

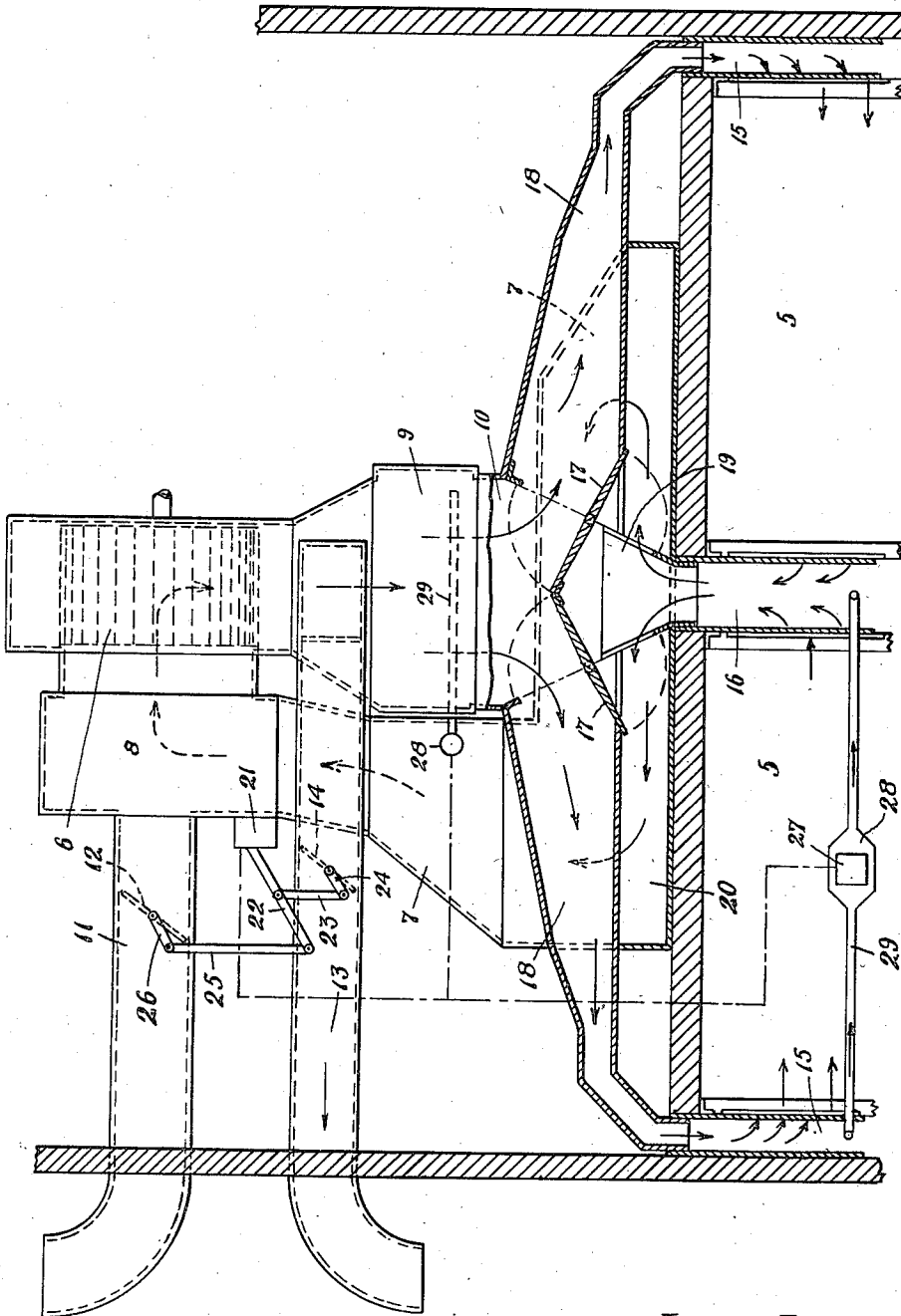
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THERMOSTATIC CONTROL FOR DRY KILNS

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THERMOSTATIC CONTROL FOR DRY KILNS

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This invention relates to the thermostatic control of the drying air in reversible flow dry kilns and has as its object the maintaining of the desired temperatures and humidities in the drying air for the most effective drying of the material under treatment.

In dry kilns for the drying of lumber, for example, it is customary for preventing warping and checking and case hardening, etc., during the drying, to dry the lumber in a number of different runs using drying air in the first run having a relatively high relative humidity and relatively low temperature, and decreasing the relative humidity of and increasing the temperature of, the drying air in the following runs as experience has shown to be desirable.

It has also been customary through the use of reversible fans or reversible flow dampers to periodically reverse the flow of the air through the kilns so that the lumber formerly in the leaving air stream is in the entering air stream, etc.

It has been difficult however, to maintain the proper relative humidities in the drying air because the lumber itself gives off moisture during the drying process and the prior controls have not taken this into account particularly in the case of reversible flow kilns.

This invention provides for maintaining the correct humidities in the drying air by having a control instrument such as a wet bulb thermostat so located and arranged in a reversible flow dry kiln that it responds always to the condition of the air entering the lumber regardless of the direction of air flow. Such a thermostat may actuate simultaneously, dampers in the fresh air inlet and in the exhaust air outlet, to admit an increased volume of fresh air and to exhaust an increased volume of moist air when the relative humidity rises above the desired level, and to admit a decreased volume of fresh air and to exhaust a decreased volume of moist air when the relative humidity falls below the desired control point.

After the wet bulb control point has been changed to a higher temperature or if due to some unusual condition or emergency such as the kiln doors being opened, the wet bulb temperature drops, then the control will function to first close both dampers after which steam will be admitted automatically through a steam jet, to quickly restore the relative humidity to the control point. Under normal operating conditions the dampers alone will maintain the wet bulb control point by the use of a modulating damper control motor which will confine varia-

tions from the control point to a very limited degree.

A feature of the invention resides in the provision of a control instrument which can be set for any desired wet bulb temperature and which acts to adjust the above mentioned dampers to positions conforming to the departure of the drying air entering the lumber, from the desired wet bulb temperature, so that the dampers are opened proportionately to the rise in wet bulb temperature thus quickly restoring the desired condition.

Another feature of this invention resides in the method of progressively lowering the relative humidity of the drying air entering the lumber, on a predetermined schedule as the drying progresses, and maintaining the wet bulb temperature on the schedule by varying the volume of fresh air into and exhaust air from, the dryer.

The invention will now be described with reference to the drawing which is a view partially in horizontal section of a portion of a reversible flow dry kiln embodying this invention.

The lumber to be dried is stacked as usual in the interior 5 of the kiln. The centrifugal fan 6 connects through the fan inlet chamber 8 with passage 7 and the outlet of the fan connects through the usual heating and humidifying chamber 9, with the outlet chamber 10.

The axial, fresh air inlet 11 of the fan contains the damper 12 for controlling the volume of fresh make-up air drawn into the kiln. The exhaust, moist air outlet 13 is for discharging a portion of the moist air recirculated through the fan, and contains the damper 14 for controlling the volume of exhaust air.

The perforated outside ducts 15 and the inside perforated duct serve to supply air from the fan into the interior 5 of the dryer or to draw air therefrom depending upon the position of the dampers 17. In the position indicated by the drawing the dampers 17 are placed for causing the outside ducts 15 to act as supply ducts, and the inside duct 16 to act as an exhaust duct.

The dampers 17 connect the fan inlet passage 7 with the passage 19 leading to the inner duct 16 or with the passage 18 leading to the outside ducts 15 and connects the outlet chamber 10 with the passages 18 to the ducts 15 or with the passage 19 to the duct 16. In the drawing the heavy lines illustrate the dampers 17 positioned to open the passages 19 and 20 from the duct 16 to the inlet passage 7 with and to close the passages connecting the duct 16 with the fan outlet

chamber 10 so that the air is supplied through the ducts 15 and is withdrawn for recirculation through the duct 16.

With the dampers 17 adjusted through angles of 90° to the positions shown by the dash-dot lines of the drawing, the outlet chamber 10 would be connected through the passage 19 to the duct 16, and the ducts 15 would be connected through the passages 18 and 20 with the fan inlet passage 7 so that the outside ducts would act as recirculation ducts and the duct 16 would act as supply duct.

The dampers are periodically changed so that the air is withdrawn from those portions of the lumber formerly in the entering air and is supplied to the opposite portions from which formerly the air was withdrawn so that all portions of the lumber are exposed to the same conditions for preventing portions drying more quickly or thoroughly than other portions.

The dampers 12 and 14 are simultaneously adjusted by the motor 21 through the linkage elements 22, 23, 24, 25 and 26 so that the dampers are simultaneously moved throughout their entire ranges of from fully open to fully closed positions. The motor 21 may be of any well known air or electric type and is actuated by the wet bulb thermostat 27 in the kiln chamber 5.

The thermostat 27 is placed in an enlargement 28 in the relatively small duct 29. The duct 29 opens at one end into the inside duct 16 and at the other end into one of the outside ducts 15. With this arrangement regardless of the direction of flow of the drying air, the control thermostat is exposed to the drying air entering the lumber. The arrows on the drawing illustrate the air flow from the outside ducts 15 acting as supply ducts, through the kiln and out the inside duct 16 acting as the recirculation duct. The air contacting the thermostat 27 has the condition of that supplied through the outside ducts 15.

When the dampers are adjusted for reverse flow the supply air will flow through the inside duct 16 and the outside ducts 15 will act as recirculated air ducts. When this happens, a portion of the air from the duct 16 will pass in contact with the thermostat 27. So regardless of the direction of air flow the thermostat responds to the condition of the drying air entering the material to be dried.

The thermostat 27 is set for the desired control wet bulb temperature and adjusts the dampers 12 and 14 automatically to maintain that temperature. The following schedule may be followed in the drying, for example, of certain hardwood lumber.

Moisture content	Dry bulb	Wet bulb	Rel. humidity
	°F.	°F.	Per cent
Initial.....	110	105	85
40%.....	115	109	80
30%.....	120	111	75
25%.....	125	112	65
20%.....	130	112	55
15%.....	135	111	45
10%.....	140	108	35

If the wet bulb temperature during a run increases above the desired temperature, the thermostat 27 adjusts the dampers 12 and 14 towards open position until the wet bulb temperature is reduced to the desired point, the degree of movement of the dampers being proportional to the degree of departure of the wet bulb tem-

perture from the desired point. Likewise if the wet bulb temperature falls below the desired point, the dampers 12 and 14 are adjusted towards closed position.

By way of example, if the wet bulb temperature falls, say 2° below the control temperature, the thermostat 27 acts to cause the motor 21 completely to close the dampers.

When the thermostat acts completely to close the dampers it also adjusts the valve 28 in the supply to the steam humidifier for increasing the humidity of the air in the dry kiln. Upon rises in wet bulb temperature the reverse action takes place.

The thermostat 27 and the motor 21 preferably are sensitive enough that the dampers may be fully closed and the humidifier rendered effective at temperature drops of as low as ½°. The variation between ½° and 2° will allow the operator to vary the sensitivity depending upon the kind and thickness of the lumber being dried.

Since the control thermostat responds to the condition of the air entering the lumber regardless of where it enters same, the supply air first entering the lumber is at the correct temperature and relative humidity for proper drying. Prior controls resulted in too high temperatures and too low relative humidities in the air entering the lumber.

The control system of this invention has been found particularly effective in the drying of thick hard woods which are green from the saw or are comparatively green from the saw.

The dry bulb temperatures of the above schedule are maintained by the usual dry bulb thermostat which also may be placed in the duct 29 and by associated apparatus which are not illustrated.

As illustrated the fresh air inlet duct 11 is larger than the exhaust duct 13 so that throughout the entire range of adjustments of the dampers, a substantial static pressure is maintained in the kiln assuring a positive discharge pressure in the exhaust duct 13.

While one embodiment of the invention has been disclosed for the purpose of illustration, it should be understood that the invention is not limited to the exact apparatus and arrangement of apparatus illustrated, as modifications thereof may be suggested by those skilled in the art, without departure from the essence of the invention.

What is claimed is:

1. A dry kiln comprising a drying chamber, ducts connecting opposite sides of said chamber, one for supplying drying air into, and the other for withdrawing drying air from, said chamber, means for reversing the flow of air through said ducts, means for changing the condition of the air supplied into said chamber, means responsive to said condition of the drying air for adjusting said last mentioned means, and a sampling duct interconnecting said ducts and by-passing said chamber and enclosing said responsive means for supplying samples of the air entering said chamber in contact with said responsive means.

2. A dry kiln comprising a drying chamber, ducts connecting opposite sides of said chamber, one for supplying drying air into, and the other for withdrawing drying air from, said chamber, means for reversing the flow of air through said ducts, means for changing the humidity of the air supplied into said chamber, means responsive to the humidity of the drying air for adjusting said last mentioned means, and a sampling duct

interconnecting said ducts and by-passing said chamber and enclosing said responsive means for supplying samples of the air entering said chamber in contact with said responsive means.

3. A dry kiln comprising a drying chamber, ducts connecting opposite sides of said chamber, one for supplying drying air into, and the other for withdrawing drying air from, said chamber, means for reversing the flow of air through said ducts, means for changing the humidity of the air supplied into said chamber, a wet bulb thermostat for adjusting said last mentioned means, and a sampling duct interconnecting said ducts and by-passing said chamber and enclosing said thermostat for supplying samples of the air entering said chamber in contact with said thermostat.

4. A dry kiln comprising a drying chamber, ducts connecting opposite sides of said chamber, one for supplying drying air into, and the other for withdrawing drying air from, said chamber, means for reversing the flow of air through said ducts, means including fresh and exhaust air passages and dampers in said passages for changing the humidity of the air supplied into said chamber, means responsive to the humidity of the drying air for adjusting said dampers for increasing the volume of fresh air and decreasing the volume of exhaust air upon a rise in humidity, and a sampling duct interconnecting said ducts and by-passing said chamber and enclosing said responsive means for supplying samples of the air entering said chamber in contact with said responsive means.

5. In a dry kiln having a fan, a drying chamber, oppositely placed recirculated air passages connected to said fan and chamber for recirculating drying air therethrough, a fresh air duct connected to the fan inlet, an exhaust air duct connected at the fan outlet, dampers in said ducts, and means for reversing the flow of drying air through said passages, the combination of a sampling duct interconnecting said passages, and means including means in said sampling duct responsive to changes in the humidity of the air passing therethrough for adjusting said dampers for increasing the volume of exhaust air and for decreasing the volume of fresh air upon a decrease in the relative humidity of the air sample.

6. In a dry kiln having a fan, a drying chamber, oppositely placed recirculated air passages connected to said fan and chamber for recirculating drying air therethrough, a fresh air duct connected to the fan inlet, an exhaust air duct connected at the fan outlet, dampers in said ducts, and means for reversing the flow of drying air through said passages, the combination of a sampling duct interconnecting said passages, and means including a wet bulb thermostat in said sampling duct for adjusting said dampers for increasing the volume of exhaust air and for increasing the volume of outdoor air upon an increase in the wet bulb temperature of the air sample.

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