VENTILATOR CONTROL FOR LUMBER KILNS

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This invention relates to the automatic control of temperature and humidity in drying kilns and the like, and, in particular, to kilns in which lumber is dried.

More specifically, the present invention relates to the control of the ventilators through which excessively warm and humid air is periodically allowed to exhaust from the drying kilns.

It is customary in large lumber drying kilns, which are provided with heating means and with automatic control for maintaining heat and humidity within prescribed limits, to have a series of ventilator openings along the top of the kiln which are closed by hinged covers or the like, and have an automatic temperature and humidity control for opening the ventilator covers whenever the temperature and humidity in the kiln reach prescribed limits.

The opening of the ventilator covers allows the hot, moist air in the kiln to be discharged quickly, causing temperature and humidity in the kiln to drop to a prescribed minimum, whereupon the ventilators are automatically allowed to close again and to remain closed until the rise in temperature inside the kiln again results in the opening of the ventilator covers.

Thermometers for the ventilators on a kiln are customarily connected so that they open and close in unison over the entire length of the kiln. In the usual large lumber kilns there will be a number of such ventilators spaced equal distances apart along the top of the kiln, and, as an average, the size of such ventilators would probably be about 21 inches square. Such equipment is more or less standard for lumber kilns.

A difficulty with this standard equipment and arrangement of ventilators, with the usual automatic means for opening and closing the ventilator covers, is that the ventilator covers always open to the full extent, or to the same extent, whenever the temperature and humidity reach the prescribed maximum. The result of the opening of the ventilator covers to the full extent is to cause the temperature and humidity to drop quickly. While this is desirable in some cases it presents a problem in others because, with some kinds of lumber, it is not desirable to have the temperature and humidity drop as quickly as with other kinds of lumber. Some woods are more sensitive to sudden changes than others during the drying operation and some lumber has considerably more moisture than others.

While it is desirable, from an efficiency standpoint, to have the lumber drying take place as rapidly as possible consistent with the best end results, nevertheless too rapid drying of wood is undesirable and produces case hardening and checking in the wood. Consequently while the customary automatic venting of the lumber kiln from time to time, as followed heretofore, will be satisfactory for some lumber it has not then been entirely satisfactory for lumber which is more sensitive to sudden changes in temperature and humidity during the drying stage.

The object of the present invention is to provide additional and improved control means for the ventilators whereby the ventilator covers, instead of opening fully each time as heretofore, can also be caused to open only to a desired and predetermined limited extent when the temperature and humidity in the kiln reach the maximum for which the automatic control has been set. Such opening of the ventilator covers only part way then reduces the rate at which the hot, humid air will be discharged from the kiln and thus makes the resulting drop in temperature and humidity in the kiln more gradual.

A related object of the present invention is to provide an additional pre-set means in the ventilator control assembly so that the extent to which the ventilator covers will be opened can be definitely and quickly set in advance for each lumber drying operation of the kiln as may be desired for the particular lot of lumber which is to be processed.

A further object of the invention is to provide an adjustable ventilator control for the purpose indicated which will be simple and practical and which can be used in conjunction with the customary air motor means now extensively in use for operating ventilator covers on large lumber drying kilns.

The manner in which these objects and other advantages are attained with the present invention, and the construction and method of operation of this improved ventilator control will be briefly described and explained with reference to the accompanying drawings, in which:

FIG. 1 is a more or less diagrammatic layout of the entire control assembly comprising the present invention, interposed in the assembly shown in FIG. 1.

FIG. 2 is an enlarged elevation of the switch control box with the front cover removed, showing the interior of the switch control box and indicating the switch elements therein.

FIG. 3 is an enlarged plan view of the supplemental switch box with the top cover removed, this view being taken on the line 3--3 of FIG. 1.

FIG. 4 is a partial wiring diagram.

FIG. 5 is a diagrammatic layout, similar in part to FIG. 1, but indicating how the single control can be used for a plurality of sets of ventilators on a large kiln requiring more than one motor for their operation.

Referring first to FIG. 1, a portion of the top of a lumber kiln is indicated at 10, and two of a series of ventilator outlets on the kiln are indicated at 11, the ventilator outlets being equipped with hinged covers 12. Arms 13 are rigidly attached to the hinged covers 12 and are interconnected by pivotal connections with a member 14 so that the covers will open and close in unison.

An air motor or diaphragm chamber is indicated at 15. The delivery of air under pressure into the diaphragm chamber 15 moves a diaphragm which operates a lever 16, this lever 16 being pivotally mounted on one of the rigid supports at 16'. The lever 16 in turn is connected by a link 17 to a master lever arm 18 (furnished at 18'). The lever arm 18 is adjustably connected by suitable means, such as the cable 19, with the member 14 and the arms 13 for the covers 12. Thus the delivery of compressed air into the air motor or diaphragm chamber 15 causes movement of the lever arm 18 in counterclockwise direction, as viewed in FIG. 1, and results in the opening of the ventilator covers 12. When the air pressure is released the ventilator covers swing back to closed position under their own weight.

Compressed air from a suitable source (not shown) is delivered through a pipe 20 to a pipe 21 through the intermediary of a standard temperature and humidity control device, indicated in general at 22. This temperature and humidity control device is well known and of standard construction and is not described in detail since no claim of patentable novelty is made for this device per se. In brief it contains a master control valve which opens whenever the temperature and humidity in the kiln rise above a predetermined maximum and the valve closes whenever the temperature and humidity have been reduced to a predetermined minimum.

The pipe 21, instead of leading directly to the motor or diaphragm chamber 15, leads to a control box 23 in which the pipe 21 is connected through the intermediary
of certain control means with a pipe 21, which then leads to the air motor or diaphragm chamber 15.

In the control box 23 (FIGS. 1, 2 and 4), a solenoid-operated valve 25 is provided in a pipe 26 connecting pipe 21 with pipe 24. The solenoid-operated valve is normally held open by spring means, but actuation of the solenoid will close the valve against the force of the spring means.

Electric current for the operation of the solenoid is obtained from a suitable source of electric energy (not shown) through conductor wires 27. A manually-operable pre-setting switch device 28, of standard construction, is interposed in the circuit to the solenoid. This pre-setting switch device includes a rotatable contact arm 29, operated manually by a hand knob, and fixed contacts 29A, 29B and 29C. The fixed contacts 29A, 29B and 29C are connected to the solenoid through the medium of switches 30A, 30B and 30C (FIG. 3) respectively which are located in an additional special switch box 31 and connected with the control box 23 by conductor wires 32. A plunger rod 32, which is pivotally connected with the lever arm 18, is slidable mounted in the switch box 31 and carries an engaging element 32A which is adapted to engage the spring contact elements for the switches 30A, 30B and 30C. Thus, as apparent from FIGS. 1 and 3, the movement of the rod 32 to the left will cause the switch 30A to be opened and 30B and 30C to be contacted in succession depending upon the extent to which the rod 32 moves.

The operation is as follows: Let it be assumed that it is desired to have the ventilator covers opened only a slight distance, instead of being opened to the full extent, for example, to keep or the room in which the assembly is installed at the prescribed maximum and thus the master control 22 will allow compressed air to pass into the pipe 21. The pre-setting switch 28 will be set so that the contact arm 29 contacts the first contact 29A (which is connected with the solenoid for the solenoid-operated valve 25 through the switch 30A). Compressed air passes from the pipe 21 into a connecting pipe 26 and through the open solenoid valve 25 in pipe 26, then into pipe 24 and into the diaphragm chamber 15. This results in movement of the lever arm 18 (counterclockwise as viewed in FIG. 1) and the ventilator covers 12 consequently begin to open. Movement of the lever arm 18 however causes movement of the rod 32 until the engaging element 32A engages the spring contact for the first switch 30A. Since this closes the switch 30A and consequently completes the circuit to the solenoid for the solenoid valve 25 through the elements 29A, 29B and 30A, the solenoid valve 25 will close and will prevent further compressed air being delivered into the diaphragm chamber 15. Then the ventilator covers will remain in this partly open position until the lowering of the temperature and humidity in the kiln will cause the master control 22 to shut off the supply of air to the pipe 21 and allow the air in pipe 21 to exhaust. When this happens air from the diaphragm chamber 15 and the pipe 24 will escape through a by-pass 34 (FIG. 2) and through a check valve 35 into pipe 21 to the exhaust provided in the master control 22.

Similarly, if the pre-set switch 28 is set so that the arm 29 contacts the fixed contact 29B, the ventilator covers, when compressed air is allowed to pass into pipe 21, will then open until the rod 32 causes the closing of the corresponding second switch 30B, whereupon further opening of the ventilator covers will cease. When the arm 29 of the pre-set switch device 28 is so set that it does not contact any of the fixed contacts 29A, 29B or 29C, the solenoid will then be inactive and the solenoid valve will be held open by its spring means and consequently the ventilator covers will then be free to be opened to the usual full extent.

In order to regulate also the speed with which the ventilator covers will open when the master temperature and humidity control 22 allows the compressed air to pass into pipe 21, a speed control or restricting valve 36 (FIG. 2) is placed in the connecting pipe 26. By means of this valve the rate at which the compressed air will be delivered into the diaphragm chamber 15 will be controlled. However, this speed regulator does not of course control the pressure nor does it in any way affect the pre-setting of the extent to which the ventilator covers will be permitted to open.

Thus far the limit control for the opening of the ventilator outlets has been described in conjunction with a single air motor or diaphragm chamber used for operating a single series of ventilator outlets. It is also possible, with slight modification, to provide a number of ventilator motors (not more than one motor and series of ventilators. Thus FIG. 5 indicates how the limit control can be used with two air motors or diaphragm chambers on two separate lines of ventilators to control both lines of ventilators at the same time. In this modification the pipe 21, leading from the master temperature and humidity control 22, connects with two branch pipes 37 and 38 which lead to the diaphragm chambers 39 and 40 respectively. Separate solenoid-operated valves, indicated at 41 and 42 in FIG. 5, are interposed in the branch pipe lines 37 and 38 respectively, and shut-off valves 47 and 48 allow each branch pipe line to be shut-off independently. The fixed contacts 29A, 29B and 29C, shown in FIG. 2, for the pre-setting switch device 28 are connected with respective switches (corresponding to switches 30A, 30B and 30C of FIG. 3) in each of the switch boxes 43 and 44, and these switches in the switch boxes 43 and 44 are connected to the solenoids 41 and 42 respectively. The switches in the switch boxes 43 and 44 are so arranged and operated in the same manner, by slide rods connected with the lever arms 45 and 46 respectively, as previously described with reference to the switches in the switch box 31 of FIG. 3. Thus, in this modification, the setting of the pre-set switch 28 so that the arm 29 (FIG. 2) engages the fixed contact 29A, since this fixed contact would be connected with a corresponding switch in each of the switch boxes 43 and 44, would result in the solenoid 41 being activated when the slide rod in switch box 43 engaged the corresponding switch, and the solenoid 42 being activated when the slide rod in switch box 44 engaged the corresponding switch.

I claim:

1. In a lumber kiln assembly having ventilator outlets provided with hinged shutters and a compressed air supply line for use in operating the shutters, with a temperature and humidity sensing and controlling device, and a diaphragm chamber and a compressed air supply line enabling air to be delivered through or exhausted through the master control, the improved controllable means for operating the shutters comprising means connecting the shutters for movement in unison, a lever arm connected with and operating said latter mentioned means, an air motor for operating said lever arm, said air motor connected with the air supply line beyond the master control, a normally open solenoid-operated shut-off valve in the compressed air supply line between the master control and said motor so arranged as to prevent any passage of compressed air to said motor when the solenoid is activated, a first switch assembly in the circuit to said solenoid, said first switch assembly including a plurality of stationary contacts and a manually operable switch member for selectively contacting any one of said stationary contacts, a second switch assembly in said solenoid circuit including a plurality of stationary contacts connected with the stationary contacts of said first switch assembly respectively, a movable contact bar in said second switch assembly adapted to contact said stationary contacts in said second switch assembly successively upon movement of said bar in one direction, said bar being connected with said motor, said movable contact bar being moved in said direction by said lever arm whenever said lever arm is operated to open said shutters, whereby the setting of said manually operable switch member into con-
tact with any one of said stationary contacts in said first switch assembly will determine the extent to which said shutters can be opened when compressed air is allowed to pass to said motor, a by-pass air line around said solenoid-operated valve, and a check valve in said by-pass line permitting air to pass in reverse direction to exhaust through the master control from said air motor when the air supply to said motor is discontinued by the master control.

2. In a lumber kiln assembly having a plurality of series of ventilator outlets provided with hinged shutters and a main compressed air supply line for use in operating the shutters, with a temperature and humidity sensing master control in the main compressed air supply line enabling air to be delivered through or exhausted through the master control, the improved controllable means for selectively operating the shutters for each series of ventilator outlets comprising means connecting the shutters of each series of outlets for movement in unison, a lever arm connected with and operating each of said latter mentioned means, an air motor for operating each lever arm, a branch compressed air line leading to each motor and connected with the main compressed air line between each motor and the master control, a normally open solenoid-operated shut-off valve in each branch compressed air line arranged to prevent any passage of compressed air to the respective motor when the solenoid is activated, a first switch assembly in the circuits to said solenoids, said first switch assembly including a plurality of stationary contacts and a manually operable switch member for selectively contacting any one of said stationary contacts, a second switch assembly in the circuit to each solenoid including a plurality of stationary contacts connected with the stationary contacts of said first switch assembly respectively, a movable contact bar in each second switch assembly adapted to contact the stationary contacts in such second switch assembly successively upon movement of the bar in one direction, each bar connected with the lever arm operated by the corresponding motor, whereby the extent to which each series of shutters can be opened when compressed air is allowed to pass to the corresponding motor will be determined by the setting of the manually operable switch member in said first switch assembly for the solenoids, a by-pass air line around each solenoid-operated valve, and a check valve in each by-pass line permitting air to pass in the reverse direction to exhaust through the master control from the air motors when the air supply is shut off by the master control.

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