

Oct. 28, 1969

A. S. HOLDEN, JR., ET AL

3,474,544

VENEER DRYER WITH PLURAL TREATING ZONES

Filed July 7, 1967

4 Sheets-Sheet 1

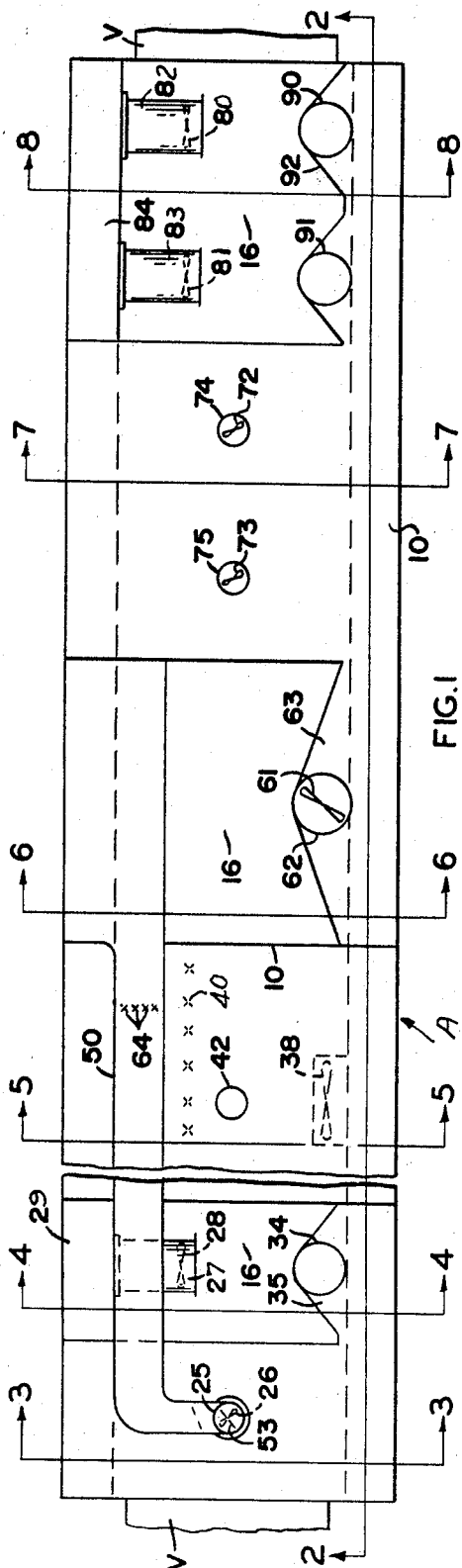


FIG. 1

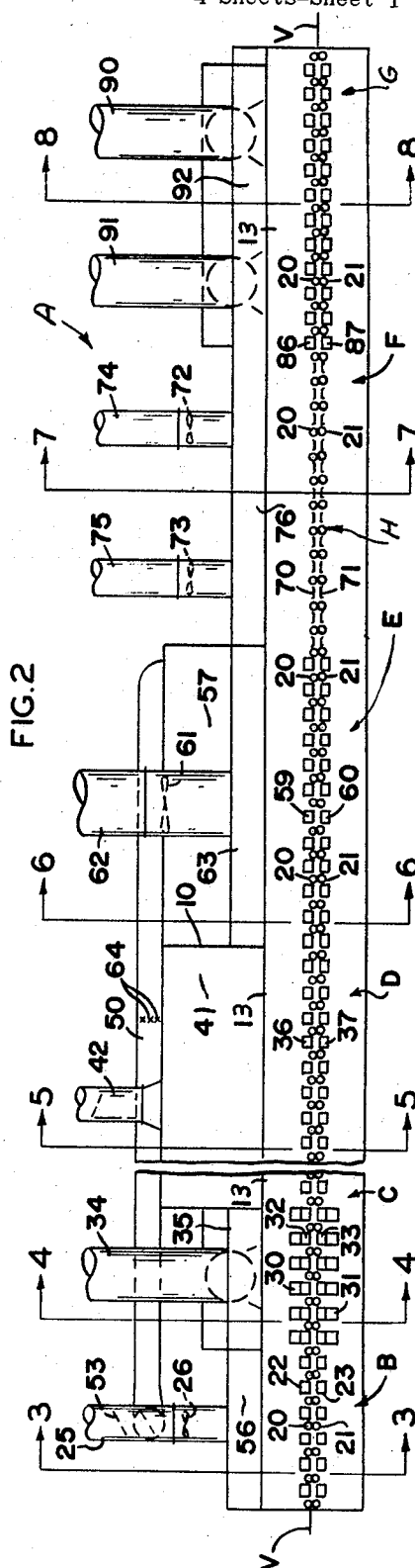


FIG. 2

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4 Sheets-Sheet 2

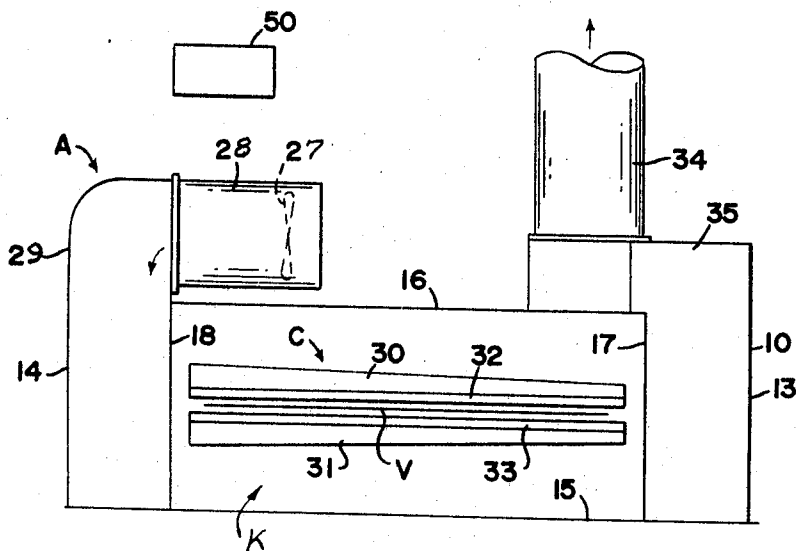
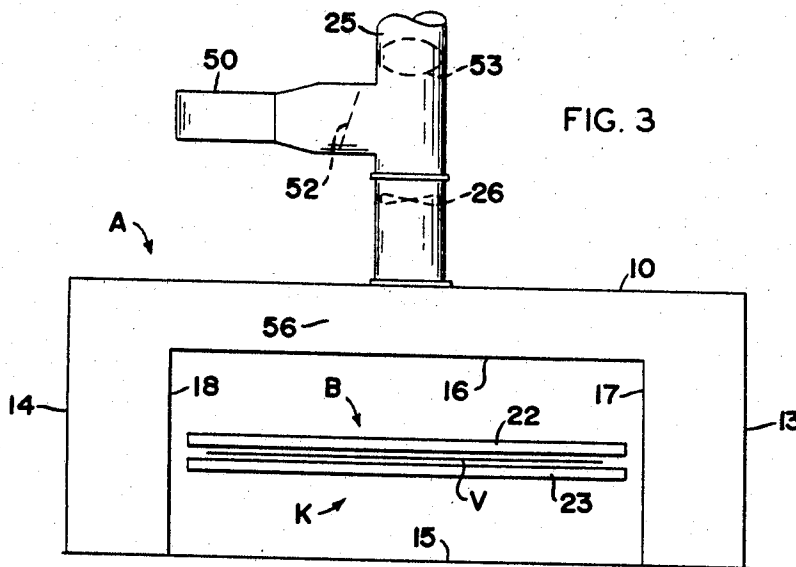


FIG.4

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4 Sheets-Sheet 3

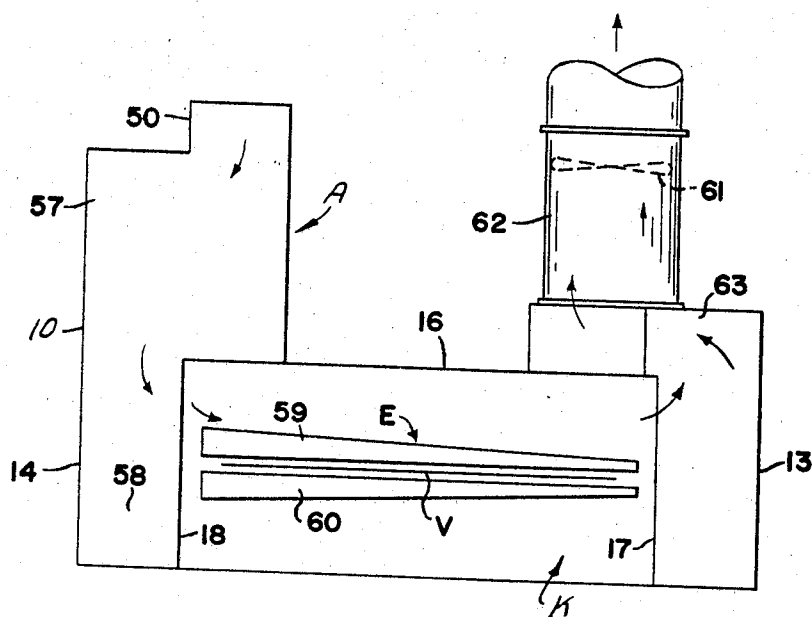
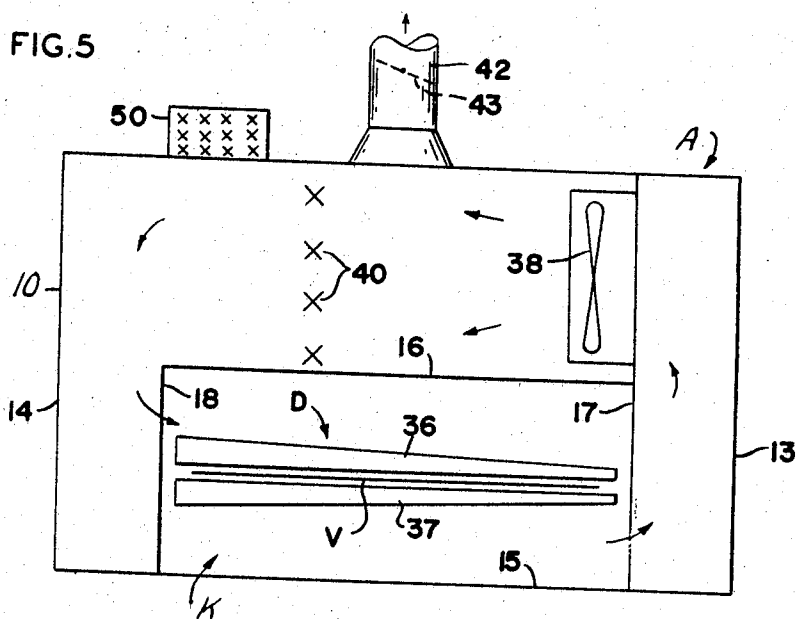


FIG. 6

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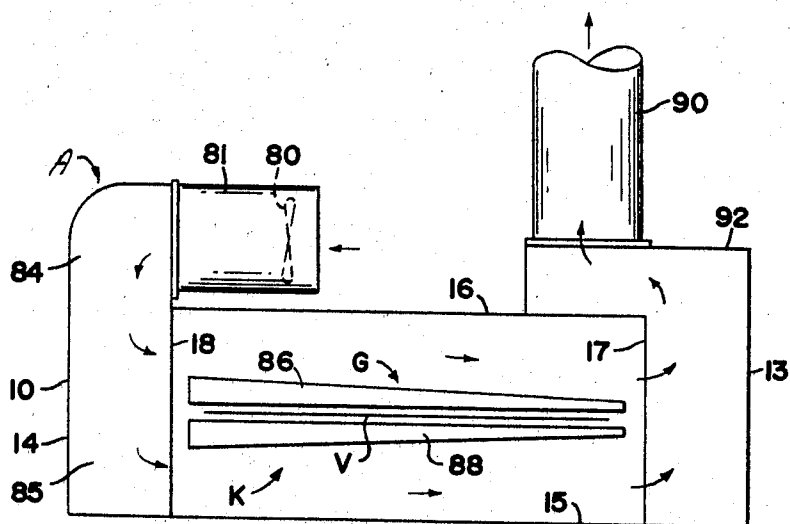
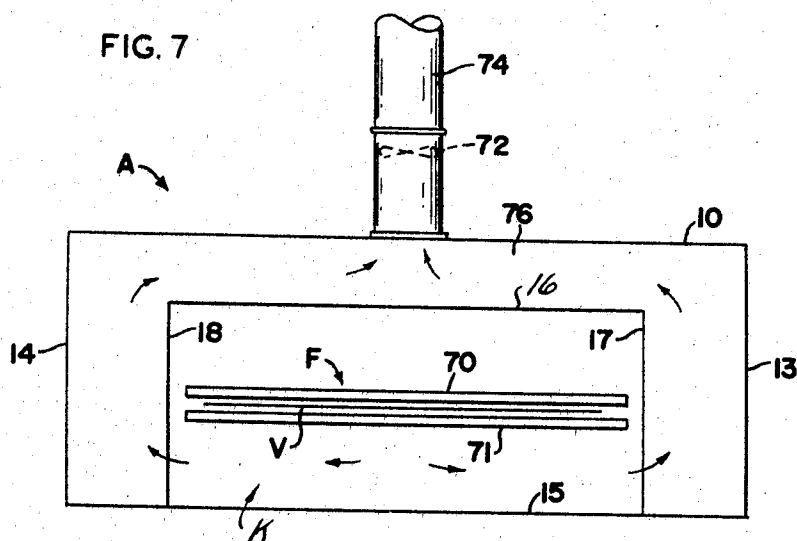
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VENEER DRYER WITH PLURAL TREATING ZONES

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3,474,544

VENEER DRYER WITH PLURAL TREATING ZONES

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2 Claims

ABSTRACT OF THE DISCLOSURE

Method and apparatus for the changing the moisture content of material in sheet form, especially material which is relatively light and apt to be warped or otherwise irregular in shape and/or to become so, or more so, during treatment, such as veneer, wherein the material is moved continuously through two or more treating areas or zones in at least one which the material being treated is heated by high frequency electromagnetic energy, preferably in the dielectric, microwave or infra-red ranges.

Technical Field

This invention provides novel and improved methods of and apparatus for changing the moisture content of material in sheet form and especially to the drying of veneer wherein the veneer is conveyed continuously through one or more treating areas or zones in at least one of which the veneer is moved by at least one high frequency transmitter operating in the infra-red radiant heating frequency range, in the microwave frequency heating range or in the dielectric frequency heating range.

Description of invention

The invention resides in certain operations, constructions and combinations and arrangements of parts, and further objects and advantages will be apparent to those skilled in the art to which the invention relates from the following description of the preferred equipment or apparatus for practicing the invention described with reference to the accompanying drawings forming a part of this specification and in which:

FIG. 1 is a diagrammatic top plan view with parts broken away of a veneer dryer embodying the present invention;

FIG. 2 is a diagrammatic sectional view of the veneer dryer shown in FIG. 1 approximately on the line 2-2 of FIG. 1; and

FIGS. 3 to 8 are diagrammatic enlarged sectional views of the dryer shown approximately on the lines 3-3 to 8-8 of FIGS. 1 and 2.

Although the illustrative equipment will be described in detail, it is to be understood that the invention is not limited to the use of equipment having the construction and arrangement shown and described, but is capable of being otherwise practiced and carried out in various ways. It is also to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation, and that there is no intention to thereby limit the invention beyond the requirements of the prior art.

Referring to the drawings, the preferred apparatus shown is a single deck dryer, designated by the reference character A, for changing the moisture content, in the present instance, drying sheets of green veneer V moving through the dryer in a linear path. The dryer, as shown, comprises a series of elongated treating or drying areas or zones B, C, D, E and F and a cooling area or zone G, arranged in tandem within a housing 10 of rectangular cross-sectional shape through which veneer is caused to

travel along a predetermined horizontal path from left to right, as viewed in FIGS. 1 and 2, on conveyor means or a conveyor system H. While in the apparatus shown the various treating zones or areas are arranged in a certain order and are within a single housing certain of the treating areas or zones shown may be omitted and/or they may be arranged in different orders and/or located in individual housing, etc.

The housing, designated generally by the reference character 10, is substantially rectangular in cross section and comprises a frame made up of suitable structural members, etc. welded and/or bolted together. The exterior of the housing is sheet metal or like material and includes a plurality of access doors, not indicated, along opposite sides. The front and rear walls of the housing 10 are designated 13 and 14. In the particular embodiment shown, the treating areas or zones are in the central portion K of the housing 10 between the floor area 15 and the ceiling 16, see FIGS. 3 to 8. The sides of this portion of the central portion K, that is, the treating areas or zones, are more or less defined by the left and right-hand frame structures 17 and 18 which support the conveyor means and other equipment in the treating zones.

The central portion K of the housing, if desired, may be divided into a plurality of compartments by transverse vertical partitions having openings in the central portions thereof to permit the passage of the material being treated therethrough, etc. Dividing the central treating portion K of the apparatus into a plurality of compartments facilitates different treating conditions to be established and maintained in the apparatus, preferably with the highest temperature treating zone at or near the entrance end of the apparatus and the other zones having progressively lower treating temperatures with the lowest temperature zone (cooling) at the exit end.

The conveyor means H shown is of the double roll type and comprises a plurality of horizontally spaced pairs of top and bottom rolls 20 and 21, respectively, extending transversely of the length of the housing 10, that is, transversely of the direction in which the material to be treated travels through the dryer. Each pair of rolls is identical and is supported and driven in the same manner. The manner of supporting and driving conveyor rolls is well known in the art and the rolls 20 and 21 may be constructed, supported and driven as are the rolls in Morris, United States Patent No. 3,314,164.

While the conveyor shown is of the double roll type it will be understood that any suitable type of conveyor may be used, for example, a cable-type conveyor, such as, shown in Morris, United States Patent No. 3,334,421, or a foraminous belt-type conveyor such as shown in Quimby et al. United States Patent No. 2,603,004 or Milligan et al. United States Patent No. 3,199,213. When thin or fragile material is to be handled a wire mesh belt conveyor with the conveying reach riding on the bottom rolls 21 may be employed for supporting the material. The top rolls 20 or a top belt can be used in conjunction with the bottom belt to hold the material in place. A wire mesh-type belted conveyor is commonly used in the plywood industry. The conveyor obviously should be made of material such that it will not be detrimentally affected by the heat to which it is subjected to. Provision can be made for cooling the conveyor, if desired, such as circulating cooling water through the pairs of rolls 20 and 21.

In the first treating area or zone B, the veneer V is passed between a plurality of pairs of top and bottom high frequency infra-red radiant heat transmitters or generators, preferably panel-type gas fired commercially available infra-red radiant heat generators 22 and 23, interposed between the pairs of conveyor rolls in the area or zone. The radiant heat transmitter or panels 22

and 23 are, like the rolls 20 and 21, extended transversely of the direction of travel of the material being treated and are supported at opposite ends in the frame structures 17 and 18 in any suitable manner.

The respective pairs of radiant heat panels can be individually controlled and are preferably operated at temperatures which will emit radiant energy at the wave length range most readily absorbed by the veneer taking into consideration its moisture content, etc. Temperatures in the order of 700° F. to about 2300° F. have been used. The preferred source or face temperature of the infra-red radiant heat generators is in the order of 1200° F. to 1650° F. While gas fired direct radiant heat panels are used in the preferred embodiment herein described and are preferred, because of the high B.t.u. per hour output per square foot of burner surface and the fact that much of the energy generated is high frequency energy, it is to be understood that other types of radiation generators, for example, electric radiation generators, can be used. Air may be circulated about the radiation generators and the material being treated in any suitable amounts and at any desired velocity. Velocities up to about 6000 feet per minute are contemplated to assist in controlling the temperatures in the treating zone and to carry away the moisture removed from the veneer by a stack 25 having a motor driven fan 26 therein. The latent heat of evaporation will assist in maintaining the temperature of the veneer within the desired range. The linear speed of the sheet, however, must be correlated with the number and size of the infra-red generators, the temperatures at which they are operated and their spacing from the veneer, etc.

The second treating area C is essentially the same as the first treating area with the exception of the fact that provision is made for circulating cooling air closely around each of the radiant heaters or heating panels at relatively high velocity, preferably, at velocities from about 2000 to about 6000 feet per minute. For this purpose a motor driven fan, designated generally as 27, is provided in a cylindrical duct 28 which is in constant communication with a chamber 29 which in turn communicates with the lower portion of the housing. Air circulated by the fan 27 passes into the treating chamber through pairs of upper and lower ducts 30 and 31 somewhat similar to the upper and lower ducts shown in Morris Patent No. 3,314,164 or Morris Patent No. 3,334,421 except that they are deeper and the sides thereof adjacent to the veneer path are open and have located therein radiant heaters 32 and 33 similar to the radiant heaters 22 and 23 in treating area or zone B. The sides of the air ducts 30 and 31 are slightly wider than the radiant heaters located therein thus providing space through which cooling air can circulate or travel around or about the heaters into the treating zone or area proper. The construction is such that the radiant heat generators are located in the open sides of a plenum chamber formed by the ducts 30 and 31. The air travels through the treating chamber or area C from left to right, as viewed in FIG. 4, and is exhausted to atmosphere through a stack 34 connected to the top of a chamber 35 in communication with the right-hand or front side of the treating area. The air ducts 30 and 31 in treating area or zone C can be supported in a manner similar to that in which the air ducts in Morris Patent No. 3,314,164 or Morris Patent No. 3,334,421 are supported. The left-hand wall 18 in this treating zone or area is preferably constructed similar to the corresponding right-hand wall in Morris Patent No. 3,314,164. It is, therefore, solid or closed except for the openings into the pairs of air ducts 30 and 31.

In the treating area D the veneer is subjected to drying by the impingement of jets of heated air against opposite sides of the veneer which air strikes the veneer at high velocity, for example, from about 2000 to about 6000 feet per minute, preferably at about 3000 feet per minute. If the temperature of the veneer entering the

zone is greater than that of the air striking the veneer the air will have a cooling effect on the veneer. The construction of this area or zone and the manner of heating the air circulated therethrough can be similar to that shown in the Morris Patent No. 3,314,164. In this event the left-hand wall structure 18, as viewed in FIG. 5, is a solid wall with the pairs of upper and lower air ducts 36 and 37 communicating therewith. In this zone the air is circulated by a fan 38 and is heated to a desired temperature of about 350° or more, by steam pipes 40 or other suitable heating means, for example, direct gas or oil firing, in a chamber 41 located immediately above the treating area or zone D. From the chamber 41 the air travels into the left-hand or rear end of the treating area or zone, travels through the pairs of air ducts 36 and 37 and is returned to the chamber 41 from the right-hand or front end of the zone. The chamber 41 is provided with a vent stack 42 having a control damper 43 therein.

In the zone E, the veneer is treated in a manner similar to that in which it is treated in zone D with the exception of the fact that the heated air for zone E is obtained from zone B in which the veneer is subjected to radiant heat by conduit means 50 connected to the stack 25 opening into the top of zone B and the left-hand or rear side of zone E. The conduit means 50 includes a damper 52 which with a damper 53 located in the stack 25 can be used to direct the heated air from zone B either to atmosphere or to zone E, as desired. It will also be understood that by proper manipulation of the dampers 52, 53, the temperature of the air supplied to zone E from zone B can be controlled. Air from zone B is exhausted to atmosphere or forced through the conduit means 50 by the motor-driven fan 26 located in the lower part of the stack 25, the lower end of which is directly connected to the housing 10 and in continuous communication with a chamber 56 above the treating chamber B, which chamber 56 is in communication with opposite ends of the treating area or zone B.

The opposite end of conduit 50 is connected with a chamber 57 in communication with a chamber 58 at the rear side of treating area or zone E. Air is supplied to treating area or zone E from chamber 58 through pairs of upper and lower ducts 59 and 60 similar to the air ducts 36 and 37 in treating zone D. Heated air is exhausted from zone E by a motor driven electric fan 61 located on a stack 62 in communication with a chamber 63 within the housing 10 and into which the right or front side of the treating chamber E opens.

If the temperature of the air or gas obtained from zone B is not sufficiently high, the temperature thereof may be increased by the use of supplemental heating means, such as, steam pipes or burners 64 located in duct 50.

In the treating chamber F the veneer is subjected to high frequency electromagnetic energy below the infra-red frequency range, preferably in the dielectric and microwave frequency ranges. This energy is applied to the veneer by high frequency electromagnetic transmitters or generators 70, 71 interposed between the pair of rolls 20 and 21 in zone F. The members 70, 71 may be plates of a dielectric heating device or a wave guide of a microwave heating device. Air is circulated about the veneer to prevent condensation of the vapor on the surface of the veneer and to withdraw the heated moist air from treating zone or area F by motor-driven electric fans 72 and 73 located in stacks 74 and 75 in communication with a chamber 76 in the top of the housing 10 which chamber communicates with both ends of the treating area or zone F.

In the last treating zone shown, that is, zone G, the veneer is subjected to cooling air circulated therethrough by motor-driven fans 80 and 81 located in conduits 82 and 83 in communication with a chamber 84 which chamber in turn communicates with a chamber 85, the left-hand or rear side of the treating chamber G. The construction of this chamber below the ceiling 16 is similar to that of the

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construction in chambers D and E. In other words, the air circulated by the fans 80 and 81 is conducted through transversely extending pairs of top and bottom conduits 86 and 87, and is impinged against opposite sides of the veneer at high velocity. The cooling air may strike the veneer at any suitable velocity, preferably, at velocities of about 3000 to 4000 feet per minute. From the treating area or zone G the air is exhausted through stacks 90 and 91 in communication with a chamber 92 which chamber in turn communicates with the right-hand or front part of the treating chamber G.

The veneer dryer which forms the preferred embodiment of the invention is capable of receiving green veneer having a high moisture content at the left-hand or green end of the dryer and reducing the moisture content to a desired uniform content usually in the neighborhood of about 4% to 8% as the veneer emerges from the dry or right-hand end of the dryer. As previously stated, the speed of the veneer must be correlated with the number and size of the radiation generators, the temperatures at which they are operated and their spacing with respect to the veneer, etc. As an illustration, the moisture content of $\frac{1}{8}$ " Southern Pine can be reduced from 100% to 10% by a radiant gas burner of the type herein contemplated operating at a surface temperature in the neighborhood of 1200° F. to 1400° F., in slightly less than three minutes. From this it will be apparent that the speed of $\frac{1}{8}$ " Southern Pine veneer through the dryer illustrated should be such that any given section of the veneer would not be exposed to the radiant heat or remain in the radiant heat treating areas more than a minute or two. Most of the remaining moisture is removed in the convection heating zone or zones and the final desired moisture content of approximately 4% to 5% being arrived at in the last or terminal high frequency treating zone F. If one or more of the convection heating zones or areas are omitted, preferably more of the moisture is removed in the radiant heating zone. As will be understood, the lengths of the respective zones and the temperatures therein can be regulated to remove almost any desired amount of moisture in any given zone or area. It will also be apparent that one or more of the treating zones can be eliminated, for example, the moisture content of the veneer can be reduced to the desired amount solely by the use of high frequency radiant heaters or the major part of the moisture removed either by high frequency radiant heating and/or convection heating and the final moisture content arrived at by using high frequency heating in the microwave and/or dielectric heating frequency regions or ranges. The present process and apparatus provide an efficient way of reducing veneer of any moisture content to a desired lesser content under controlled conditions and in minimum time.

While a preferred embodiment of the invention has been illustrated and described, it is to be understood, as previously stated, that the invention is not limited to the use of the equipment shown, for example, any one or more of the treating zones and equipment described therein could be used for the purposes of changing the moisture content of veneer so long as one of the zones utilizes high frequency heating in the infra-red, microwave or dielectric frequency ranges.

One of the advantages of radiant or infra-red heat is the rapidity with which it can be used to remove moisture from the veneer. One of the principal advantages of high frequency heat in the microwave and/or dielectric heat-

ing frequency regions or ranges is the fact that it produces a uniform moisture content in the veneer since its effectiveness is the function of the moisture in various parts of the veneer. Preferably the high frequency treatment in the microwave and/or dielectric heating frequency regions or ranges is used when the veneer has reached a moisture content closely approaching the ultimate desired level, or with veneer that is already of low moisture content. High frequency treatment in the microwave and/or dielectric heating frequency regions or ranges is ideal for carrying out finish drying operations regardless of how the initial drying was accomplished.

From the foregoing description it will be apparent that the objects and others heretofore enumerated have been accomplished and that there has been provided novel and improved methods and apparatus for changing the moisture content of material in sheet form and especially veneer.

Having thus described our invention, what we claim is:

1. In a method of treating veneer to change its moisture content, the steps of moving veneer to be treated in a predetermined path through a plurality of treating zones in at least one of which the veneer is moved between at least one infra-red radiation heater located closely adjacent to each opposite side of said path, in another of which zones the veneer is moved between at least one conduit adjacent to each opposite side of said path and through which a gaseous medium is circulated with the gaseous medium being discharged from said conduits through said apertures and against opposite sides of said veneer, and in a third of which zones the veneer is moved by at least one high frequency transmitter operating at a heating frequency range below infra-red located adjacent to said path.

2. In an apparatus having a plurality of zones for treating veneer to change its moisture content, means for moving veneer to be treated in a predetermined path through a plurality of said zones, at least one infra-red radiation heater in one of said zones located closely adjacent to each opposite side of said path, at least one conduit in a second of said zones adjacent to each opposite side of said path, said conduits having apertures therein facing said path, means for circulating a gaseous medium through said conduits with the gaseous medium being discharged from said conduits through said apertures, and at least one high frequency source in a third of said zones operable at a heating frequency below infra-red located adjacent to said path.

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U.S. Cl. X.R.

34—18, 68, 155, 216; 219—10.47, 10.71