is seen therefore that the new drying unit is lightweight, easy to handle, set up, and adjust, relatively simple to operate and clean, and saves floor space.

Having thus described my invention and the advantages thereof, I do not wish to be limited to the details herein disclosed, otherwise than as set forth in the claims, but what I claim is:

1. A drying apparatus comprising: a supporting framework; an energy source connected to said supporting framework; supporting member means coupled to said supporting framework; housing means rotatably mounted upon said supporting member means, said housing means capable of being rotated through a complete circular path about an axis through said supporting member means; a first plurality of electrodes connected to said housing means; plate means mounted within and insulated from said housing means; a second plurality of electrodes connected to said plate means; a grounding terminal and said second electrodes to said energy source, said coupling means providing said coupling regardless of the degree of rotation of said housing means.

2. A drying apparatus comprising: a supporting framework; first means connected to said supporting framework for positioning said supporting framework; an energy source connected to said supporting framework; supporting member means; second means connected to said supporting member means for positioning said supporting member means upon said supporting framework with respect to said energy source; housing means coupled to said supporting member means and adapted for rotation about an axis through said supporting member means; a first plurality of electrodes connected to said housing means; plate means mounted within said housing means and insulated therefrom; a second plurality of electrodes mounted upon said plate means; a ground terminal; and coupling means coupling said ground terminal to said housing means and said energy source to said plate means; a plurality of electrodes mounted upon said plate means and insulated from said housing means, said adjustable plate means being adjustable with respect to said plate means; a ground terminal; and coupling means coupling said ground terminal to said housing means and said energy source to said plate means, said coupling means providing said coupling regardless of the degree of rotation of said housing means.

3. A drying apparatus comprising: a supporting framework; first means connected to said supporting framework for positioning said supporting framework; an energy source connected to said supporting framework; supporting member means; second means connected to said supporting member means for positioning said supporting member means upon said supporting framework with respect to said energy source; housing means coupled to said supporting member means; first plurality of electrodes connected to said housing means; plate means mounted within said housing means and insulated therefrom; a second plurality of electrodes mounted upon said plate means; a ground terminal; and coupling means coupling said ground terminal to said housing means and said energy source to said plate means; a plurality of electrodes mounted upon said plate means and insulated from said housing means, said adjustable plate means being adjustable with respect to said plate means; a ground terminal; and coupling means coupling said ground terminal to said housing means and said energy source to said plate means, said coupling means providing said coupling regardless of the degree of rotation of said housing means.

4. In an article handling system having a transport path along which articles are moved, a drying apparatus comprising: a supporting framework positioned transverse to said transport path; first guide means positioned transverse to said transport path; said guide means being alternately arranged with said first electrodes; a ground terminal, and coupling means coupling said ground terminal to said housing means and said energy source to said second electrodes, said coupling means providing said coupling regardless of the degree of rotation of said housing means.

5. In an article handling system having a transport path along which articles are moved, a drying apparatus comprising: a supporting framework positioned transverse to said transport path; first guide means positioned transverse to said transport path; said guide means being alternately arranged with said first electrodes; a ground terminal, and coupling means coupling said ground terminal to said housing means and said energy source to said second electrodes, said coupling means providing said coupling regardless of the degree of rotation of said housing means.

6. In an article handling system having a transport path along which articles are moved, a drying apparatus comprising: a supporting framework positioned transverse to said transport path; first guide means positioned transverse to said transport path; said guide means being alternately arranged with said first electrodes; a ground terminal, and coupling means coupling said ground terminal to said housing means and said energy source to said second electrodes, said coupling means providing said coupling regardless of the degree of rotation of said housing means.

7. In an article handling system having a transport path along which articles are moved, a drying apparatus comprising: a supporting framework positioned transverse to said transport path; first guide means positioned transverse to said transport path; said guide means being alternately arranged with said first electrodes; a ground terminal, and coupling means coupling said ground terminal to said housing means and said energy source to said second electrodes, said coupling means providing said coupling regardless of the degree of rotation of said housing means.
framework with respect to said energy source; housing means coupled to said supporting member means transverse to said transport path, said housing means coupling permitting the rotation of said housing means about an axis through said supporting member means transverse to said transport path; a first plurality of electrodes connected to said housing means; means coupled to said housing means to permit the passage of said articles through said housing means, above and spaced apart from said first plurality of electrodes; plate means mounted within said housing means and insulated therefrom; a second plurality of electrodes mounted upon said first plate means, said second electrodes being alternately arranged with said first electrodes; an adjustable plate means mounted within said housing below said plate means and insulated from said housing means, said adjustable plate means being adjustable with respect to said plate means to vary the coupling between said plate means and adjustable plate means; a ground terminal; and coupling means coupling said ground terminal to said housing means and said energy source to said plate means, said coupling means providing said coupling regardless of the degree of rotation of said housing means.

6. In a web handling system having a transport path along which webs containing moisture are moved, a drying apparatus comprising: a supporting framework positioned transverse to said transport path; first guide means positioned transverse to said transport path; first roller means connected to said supporting framework and coupled to said first guide means to permit the movement of said supporting framework with respect to said transport path; an energy source connected to and supported by said supporting framework; supporting member means; second guide means connected to said supporting framework; second roller means connected to said supporting member means and coupled to said second guide means for positioning said supporting member means upon said supporting framework with respect to said energy source; housing means coupled to said supporting member means transverse to said transport path, said housing means coupling permitting the rotation of said housing means about an axis through said supporting member means transverse to said transport path; a first plurality of electrodes connected to said housing means; means coupled to said housing means to permit the passage of said webs through said housing means, above and spaced apart from said first plurality of electrodes; plate means mounted within said housing means and insulated therefrom; a second plurality of electrodes mounted upon said first plate means, said second electrodes being alternately arranged with said first electrodes; a ground terminal; and coupling means coupling said ground terminal to said housing means and said energy source to said second electrodes, said coupling means providing said coupling regardless of the degree of rotation of said housing means.

7. An apparatus as defined in claim 1, wherein said coupling means comprises: a pair of concentric male members including an inner male member and an outer male member; a pair of concentric female members including an inner female member and an outer female member, one of said pairs connected to said energy source and the other of said pairs connected to said housing means; said first assembly means permitting the rotation of said outer male member to said outer female member, said first assembly means permitting the rotation of said outer male and female members with respect to one another while maintaining their coupling; second assembly means for coupling said inner male member to said outer female member, said second assembly means permitting the rotation of said inner male and female members with respect to one another while maintaining their coupling; second assembly means for coupling said outer male member to said inner female member, said second assembly means permitting the rotation of said outer male and female members with respect to one another while maintaining their coupling; second assembly means being coupled to said outer female member whereby the operation of said first assembly means operates said second assembly means to simultaneously couple said inner and outer male and female members.

8. An apparatus as defined in claim 2, wherein said coupling means comprises: a pair of concentric male members including an outer male member and an inner male member; a pair of concentric female members including an outer female member and an inner female member, one of said pairs connected to said energy source and the other of said pairs connected to said housing means; first assembly means for coupling said outer male member to said outer female member, said first assembly means permitting the rotation of said outer male and female members with respect to one another while maintaining their coupling; second assembly means for coupling said inner male member to said inner female member, said second assembly means permitting the rotation of said outer male and female members with respect to one another while maintaining their coupling; second assembly means being coupled to said outer female member whereby the operation of said first assembly means operates said second assembly means to simultaneously couple said inner and outer male and female members.

9. An apparatus as defined in claim 3, wherein said coupling means comprises: a pair of concentric male members including an inner male member and an outer male member; a pair of concentric female members including an inner female member and an outer female member, one of said pairs connected to said energy source and the other of said pairs connected to said housing means; first assembly means for coupling said outer male member to said outer female member, said first assembly means permitting the rotation of said outer male and female members with respect to one another while maintaining their coupling; second assembly means for coupling said inner male member to said inner female member, said second assembly means permitting the rotation of said outer male and female members with respect to one another while maintaining their coupling; second assembly means being coupled to said outer female member whereby the operation of said first assembly means operates said second assembly means to simultaneously couple said inner and outer male and female members.

10. An apparatus as defined in claim 4, wherein said coupling means comprises: a pair of concentric male members including an inner male member and an outer male member; a pair of concentric female members including an inner female member and an outer female member, one of said pairs connected to said energy source and the other of said pairs connected to said housing means; first assembly means for coupling said outer male member to said outer female member, said first assembly means permitting the rotation of said outer male and female members with respect to one another while maintaining their coupling; second assembly means for coupling said inner male member to said inner female member, said second assembly means permitting the rotation of said outer male and female members with respect to one another while maintaining their coupling; said second assembly means being coupled to said outer female member whereby the operation of said first assembly means operates said second assembly means to simultaneously couple said inner and outer male and female members.

11. An apparatus as defined in claim 5, wherein said coupling means comprises: a pair of concentric male members including an inner male member and an outer male member; a pair of concentric female members including an inner female member and an outer female member, one of said pairs connected to said energy source and the other of said pairs connected to said housing means; first assembly means for coupling said outer male member to said outer female member, said first assembly means permitting the rotation of said outer male and female members with respect to one another while maintaining
their coupling; second assembly means for coupling said inner male member to said inner female member, said second assembly means for permitting the rotation of said inner male and female members with respect to one another while maintaining their coupling; second assembly means being coupled to said outer female member whereby the operation of said second assembly means operates said second assembly means to simultaneously couple said inner and outer male and female members.

12. An apparatus as defined in claim 6, wherein said coupling means comprises: a pair of concentric male members including an inner male member and an outer male member; a pair of concentric female members including an inner female member and an outer female member, one of said pairs connected to said housing means; first assembly means for coupling said outer male member to said outer female member, said first assembly means permitting the rotation of said outer male and female members with respect to one another while maintaining their coupling; second assembly means for coupling said inner male member to said inner female member, said second assembly means permitting the rotation of said inner male and female members with respect to one another while maintaining their coupling; second assembly means being coupled to said outer female member whereby the operation of said first assembly means operates said second assembly means to simultaneously couple said inner and outer male and female members.

13. An apparatus as defined in claim 1, wherein said coupling means comprises: an inner female member; an outer female member, said inner and outer female members concentrically mounted upon a first mounting plate; first adjustable means for adjustable mounting said first mounting plate upon said energy source; an inner male member; an outer male member; said inner and outer male members concentrically mounted upon said housing means; said first adjustable means being adjustible to align said inner and outer female members with said inner and outer male members, first assembly means for coupling the outer female and male members, said first assembly means permitting the rotation of said outer male and female members with respect to one another while maintaining their coupling; second assembly means for coupling said inner female and male members, said second assembly means permitting the rotation of said inner male and female members with respect to one another while maintaining their coupling; said second assembly means being coupled to said outer female member whereby the operation of said first assembly means operates said second assembly means to simultaneously couple said inner and outer male and female members.

14. An apparatus as defined in claim 2, wherein said coupling means comprises: an inner female member; an outer female member, said inner and outer female members concentrically mounted upon a first mounting plate; first adjustable means for adjustable mounting said first mounting plate upon said energy source; an inner male member; an outer male member; said inner and outer male members concentrically mounted upon said housing means; said first adjustable means being adjustable to align said inner and outer female members with said inner and outer male members, first assembly means for coupling the outer female and male members, said first assembly means permitting the rotation of said outer male and female members with respect to one another while maintaining their coupling; second assembly means for coupling said inner female and male members, said second assembly means permitting the rotation of said inner male and female members with respect to one another while maintaining their coupling; said second assembly means being coupled to said outer female member whereby the operation of said first assembly means operates said second assembly means to simultaneously couple said inner and outer male and female members.

15. An apparatus as defined in claim 3, wherein said coupling means comprises: an inner female member; an outer female member, said inner and outer female members concentrically mounted upon a first mounting plate; first adjustable means for adjustable mounting said first mounting plate upon said energy source; an inner male member; an outer male member, said inner and outer male members concentrically mounted upon said housing means; said first adjustable means being adjustable to align said inner and outer female members with said inner and outer male members, first assembly means for coupling the outer female and male members, said first assembly means permitting the rotation of said outer male and female members with respect to one another while maintaining their coupling; said second assembly means for coupling said inner female and male members, said second assembly means permitting the rotation of said inner male and female members with respect to one another while maintaining their coupling; second assembly means for coupling said inner female and male members, said second assembly means permitting the rotation of said inner male and female members with respect to one another while maintaining their coupling; said second assembly means being coupled to said outer female member whereby the operation of said first assembly means operates said second assembly means to simultaneously couple said inner and outer male and female members.

16. An apparatus as defined in claim 4, wherein said coupling means comprises: an inner female member; an outer female member, said inner and outer female members concentrically mounted upon a first mounting plate; first adjustable means for adjustable mounting said first mounting plate upon said energy source; an inner male member; an outer male member; said inner and outer male members concentrically mounted upon said housing means; said first adjustable means being adjustable to align said inner and outer female members with said inner and outer male members, first assembly means for coupling the outer female and male members, said first assembly means permitting the rotation of said outer male and female members with respect to one another while maintaining their coupling; second assembly means for coupling said inner female and male members, said second assembly means permitting the rotation of said inner male and female members with respect to one another while maintaining their coupling; said second assembly means being coupled to said outer female member whereby the operation of said first assembly means operates said second assembly means to simultaneously couple said inner and outer male and female members.

17. An apparatus as defined in claim 5, wherein said coupling means comprises: an inner female member; an outer female member, said inner and outer female members concentrically mounted upon a first mounting plate; first adjustable means for adjustable mounting said first mounting plate upon said energy source; an inner male member; an outer male member; said inner and outer male members concentrically mounted upon said housing means; said first adjustable means being adjustable to align said inner and outer female members with said inner and outer male members, first assembly means for coupling the outer female and male members, said first assembly means permitting the rotation of said outer male and female members with respect to one another while maintaining their coupling; second assembly means for coupling said inner female and male members, said second assembly means permitting the rotation of said inner male and female members with respect to one another while maintaining their coupling; said second assembly means being coupled to said outer female member whereby the operation of said first assembly means operates said second assembly means to simultaneously couple said inner and outer male and female members.

18. An apparatus as defined in claim 6, wherein said coupling means comprises: an inner female member; an outer female member, said inner and outer female members concentrically mounted upon a first
mounting plate; first adjustable means for adjustably mounting said first mounting plate upon said energy source; an inner male member; an outer male member; said inner and outer male members concentrically mount- ed upon said housing means; said first adjustable means being adjusted to align said inner and outer female members with said inner and outer male members, first as- sembly means for coupling the outer female and male members, said first assembly means permitting the rotat- ion of said outer male and female members with respect to one another while maintaining their coupling; second assembly means for coupling said inner female and male members, second assembly means permitting the rotation of said inner male and female members with respect to one another while maintaining their coupling; said second assembly means being coupled to said outer female member whereby the operation of said first assembly means operates said second assembly means to simultaneously couple said inner and outer male and female members.

19. An apparatus as defined in claim 13, wherein said supporting member means includes second adjustable means to permit adjustment of said supporting member means thereby altering the spacing between said housing means mounted upon said supporting member means and said supporting framework.

20. An apparatus as defined in claim 3, wherein said energy source is an RF energy source, and said adjustable plate means can be adjusted to vary the RF field applied to said second electrodes.

21. An apparatus as defined in claim 5, wherein said energy source is an RF energy source, and said adjustable plate means can be adjusted to vary the RF field applied to said second electrodes.

22. An apparatus as defined in claim 6, wherein said energy source is an RF energy source, and said plate means can be adjusted to vary the RF field applied to said second electrodes.

23. Apparatus for drying a traveling web in a high fre- quency field: comprising a generally rectangular frame- work, electrodes on said framework, an oscillator for providing high frequency energy, said oscillator being located completely to one side of said framework in a predetermined position with respect thereto, a connection between said oscillator and said electrodes on said frame- work including a central member and a separate concentric outer member cooperatively connected to said oscill- ator and a similar central member and separate concentric other member cooperatively connected with said electrodes and adapted for complementary engagements with said central member and said separate concentric other member on said oscillator, said central member and said separate concentric other members being adapted for separation one from the other upon movement of said framework away from said oscillator and interconnection upon movement of said framework towards said oscillator, means mounting said framework to swivel on an axis through said connecting members, said framework mounting means including a pair of spaced yokes one at each end of said framework said yokes including recesses, an element axially aligned with said connecting members and being received in one recess, and said connection members being received in said other recess.

24. Apparatus for drying a web: comprising a track, a pair of spaced yokes arranged across said track and being moveable thereon, each of said yokes having an upwardly open recess, a framework, axially aligned elements on said framework one at each end thereof, said axially aligned elements being received in said recesses and said yoke supporting said framework thereby, a series of elec- trodes on said framework, a cabinet, a source of high fre- quency electric energy disposed in said cabinet, a connec- tion from said source of high frequency electric energy to said electrodes, said connection including one of said axially aligned elements and a complementary element of said cabinet.

25. The drying apparatus of claim 24: wherein the ele- ments comprising the connection are detachable.

26. The apparatus of claim 24: wherein the elements comprising the connection are detachable and include complementary mating surfaces.

27. The apparatus of claim 24: wherein the connection elements are annular and mating.

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