

PATENT SPECIFICATION

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(54) PROCESS AND APPARATUS FOR SEASONING WOOD

(71) I, EDWARD KOPPELMAN, of 4424 Bergamo Drive, Encino, California 94316, United States of America, a citizen of the United States of America, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to a process and an apparatus for effecting an accelerated seasoning or drying of green or partially dried lumber by uniformly heating the wood by an electrically created field under vacuum in a manner to effect a volatilization of the water and other volatile substances entrapped within the internal structure of the wood and a removal thereof at a controlled rate and temperature which avoids cracking or other damage to the wood structure. By avoiding corona, arcing, glow discharges and similar effects, the invention permits the first practical and successful combination of the advantages of both di-electric and vacuum drying techniques.

A variety of techniques have heretofore been used or proposed for facilitating the drying of unseasoned lumber, boards, planks and beams cut from green timber in order to reduce the moisture level thereof to within an acceptable range. Generally, the moisture content of green timber will range from as low as about 28% by weight to as high as about 60% by weight depending upon the particular species of tree and seasonal conditions at the time of cutting. A reduction in the moisture content of such green timber to within a range of from about 5% to about 10% by weight is necessary in order to render the wood dimensionally stable throughout the various manufacturing processes employed for converting the lumber into useful products.

Proper seasoning also reduces manufacturing difficulties, provides for time savings and reduces the amount of waste. Additionally, proper moisture contents of wood are necessary to render the wood products suitable for gluing and finishing and to further facilitate the handling of wood products such as thin veneers, for example.

Conventionally, green lumber is commercially dried employing a kiln drying process or a tunnel air drying process which generally requires upwards of six days for most wood species to reduce the water content thereof to within an acceptable range. Typical kiln drying periods for one-inch green lumber to a moisture content of 6% ranges from 25 to 35 days for California black oak, which is representative of some of the hard wood species; from 11 to 15 days for white ash; and from 2 to 7 days for Douglas-fir as being representative of some of the soft wood species. A simple seasoning of such green lumber by air drying achieved by prolonged storage in a yard has also been used and requires from three months to three years, depending on environmental conditions and wood species to produce a satisfactory drying of the lumber.

Due to the growing shortage of certain selected hard woods and the general increase in demand and consumption of seasoned wood products, there has been an increasing need for providing techniques and equipment for accelerating the seasoning of wood to reduce the moisture content thereof within time periods substantially shorter than those normally required in accordance with prior art practices. Some of the techniques heretofore proposed have suggested the use of vacuum to facilitate an extraction of the moisture from the green lumber. Unfortunately, difficulty has been encountered in applying heat

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uniformly to the green lumber being dried which in combination with the imposition of high vacuums has occasioned a rapid uncontrolled and nonuniform extraction of volatiles from the green timber, resulting in distortion, warping and, in some instances, physical destruction or deterioration of localized sections of the wood as evidenced by cracks and other surface fractures.

Others have proposed use of dielectric heating methods because of their known ability to supply heat internally throughout the wood to be dried. But at drying rates necessary to justify their commercial use, such methods have tended to heat the wood too rapidly leading to uncontrolled and destructive temperatures and pressures particularly in the interior portions of the wood. This again has occasioned unacceptable levels of physical damage to the wood.

While it is known that the application of a vacuum permits the volatilization of liquids at lower temperatures than under atmospheric conditions, it has heretofore been considered impractical and undesirable to combine the advantages of dielectric heating and vacuum drying methods for seasoning of lumber on a commercial scale, because at the voltage and power levels necessary for volume operation, the moisture being extracted from the wood and the high relative humidity of the surrounding reduced pressure atmosphere have led to corona effects, arcing, glow discharges and similar phenomenon which not only destroy efficiency by their energy waste, but in many cases lead to localized combustion and charring of the wood.

The present invention overcomes the problems, disadvantages and time consuming practices of prior art techniques by providing a process which effects a comparatively rapid drying of wood at comparatively low temperatures, and wherein the moisture and other volatiles are extracted in a manner so as to avoid distortion and other physical damage to the wood during the drying process.

According to the present invention there is provided a process for drying unseasoned wood comprising the steps of placing the wood to be dried in an enclosed space; evacuating the gaseous substance from said enclosed space so as to impose a subatmospheric pressure on said wood; applying an alternating electric potential between electrodes having means for preventing arcing or other sudden discharges, the potential being of such a frequency and being applied across the wood so as to effect a dielectric heating of the wood and the moisture entrapped within the interior thereof by an elec-

trically-created field to a temperature at which the water volatilizes at the prevailing subatmospheric pressure present in the enclosed space, the electrodes being disposed within the enclosed space and maintained in fixed relationship to the wood while the electric potential is applied; continuing the addition of heat to the wood at an input rate substantially equal to the latent heat of vaporization of the water being evaporated and maintaining the subatmospheric pressure within said enclosed space until the water content of the wood attains the desired level; and thereafter removing the dried wood from the enclosed space.

The invention also provides an apparatus for drying unseasoned wood comprising means defining a chamber, means for supporting wood to be dried within said chamber, means in communication with the interior of said chamber for evacuating the gaseous substances therefrom, means disposed within the chamber for applying an alternating electric potential across wood within the chamber to effect a dielectric heating of the interior thereof to a temperature at which the water and other volatile substances in the wood volatilize at the prevailing subatmospheric pressure present in the chamber, means for preventing discharge of the alternating electric potential, control means for controlling the rate of heat input to the wood and the subatmospheric pressure present within the chamber.

The subatmospheric pressure on the wood is preferably between 15 mm Hg. and 375 mm Hg. and more preferably less than 100 mm Hg. The specific vacuum employed will vary depending on the species of wood being dried and can also vary during the course of a drying cycle in order to optimize the removal of moisture and other volatiles without exceeding a temperature which would cause physical damage to the internal wood structure. A heating of the water and other volatile constituents entrapped within the internal wood structure is effected by dielectric heating. The application of vacuum and the heating of the wood can be performed simultaneously and continuously although it is also contemplated that the heating can be intermittent and controlled in magnitude so as to replenish the latent heat required for the vaporization of volatiles, while simultaneously avoiding excessive temperatures which are harmful to the wood fibres and preventing a build up of excessive pressures within the internal wood structure. The heating of the wood and the application of a subatmospheric thereto could also be performed alternately.

A preferred apparatus comprises a rigid

enclosure within which the lumber to be dried is loaded and the enclosure is subsequently sealed to permit an evacuation of the gaseous substances therein. The enclosure further contains a movable electrode which is positionable relative to the green lumber and a supporting electrode on which the lumber is placed, whereafter a dielectric heating of the lumber is effected to cause a liberation and extraction of the moisture and other volatile constituents. The electrodes are provided with a thin film of insulating substance, such as a polyethylene coating, which prevent corona, arcing and glow discharge effects during the drying operation.

In the accompanying drawings:

Figure 1 is a plan view of a vacuum chamber and associated equipment constructed in accordance with a preferred embodiment of the present invention;

Figure 2 is a side elevational view of the vacuum chamber and vacuum line as shown in Figure 1;

Figure 3 is a magnified transverse sectional view of the vacuum chamber incorporating a load of green lumber and taken substantially along the line 3-3 of Figure 2;

Figure 4 is a transverse vertical sectional view of an alternative vacuum chamber construction incorporating a plurality of electrodes disposed in superimposed space relationship;

For the purposes of this description and the subjoined claims, the terms "wood" and "lumber" are intended to encompass green or partially-dried timber as originally cut, as well as in any one of the intermediate stages of processing in accordance with usual sawmill practices. Accordingly, these terms encompass green timber substantially in the as-cut condition; boards or flicks derived from the first cutting of logs; planks which have been ripped to appropriate widths, trimmed planks or boards of appropriate length in addition to usual sawmill waste products, such as chips, for example, which ultimately can be converted into useful products such as chip-board and the like.

Referring now in detail to the drawings, and as may be best seen in Figures 1 and 2 thereof, the apparatus for achieving a controlled accelerated drying of green lumber comprises a pressure vessel or tank 10 of a generally circular cross sectional configuration closed at one end by a dish-shaped wall 12 and at the opposite end by a hinged cover member 14. The tank 10 is supported in a substantially horizontal position by means of transverse base members 15 disposed beneath each end portion thereof.

The interior of the tank 10 defines an

enclosed space or chamber 16 in which a load of stacked green or partially-dried lumber, indicated generally at 18 in Figure 3, is loaded and retained during the drying cycle. In accordance with a preferred embodiment of the present invention, the planks or boards 20 are stacked directly in longitudinal aligned relationship on the upper surface of a cart 22 which is movably supported by means of grooved wheels 24 on V-shaped rails 26 secured to the bottom wall of the tank 10 as best seen in Figure 3. The upper surface of the cart 22 is formed with a metallic platform or plate 28 which defines a lower electrode for dielectrically heating the lumber during the vacuum drying cycle. A suitable framework fragmentarily indicated at 30 in Figure 1 is positioned outside of the tank 10 and in aligned relationship relative to the rails 26 in the tank to facilitate movement of the cart in loading and unloading of the drying apparatus.

As best seen in Figure 3, a generally U-shaped framework 32 is secured to and depends from the upper portion of the interior of the tank 10 on which the upper electrode assembly 34 is supported for vertical movement between a lowered position as shown in solid lines in Figure 3 and a raised position vertically spaced therefrom. The electrode assembly 34 comprises a plate or upper electrode 36 which is substantially coextensive with the lower electrode 28 defining the upper platform of the cart. Three vertical members 38 extend longitudinally of the electrode 36 and are secured by means of angle iron stringers 40 to the upper surface thereof. The upper end portions of the vertical members 38 are securely fastened to a horizontal supporting member 42 which is comprised of an insulating material such as a phenolic resin material. The vertical members 38 similarly are comprised of a reinforced phenolic resin material in order to electrically insulate the upper electrode 36 from the overhead supporting framework 32.

The horizontal member 42 of the electrode assembly is secured at longitudinally spaced intervals along the length thereof to a number of pairs of vertically extending rods 44, which are upwardly biased by means of coil springs 46. A corresponding number of inflatable air bags 48 are interposed between the upper surface of the horizontal member 42 and the lower face of the U-shaped framework 32, which, upon inflation, serve to move the electrode assembly downwardly in opposition to the biasing force of the coil springs 46. The supply of a suitable actuating fluid, such as air, to each of the air bags 48 is conveniently achieved by means of flexible

hoses 50 connected through the wall of the tank to a supply manifold 52.

In normal operation of the upper electrode assembly, pressure is released from the interior of the air bags 48 to permit the electrode assembly to be raised in clearance relationship relative to a load of lumber in order to facilitate a loading and unloading of the pressure vessel. After the cart and lumber load have been placed in appropriate position, the air bags are pressurized so that the upper electrode moves downwardly either in contact with or in close proximity to the upper surface of the wood load.

The electrodes are provided with a thin film of insulating substance, such as a polyethylene coating, which has the effect of preventing corona, arcing and glow discharge phenomenon. This enables use of the high voltages and vacuums contemplated by the invention for volume drying of commercial sized loads of lumber. The high vacuum strengths appear to increase the efficiency of the drying operation in several respects. Not only do they permit higher voltages without an excessive and destructive rise in temperature throughout the interior of the wood, but they increase the rate of moisture extraction to a point where a greater than proportionate share of the electrical energy can be absorbed by the wetter portions of the wood (where the dielectric constant and the power factor are usually higher) without excessive volatilization and pressure build up in these localized areas. Where the moisture content in the green lumber is not uniform, this improves the uniformity of moisture content in the final product. Moreover, in many cases the high vacuum strengths cause some of the moisture to be extracted in liquid form without the consumption of the energy necessary for volatilization and this further increases efficiency. The use of high vacuum strengths, however, depends upon means to prevent arcing and corona effects, since sudden arcing can lead to localized charring and combustion of the lumber. This problem has heretofore prevented the successful combination of dielectric and vacuum drying techniques for seasoning lumber in all but the most specialized low power experimental applications.

The upper electrode is conveniently connected to an electric power source, as schematically indicated at 54 in Figure 3. In order to assure proper grounding of the lower electrode, the cart is preferably connected by a pigtail 56 to the tank structure prior to initiation of the dielectric heating cycle. The generator for the electric power can be conveniently housed in a module 58, as shown in Figure 1, disposed ad-

jacent to the tank 10, and the power lines connected thereto extend through a conduit 60. The control of the electrically created field heating, as well as the vacuum imposed on the wood during the drying cycle, is regulated by means of a control module 62 as shown in Figure 1.

The interior of the vacuum chamber 16 is connected to flange ports 64, which in turn are connected to a suction manifold pipe 66 provided with a flanged cross 68 in the center portion thereof. The upper arm of the flanged cross 68 is provided with a blind flange 70, while the opposite lower end is provided with a downcomer tube 72. The base of the downcomer 72 is connected to a waste line 74, which is connected to the inlet side of a waste pump 76 for pumping out any accumulation of water in the manifold system. A suction line 78 formed with a beveled inlet end projects into the interior of the downcomer at a position intermediate the ends thereof for withdrawing air and other gaseous products from the suction manifold pipe and the vacuum chamber 16.

The operation of a vacuum pump 80 connected to the suction line 78 is controlled by sensing devices connected to the control system in the control module 62 so as to maintain a vacuum level within the chamber during a drying cycle of at least 375 mm Hg. At a subatmospheric pressure of the foregoing magnitude, an internal heating of the wood structure to temperatures generally ranging from 100°F to 190°F occasions a relatively rapid volatilization of the water content thereof without thermally decomposing or heat softening the cellulosic structure and resinous components of the wood. Preferably the temperature of the wood during the drying cycle does not exceed 180°F. Once a volatilization and extraction of water commences, the vacuum is at least in part maintained by the subsequent condensation of the water vapors generated and the vacuum pump accordingly is employed for maintaining the vacuum within prescribed ranges.

In order to facilitate a condensation of the water extracted from the wood being dried, at least a portion of the peripheral section of the pressure vessel is provided with an encircling shroud or jacket 82, as best seen in Figures 2 and 3, which is formed with a waste or drain line 84 in the bottom thereof. A longitudinally extending slot 86 is formed in the upper section of the shroud and a distributor pipe 88 is positioned therein, the pipe being connected to a supply of cooling water by means of supply line 90. The distributor pipe 88 is provided with a plurality of nozzles 89 for discharging a plurality of

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streams of cooling water in impinging relationship against the peripheral surface of the exterior of the tank 10 to effect a cooling of the tank and an extraction of the heat liberated by the condensation of extracted moisture on the inner surfaces of the tank. The extracted liquid concentrate formed in the interior of the tank 5 is suitably drained, as shown in Figure 2, by a drain 92 in the base of the closed end of the tank, which preferably is at a level slightly lower than that of the opposite open end thereof. The drain 92 is connected, as shown in Figure 2, to the suction line 78 connected to the inlet side of the vacuum pump 80.

Under certain conditions, the quantity of water vapors extracted from the wood being dried may exceed the cooling capacity of the cooling system surrounding the periphery of the tank, whereby the uncondensed water vapors tend to cause a rise in the pressure within the vacuum chamber. To avoid such a pressure rise, a supplemental spray cooling system is embodied in the flanged cross 68, as best seen in Figures 2 and 3, to cool and effect a condensation of the vapors entering the inlet of the downcomer. As shown, a first nozzle 94 is mounted centrally of the blind flange 70 and is adapted to discharge a fine spray of cooling water in the form of a conical spray, indicated at 96, into the upper end of the downcomer. A second nozzle 98 is disposed intermediate the first nozzle and the beveled inlet of the suction line 78 and similarly is adapted to discharge a fine spray of cooling water in the form of a conical spray, indicated at 100, in order to condense any residual water vapors present. The first nozzle and second nozzle are connected by means of supply lines and a connector 102, through which pressurized cooling water is delivered when an opening of a remotely actuated valve 104 occurs in response to a signal from the control module 62.

In accordance with the foregoing arrangement, a typical drying cycle comprises loading a plurality of rough cut green red alder timber comprising 500 board feet on the cart in compact stacked relationship as shown in Figure 3, obviating the heretofore costly and time consuming practice of "sticking" the load to provide for a separation of adjoining planks in order to enable an extraction of moisture therefrom. The cart is next moved inwardly of the pressure vessel and the pigtail 56 is connected. The movable end door 14 is closed and the electrode assembly is actuated such that the upper electrode is moved downwardly in close proximity to the upper surface of the load. Thereafter, the vacuum pump 80 is en-

ergized, causing a progressive evacuation of the air in the chamber until a vacuum of about 88 mm Hg is attained. At that time, or during the course of the evacuation of the chamber, a dielectric heating of the wood load is achieved by applying a 2 megacycle up to a 5 megacycle high frequency electric current source across the upper and lower electrodes in a manner to effect an internal heating of the wood load and the water entrapped within the interstices thereof. The initial impressed voltage is 600 volts. The temperature of the load may be suitably monitored by thermal probes (not shown) extending within the interior of the load and the dielectric heating in consideration of the prevailing vacuum is controlled within a temperature range of 100°F up to 155°F.

As water vapor is formed and extracted from the wood, cooling water is discharged from the distributor pipe 88 to promote a condensation of the water vapors on the interior surfaces of the tank. The operation of the vacuum pump is controlled so as to supplement the vacuum resulting from the condensation of such gaseous substances to maintain it within prescribed limits. The drying operation is continued until the water content of the lumber charge is within the prescribed limits as may be suitably ascertained by a measurement of the quantity of condensate recovered. Typically, a load of red alder one-inch thick green lumber containing about 49% water by weight when placed in an apparatus as shown in Figures 1-3 of the drawings can be satisfactorily seasoned to reduce its water content to a level of 6-9% at a temperature of 110°F up to 155°F and at a vacuum of 88 mm Hg in a period of about 3 hours. A drying of a similar green lumber one-inch thick by conventional kiln and air tunnel drying techniques ordinarily requires a period of about 10 days.

Another alternative satisfactory embodiment of a rigid vacuum chamber is illustrated in Figure 4 which is somewhat similar to the arrangement previously described in connection with Figures 1-3 but wherein the chamber incorporates a plurality of electrodes in spaced overlying relationship. As shown, a rigid chamber 158 of a generally circular cylindrical configuration is supported on transverse legs 160 and is enclosed within a cylindrical shroud 162 for confining the water discharged against the periphery thereof through cooling nozzles 164 in a distribution pipe 166 and an appropriate vacuum is drawn in the interior of the chamber through flange ports 168 connected to a manifold system identical to that previously described in connection with Figures 1-3. A control of the vacuum

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and of the temperature to which the wood is heated during the drying cycle is achieved in the same manner as previously described.

5 The principal distinction between the apparatus shown in Figure 4 and that shown in Figure 3 is in the use of a plurality of stacked electrodes of alternating polarity, such as electrodes 170, 172, each defining a shelf within which a relatively large slab of green lumber 174 is positioned. The electrodes are provided with a thin film of insulating material in the same manner as the electrodes of the apparatus of Figs. 10 1-3. The arrangement of Figure 4 is particularly satisfactory for drying boards or flicks derived from a preliminary cutting operation of green logs, whereafter the resultant dried flicks are subjected to further 20 sawmill operations to cut smaller cross sectional boards enabling the use of substantially thinner blades, thereby reducing waste.

The pairs of stacked electrodes 170, 172 25 are retained in vertically spaced relationship by means of tubular members 176 which are slidably disposed around upright rods 178 having their lower ends affixed to the inner tank structure. The lowermost electrode 170 is fixedly supported and 30 secured to a pedestal 180 which also is secured to the inner side of the tank structure. The uppermost electrode is securely fastened to the upper ends of the tubular members 176 by a pair of collars 182. The electrodes intermediate the uppermost and lowermost electrodes are slidably supported on the tubular members 176 and are retained in vertically spaced position by 40 means of annular stops 184 secured at spaced intervals to the periphery of the tubular members. A fluid-actuated cylinder or other expandable-contractible device 186 has its closed end affixed to the top of the 45 inner tank structure and the rod end thereof secured to the center of the uppermost electrode for effecting a vertical reciprocation thereof, as well as a reciprocation of the tubular members 176 50 along the rods 173.

The position of the electrode assembly is illustrated in Figure 4 with the top electrode and the tubular members in a fully raised position wherein the intermediate 55 electrodes are at a maximum spacing providing for clearance between each slab of green lumber 174 and the adjacent surface of the electrode thereabove. The clearance thus provided between pairs of electrodes accommodates slight variations in the thickness of the rough cut slabs 174 60 facilitating a loading and unloading thereof. After the slabs have been loaded between the pairs of electrodes, the fluid-actuated cylinder 186 is actuated causing the up-

permost electrode and the tubular members connected thereto to move downwardly to a position as indicated in phantom in Figure 4, whereby the remaining electrodes 70 move downwardly and become supported against the upper face of the wood slab positioned therebelow. In this way the opposed surfaces of the adjacent electrodes are in close proximity with respect to each piece of wood to be dried. 75

The supply of electric power to the electrodes is achieved in a manner similar to that previously described in connection with Figure 3 including a cable 188 passing through a supply conduit 190 which is connected to the uppermost electrode 170 and wherein the remaining electrodes 170 are interconnected by jumper cables 192. The electrodes 172 are interconnected by jumper cables 194 and are grounded by means 85 of ground cable 196 to the tank structure. The actual drying cycle of the wood slabs 144 is performed under conditions identical to those previously described in connection with the apparatus shown in Figures 1-3. 90

WHAT I CLAIM IS:

1. A process for drying unseasoned wood comprising the steps of placing the wood to be dried in an enclosed space; evacuating the gaseous substance from said enclosed space so as to impose a sub-atmospheric pressure on said wood; applying an alternating electric potential between electrodes having means for preventing arcing or other sudden discharges, the potential being of such a frequency and being applied across the wood so as to effect a dielectric heating of the wood and the moisture entrapped within the interior thereof by an electrically-created field to a temperature at which the water volatilizes at the prevailing subatmospheric pressure present in the enclosed space, the electrodes being disposed within the enclosed space and maintained in fixed relationship to the wood while the electric potential is applied; continuing the addition of heat to the wood at an input rate substantially equal to the latent heat of vaporization of the water being evaporated and maintaining the subatmospheric pressure within said enclosed space until the water content of the wood attains the desired level; and thereafter removing the dried wood from the enclosed space. 120

2. A process as claimed in claim 1 in which the enclosed space is defined by a rigid chamber.

3. A process as claimed in claim 1 or 2, wherein the alternating electric potential is applied by positioning the wood to be dried between two electrodes disposed within the enclosed space and applying a high frequency electric potential to the two electrodes in a manner to effect said 130



and of the temperature to which the wood is heated during the drying cycle is achieved in the same manner as previously described.

- 5 The principal distinction between the apparatus shown in Figure 4 and that shown in Figure 3 is in the use of a plurality of stacked electrodes of alternating polarity, such as electrodes 170, 172, each defining a shelf within which a relatively large slab of green lumber 174 is positioned. The electrodes are provided with a thin film of insulating material in the same manner as the electrodes of the apparatus of Figs. 1-3. The arrangement of Figure 4 is particularly satisfactory for drying boards or flicks derived from a preliminary cutting operation of green logs, whereafter the resultant dried flicks are subjected to further sawmill operations to cut smaller cross sectional boards enabling the use of substantially thinner blades, thereby reducing waste.

- The pairs of stacked electrodes 170, 172 are retained in vertically spaced relationship by means of tubular members 176 which are slidably disposed around upright rods 178 having their lower ends affixed to the inner tank structure. The lowermost electrode 170 is fixedly supported and secured to a pedestal 180 which also is secured to the inner side of the tank structure. The uppermost electrode is securely fastened to the upper ends of the tubular members 176 by a pair of collars 182. The electrodes intermediate the uppermost and lowermost electrodes are slidably supported on the tubular members 176 and are retained in vertically spaced position by means of annular stops 184 secured at spaced intervals to the periphery of the tubular members. A fluid-actuated cylinder or other expandable-contractible device 186 has its closed end affixed to the top of the inner tank structure and the rod end thereof secured to the center of the uppermost electrode for effecting a vertical reciprocation thereof, as well as a reciprocation of the tubular members 176 along the rods 173.

- The position of the electrode assembly is illustrated in Figure 4 with the top electrode and the tubular members in a fully raised position wherein the intermediate electrodes are at a maximum spacing providing for clearance between each slab of green lumber 174 and the adjacent surface of the electrode thereabove. The clearance thus provided between pairs of electrodes accommodates slight variations in the thickness of the rough cut slabs 174 facilitating a loading and unloading thereof. After the slabs have been loaded between the pairs of electrodes, the fluid-actuated cylinder 186 is actuated causing the up-

permost electrode and the tubular members connected thereto to move downwardly to a position as indicated in phantom in Figure 4, whereby the remaining electrodes move downwardly and become supported against the upper face of the wood slab positioned therebelow. In this way the opposed surfaces of the adjacent electrodes are in close proximity with respect to each piece of wood to be dried.

The supply of electric power to the electrodes is achieved in a manner similar to that previously described in connection with Figure 3 including a cable 188 passing through a supply conduit 190 which is connected to the uppermost electrode 170 and wherein the remaining electrodes 170 are interconnected by jumper cables 192. The electrodes 172 are interconnected by jumper cables 194 and are grounded by means of ground cable 196 to the tank structure. The actual drying cycle of the wood slabs 144 is performed under conditions identical to those previously described in connection with the apparatus shown in Figures 1-3.

WHAT I CLAIM IS:

1. A process for drying unseasoned wood comprising the steps of placing the wood to be dried in an enclosed space; evacuating the gaseous substance from said enclosed space so as to impose a sub-atmospheric pressure on said wood; applying an alternating electric potential between electrodes having means for preventing arcing or other sudden discharges, the potential being of such a frequency and being applied across the wood so as to effect a dielectric heating of the wood and the moisture entrapped within the interior thereof by an electrically-created field to a temperature at which the water volatilizes at the prevailing subatmospheric pressure present in the enclosed space, the electrodes being disposed within the enclosed space and maintained in fixed relationship to the wood while the electric potential is applied; continuing the addition of heat to the wood at an input rate substantially equal to the latent heat of vaporization of the water being evaporated and maintaining the subatmospheric pressure within said enclosed space until the water content of the wood attains the desired level; and thereafter removing the dried wood from the enclosed space.

2. A process as claimed in claim 1 in which the enclosed space is defined by a rigid chamber.

3. A process as claimed in claim 1 or 2, wherein the alternating electric potential is applied by positioning the wood to be dried between two electrodes disposed within the enclosed space and applying a high frequency electric potential to the two electrodes in a manner to effect said



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dielectric heating of the wood.

4. A process as claimed in any preceding claim in which the heating of the wood and the application of a sub-atmospheric pressure to the wood is performed continuously and concurrently.

5. A process as claimed in any one of claims 1 to 3 in which the heating of the wood and the application of a sub-atmospheric pressure thereto are performed alternately.

6. A process as claimed in any one of claims 1 to 3 in which the alternating electric potential is applied intermittently.

7. A process as claimed in any preceding claim in which the temperature of the wood during the drying cycle is controlled so as not to exceed 190°F.

8. A process as claimed in any one of claims 1 to 6 in which the temperature of the wood during the drying cycle is controlled so as not to exceed 180°F.

9. A process as claimed in any preceding claim in which the subatmospheric pressure present during the drying cycle is less than 375 mm Hg. absolute.

10. A process as claimed in claim 9 in which the subatmospheric pressure within the enclosed space is less than 100 mm Hg. absolute.

11. A process as claimed in any preceding claim in which the temperature of the wood during the drying cycle is controlled between 100°F to 155°F.

12. A process as claimed in any preceding claim in which the temperature and the subatmospheric pressure within the enclosed space are sufficiently low that unvaporized moisture is extracted from the wood without damage thereto.

13. A process for drying unseasoned wood, substantially as herein described with reference to the accompanying drawings.

14. An apparatus for drying unseasoned wood comprising means defining a chamber, means for supporting wood to be dried within said chamber, means in communication with the interior of said chamber for evacuating the gaseous substances therefrom, means disposed within the chamber for applying an alternating electric potential across wood within the chamber

to effect a dielectric heating of the interior thereof to a temperature at which the water and other volatile substances in the wood volatilize at the prevailing sub-atmospheric pressure present in the chamber, means for preventing discharge of the alternating electric potential, control means for controlling the rate of heat input to the wood and the subatmospheric pressure present within the chamber.

15. An apparatus as claimed in claim 14, in which the means defining said chamber comprises a rigid enclosure.

16. An apparatus as claimed in claim 14 or 15 wherein the means for preventing discharge of the alternating electric potential comprises a coating of insulating material on the surface of the electrodes.

17. An apparatus as claimed in claim 14, 15 or 16 in which said means for applying an alternating electric potential across the wood comprises a pair of spaced electrodes between which the wood is disposed for applying a dielectric field thereto.

18. An apparatus as claimed in claim 14, 15 or 16 in which said means for applying an alternating electric potential across the wood comprises a plurality of electrodes disposed in spaced superimposed relationship and wherein alternate ones of said electrodes are electrically charged with a polarity opposite to that of the adjacent electrodes so as in use to apply a dielectric field to wood interposed between adjacent electrodes.

19. An apparatus as claimed in claim 18 further including means for moving at least some of the electrodes to and from a closed position in close proximity to opposed faces of the wood and an open position disposed in clearance relationship to the wood.

20. An apparatus for drying unseasoned wood, substantially as herein described with reference to the accompanying drawings.

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