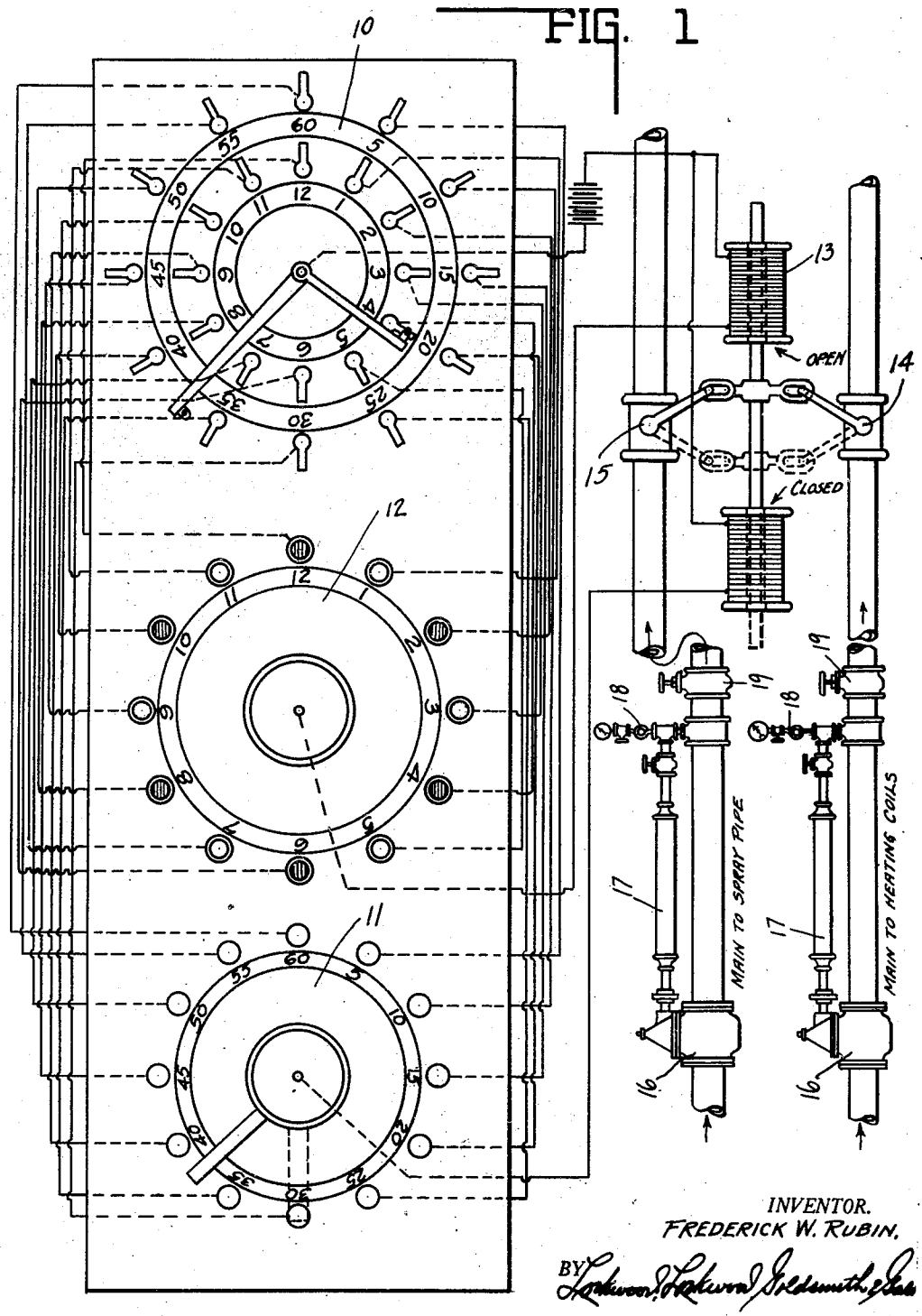
June 21, 1932. F. W. RUBIN 1,863,943

PROCESS AND APPARATUS FOR DRYING LUMBER

Filed Dec. 7, 1928 2 Sheets-Sheet 1

FIG. 1



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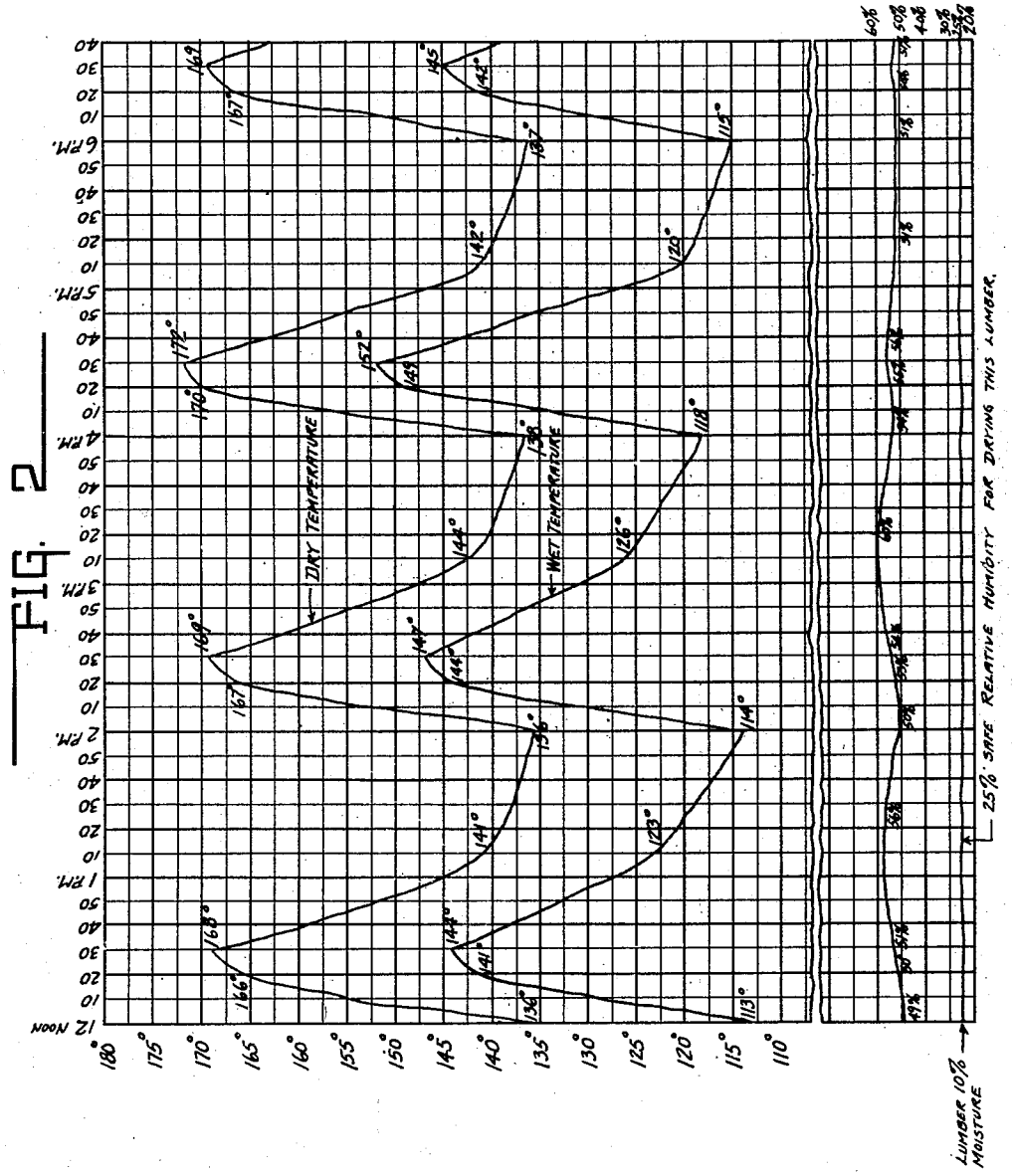
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FIG. 2



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UNITED STATES PATENT OFFICE

FREDERICK W. RUBIN, OF INDIANAPOLIS, INDIANA, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE UTILITY MANUFACTURING AND SALES COMPANY, OF INDIANAPOLIS, INDIANA

PROCESS AND APPARATUS FOR DRYING LUMBER

Application filed December 7, 1928. Serial No. 324,447.

This invention relates to a process of drying lumber in dry kilns and the like. Various processes and theories have been expounded with respect to the most satisfactory and quickest manner of drying lumber while still avoiding case hardening and checking. One method heretofore employed consisted in maintaining a substantially constant relative humidity and intermittently steaming the lumber by discharging steam therein when there appeared to be danger of the lumber checking during the drying operation. This intermittent steaming which occurred at intervals throughout the drying process had the effect of materially raising the relative humidity at these periods which was contrary to the fundamental principle involved in the process of maintaining the relative humidity substantially constant. It was also the practice to endeavor to maintain a substantially constant relative humidity, and gradually decreasing the same with the decrease of moisture in the lumber, but maintaining a substantially constant dry and wet bulb temperature, which practice was not entirely satisfactory for rapid drying.

It is the object of this invention to improve upon the art of drying lumber wherein the practice of intermittent steaming or the alternate raising and lowering of the relative humidity between wide limits is eliminated, as well as the practice of maintaining a substantially constant relative humidity by substantially constant wet and dry bulb temperatures.

This invention contemplates, on the other hand, maintaining for each cycle a substantially constant or unvarying relative humidity by the alternate and simultaneous raising and lowering of the dry and wet bulb temperatures in corresponding relation. While the corresponding raising and lowering thereof maintains a substantially constant relative humidity, and excepting for kiln and lumber conditions, would theoretically maintain an absolute constant relative humidity, the lumber is subjected to rapid variations in both dry heat and steam application which acts to highly heat the lumber while safe-guarding the surface against checking, and then rapidly reducing the heat of the air surrounding the surface of the lumber. Thus, the interior of the lumber is highly heated by the abnormally high temperatures periodically reached, whereupon the moisture contained interiorly is caused to expand and is forced out to the surface of the lumber, due to the softened condition of the surface maintained by the corresponding periodic applications of steam.

The invention will be more clearly understood from the drawings and the following description and claims:

Fig. 1 is a diagrammatic illustration of one means of controlling the wet and dry bulb temperatures. Fig. 2 is an illustrative chart showing the corresponding periodic rise and fall of the dry and wet bulb temperatures, with the corresponding substantially constant relative humidity resulting therefrom.

The invention consists in the process or method of drying lumber by periodically and simultaneously turning on and off both the dry and wet steam. Thus, as illustrated in the accompanying chart, Fig. 2, the dry and wet steam is turned on for thirty minutes, thus simultaneously raising the dry temperature with the wet temperature. Thereupon, both the dry and wet steam are simultaneously turned off and remain turned off for 1½ hours, permitting at first a rapid reduction in both wet and dry temperature and then a more gradual reduction, owing to the elimination of heat and moisture from the lumber. Thereupon, the wet and dry steam is again turned on and the cycle is repeated.

The object of the operation is to maintain a substantially constant relative humidity for each cycle by reason of the substantially constant relation between the wet and dry bulb temperatures. However, it is to be understood that it is immaterial to the process or to the drying of the lumber that the relative humidity be constantly maintained at any particular percentage so long as it is maintained sufficiently high to avoid any danger of checking or case hardening in the drying of the lumber. As is well known, the actual constant relative humidity maintained will gradually decrease through the drying operation

and vary in various parts of the kiln depending largely upon the construction of the kiln, the dampers and ventilation thereof, the character of the lumber being dried and the moisture content thereof.

While a clock mechanism or timing device is herein illustrated as controlling the operation, whereby the wet and dry steam is turned on during a definite period and turned off during a definite period, the drying process may also be accomplished by employing a wet and dry bulb controlled mechanism such as disclosed in my Letters Patent No. 1,662,283, issued March 13, 1928. Thus, an electric contact for the wet bulb may be set to turn on both the wet and dry steam when the temperature reaches a minimum and turn them off when a maximum temperature is reached, or the dry bulb control may be similarly set to turn on and off both the dry and wet steam when the temperature reaches a minimum or maximum, respectively. In other words, the operation may be conducted by either a clock controlled apparatus, or by an electrically or mechanically wet and dry bulb temperature controlled apparatus.

The apparatus disclosed herein embodies one form of control as illustrated in Fig. 1, wherein there is provided a time switch 10 in the form of a clock having a plurality of minute and hour contact points, the minute contact points being connected individually with the minute contact switch 11 and the hour contacts with the contact switch 12. The contact switches 11 and 12 through manual control thereof or adjustment will close a circuit through the solenoids 13 upon the contact of the clock hands with the corresponding contacts in the time switch 10. The switch 12 is connected with the opening solenoid 13 and the switch 11 with the closing solenoid 13, said solenoids being connected with the wet and dry steam valves 14 and 15 for opening or closing the same. Thus when suitably adjusted by manually setting the contact switches 11 and 12, when the hour hand reaches the contacts 2, 4, 6, 8, 10 or 12, for purposes of illustration, the open solenoid will be actuated to open the steam valves and allow both wet and dry steam as a decasing and drying medium, respectively, to be simultaneously discharged into the kiln. When the minute hand reaches 30, or thirty minutes later, the switch 11 being set accordingly, the closing solenoid, will be energized for closing the valves and simultaneously shutting off both the wet and dry steam, thereby permitting the high temperature of the kiln to rapidly dry the lumber while the lumber is fully protected by the simultaneous bath of wet steam, the relative humidity, however, remaining substantially constant.

During this period of 1½ hours, the cooling process takes place by the drop in both dry and wet bulb temperatures, and simultaneously therewith the moisture of the lumber is carried away from the surface thereof which effects a cooling action by reason of the relatively rapid evaporation. The heat which has permeated to the center of the lumber during the high temperature period expands the moisture in the center and drives it to the surface where it will be ultimately evaporated therefrom. Thus, by the rapid drop in temperature and moisture causing the evaporation and cooling of the surface of the lumber throughout repeated cycles, the interior moisture of the lumber is caused to flow outwardly therefrom. It will be noted that the periodic baths of steam, however, eliminate any danger of surface checking or case hardening so as to maintain the surface of the lumber always open to permit the expulsion of moisture from the interior.

Obviously, the durations of time of the respective cycles are dependent upon not only the character and construction of the kiln and the dampers used, but the character and dimensions of the lumber being dried. The quantity and pressure of the steam is also a determining factor. Wherein the control is obtained through the medium of wet and dry bulbs placed within the kiln, the high and low limits of the wet and dry bulb thermometer temperatures must be determined by the above conditions.

As illustrated in Fig. 2, there is shown a rapid rise in wet and dry bulb temperature during the first twenty minute period. During the following ten minute period the rise is less rapid, owing to the absorption of the heat and moisture by the lumber. At the end of thirty minutes, when the valves are closed there is a rapid decline in both temperatures for thirty-five minutes, the decline being less rapid during the next twenty-five minutes, owing to the fact that moisture and temperature is being given off by the lumber. As this chart was derived from an actual application of the process, it will be noted that while the rise and fall of the dry and wet bulb temperatures are substantially the same, there will be slight variations owing to internal conditions of the kiln including drafts and lumber conditions. As shown at the bottom of the chart, the relative humidity has been calculated for the purpose of illustrating the fact that it remains substantially constant for the cycles shown and has no direct bearing one way or the other upon the process. This results in an irregular wavy line, due to the above variations created by conditions of the lumber and the interior atmospheric conditions of the kiln.

The term "wet steam" as used herein indicates the steam spray, wherein the steam is sprayed directly into the interior of the kiln carrying the moisture therewith, and, therefore, will affect the wet bulb temperature. The term "dry steam" means the dry heat

produced by the steam passing through heating coils.

Both of the mains leading to the steam spray for delivering wet steam, and into the heating coils for delivering dry steam, are provided with a pressure regulating valve 16 of the usual character connected by a pilot line 17 with the pressure gauge 18. Hand valves 19 are also positioned in the mains for manual control. By means of this arrangement, the steam pressure in both mains may be maintained substantially equal or constant so as to properly control the operation.

As will be understood in the art, while the relative humidity will be maintained substantially constant throughout a cycle of the operation, there will necessarily be a gradual decrease in the general trend of the relative humidity from the beginning of the drying process to the end thereof, but said gradual decrease will be substantially unvarying.

It may be noted that the underlying principle involved in the above described process results in forcing the moisture from the interior of the lumber toward the surface thereof by what may be termed a differential pressure created by the difference of temperature between the interior of the lumber and the surface during that portion of the cycle wherein the temperature is rapidly decreased with the corresponding decreasing in wet temperature, and while the relative humidity remains substantially constant. This is caused by the temperature of the surface decreasing more rapidly than the interior of the lumber, finally arriving at an equilibrium of temperature between the interior and the surface at the end of the cycle when the wet and dry temperatures are again rapidly raised.

It may further be noted that the moisture absorbing power of the surrounding air is at its maximum when the wet and dry bulb temperatures are at their highest (the relative humidity remaining substantially constant), the drying power of the air having no ill effect at this period because of the high degree of wet temperature. The drying power of the air then falls rapidly so as to discontinue the rapid drying of the surface of the lumber and thereby avoiding case hardening during the time the differential pressure within the lumber is acting to force the moisture outwardly from the core. Thus an equilibrium is established between the interior and exterior of the lumber with no ill effects to the latter, before the next cycle of rapid surface drying is started.

The invention claimed is:

1. The process of rapidly drying lumber or the like consisting in subjecting the same to a series of cycles of treatment, each cycle consisting of subjecting the lumber to a simultaneous and corresponding rise in dry and wet bulb temperature followed by a simultaneous and corresponding decrease in the dry and wet bulb temperatures, the relative increase and decrease of said dry and wet bulb temperatures for each cycle being substantially the same.

2. The process of rapidly drying lumber or the like consisting in maintaining a substantially constant relative humidity by intermittently and simultaneously raising and lowering the wet and dry bulb temperatures, the relative increase and decrease of said dry and wet bulb temperatures for each cycle of treatment being substantially the same, thereby maintaining a substantially constant differential therebetween.

3. The process of rapidly drying lumber or the like consisting in exposing the lumber to the air in a kiln, and simultaneously, repeatedly and alternately, raising and lowering the dry and wet bulb temperature within said kiln between wide limits, the relative raising and lowering of the wet and dry bulb temperatures for each cycle of treatment being substantially the same to maintain a substantially constant relative humidity.

4. The process of rapidly drying lumber or the like consisting in exposing the lumber to the air in a kiln, periodically and repeatedly raising the dry bulb temperature and immediately lowering the same, and simultaneously raising and lowering the wet bulb temperature therewith, the relative increase and decrease of said dry and wet bulb temperatures for each cycle of treatment being substantially the same, to thereby maintain a substantially constant relative humidity.

5. The process of rapidly drying lumber or the like consisting in exposing the lumber to the air in a kiln and subjecting the same to a number of successive cycles of treatment, each cycle consisting of simultaneously, correspondingly and immediately raising and lowering the dry and wet bulb temperature within said kiln, the relative increase and decrease of said dry and wet bulb temperatures of each cycle being substantially the same, to maintain a substantially constant relative humidity.

6. The process of rapidly drying lumber or the like consisting in exposing the lumber to the air in a kiln, and subjecting the same to a number of successive cycles of treatment, each cycle consisting of successively increasing and diminishing the wet and dry bulb temperatures in said kiln, the relative increase and decrease in said temperatures of each cycle remaining approximately the same, whereby to produce a substantially constant relative humidity in said kiln.

In witness whereof, I have hereunto affixed my signature.

FREDERICK W. RUBIN.