Sept. 22, 1942. W. TONEY 2,296,546

METHOD OF ARTIFICIALLY SEASONING LUMBER

Filed March 15, 1941 3 Sheets-Sheet 1

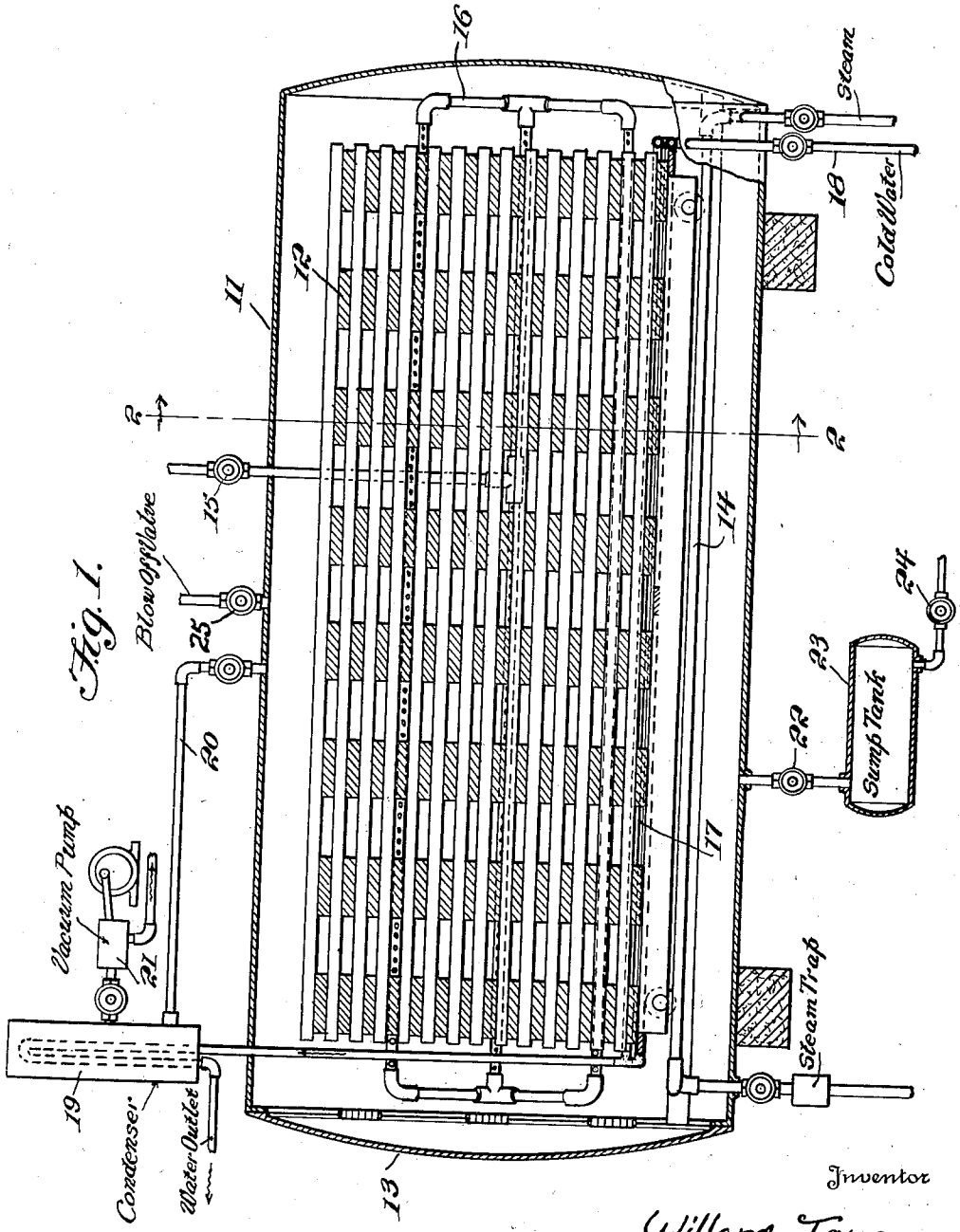


Fig. 1.

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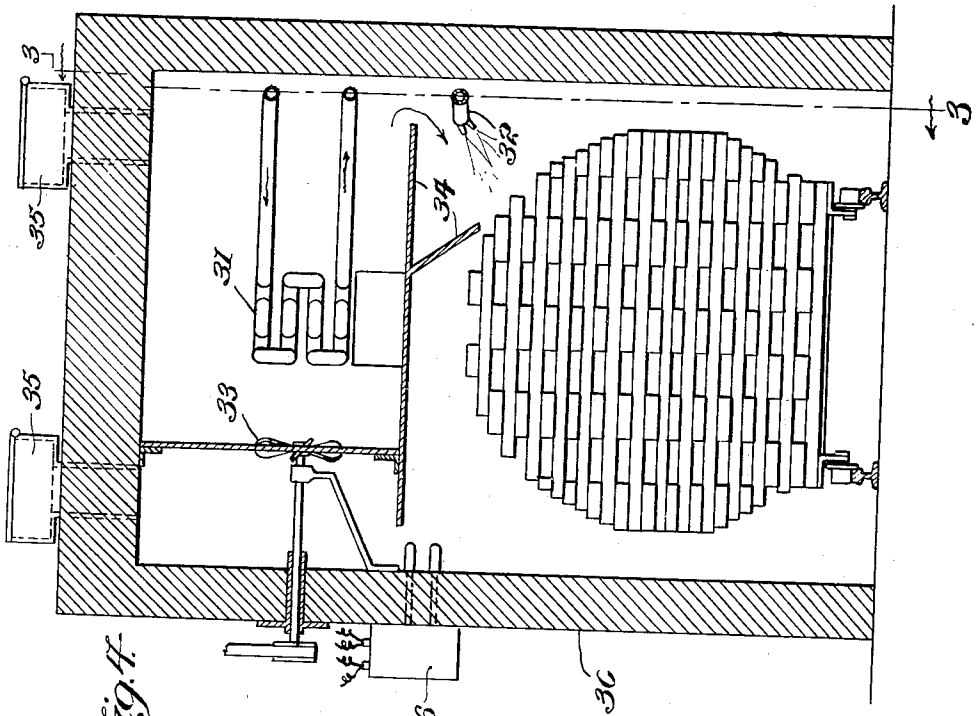


Fig. 4.

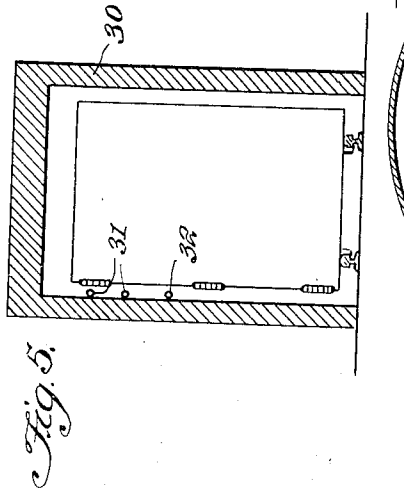


Fig. 5.

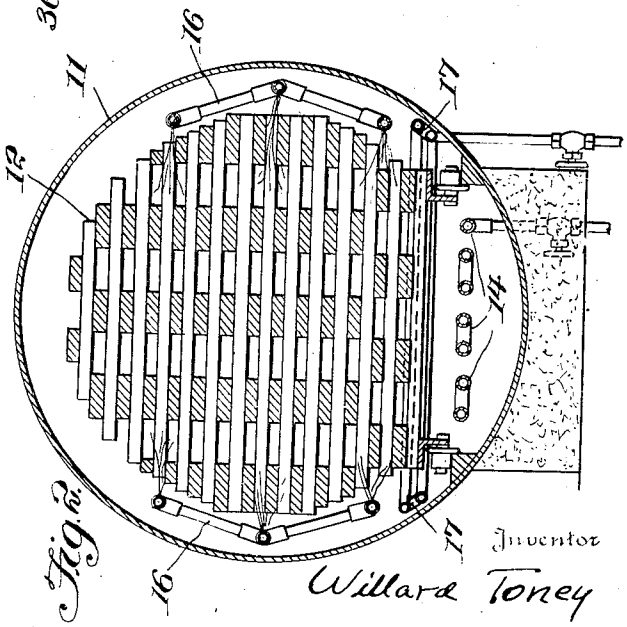


Fig. 6.

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METHOD OF ARTIFICIALLY SEASONING LUMBER

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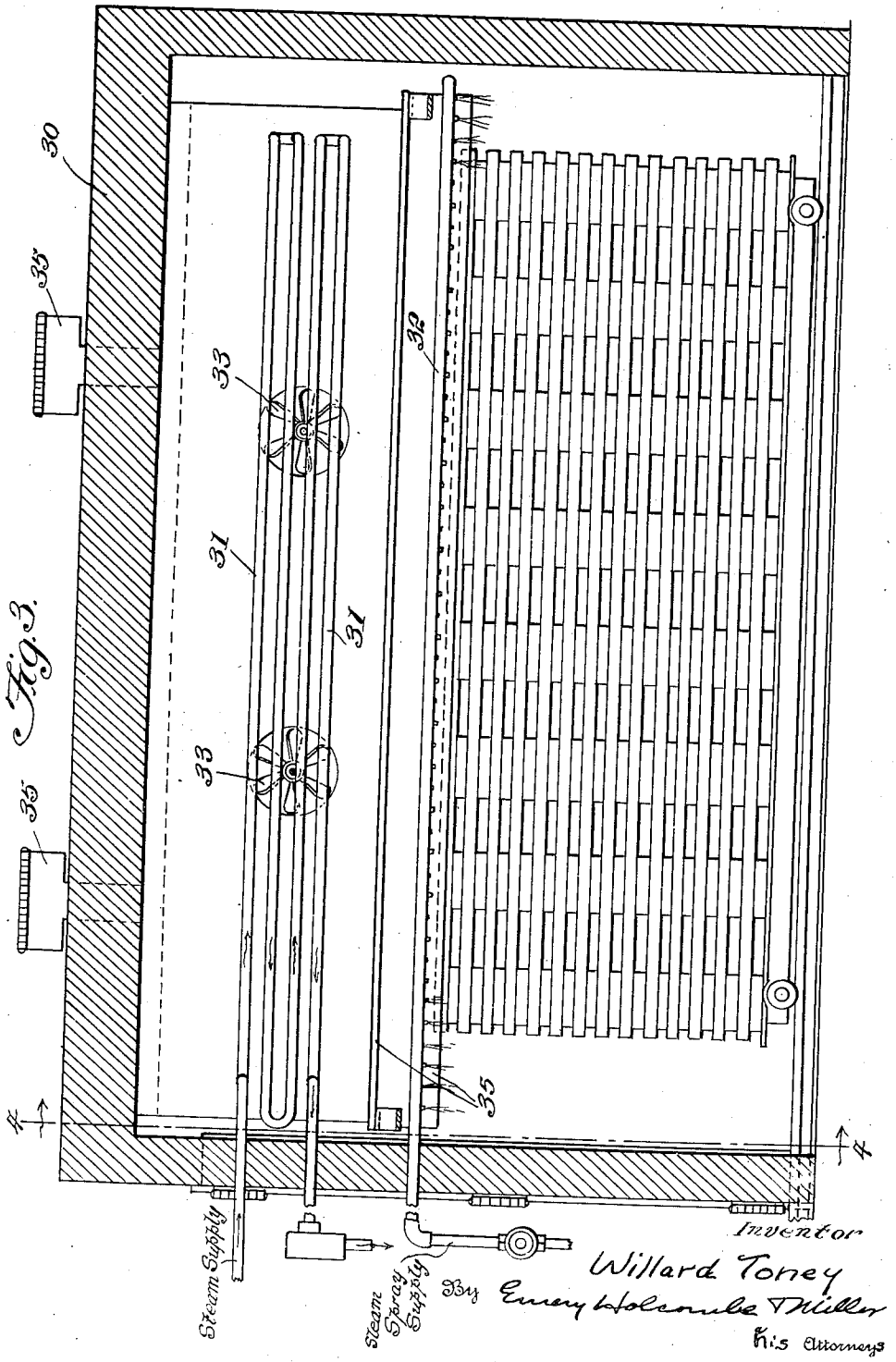


Fig. 3.

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Patented Sept. 22, 1942

2,296,546

UNITED STATES PATENT OFFICE

2,296,546

METHOD OF ARTIFICIALLY SEASONING LUMBER

Willard Toney, Crossett, Ark., assignor to Crossett Lumber Company, Crossett, Ark., a corporation of Arkansas

Application March 15, 1941, Serial No. 383,638

10 Claims. (Cl. 34—15)

This invention relates to the seasoning of lumber as it is produced at the sawmill to dry it and prepare it for shipment and use, and particularly to a method involving the use of steam under low pressure in a suitable vacuum chamber.

Air drying lumber out of doors cannot be satisfactorily practiced at all seasons of the year, and it may take from six weeks to eight or more months to air dry one inch common pine lumber, depending upon the time of year and weather conditions, in order to obtain results within the requirements for moisture content and uniformity. Thus the problem of storage and protection for sawed stock while drying by air is a serious one; and the same applies to kiln dried lumber to a substantial degree, which, according to prevailing methods, requires from sixty to ninety hours, and results in an objectionable degrading and wastage of the stock thus treated.

My invention aims to reduce the time heretofore found necessary for seasoning lumber by air or in dry-kilns, and to improve the uniformity and quality of the product without increasing the wastage and degrading attendant upon present methods. The invention further aims to reduce the cost of kiln-drying lumber by utilizing the energy of the live steam used for both heating and circulating the vapors produced in the treating of lumber, and preventing waste of heat.

The invention comprises first treating the lumber with steam at low pressure and in a partial vacuum to soften the wood and remove objectionable constituents of the sap, followed by kiln-drying the partially dehydrated lumber while hot under controlled humidity and temperature conditions to reduce the moisture content to the desired amount, all as one continuous process.

Further details and advantages of the invention appear in connection with the following description and the accompanying illustrative examples, and what the invention comprises more fully appears in the appended claims.

The invention may be practiced with the aid of large pressure cylinders, steam control valves, pumps, humidity control apparatus etc. now available in the industry, together with dry kilns of either the compartment or continuous type, and no claim is made herein for the apparatus as such although the combination of facilities and instruments for carrying out the process is believed to be new in the art of seasoning lumber.

For illustrative purposes, the invention is herein described in connection with the apparatus disclosed in the accompanying drawings, wherein Fig. 1 is a longitudinal section taken vertically on the principal axis of a pressure and vacuum treating cylinder large enough to receive a truckload of lumber; Fig. 2 is a vertical cross section thereof on the line 2—2 in Fig. 1; Fig. 3 is a vertical longitudinal cross section of a drying kiln, drawn to approximately the same scale as Figs. 1 and 2, the section being taken on the line 3—3 in Fig. 4; Fig. 4 is a vertical cross section of the dry kiln on the line 4—4 in Fig. 3 looking in the direction of the arrows; and Fig. 5 is a vertical cross section of the dry kiln on the line 4—4 in Fig. 3, looking in the opposite direction to that of the arrows and drawn to a smaller scale.

The process may be conveniently divided into two parts, the first part being conducted preferably in a large steam heated pressure chamber, such as a steel cylinder 11 of ample size to receive a car of lumber 12 and having doors 13 at one or both ends capable of withstanding steam pressure up to five or ten pounds and a vacuum of from fourteen to twenty inches or more of mercury, which may be heated with steam coils 14. This cylinder is provided with a supply of steam through a valve 15 at a slight degree of superheat, said steam being discharged into the pressure chamber through openings in the side heating coils 16 facing towards the lumber. Bottom cooling coils 17 are provided, through which cold water may be circulated from a valved supply pipe 18, and discharged through a surface condenser 19, the shell of which is connected to the cylinder by a valved pipe 20 and to a vacuum pump 21 discharging into the atmosphere. A valved bleeder pipe 22 and trap 23 for condensate are also provided. The vacuum pump 21 is capable of exhausting the fluid contents of the cylinder while steam is being admitted to maintain a vacuum of fourteen inches or so. The second part of the process may be conducted advantageously in a drying kiln 30 having steam heating coils 31 and spray pipes 32, circulating fans 33, baffles 34 and ventilating flues 35, and automatic humiditiy controlling apparatus 36; and the drying kilns and pressure cylinders are preferably arranged for rapid and convenient transferring of the successive lumber charges from one to the other with as little delay and loss of heat from the lumber as possible.

In carrying out the process, a charge of lum-

ber, stacked to provide a plurality of vertical circulating flues, is run into the pressure cylinder, the doors are closed, and live steam at from three to five pounds pressure turned into the chamber, the steam being distributed throughout the chamber from two or more side pipes 16 provided with fine orifices to discharge the steam at high velocity and promote circulation through the charge. Steam is also admitted to the heating coils 14 to bring them up to a temperature of 220° to 230° F. The steam is left on for from two to four and one-half hours, being turned off when the lumber is heated throughout to a temperature of about 220° F., which may be ascertained by periodically reading the temperature within the cylinder and stopping the process when the temperature at the middle of the stack ceases to rise, indicating that a balance has been reached between absorption of heat by the lumber and vaporization of its most readily vaporized constituents at the pressure at which the steam is supplied, which is not high enough to injure the wood.

The pressure cylinder is equipped with a bleeder pipe 22 and trap 23, and a bottom vent 24, to permit draining of condensate and sap expelled from the wood by the steam and heat, all during the heating operation, and this vent 24 is opened full at the completion of the heating to permit the surplus steam to blow off rapidly, preparatory to closing the vent and exhausting the remaining vapor by means of the vacuum pump. A top blow-off valve 25 is also provided to expedite the operation. The cooling coil circulating water is turned on throughout the steam and vacuum treatment to promote circulation and assist in reducing the pressure rapidly after the blow off valve is closed. The vacuum treatment is continued at about 14 inches of mercury, so long as vapor continues to be given off by the wood, usually for about two and one-half hours, steam being left in the heating coils during this operation, at the end of which time the temperature will have dropped to about 160° F. and the vacuum may be about 20 inches of mercury, this being some six or eight degrees higher than the boiling point of the saturated vapor at the low pressure maintained by the vacuum pump. Live steam is admitted to the cylinder periodically during the vacuum treating operation to promote circulation and add heat to the contents of the cylinder, thereby preventing condensation of moisture from remaining on the lumber and also preventing surface checking of the wood due to the temperature in the cylinder being hotter than that of the lumber. This treatment is followed by opening the cylinder and transferring the lumber charge to the dry kilns with as little loss of heat as possible.

By this method of treatment, a substantial part of the original moisture in the green wood is vaporized in the vacuum cylinder and carried away without affecting the resinous constituents or injuring the surface or interior of the wood; and the lumber is put in condition for rapid treatment in the dry kiln, whereby closely controlling the heat and the humidity and maintaining rapid and thorough circulation of the atmosphere and removal of moisture therefrom, from eighteen to twenty-four hours treatment suffices to reduce the moisture content of the wood to the degree desired for marketing the lumber.

The following examples are typical of the procedure as applied to 1 inch and 2 inch common southern pine lumber fresh from the saw:

Charge No. 1, material—1" #2 Com.

Time		Pressure or vacuum	Temperature	Steam	
Start	End			Coils	Live steam
10:00	12:00	Up to 3#	222	On	On.
12:30	1:30	Held 3#	222	On	On.
1:30	1:45	Blowing off			Off.
1:45	2:45	Up to 14"	182	On	Off.
2:45	3:45	Held 14"	182	On	On.
3:45	4:30	Held 20"	162	On	Off.

6.50 hours cylinder time.
Condition from cylinder—good.

Time in hrs.	Kiln dry bulb temperature	Wet bulb temperature	Relative humidity
			Per cent
2	200	180	68
4	205	175	54
6	210	175	46
6	210	170	42

18 hours kiln time.
24.50 total drying time.
Average moisture 16%.
Remarks: No cups, checks or warp.

Charge No. 2, material—1" #2 Com.

Time		Pressure or vacuum	Temperature	Steam	
Start	End			Coils	Live steam
9:00	12:00	Up to 3#	222	On	On.
12:00	1:00	Held 3#	222	On	On.
1:00	1:15	Blowing off		On	Off.
1:15	2:15	Up to 14" vol	182	On	Off.
2:15	3:15	Held to 14"	182	On	On.
3:15	3:45	Held to 20"	162	On	Off.

6.75 hours cylinder time.
Condition from cylinder O. K.

Time in hours	Kiln dry bulb temperature	Wet bulb temperature	Relative humidity
			Per cent
2	200	180	68
6	205	175	54
6	210	175	46
4	210	170	42

18 hours kiln time.
24.75 total drying time.
Average moisture content—14%.

Charge No. 3, material—1" #2 Com.

Time		Pressure or vacuum	Temperature	Steam	
Start	End			Coils	Live steam
7:40	11:00	Up to 3#	222	On	On
11:00	12:00	Held 3	222	On	On
12:00	12:15	Blowing off		On	Off
12:15	1:15	Up to 14"	182	On	Off
1:15	2:15	Held 14"	182	On	On
2:15	2:45	Held 20"	162	On	Off

7.08 hours cylinder time.

Time in hours	Kiln dry bulb temperature	Wet bulb temperature	Relative humidity
			Per cent
2	200	180	68
4	205	175	54
6	210	175	46
6	210	170	42

18 hours kiln time.
25.08 total drying time.
Average moisture content 16%.

Charge No. 4, material—2" #1 Com.

Time		Pressure or vacuum	Temperature	Steam	
Start	End			Coils	Live steam
4:45	7:45	Up to 5#----------	228	On	On
7:45	9:15	Held 5#----------	228	On	On
9:15	9:30	Blowing off------	----------	On	Off
9:30	10:30	Up to 14"--------	182	On	Off
10:30	11:30	Held 14"---------	182	On	On
11:30	12:00	Held 20"---------	162	On	Off

7.25 hours cylinder time.
Condition from cylinder, good.

Time in hours	Kiln dry bulb temperature	Wet bulb temperature	Relative humidity
			Per cent
6	200	180	68
6	205	175	54
6	210	175	46
6	210	170	42

24 hours kiln time.
31.25 total drying time.

From the foregoing examples of the treatment as applied to common pine lumber, it will be noted that the green lumber is subjected in the steam heated pressure cylinder to the action of substantially dry live steam at from 3 to 5 lbs. pressure for a period of from three and one-half to four and one-half hours, sufficient to heat it throughout to a temperature of 220° F. or thereabouts without injury, followed by blowing off the steam and carrying with it the condensate and part of the readily vaporizable constituents of the wood, this operation taking place rapidly and being completed in about fifteen minutes, immediately after which the pressure is reduced to a partial vacuum of about 14" of mercury, increasing to 20 inches toward the end of the process, under a gradually falling temperature of from 220° F. to 160° F., the temperature being maintained by the steam coils at about six degrees higher than the boiling point of water at the vacuum existing, thereby further reducing the moisture content of the wood to about 75% of that originally present.

The lumber is transferred to the dry kiln at its temperature of 160° F. or thereabouts, and gradually raised to about 200° F. by the steam coils and steam and air circulated therein, the humidity being controlled between 68% and 42%, in the successive stages by the admission of steam and air and withdrawal of vapor during the drying process and resulting in the removal of about 60% more of the original moisture, leaving some 14% to 16% in the wood, which is satisfactory for shipping and marketing it, the entire operation taking place in from 24 to 32 hours, as compared with from 60 to 90 hours to dry the same lumber to the same moisture content by the usual dry kiln processes not involving preliminary live steam and vacuum treatment.

The temperature and duration of the treatment in the dry kilns are regulated and timed in each of the four stages or compartments to suit the condition of the wood, as determined by tests of its moisture content, the aim being to expel about 32% in the first stage, about 15% in the second stage, about 8% in the third stage, and about 4% in the last stage, without case hardening the wood or causing internal or superficial checks or cracks, loosening knots, or otherwise injuring the wood so as to prevent its being finished without cupping, warping, splitting or otherwise failing to meet the requirements of manufacturers and users of properly seasoned lumber. The high temperatures and short time schedules made use of in my process in the drying kilns would be impossible of attainment without injuring the wood were it not for the preliminary steam and vacuum treatment which conditions the wood and prepares it for rapid seasoning.

I claim:

1. The method of seasoning lumber which comprises stacking in charges and subjecting each charge to live steam under low pressure insufficient to remove the resinous constituents and injure the wood for a length of time sufficient to heat and soften the wood followed by reducing the pressure to vaporize internal constituents of the wood at a higher temperature than that corresponding to the steam at the reduced pressure, the temperature ranging from above to below that of boiling water at atmospheric pressure, until at least 20% of the vaporizable constituents have been expelled, removing the vaporized constituents of the wood and surface moisture to partially dry the same, and subjecting the heated charge to combined heat and moisture in a circulating atmosphere of controlled humidity and temperature in successive stages of decreasing humidity and increasing temperature for periods of time sufficient to vaporize successive decreasing increments of internal moisture whereby substantially 60% more of the originally vaporizable constituents of the charge are vaporized and expelled, the entire series of treatments being carried out as a continuous process and completed in not more than 30 hours for lumber not over one inch in thickness.

2. The process of claim 1 wherein the first heating by live steam does not exceed a temperature of about 225° F.

3. The process of claim 1 wherein the reduction in pressure following the heating by live steam is of the order of about one-half an atmosphere.

4. The process of claim 1 wherein the steam heating and reduced pressure vaporization treatments do not exceed eight hours in time.

5. The process of claim 1 wherein the successive treatments at decreasing humidity and increasing temperature do not exceed the equivalent of four treatments of about six hours each.

6. The process of claim 1 wherein the wood is subjected to live steam treatment during the low pressure vaporization step to promote circulation throughout the charge.

7. The process of claim 1 wherein the increments of internal moisture vaporized in successive stages each bears approximately a constant ratio to preceding and succeeding increments.

8. The method of seasoning sawed lumber containing sap which comprises stacking in charges of similar sizes and subjecting each charge to live steam under low pressure insufficient to remove the resinous constituents and change the character of the wood for a length of time sufficient to heat and soften the wood and dilute the moisture contained in the sap, followed by reducing the pressure to vaporize said diluted sap moisture, the temperature varying from not over twenty degrees above during the pressure treatment to about thirty degrees below during the

vaporizing treatment the boiling point of water during said treatment, and maintaining said reduced pressure until not less than twenty per cent of the vaporizable constituents have been expelled, removing the vaporized constituents of the wood and surface moisture to partially dry the charge, subjecting the heated charge to combined heat and moisture in a circulating atmosphere of controlled humidity and temperature in successive stages of decreasing humidity and increasing temperature for periods of time sufficient to vaporize successive decreasing increments of internal moisture whereby sixty per cent more of the originally vaporizable constituents of the charge are vaporized and expelled, the entire series of treatments being carried out as a continuous process, substantially as described.

9. The process of claim 8 wherein live steam is introduced during the reduced pressure stage.

10. The process of claim 8 wherein the circulating atmosphere comprises live steam and air commingled to assist in the circulation thereof through the charge.

WILLARD TONEY.