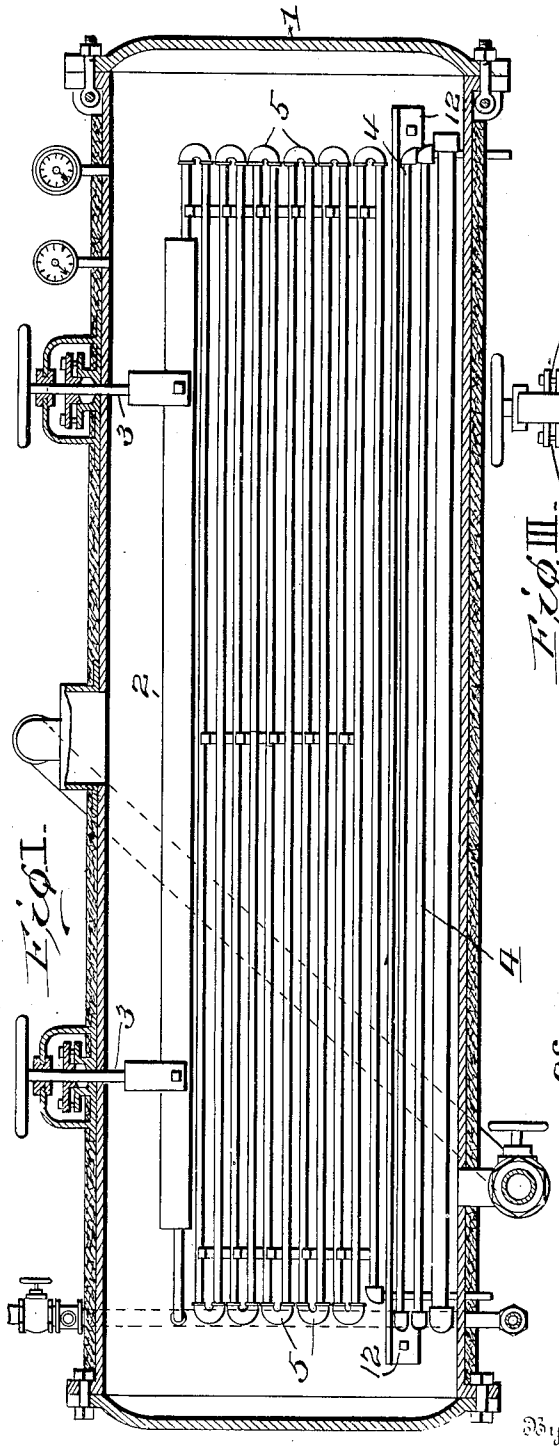
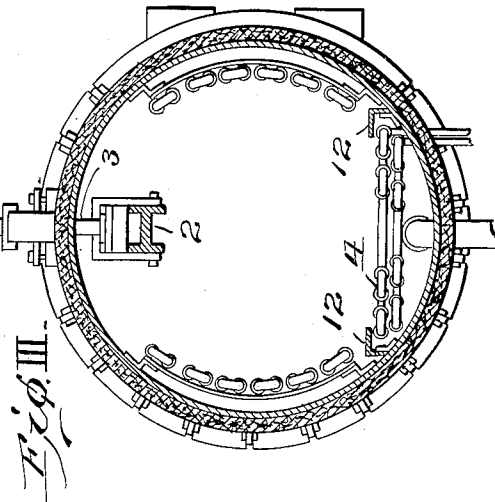
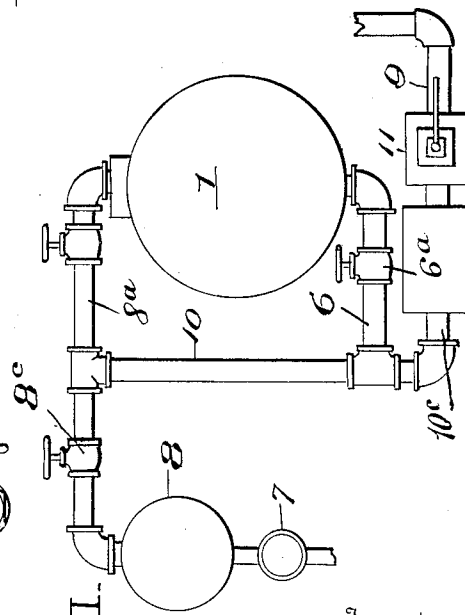


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 APPLICATION FILED SEPT. 20, 1916. RENEWED NOV. 9, 1918.

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Patented Jan. 20, 1920.
 2 SHEETS—SHEET 1.



Inventor
 Frederick K Fish Jr.
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 Attorney

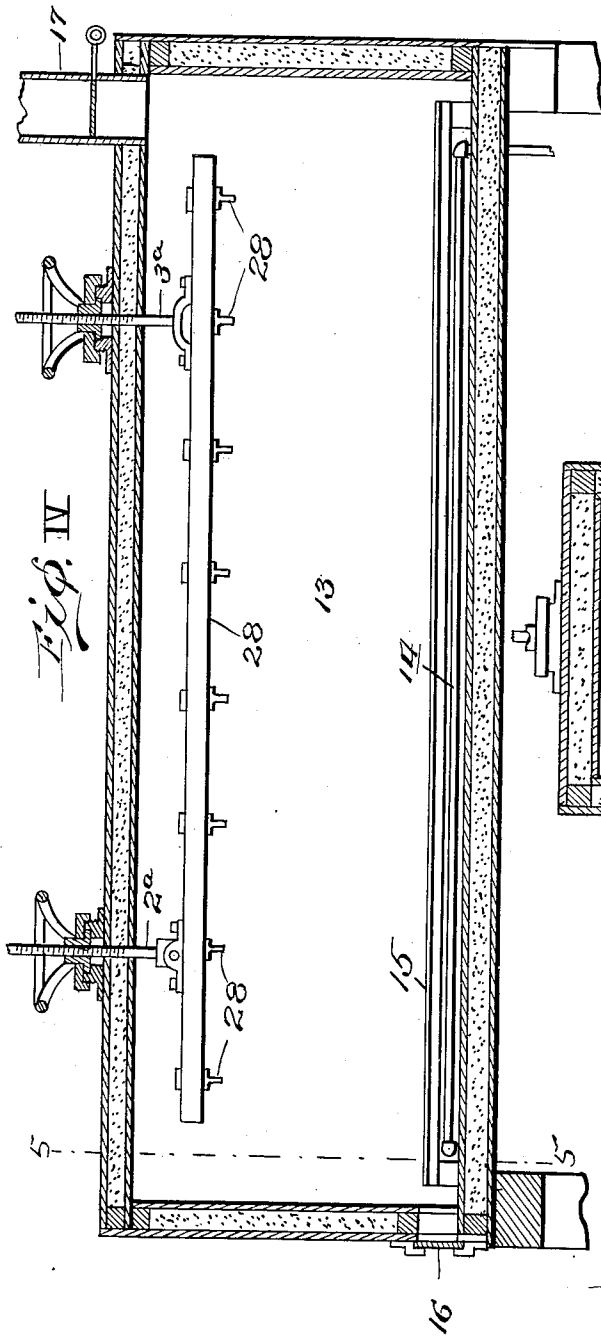
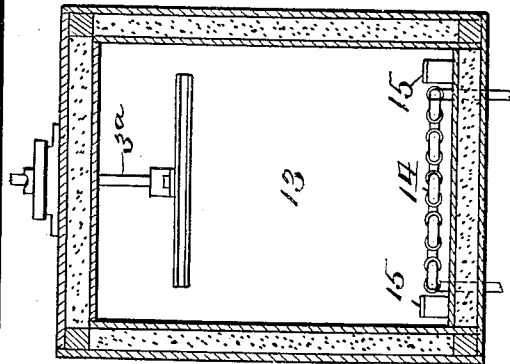
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UNITED STATES PATENT OFFICE.

FREDERICK K. FISH, JR., OF NEW YORK, N. Y., ASSIGNOR TO LUMBER TIE AND TIMBER VULCANIZING COMPANY, OF NEW YORK, N. Y.

PROCESS OF DRYING LUMBER.

1,328,505.

Specification of Letters Patent.

Patented Jan. 20, 1920.

Application filed September 20, 1916, Serial No. 121,187. Renewed November 9, 1918. Serial No. 261,938.

To all whom it may concern:

Be it known that I, FREDERICK K. FISH, Jr., a citizen of the United States, residing at 2 Stone street, New York city, in the county of New York and State of New York, have invented certain new and useful Improvements in Processes of Drying Lumber, of which the following is a specification.

This invention relates to improvements in a process for treating, seasoning, curing, sterilizing and drying wood.

Wood consists mainly of cellulose with its incrusting layer of lignin, and sap containing water, resins, tannins, coloring matter with other organic substances, together with a minor proportion of mineral matter. Lignin, while not fully understood chemically, is closely allied to the cellulose of the wood, and since it forms a part of the permanent structure of the wood, it may, for purpose of the present invention, be regarded as identical with the cellulose.

Of the other organic substances, the principal are starches, sugars, gummy substances, albuminous compounds and "sap" together with resin or resinous compounds mainly to be found in resin cells or ducts. The starches, sugars, gums and albuminous substances with the "sap" are elements principally necessary to the life of the growing tree but their presence in felled wood, timber or lumber, if in any quantity, is largely detrimental as affording principal elements leading to the decay or destruction of the wood. Therefore, any proper treatment to preserve the wood should be directed to the removal of injurious starches, soluble gums, albuminous substances and sap with the proper preservation and distribution of the resins and resinous substances throughout the structural elements, care being taken to arrest the treatment and if a liquid is employed to remove the same from around the wood before disintegration of the wood begins so that all elasticity, strength and that which is termed "life" are retained.

In carrying out my improved process, certain steps are provided to utilize the natural resins, acetic acid and tannic acid existing in the wood, as preservative agents; that is to say, these constituents or substances are dislodged from their cellular confinement, and separated from their original vehicle,

the water soluble constituents being dissolved, and the major portion removed from the wood, the remainder being distributed through the fibrous structure of the wood.

To obtain the best results, the wood is first subjected to a vacuum to remove the air from within the wood which renders it more receptive for penetration throughout of a heated dissolving vehicle to attack the soluble constituents and render the wood hot and condition the contained resins to the succeeding steps in the process. The vehicle, preferably boiling water under pressure, is forced into the entire fibrous structure of the wood, and dissolves and dislodges the soluble gummy sap matters and softens the resins. This step causes the soluble gummy sap matters and the sap water to become intermingled with the vehicle in the container. To obtain the desired results, the period of treatment, the temperature and the pressure, must be such as not to injure the wood. This step in the process also saturates and swells the wood, causing it to further expand upon removal of pressure, and softens the resins and puts them in condition to permeate the wood structure in a subsequent step or steps in the process. This step in the process also puts the wood in good physical condition to give up its aqueous content in the subsequent steps of the process.

In the next step, as the water and pressure are removed from around the wood, the differences between the internal pressure within the wood and the external pressure surrounding it causes the wood and the liquid within the wood to further expand and considerable of the liquid with its dissolved constituents are removed from the wood in the form of vapor and otherwise. Then a partial vacuum is created, the vacuum being maintained for a sufficient time to remove a portion of the aqueous content of the wood to be evaporated without taking with it the values of the sap, such for instance as the resin or the resin-producing constituents. But this vacuum should not be continued long enough to greatly cool down the wood, allow its resins to harden, or close the moisture outlets of the wood at the surface. To assist the withdrawal of the moisture from the wood the vacuum is replaced with live

steam, and a pressure created in and around the wood thereby raising the temperature of the wood, the last named vacuum materially assisting the live steam to penetrate the wood structure.

Next, the wood is again subjected to a vacuum for a suitable period, which continues the drying of the wood.

Finally, the wood is subjected to what I term an equalizing step, which consists in maintaining around the wood an atmosphere of proper humidity, and a temperature sufficient to cause continuous evaporation of moisture, at the same time keeping the resins in a softened state until the wood is seasoned. It is in this step particularly that permeation of the wood fibers by the softened resins takes place. The wood thus described will be sterilized, tanned and dried, without removing the insoluble resins, the fibrous structure of the wood being permeated with these resins. The wood is furthermore rendered substantially non-hygroscopic, and correspondingly immune from spores, or fermentation or the like, and undergoes the minimum amount of shrinkage.

To illustrate one way of carrying out the process, reference is made to the accompanying drawings wherein:—

Figure 1 is a vertical longitudinal section of a container, in which the wood is partially treated.

Fig. 2 is a cross section taken through the container.

Fig. 3 is a diagrammatic illustration of an apparatus for carrying out the steps of the process in the container.

Fig. 4 is a vertical sectional view of an equalizing chamber.

Fig. 5 is a cross section of the same on the line 5—5 of Fig. 4.

In the drawings, the same reference characters designate like parts in all the figures.

1 indicates a container suitable for containing water under pressure at a temperature above the boiling point. In the container is a presser plate 2, adjusted by screws 3, by means of which the wood, retained under mechanical pressure is prevented from floating and warping while being subjected to treatment. The container is also provided with heating coils 4, by means of which the temperature of the atmosphere within the container and the temperature and pressure of the water in the container may be regulated. Perforated pipes 5, are arranged in the container for supplying free steam to the latter, when desired.

Suitable equipment is associated with the container for conveniently developing the various conditions incident to the different steps in the process; 10 indicating a pipe leading from an elevated water tank (not

shown) and connected to the top of the container by a branch pipe 9, and to the bottom of the container by means of a branch pipe 6, provided with a valve 6^a; and in the pipe 10^a is a double acting pump 11. Extending from the junction of the pipes 9 and 10, is a branch pipe 8^a, provided with a valve 8^a, leading to a condenser 8, and from the condenser extends a short pipe connected to a vacuum pump 7. In the bottom of the container are rails to receive a truck, upon which the wood to be treated is loaded.

Referring to Figs. 4 and 5, 13 indicates an equalizing chamber constructed to have a high co-efficient of heat insulation, and is preferably provided with a presser device 2^a, 3^a similar to that employed in the container. The equalizing chamber is further provided with heating pipes 14, and a lower air inlet controlled by a suitable damper 16, and a stack or outlet, controlled by a damper 17. In the bottom of the equalizing chamber are tracks for convenient introduction of the truck with the charge of wood, previously treated in the container.

In practising the process, a charge of wood is loaded on a truck, and is introduced into the container, the pressure devices are screwed down, and the container is hermetically closed. The appropriate valves are opened, and the vacuum pump 7, is operated, and a partial vacuum created in the container 1. This partial vacuum is maintained for a suitable time to expel air from the wood, and render the fibrous structure more receptive to the penetration of the boiling water. This step also preliminarily prepares the wood for the future treatments.

The valves are closed, and boiling water from the elevated tank is introduced into the container through the pipes 9 and 10, the water being fed to the container by gravity, or by pump 11. The vacuum in the container is broken by the introduction of the boiling water.

Sufficient water is introduced into the container to submerge the wood, and about twenty pounds pressure is produced and maintained by introducing steam through the heating coils 4, which continues the boiling of the water and produces the necessary pressure and temperature to superheat the water.

This superheated water step is maintained for a sufficient time to dissolve the water soluble constituents of the wood, the superheated water being forced through the entire fibrous structure of the wood. For one inch yellow pine green from the saw about one hour is required.

By treating the wood in superheated water the wood is rendered hot and soft the internal stresses are relieved; the resins are softened and the water soluble substances are dissolved and with the sap water are

mixed or intermingled with the water surrounding the wood. In addition to these results, the superheated water being confined causes a deposition of the colloidal substances on the fibers of the wood, and tans the surface of the latter giving the wood a distinctive appearance.

The water introduced into the container, and in which the wood is submerged, remains as a relatively fixed body during the treatment, the valves being closed to prevent circulation, and the pressure devices preventing the wood floating or warping during this step in the process.

After the wood is subjected to the boiling step, the valve 6^a is opened, and the pressure in the container will force the water back into the elevated tank, or the pump 11, may be operated to effect this result. The valve 6^a is closed, and the valve 8^c is opened and the vacuum pump 7 is started and a partial vacuum of about 20 inches is created in the container, the change from liquid pressure to vacuum being effected as quickly as possible, say in about fifteen minutes. The wood now has a high internal temperature and some pressure which will readily convert water into steam, making the whole body of the wood favorable to giving up moisture.

The vacuum may be maintained for a sufficient time to cause the aqueous content of the wood to largely evaporate without taking with it the resins or resin-producing constituents. But this evaporation should not be continued long enough to greatly cool down the wood, or close its pores at the surface. Now to continue the evaporation of moisture from the interior of the wood and prevent external drying, or danger of checking, the vacuum is gradually replaced by an artificial atmosphere of high temperature, say about 290 degrees F. This condition is created by introducing steam to the container, through the perforated pipes 5, the increase in temperature being assisted by circulating steam through the heating coils. Some pressure is maintained during this time—say about thirty pounds, and the step is continued for—say one-half hour, and has the effect of raising the temperature of the wood throughout well above the boiling point and keeping the retained resins in good permeating condition.

Next the steam is cut off from the perforated pipes 5 and the wood, at high internal temperature and with softened fibrous structure, favorable to giving up moisture, is again subjected to a partial vacuum of about fifteen inches, but this time with heat obtained from the closed heating coils 4. This step is preferably continued for about two hours, but the vacuum may be increased—say to about twenty-five inches—toward the end of the step—say for the last

half hour thereof. This step in the process has the effect of aiding the uniform distribution of the resins throughout the wood structure, and when completed, the wood is in condition to be removed from the container.

The load of wood is now transferred as rapidly as possible, to the equalizing chamber 13, the load being preferably covered to minimize loss of heat during the transfer. While the wood is being treated in the equalizing chamber, another charge can be introduced to the container.

It is important in carrying out the final step of the process that the temperature and humidity be such as to prevent premature hardening of the resins of the wood, and insure continuous evaporation of moisture, without checking or otherwise deteriorating the value of the wood. It is to be borne in mind that the internal temperature of the wood when introduced into the equalizing chamber is high, and that it contains moisture, and the resins are in a softened state. It is here, and while the resins are in this condition that permeation of the cellulose by resins and such of the gummy substances remaining in the wood takes place.

Steam is admitted to the heating pipes 14, to maintain a temperature favorable to continuous evaporation of moisture from the wood, and the dampers 16 and 17 are opened periodically to create a current or currents of air to the chamber for periodically carrying off the moisture as it accumulates. This step evaporates moisture from the wood and equalizes its moisture content and insures the permeation of the individual fibers of the wood with its resins.

In the treatment and drying of wood, I have had in mind the fact that it is essential that the resins must be retained and yet the major portion of the water soluble constituents and the water sap closely associated therewith, must be removed without breaking down or disintegrating the cellular structure. It is with a fine appreciation of this condition, I have provided the foregoing steps in the process, each step performing its function in sequence to effect the common and final result.

When the green wood is introduced into the container, its pores are, or may be partially closed, and its internal cellular structure contains more or less air, which for practical purposes and to expedite the treatment, should as far as possible, as a preliminary step, be removed. Hence, when the wood is placed in the sealed container and the first vacuum is created, a large portion of the air throughout the body of the wood is expelled, and while the wood is in this condition boiling water is introduced to at least submerge the wood. Then pressure is created in the container by operating the

pump and the temperature of the water is raised by introducing steam through the coils 4, the added temperature and consequent pressure causing the water to be superheated, and in this condition it is forced into the wood. The change from vacuum to pressure takes place to insure as perfect penetration of the wood as possible, the condition of change from vacuum to pressure being controlled by the proper manipulation of the valves. The wood is, by this means, and without loss of time, put into good condition for the effective penetration of the water, to readily attack the water soluble constituents throughout the whole wood structure. The vacuum having been broken or destroyed, and the superheated water having been substituted, the wood is treated until it is rendered hot and soft and will become enlarged upon release of the pressure surrounding it. The water soluble constituents are dislodged from their cellular confinement, and dissolved in the water in the wood, and because of the boiling action under pressure these dissolved ingredients are conveyed or removed from the interior of the wood and become mixed or intermingled with the confined body of water in the container. The water and heat, together with the pressure which forces the water into the wood, acts to dissolve the gummy sap matters, but in so doing care must be taken to regulate the temperature and pressure and duration of treatment to prevent disintegration or destruction of the wood.

Stress is put on the fact that treating the wood for a short time under low heat and corresponding pressure to soften the resins and expel water soluble constituents, is to be distinguished from what is known in the art as cooking the "life" from the wood.

The superheated water, charged with the water soluble gums and sap water, is removed from the container by manipulation of the proper valves, and returned to the elevated tank for re-use. The wood now is hot and soft, the internal stresses having been relieved, its pores are opened up, and its contained resins are in a softened state. Therefore, the succeeding steps in the process have to do largely with the evaporation of the moisture in the wood structure, the maintaining of the resins in good condition to permeate the fibers, and the thorough permeation of the fibers with the resins, without liability to produce checking of the wood.

The water having been removed, a second vacuum is now created to evaporate the moisture content of the wood and permit penetration of steam introduced in a further step. The second mentioned vacuum is gradually replaced by artificial atmosphere of high pressure and high temperature to raise the internal heat in the wood well

above the boiling point. This step insures the retained resins in the wood remaining in a softened condition, to later enable them to permeate the individual fibers of the wood in a subsequent step or steps in the process.

After this step of the treatment, the wood is subjected to the action of the third vacuum with dry heat which acts to cause the softened resins to be uniformly distributed throughout the wood structure.

It is essential however that the wood be further treated to complete its drying without hardening its resins and checking or otherwise degrading it. Therefore, I provide the next or equalizing step in the process. After the last mentioned, or third vacuum is broken, the load of wood is removed to the equalizing chamber where it is permitted to remain until sufficient moisture evaporates. The wood at this time contains high internal heat, and the chamber is provided with means to maintain a temperature effective to sustain a moderated and continuous evaporation of the moisture in the wood and to maintain the resins in a melted condition in the wood until the wood is finally dried and cooled.

Upon the first introduction of the wood in the chamber the dampers 16 and 17 are closed and the evaporated moisture rapidly creates a humid condition within the chamber. As the humidity increases, a deposition of moisture occurs on the surface of the wood, and as the point of saturation is approached evaporation of the moisture ceases. At such time the dampers are operated to relieve the condition within the chamber, and this may be secured either by opening the upper damper alone, or by periodically opening both dampers. If the upper damper alone is opened it causes a lowering of the slightly raised pressure within the chamber, the excess moisture around the wood being removed from the equalizing chamber. As the pressure within the chamber is so lowered the high heat and consequent pressure within the interior of the wood produces vaporization of the interiorly contained moisture and such pressure within the wood causes a movement of the moisture surfacewise, whereby a too rapid surface drying is avoided and in addition an increased rapidity of drying of the wood as a whole is secured.

If the lower damper is opened simultaneously or periodically with the upper damper open, a current of air is caused to circulate throughout the chamber to accelerate the evaporation of the moisture.

As the moisture content evaporates from the wood fibers, the resins being in a softened condition spread, and replace this evaporated moisture the resins permeating the wood structure and flowing about and into the wood fibers in such manner that

upon cooling the setting resins aid to maintain the wood fibers in their expanded condition so that when finally dried the wood shows the minimum degree of shrinkage.

5 As previously stated, the process contemplates re-use of the water. This is not only economical, but it has been found that the water soluble elements expelled from the wood in previous treatments forms a diluted
10 solution, and when treating the next load of green wood, the contained substances act to tan the wood, the effect and result depending largely on the character of wood and the number of times the water is used.

15 What I claim is:—

1. The process of treating wood comprising subjecting the wood to superheated water until its water soluble constituents are dissolved and with its sap water largely removed and the wood thoroughly sterilized
20 throughout, and arresting the treatment before any deterioration of the wood occurs, to produce a wood resistant to decay and with its strength and elastic properties unimpaired.

2. The herein described process of treating wood comprising the subjection of the wood to heated water under pressure to dissolve its water soluble matter while held
30 submerged and to prevent warping, removing the water and releasing the wood, and subsequently drying the wood.

3. The herein described process which comprises dissolving in wood substantially
35 all water soluble constituents and removing the major portion of the same, then drying the wood at a temperature sufficient to cause evaporation of the moisture in the wood, prevent hardening of its resins and cause
40 permeation of the fibers with the residue and the resins.

4. The process of treating wood comprising applying boiling water to wood, submerging the wood therewith, and thereafter
45 superheating the water to raise its temperature and pressure to cause same to permeate the wood throughout, and arresting the treatment before deterioration of the wood occurs.

50 5. The process of treating wood comprising submerging wood in a confined body of superheated water to dissolve and extract the soluble gums and sap, and subsequently subjecting the wood to a temperature to induce evaporation of the moisture of the
55 wood and prevent hardening of the resins, causing the resins to permeate the fibers of the wood.

6. A process of treating wood comprising
60 treating the wood to dissolve and remove its sap matters, subjecting the wood to alternate vacuum and pressure treatments and maintaining a temperature in the wood sufficient to cause the moisture in the wood to
65 evaporate and prevent hardening of the

resins thereby causing the same to permeate the fibers of the wood.

7. The process of treating wood which comprises surrounding the wood with a fixed body of heated water which has been
70 previously similarly employed, then applying pressure to the heated water to cause permeation of the wood throughout and to dissolve substantially all constituents which may be dissolved in water and removing the
75 major portion of these constituents with the water, and drying the wood.

8. The process of treating wood comprising submerging the wood in a fixed body of water under pressure and with heat to
80 extract water-soluble constituents and sap water from the wood and melt the resins therein, removing the water, and subsequently subjecting the wood to a temperature sufficient to induce evaporation of the
85 moisture in the wood and prevent hardening of the resins and cause the resins to permeate the individual fibers of the wood.

9. The process of treating wood comprising submerging the wood in water containing the water soluble constituents of
90 wood under pressure to saturate the same, dissolve and extract the major portion of the water soluble constituents and subsequently drying the wood.

10. The process of treating wood by subjecting it to a deposition of tanning colloidal substances on the surface portions of the wood thereby tanning the same while removing the major portion of the water soluble
95 constituents.

11. The herein described process which comprises treating the wood to remove the major portion of the water soluble constituents and sap water therefrom, and expand
105 the fibers thereof, then drying the wood to remove the major portion of the moisture in the wood, the tanning colloids removed from the wood and retained in the water being deposited on the fibers of the wood to there-
110 by tan the same.

12. The process of treating and drying wood, comprising subjecting the wood to steam and heat, to maintain the steam and raise the temperature throughout the wood,
115 then to a vacuum to cause a movement of the interior moisture surface-wise to evaporate moisture therefrom, and finishing the drying at atmospheric pressure.

13. The process of treating wood comprising applying boiling water to wood, which has been previously employed in a similar treatment of wood, then submerging
120 the wood therewith and thereafter superheating the water to raise its temperature and pressure to cause same to permeate the wood throughout.

14. The process of treating wood which comprises surrounding the wood with heated water which has been previously similarly
130

used, then applying pressure to the heated water to cause permeation of the wood throughout and dissolve the major portion of the water soluble constituents, removing the water from around the wood, and drying the wood.

15 15. The process of treating softened wood with water soluble constituents and sap water removed and containing its resins in a melted condition, comprising subjecting the wood to a temperature to induce evaporation of the moisture in the wood, prevent hardening of the resins and to cause the latter to permeate the fibers of the wood.

15 16. The process of drying wood having soluble gums and sap water removed and its resins in a softened condition, consisting in subjecting the wood to heat sufficient to induce evaporation of the moisture in the wood and prevent hardening of the resins, causing the resins to permeate the fibers of the wood, and periodically subjecting the wood to a current of air to carry off the moisture as it accumulates around the wood, at the time the wood is subjected to the heat.

17. The process of drying wood having a portion of its gummy sap matter and sap water removed and its resin softened, consisting in subjecting the wood to alternate vacuum and pressure and maintaining sufficient heat to prevent hardening of the resins, and then removing the moisture surrounding the wood by periodically subjecting the wood to a current of air to produce a substantially sterilized wood, having its preservative elements retained and distributed throughout the structure.

18. The process of treating wood comprising treating the wood with water to dissolve, dilute and remove the major portion of its water soluble constituents, and cause the thorough permeation of the wood with the unremoved remaining preservative elements and drying the wood.

19. The process of treating wood comprising subjecting the wood to treatment to remove the major portion of the soluble gums and sap matter and thereafter treating the wood to evaporate moisture and cause the retained resins to spread throughout the wood to substantially replace the soluble gums and sap matter.

20. The process of treating wood, comprising placing the wood in a container, creating a vacuum therein, submerging the wood in boiling water, withdrawing the water, then creating a vacuum in said container while supplying heat therein to evaporate moisture and create expansion in the wood.

21. The process of treating wood, comprising treating the wood in superheated water, to soften its structure and dissolve water soluble constituents, subsequently with-

drawing the water from around the wood, and creating a vacuum while applying heat to evaporate moisture and create an expansion in the wood.

22. The process of treating wood comprising subjecting the wood to a vacuum to expel a portion of the air therefrom, then subjecting the wood to superheated water to soften its fibers and dissolve the water soluble constituents and finally drying the wood while maintaining heat sufficient to induce evaporation and prevent hardening of the resins.

23. The process of treating wood comprising subjecting the wood to a vacuum to expel a portion of the air therefrom, then treating the wood in superheated water to permeate the same to dissolve and remove its water soluble constituents, and arresting the treatment before deterioration of the wood occurs.

24. The process of treating wood comprising subjecting the wood to superheated water until its structure is softened and water soluble constituents are dissolved, removing the water from around the wood, then subjecting the wood to a vacuum to evaporate moisture and cause expansion in the wood, drying the wood while maintaining heat sufficient to induce evaporation and prevent hardening of the resins to permit them to replace the removed substances.

25. The process of treating wood which comprises subjecting wood to the action of superheated water for a period of time to melt the resins of the wood and dissolve its water soluble constituents, then removing the water and subjecting the wood to heat sufficient to cause evaporation of the water in the wood and prevent hardening of the resins of the wood and insure a permeation of the fibrous structure of the wood by its resins.

26. The process of treating wood comprising subjecting the wood to superheated water until its structure is thoroughly softened and its water soluble constituents are dissolved, removing the water, then subjecting the wood to a vacuum until a portion of its moisture is withdrawn and expansion is created in the wood, then subjecting the wood to steam to raise the temperature of the wood and evaporate a portion of its moisture.

27. The process of treating wood comprising the subjection of the wood to superheated water until its soluble constituents and sap matter are dissolved and largely removed and the wood thoroughly sterilized throughout, arresting the treatment before any substantial deterioration of the wood occurs, removing the water and subjecting the wood to steam under pressure to raise the temperature and evaporate a portion of

the moisture, and finally subjecting the wood to heat sufficient to induce evaporation and preventing hardening of the resins.

28. The process of treating wood comprising the subsection of the wood to superheated water until its soluble constituents and sap matters are dissolved and largely removed and the wood thoroughly sterilized throughout, arresting the treatment before any substantial deterioration of the wood occurs, removing the water, and subjecting the wood to steam to raise the temperature and evaporate a portion of its moisture.

29. The process of treating wood comprising subjecting the wood to superheated water until its structure is thoroughly softened and its water soluble constituents are dissolved, removing the water, then subjecting the wood to a vacuum while applying heat until a portion of its moisture is withdrawn and expansion is created in the wood, then subjecting the wood to steam under pressure, to raise the temperature of the wood and evaporate a portion of its moisture, then creating a vacuum while applying heat to further evaporate moisture, then drying the wood while maintaining heat sufficient to induce evaporation and prevent hardening of the resin.

30. The process of treating wood comprising subjecting the wood to superheated water until its structure is thoroughly softened and its water soluble constituents are dissolved, removing the water, then subjecting the wood to a vacuum until a portion of its moisture is withdrawn, then subjecting the wood to steam to raise the temperature of the wood and evaporate a portion of its moisture, then creating a vacuum while applying heat to further evaporate moisture.

31. The process of treating wood, comprising subjecting the wood to a vacuum, then submerging the wood in boiling water and raising the pressure thereof and treating the wood in superheated water, removing the water and substituting therefor a vacuum; then subjecting the wood to steam while creating a high temperature around the wood, finally drying the wood at about atmospheric pressure and in the presence of heat while periodically removing the accumulating moisture from the atmosphere surrounding the wood.

32. The process of treating wood comprising subjecting wood to a vacuum, to expel a portion of the air therefrom, treating the wood to superheated water to soften its structure and dissolve the water soluble constituents, removing the water, then subjecting the wood to a vacuum to evaporate the moisture from the wood, and finally treating the wood with steam to induce evaporation and prevent hardening of the resins.

33. The process of treating wood compris-

ing subjecting the wood to superheated water until its structure is thoroughly softened and its water soluble constituents are dissolved, removing the water, subjecting the wood to steam under pressure to raise the temperature of the wood and evaporate a portion of its moisture, then creating a vacuum to evaporate moisture and cause expansion in the wood, then drying the wood while maintaining heat sufficient to induce evaporation and prevent hardening of the resin.

34. The process of treating wood, comprising subjecting the wood to a vacuum; then replacing the vacuum with boiling water and thereafter superheating the water, then removing the water and substituting therefor a vacuum; then replacing this vacuum by steam; then replacing the steam with a vacuum; and finally finishing the drying at about atmospheric pressure and in the presence of heat, while periodically removing the accumulating moisture from the atmosphere surrounding the wood.

35. The process of treating wood, comprising subjecting the wood to boiling water to soften its structure, open up its pores and dissolve its sap; then subjecting the wood to successive vacuum treatments with an intervening raising of the pressure around the wood; the temperature of the wood during these steps being maintained sufficient to induce evaporation and prevent hardening of the resins, the wood being finally dried at about atmospheric pressure.

36. The process of treating wood, comprising boiling the wood to soften its structure, open up its pores and dissolve its sap; then subjecting the wood to a plurality of vacuum treatments alternated with steam, the temperature of the wood during these steps being maintained sufficient to induce evaporation and prevent hardening of the resins; the wood being finally dried by heat at about atmospheric pressure, the temperature being maintained sufficient to prevent hardening of the resins and permeate the fibers of the wood with its resins.

37. The process of treating wood, comprising subjecting the wood to a vacuum, then replacing the vacuum by boiling water and raising the pressure above atmospheric, removing the water, and treating the wood with steam under pressure; then creating a vacuum; and finishing the drying at about atmospheric pressure with heat while periodically removing the accumulating moisture surrounding the wood.

38. The process of treating wood, comprising subjecting the wood to a vacuum and immediately thereafter boiling it in water until its structure becomes soft, its pores are opened and its gummy sap matters are dissolved; then withdrawing the water and sub-

jecting the wood to steam and heat and raising the pressure surrounding it; then subjecting it to a vacuum, finally drying the wood at about atmospheric pressure.

39. The process of treating wood, comprising placing the wood in a container, surrounding the wood with boiling water until its pores are opened up, its structure thoroughly softened and its water soluble constituents are dissolved; withdrawing the water and creating a vacuum in said container while applying heat to evaporate moisture and cause expansion in the wood.

40. The process of treating wood comprising subjecting the wood to boiling water until its structure is thoroughly softened and its water soluble constituents are dissolved, removing the water, treating the wood to steam under pressure to increase the internal heat of the wood and evaporate a portion of the moisture, then subjecting the wood to a vacuum while applying heat to evaporate moisture and cause expansion in the wood.

41. The process of treating wood, comprising boiling the wood to soften its structure, open up its pores, and dissolve its sap, then subjecting the wood to a plurality of vacuum treatments alternated with steam, the temperature of the wood during these steps being maintained up to a degree sufficient to induce evaporation and prevent hardening of the resins and drying while periodically removing accumulating moisture surrounding the wood.

42. The process of treating wood comprising submerging the wood in heated water to dissolve and remove soluble gums and sap, removing the water, and subjecting wood to steam under pressure and simultaneously introducing dry heat to maintain the temperature of the steam to evaporate the moisture in the wood.

43. The process of treating wood, comprising subjecting the wood to heated water under pressure until the pores of the wood are opened up, its structure thoroughly softened and its gummy sap matter dissolved, and largely removed, removing the water, subsequently subjecting the wood to a vacuum while applying heat to evaporate moisture.

44. The process of treating wood, comprising boiling the wood to soften its structure, open up its pores and dissolve its sap, then subjecting the wood to heat and steam under pressure; the wood being finally dried at a temperature sufficient to cause evaporation of the moisture from the wood and prevent hardening of the resins and cause permeation of the wood fibers with its resins.

45. The process of treating wood comprising subjecting the wood to boiling water until its structure is thoroughly softened and water soluble constituents are dissolved and

removed, removing the water, treating the wood with steam under pressure to increase the internal heat of the wood, and evaporate a portion of the moisture and then drying the wood.

46. The process of treating wood, comprising boiling the wood to soften its structure, open up its pores and dissolve its sap; then subjecting the wood to a plurality of vacuum treatments alternated with a raising of the pressure around the wood; the temperature of the wood during these steps being maintained up to a degree sufficient to induce evaporation and prevent hardening of the resins and cause a permeation of the fibers of the wood by its resins.

47. The process of treating wood, comprising boiling the wood to soften its structure, open up its pores and dissolve its sap; then subjecting the wood to a plurality of vacuum treatments alternated with live steam, the last of said vacuum treatments being varied in its intensity; the temperature of the wood during these steps being maintained up to a degree sufficient to induce evaporation and prevent hardening of the resins; the wood being finally dried at about atmospheric pressure.

48. The process of treating wood comprising subjecting wood to a vacuum to expel a portion of the air therefrom, treating the wood with steam, then a vacuum to evaporate moisture, and then subjecting the wood to heat at about atmospheric pressure while periodically removing the accumulating moisture surrounding the wood.

49. The process of treating wood comprising subjecting the wood to a vacuum, treating the wood to steam, to increase its internal temperature and evaporate moisture, then to a vacuum to evaporate moisture from the wood and expand the wood and then subjecting the wood to heat while periodically removing the accumulating moisture and subjecting the wood to a current of air.

50. The process of treating wood comprising submerging the wood in superheated water to dissolve and remove soluble gums and sap, removing the water, subsequently drying the wood in a moderately heated atmosphere with moisture sufficient to prevent too superficial drying.

51. The process of treating wood comprising subjecting the wood to a vacuum to expel a portion of the air therefrom, treating the wood with steam and heat to increase its internal temperature and evaporate moisture therefrom, finally drying the wood at about atmospheric pressure to induce evaporation.

52. The process of treating wood, comprising subjecting the wood to a vacuum, and thereafter boiling it until its structure becomes soft, its pores are opened and its

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gummy sap matters are dissolved; then subjecting the wood to a plurality of vacuum treatments alternated with a treatment of steam under pressure, and finally drying the wood.

53. The process of treating wood comprising subjecting the wood to a vacuum to expel a portion of the air therefrom, treating the wood with steam and heat to increase its internal temperature, then to a vacuum to evaporate moisture from the wood, then subjecting the wood to heat at about atmospheric pressure sufficient to evaporate moisture therefrom while periodically removing moisture from the wood.

54. The process of treating wood, comprising subjecting the wood to vacuum and thereafter boiling it until its structure becomes soft, its pores are opened and its gummy sap matters are dissolved; then subjecting the wood to a vacuum; then, while maintaining the internal heat of the wood, raising the pressure surrounding it; then subjecting it to vacuum and finally drying the wood at about atmospheric pressure while periodically removing the accumulating moisture surrounding the wood.

55. The process of treating wood comprising subjecting the wood to the action of a vacuum to remove the air therefrom, then submerging the wood in water under pressure to dissolve and extract the soluble gums and sap water, arresting the treatment, and subsequently drying the wood.

56. The process of treating wood, comprising subjecting the wood to a vacuum and thereafter to heated water until its structure becomes soft, its pores are opened and its gummy sap matters are dissolved; then subjecting the wood to vacuum; then, while maintaining the internal heat of the wood, raising the pressure surrounding it; subsequently subjecting it to vacuum and finally drying the wood at about atmospheric pressure.

57. The process of treating wood, comprising submerging the wood in water under pressure and heating the water to dissolve and extract the soluble gums and sap and melt the resins, removing the water and subsequently subjecting the wood to a temperature sufficient to induce evaporation of the moisture in the wood and prevent hardening of the resins, thereby causing the resins to permeate the fibers of the wood.

58. The process of treating wood which comprises placing wood in a container submerging said wood in water previously used in a similar treatment of wood to dissolve and remove water soluble constituents, and by pressure forcing the water into said wood to uniformly permeate the fibers and dilute the sap, withdrawing the water from the wood, and subjecting the wood to treatment to evaporate the moisture in the wood.

59. The process of treating wood, comprising subjecting the wood to heated water under pressure until its structure is thoroughly softened and its sap matters are dissolved; then subjecting it to a vacuum until a portion of its moisture is withdrawn; then subjecting it to steam under pressure; then subjecting it to a vacuum of increasing intensity while applying heat.

60. The process of treating wood, comprising subjecting the wood to heated water under pressure until its pores are opened and its gummy sap matters dissolved, subsequently subjecting the wood to a vacuum to evaporate moisture and cause expansion in the wood and subsequently surrounding the wood with a body of drying heat sufficient to prevent the hardening of the resins of the wood.

61. The process of treating wood, comprising submerging the wood in water at a temperature and at a pressure sufficient to open its pores and dissolve its gummy sap matters, then creating a vacuum around the wood to evaporate moisture and create expansion in the wood, and finally subjecting the wood to heat to evaporate the moisture therefrom, the temperature being maintained to prevent hardening of the resins and cause permeation of the fibers of the wood by its resins.

62. The process of treating wood, comprising subjecting the wood to heated water under pressure until its structure is thoroughly softened and its water soluble constituents are dissolved, then withdrawing the water and subsequently subjecting the wood to steam under pressure and applying heat; then subjecting the wood to a vacuum, and finally drying the wood at or about atmospheric pressure.

63. The process of treating wood, comprising subjecting the wood to heated water under pressure to soften its structure, open up its pores and dissolve its water soluble constituents; subsequently subjecting the wood to steam under pressure; the temperature of the wood being maintained up to a degree sufficient to induce evaporation and prevent hardening of the resins.

64. The process of treating wood, comprising immersing the wood in water under pressure until the wood is softened, the pores opened up and the water soluble constituents dissolved, then applying heat sufficient to evaporate the moisture from the wood, and periodically removing the accumulating moisture from around the wood and intermittently passing a current of air over the wood.

65. The process of treating wood, comprising subjecting the wood to heated water to soften its structure, open up its pores and dissolve its saps; then subjecting the wood to a plurality of vacuum treatments alternating

nated with a raising of the pressure around the wood; the temperature of the wood during these steps being maintained up to a degree sufficient to induce ready evaporation and prevent hardening of the resins.

66. The process of treating wood which comprises placing wood in a container, submerging said wood in water and by pressure sufficient to force the water into said wood to permeate its fibers and to dissolve and remove the water soluble constituents, withdrawing the water, and subjecting the wood to treatment to evaporate the moisture.

67. The process of treating wood comprising submerging wood in heated water under pressure, then subjecting the wood to the action of a vacuum, and subjecting the wood to heat at a temperature to induce evaporation of moisture of the wood and prevent hardening of the resins thereby causing the resins to permeate the individual fibers of the wood.

68. The process of treating wood, which comprises placing wood in a container submerging said wood in a fixed body of water and by pressure forcing the water into said wood to permeate the wood fibers and dilute the sap of the wood, withdrawing the water from the wood, and subjecting the wood to heat to evaporate the moisture in the wood, and cause the resins to permeate the fibers.

69. The herein described process of treating wood comprising the subsection of the wood to a vacuum to withdraw air from the wood, then subjecting the wood to heated water to dissolve its water soluble substances and open up its pores and expand the wood, removing the water, again subjecting the wood to a vacuum to evaporate moisture, from the wood, the wood being held in fixed position to prevent warping while being subjected to treatment, and subsequently drying the wood.

70. The process of treating wood, comprising boiling the wood to soften its structure, open up its pores and dissolve and remove water soluble constituents, and then subjecting the wood to heat and steam under pressure to evaporate moisture from the wood.

71. The process of treating wood comprising boiling the wood to soften its structure, open up its pores and dissolve and remove water soluble constituents, then subjecting the wood to a vacuum, thereafter treating the wood to steam under pressure, and then treating the wood to a vacuum to evaporate moisture.

72. The process of treating wood, comprising subjecting the wood to boiling water to soften its structure, open up its pores and dissolve and remove water soluble constituents, then subjecting the wood to a vacuum, and thereafter treating the wood to steam under pressure to evaporate the moisture.

73. The process of treating wood, comprising subjecting the wood to boiling water to soften its structure, open up its pores and dissolve and remove water soluble constituents and thereafter subjecting the wood to a vacuum and to heat to evaporate moisture from the wood and prevent hardening of the resins.

74. The process of treating wood comprising subjecting the wood to a vacuum to expel air therefrom, then subjecting the wood to boiling water to dissolve the water soluble constituents, then to a vacuum, thereafter subjecting the wood to steam under pressure, and then drying the wood at about atmospheric pressure while periodically removing accumulating moisture from the atmosphere surrounding the wood.

75. The process of treating wood comprising subjecting the wood to a vacuum to expel air therefrom, then subjecting the wood to boiling water to dissolve and remove water soluble constituents, then to a vacuum, then subjecting the wood to steam under pressure to evaporate the moisture.

76. The process of treating wood comprising treating the wood in boiling water, applying pressure to the boiling water to force the latter into the wood to dissolve and remove the major portion of water soluble constituents, arresting the treatment before removal of the preservative elements, and then applying heat to dry the wood.

77. The process of treating wood comprising subjecting the wood to boiling water to open the pores and dissolve and remove the major portion of the water soluble constituents, and then drying the wood at about atmospheric pressure while periodically removing accumulating moisture from the atmosphere surrounding the wood.

78. The process of treating wood comprising boiling the wood to open its pores and dissolve and remove the major portion of the water soluble constituents, and melt and diffuse the contained resins, thereafter drying the wood at a temperature to cause evaporation of moisture from the wood, prevent hardening of the resins and cause permeation of the fibers of the wood by its resins.

79. The process of treating wood comprising boiling the wood, to open its pores and dissolve the sap, thereafter subjecting the wood to steam under pressure, then to the action of a vacuum, and then drying the wood at a temperature to cause evaporation of moisture from the wood, prevent hardening of the resins and cause permeation of the fibers of the wood by its resins.

80. The process of treating wood comprising boiling the wood to open its pores and dissolve the sap, then subjecting the wood to a vacuum, then to steam under pressure, then to a vacuum, and thereafter

subjecting the wood to a temperature sufficient to evaporate moisture from the wood and permeate the fibers with its resins.

81. The process of drying wood comprising 5
ing subjecting the wood to heat sufficient to evaporate the moisture, and periodically removing the accumulating moisture from around the wood and intermittently passing a current of air over the wood to cause 10
uniform evaporation.

82. The process of treating and drying wood comprising heating the wood to cause evaporation of the moisture from the wood while preventing the removal of the moisture 15
around the wood a humid condition above saturation, then relieving the humidity and periodically passing a current of air around the wood, the internal temperature of the 20
wood being maintained at a temperature sufficient to vaporize the interior moisture of the wood.

83. The process of treating and drying wood comprising heating the wood to cause 25
evaporation of the moisture from the wood while preventing the removal of the moisture from the drying chamber to create around the wood, a humid condition above saturation, then relieving the humidity and 30
passing a current of air around the wood, the internal temperature of the wood being maintained at a temperature sufficient to vaporize the interior moisture of the wood.

84. The process of drying wood comprising 35
ing subjecting the wood to a temperature in a substantially fixed air until the humidity approaches saturation to a deposition of moisture on the surface of the wood, and then relieving the humidity to evaporate 40
such moisture, the interior of the wood being maintained at a temperature sufficient to vaporize the interior moisture.

85. The process of treating wood comprising 45
ing subjecting the wood to steam under pressure and to temperature for sufficient time to melt its resins, dilute its sap and raise the interior temperature of the wood, then to a vacuum to remove vapor therefrom, and then to heat and about atmospheric 50
pressure, while periodically subjecting the wood to a current of air.

86. The process of treating and drying wood comprising subjecting wood to steam while maintaining heat to raise the temperature throughout the wood and evaporate vapor therefrom, then to a vacuum to 55
cause moisture and sap to move toward the

surface of the wood and to remove moisture therefrom, and then subjecting the wood to heat at about atmospheric pressure sufficient to cause evaporation while periodically 60
removing accumulating moisture from the atmosphere surrounding the wood.

87. The process of drying and treating wood comprising forcing water into the wood to dissolve and remove the major portion 65
of the water soluble constituents, the water being heated to raise the interior temperature of the wood, arresting the treatment before deterioration of the wood occurs, and thereafter subjecting the wood to 70
heat to dry it without degrading it.

88. The process of treating wood comprising subjecting the wood to alternating vacuum and water treatment under pressure, said water being at a temperature 75
above the boiling point, and thereafter drying the wood.

89. The process of treating wood comprising subjecting the wood to steam under pressure, and to temperature for sufficient 80
time to melt its resins, dilute its sap and raise the interior temperature of the wood, then to a vacuum to remove vapor therefrom, and then to heat and about atmospheric pressure while subjecting the wood 85
to a current of air.

90. The process of treating wood comprising subjecting the wood to steam under pressure, and to temperature for sufficient 90
time to melt its resins, dilute its sap and raise the interior temperature of the wood, then to a vacuum to remove vapor therefrom, and then to heat and about atmospheric pressure while subjecting the wood 95
to a current of air to complete the drying.

91. The process of treating wood comprising subjecting the wood to steam under pressure and to temperature for sufficient 100
time to melt its resins, dilute its sap and raise the interior temperature of the wood, then to a vacuum to cause the moisture in the wood to move surface-wise.

92. The process of treating wood comprising subjecting the wood to a vacuum, thereafter treating the wood to steam under 105
pressure and to temperature for sufficient time to melt its resins dilute its sap and remove moisture, then to a vacuum to remove vapor therefrom, and then to a current of 110
air.

In testimony whereof I affix my signature.

FREDERICK K. FISH, JR.