

May 4, 1926.

J. B. WELCH

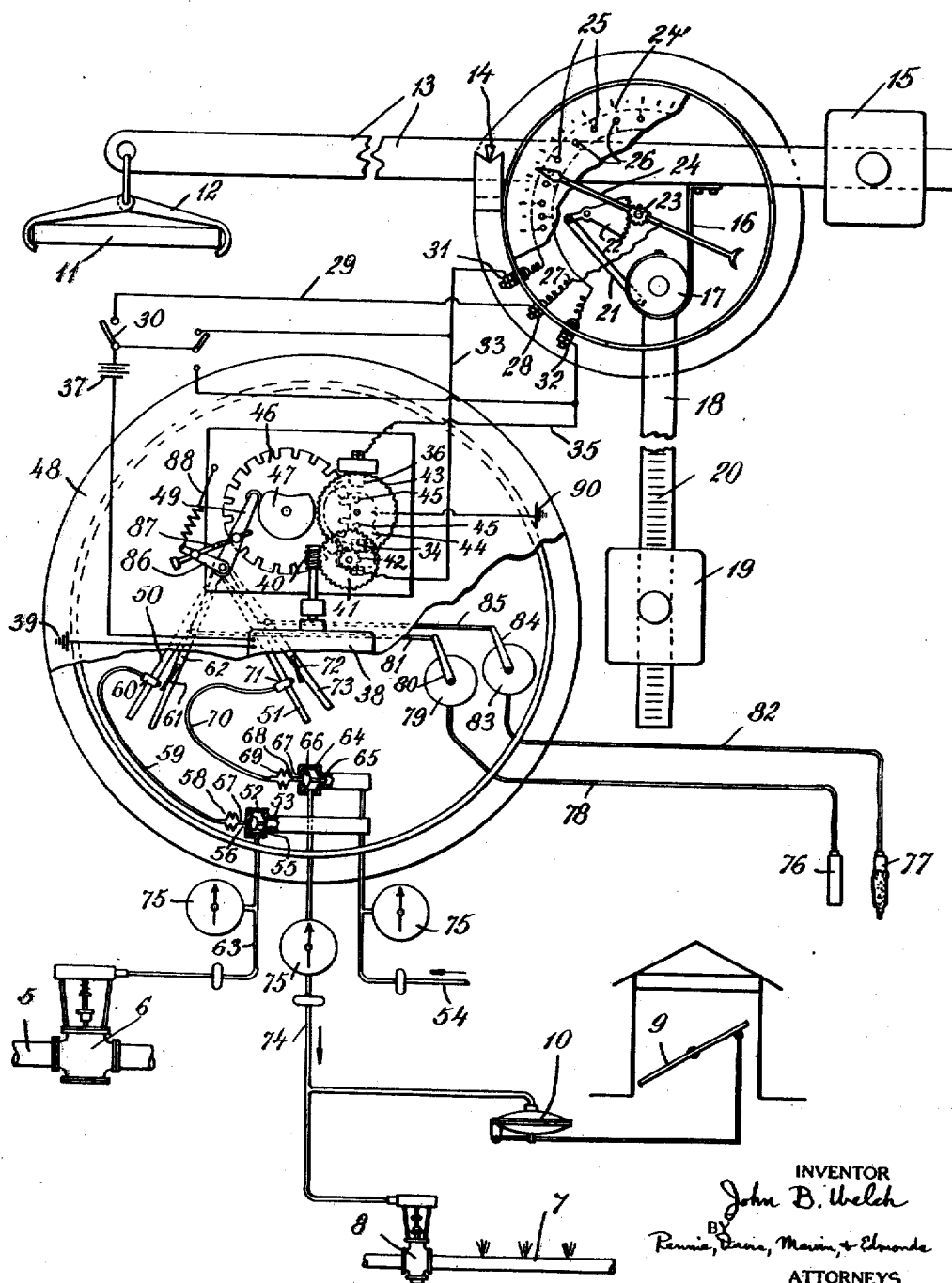
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APPARATUS FOR DRYING AND THE LIKE

Filed Dec. 5, 1924

2 Sheets-Sheet 1

Fig. 1,



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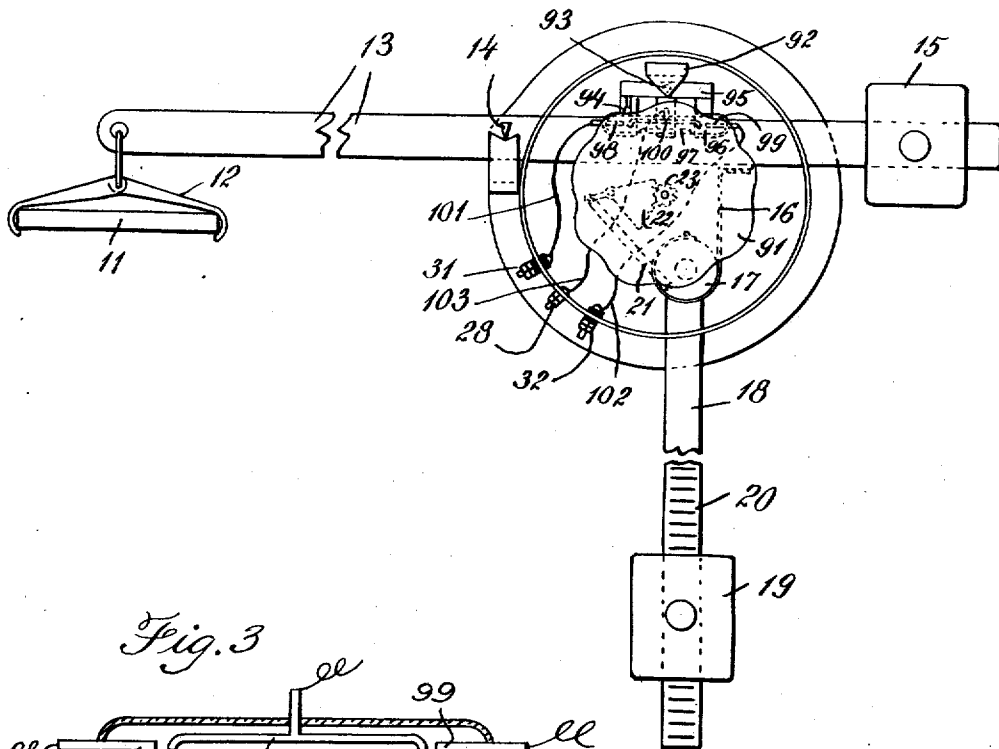
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APPARATUS FOR DRYING AND THE LIKE

Filed Dec. 5, 1924

2 Sheets-Sheet 2

Fig. 2,



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APPARATUS FOR DRYING AND THE LIKE.

Application filed December 5, 1924. Serial No. 754,031.

To all whom it may concern:

Be it known that I, JOHN B. WELCH, a citizen of the United States, residing at New Orleans, in the parish of Orleans, State of Louisiana, have invented certain new and useful Improvements in Apparatus for Drying and the like; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to apparatus for drying and the like. Particularly, the invention relates to apparatus for drying materials, such as lumber, wood, or the like, requiring different conditions of humidity and/or temperature during the drying operation. In its more general aspect, the invention relates to apparatus for treating materials requiring progressively different conditions of an operating medium as the material being treated undergoes characteristic changes in the course of the treatment operation.

The invention has for its object the provision of an improved apparatus of the character above described. More particularly, the invention aims to provide an improved apparatus for treating materials requiring progressively different conditions of an operating medium as the material being treated undergoes characteristic changes in the course of the treatment operation, in which the condition of such operating medium is automatically controlled in response to the characteristic changes in a representative sample of the material being treated so as to progressively establish and maintain the different conditions of such operating medium required in the course of the treatment operation. As applied to drying apparatus, the invention aims to provide an improved apparatus for drying materials, such as lumber or wood, in which the temperature and/or humidity of the drying medium are automatically controlled in response to changes in a varying characteristic (such as weight or moisture content) of the material being dried as the drying progresses.

The improved apparatus of the invention is especially adapted for the drying of lumber or wood, and on this account the inven-

tion will hereinafter be more particularly described as applied to that industry. It is to be understood, however, that the improved apparatus of the invention is applicable to the drying or treatment of other materials where progressively different conditions of an operating medium are required as the material being treated undergoes characteristic changes as a result of the treatment operation.

The improved apparatus of the invention is especially adapted for carrying out the method of drying lumber, wood, and the like, described and claimed in my copending application for Letters Patent of the United States filed May 24, 1924, Serial No. 715,516.

The controlling factors in the drying of lumber and of wood generally are the moisture content of the wood, the thickness of the wood and the species. Woods that are easily subject to splitting in drying must be treated at low temperature and high humidity. If the wood has a high percentage of moisture the starting temperature must be lower and the humidity higher than if the same wood had been air-dried down to a low moisture content before being placed in the drying kiln. In other words, the moisture content of the wood is the controlling factor for any particular thickness and species.

In the careful drying of wood, the moisture content of the wood is first determined and the appropriate temperature and humidity of the drying medium for that moisture content are thereby established. After the wood has been dried down to a lower moisture content more severe conditions of temperature and humidity of the drying medium are allowable. Heretofore, in the careful drying of wood, it has been necessary for the operator to periodically go into the kiln, take a sample of the wood undergoing drying and make a moisture determination of that sample in order to find out if the moisture content is low enough to permit or warrant a new setting of the conditions of temperature and humidity. In practice, this necessitates daily weighing of samples from each kiln to determine the appropriate conditions for the drying operations. Often, even in the hands of a skillful operator, the drying proceeds too far before conditions are changed and then again conditions are some-

times changed before the lumber or wood is dry enough to stand the altered conditions of temperature and humidity.

The high temperatures and humidity within a lumber drying kiln make the duty of entering the kiln for obtaining samples most arduous and on this account the drying is seldom controlled by the moisture content of the wood as it should be but is more often based on a time schedule. This schedule is set after the moisture content of the woods is determined and before drying commences. If everything proceeds without interruption, good drying may be accomplished. However, any interruptions in the drying, such as low steam pressure, shutting down of the kilns or boilers for repairs, changes in weather conditions which affect the temperature within the kiln, and a variety of other causes often slow up the actual drying so that the lumber or wood is not able to stand the increasing temperature and decreasing humidity called for by the drying time schedule. As a result, there is often a considerable loss of lumber due to splitting caused by too rapid drying.

In the improved apparatus of the present invention, a representative sample of the material being treated automatically prescribes the appropriate different conditions of the operating medium required in the course of the treatment operation. Thus, the improved apparatus of the invention includes appropriate controlling instrumentalities for establishing and maintaining different desired conditions of the operating medium, such, for example, as different conditions of temperature and/or humidity within a lumber drying kiln. In the apparatus of the invention the controlling instrumentalities are automatically set or adjusted by control means responsive to characteristic changes (such as changes in weight or moisture content) in a representative sample of the material being treated. Thus, the control means produces an action indicative of the characteristic changes in the representative sample as the treatment operation progresses, and this action is caused to so adjust the controlling instrumentalities as to establish and maintain the different conditions of the operating medium required in the course of the treatment operation. Preferably, the controlling instrumentalities are actuated by a movable cam of such configuration or design that when appropriately moved, the cam progressively adjusts or sets the control instrumentalities to maintain predetermined different conditions of the operating medium (for example, predetermined different conditions of temperature and/or humidity within a lumber drying kiln). Any appropriate mechanism may be employed for operatively connecting the control means to the controlling instrumentalities. In what I

now consider the preferred form of the invention, this mechanism is of the electromagnetic type periodically energized or operated by the engagement of a movable contact member (responsive to characteristic changes in the representative sample) with appropriately spaced electric contacts.

As embodied in an apparatus for drying materials such as lumber or wood, the apparatus of the invention includes a temperature and/or humidity controller or controllers having temperature-setting means (and/or humidity-setting means) cooperating with means for maintaining the temperature substantially uniform (and/or means for maintaining the humidity substantially uniform), in combination with a suitable mechanism (preferably an electromagnetic device) for adjusting the temperature-setting means (and/or the humidity-setting means) to maintain the different conditions of temperature (and/or humidity) required in the course of the drying operation, such mechanism being controlled by an action indicative of the loss (or change) in weight of a representative sample of the material being dried as the drying operation progresses. The temperature and humidity controllers may be of well-known types and may be conveniently modified for inclusion in the improved apparatus of the invention by the provision of cams of appropriate configuration or design for effecting the desired settings or adjustments of the controllers. The cams are operatively connected to the control means responsive to changes in weight of the representative sample of the material being dried.

The novel features of the invention will be more clearly understood from the following description taken in conjunction with the accompanying drawings, in which—

Fig. 1 diagrammatically illustrates what I now consider the preferred embodiment of the invention, and

Fig. 2 illustrates a modified contact-making device.

Fig. 3 shows a detail view of the contact-making device of Fig. 2.

The apparatus illustrated in Fig. 1 of the drawings is particularly adapted for controlling the conditions of temperature and humidity within a lumber drying kiln, and is shown in the drawings as applied to that purpose. The kiln is provided with heating pipes adapted to be supplied with steam from a steam main 5. A compressed air operated valve 6 is included in the steam main 5 and is adapted to be manipulated by the automatic temperature controlling instrumentalities hereinafter described. The kiln is further provided with a spray system 7 in the supply pipe of which is positioned a compressed air-operated valve 8. The kiln is further provided with a damper 9 ar-

ranged to be manipulated by the compressed air-operated valve 10. The spray valve 8 and damper valve 10 are actuated by the automatic humidity controlling instrumentalities hereinafter described.

A representative sample 11 of the lumber (or other material) to be dried is appropriately associated with a special type of scales or balancing device operatively mounted within the kiln. The sample 11 is preferably so positioned that the action thereon of the drying medium within the kiln is fairly representative of the action of that medium throughout the kiln. In the drying of lumber, the sample 11 may conveniently be approximately 8 inches wide, 24 inches long and the average thickness of the lumber undergoing drying.

The sample 11 is carried by a pair of depending grab hooks 12 pivotally mounted near one end of a horizontally positioned balance arm 13. The balance arm is operatively supported by a pair of knife edge pivots 14, one on each side of the arm. A balancing weight 15 is mounted on the arm 13, the balancing weight 15 and grab hooks 12 being positioned on opposite sides of the pivots 14. The balancing weight 15 is designed to counter-balance the grab hooks 12 and when appropriately adjusted brings the balance arm 13 to a balanced position when no sample is carried by the grab hooks.

A flexible strap 16 is secured to the underside of the balance arm 13, between the pivot 14 and the adjustable weight 15, and has its other end secured to an appropriately pivoted drum 17. A depending arm 18 is secured to the pivoted drum 17 and moves therewith. An adjustable weight 19 is mounted on the arm 18. The arm 18 has a scale 20 for indicating the position thereon of the adjustable weight 19.

A link 21 connects the pivoted drum 17 with a pivoted sector-shaped gear 22 meshing with a pinion 23. A combined electric contact and pointer 24 is secured to the pinion 23 and is adapted to sweep over and alternately engage two series of stationary electric contacts 25 and 26. By means of the gears 22 and 23 a small movement of the pivoted drum 17 is translated into a greater movement of the contact pointer 24. A scale or dial 24' is associated with the pointer 24 and is graduated in percentage moisture from 0 to 200 per cent.

The movable contact pointer 24 is electrically connected by a conductor 27 to a terminal or binding post 28 and thence by a conductor 29 to one contact of a switch 30. The stationary contacts 25 are electrically connected together and to a terminal or binding post 31. The contacts 26 are similarly connected together and to a binding post 32. A conductor 33 connects the binding post 31 to a stationary contact 34, and

similarly the terminal 32 is connected by a conductor 35 to a stationary contact 36.

The switch 30 is connected through a battery 37, or other appropriate source of electric energy, to one terminal of a constant speed electric motor 38, the other terminal of the motor being grounded at 39.

The shaft of the motor 38 carries a worm 40 meshing with a gear 41. A pinion 42 is secured to the gear 41 and meshes with a gear 43 to which is secured a movable contact 44. The movable contact 44 rotates with the gear 43 and has a substantially semi-circular contact element of such configuration that it is always in engagement with either one or the other of the contacts 34 and 36 and in two positions of each revolution engages both of the contacts 34 and 36.

The contact 44 carries two diametrically positioned pins 45 adapted (in consequence of the rotation of the contact 44) to alternately engage the teeth of a star wheel 46. A temperature-adjusting cam 47 is secured to the star wheel 46, and similarly a humidity-adjusting cam (not shown) is also secured to the star wheel.

The contacts 34 and 36, the star wheel 46 and associated elements are preferably combined and mounted in a single instrument case indicated generally by reference character 48 in the drawings.

A cam lever arm 49 is associated with the cam 47 and is operatively connected to a temperature-setting means or pointer 50. It will be understood that movement of the lever 49 is appropriately transmitted to the pointer 50. Similarly, a humidity-setting means or pointer 51 is operatively connected to and adapted to be actuated by the humidity-adjusting cam secured to the star wheel 46, but not shown in the accompanying drawings for the sake of simplicity.

A duplex valve mechanism is mounted within the case 48 of the combined temperature and humidity controller illustrated in the accompanying drawings. This mechanism comprises a temperature control valve having a valve chamber 52 which communicates by a passage 53 with a compressed air supply pipe 54. The valve chamber 52 contains a valve head 55 adapted to open or close a port 56 to the atmosphere and simultaneously to close or open (respectively) the passage 53. The valve head 55 is carried by a hollow valve stem 57 providing communication between the valve chamber 52 and a bellows diaphragm 58. The diaphragm 58 communicates by a flexible tubing 59 with an air nozzle 60 mounted upon the temperature-setting pointer 50. A flapper valve 61 is mounted upon a temperature-indicating pointer 62 so as to close the air nozzle 60 as the temperature-indicating pointer 62 moves into a predetermined position.

tion with respect to the temperature-setting pointer 50. An air pipe 63 provides communication between the valve chamber 52 and the air operated steam valve 6.

5 The humidity control valve is of similar construction to the temperature control valve and comprises a valve chamber 64 having a passage 65 connected to the air supply pipe 54. A valve head 66 is adapted to open or
10 close a port 67 to the atmosphere and simultaneously to close or open (respectively) the passage 65. The valve head 66 is mounted on a hollow valve stem 68 communicating between the valve chamber 64 and a bellows
15 diaphragm 69. The diaphragm 69 communicates by a flexible tubing 70 with an air nozzle 71 mounted on the humidity-setting pointer 51. A flapper valve 72 is mounted on a humidity-indicating pointer 73 to close
20 the air nozzle 71 as the humidity-indicating pointer 51 approaches within a predetermined distance of the humidity-setting pointer 73. An air pipe 74 communicates between the valve chamber 64 and the air operated
25 spray valve 8. The air pipe 74 also communicates with the damper valve 10 for opening or closing the damper 9.

30 The air pipes 54, 63 and 74 are provided with pressure gauges 75 to indicate the air pressure in these lines.

The temperature-indicating pointer 62 is actuated by a temperature element or dry bulb 76, while the humidity-indicating pointer 73 is actuated by a wet bulb 77. The
35 temperature element or dry bulb 76 is of the usual type, containing a volatile liquid which, when subjected to heat, volatilizes and the resulting vapor pressure is transmitted through a flexible tube 78 to a helical
40 coil 79. The movement of the helical coil 79 is transmitted to the temperature-indicating pointer 62 by means of links 80 and 81. The humidity-indicating pointer 73 is actuated in like manner by the wet bulb 77
45 through the flexible tube 82, helical coil 83 and links 84 and 85.

The operation of the apparatus is substantially as follows. The initial moisture content in per cent of the representative sample
50 11 is first determined. This may conveniently be done by the autocalculator, a device for directly measuring or indicating the moisture content of a sample of lumber. The sample is then secured to the grab hooks
55 12, and the weight 19 adjusted until the pointer 24 indicates on the scale 24' the determined initial moisture content of the sample 11. Thereafter (as the moisture content of the sample decreases in the course of the
60 drying operation) the position of the pointer 24 with respect to the scale 24' will directly indicate the actual percentage moisture content of the sample 11. The apparatus is then ready to proceed with the control of the
65 drying.

As the moisture content in the sample 11 decreases, in the progress of the drying operation, the contact pointer 24 engages first a contact 25 and then a contact 26, and so on alternately engaging a contact 25 and a 70 contact 26 throughout the drying operation. When the pointer 24 engages a contact 25 the contact element 44 will be in engagement with the contact 34 and the electric motor 38 will be energized through the circuit
75 31-38-34-44-ground-motor-37-30-29-28-27-24-25. The motor will thereupon operate to turn the gear 43 and contact 44 through one half revolution, when the contact 44 will move out of engagement with 80 the contact 34, but not until the contact 44 has moved into engagement with the contact 36. As the drying progresses, the pointer 24 moves from engagement with one of the contacts 25 into engagement with the next adjacent contact 26, whereupon the electric
85 motor is again energized and the gear 43 and contact 44 moved half a revolution. This sequence of operations is repeated throughout the entire drying operation. 90

Each time the electric motor 38 is energized, one of the pins 45 engages in a tooth of the star wheel 46 and turns the star wheel through a predetermined angle. This movement of the star wheel is transmitted to the
95 temperature-adjusting cam 47 and to the humidity-adjusting cam (not shown). In this manner, the temperature-setting pointer 50 is moved a predetermined prescribed amount by means of its operative connection with 100 the cam lever 49 each time the electric motor 38 is energized. Likewise, the humidity-setting pointer 51 is moved a predetermined prescribed amount each time the motor is energized. 105

The star wheel 46 is moved uniformly, that is, through the same angle, each time the motor 38 is energized. The temperature-adjusting cam 47 is designed to progressively
110 move the temperature-setting pointer 50 so as to maintain within the kiln a desired drying schedule with respect to temperature throughout the entire drying operation. Different drying schedules may be obtained, as required, by employing temperature-ad-
115 justing cams 47 of the appropriate different configuration or design.

When the valve head 55 closes the port 56 and opens the passage 53, the air supply pipe 54 is in direct communication with the
120 air pipe 63, thereby permitting compressed air to pass into the pipe 63 and open the steam valve 6, whereupon steam enters the heating pipes within the kiln. So long as the temperature within the kiln remains
125 lower than the predetermined temperature prescribed by the portion of the temperature-setting pointer 50, the valve 6 will remain open. As the temperature within the kiln rises (due to the open steam valve 6), 130

the temperature-indicating pointer 62 moves towards the temperature-setting pointer 50 until the temperature within the kiln reaches the predetermined prescribed temperature, whereupon the flapper-valve 61 engages and closes the air nozzle 60. This causes the air pressure to be thrown back into the bellows diaphragm 58, which thereupon expands and moves the valve head 55 to close the passage 53, thereby permitting the compressed air in the pipe 63 and steam valve 6 to escape to the atmosphere through the port 56 in the valve chamber 52. The steam valve 6 thereupon closes and shuts off the steam supply to the kiln. When the temperature within the kiln has again fallen to below the predetermined prescribed temperature, the temperature-indicating pointer 62 will move away from the temperature-setting pointer 50, causing disengagement between the nozzle 60 and the flapper valve 61. The bellows diaphragm 58 will then contract and permit the valve head 55 to return to its original position, whereupon the steam valve 6 is again opened by the action of the compressed air in the pipe 63.

In a similar manner, when the humidity within the kiln falls below the predetermined prescribed condition, the humidity-indicating pointer 73 will move towards the humidity-setting pointer 51 until the flapper valve 72 closes the air nozzle 71. This causes the escape of the compressed air in the pipe 73 and the attendant appropriate manipulation of the spray valve 8 and damper valve 10 for increasing the humidity within the kiln.

As the drying operation progresses, the moisture content of the material being dried becomes lower and more severe conditions of temperature and humidity become possible. The loss in weight of the representative sample 11 sets in action the controlling instrumentalities that establish and maintain these different and more severe conditions of temperature and humidity. As hereinbefore mentioned, any appropriate or desired schedule of temperature and humidity conditions may be established and maintained within the kiln by employing a temperature-adjusting cam (47) and a humidity-adjusting cam of the proper designs.

In the apparatus illustrated in the drawings, the temperature-setting pointer 50 is adjustably connected to the cam shaft 49 so that the cam schedule may, if desired, be adjusted to read higher or lower over the whole course of the cam's action. Thus, the pointer 50 is rigidly secured to an arm 86. The arm 86 is adjustably connected to the cam arm 49 by a threaded rod 87. The rod 87 engages screw-threaded elements secured to the arms 49 and 86 in such a manner that by turning the rod 87 the relative positions of the cam arm 49 and pointer 50 are ap-

propriately adjusted. A spring 88 is secured to the arm 86 and holds the cam follower of the arm 49 against the cam 47.

It will have been understood from the foregoing description that the movable contact 44 is electrically grounded, as at 90. The contacting element of the stationary contacts 34 and 36 is preferably a pair of resilient, spaced contacts between which the contacting element of the movable contact 44 passes, as in the well-known knife switches.

The apparatus illustrated in the drawings provides a positive motor action for adjusting the humidity-setting means and the temperature-setting means. This motor action is definitely controlled by a positive, but simple, switch movement. The apparatus has no parts that are likely to become stuck in operation and no electrical windings that are likely to become overheated and burned out.

An appropriate scale may, if desired, be associated with the star wheel 46 whereby the moisture content of the representative sample can be directly read at any time during the drying operation. This is possible because the movement of the start wheel 46 is directly proportional to the loss in moisture of the representative sample. By this means the moisture content of the material being dried can be accurately indicated wherever the controlling instruments are located which may, of course, be remote from the kiln itself.

In Fig. 2 of the drawings, I have illustrated a modified contact-making device. This device may be employed in place of the alternate contacts 25 and 26 illustrated in Fig. 1. The same parts in Figs. 1 and 2 are indicated by the same reference characters. As shown in Fig. 2, a cam 91 is secured to the shaft upon which is positioned the pinion 23 so that with each movement of the scale beam 13 and the pinion 23 there will be a corresponding movement of the cam 91. The cam 91, if desired, may have positioned thereon a scale calibrated in terms of percentage moisture content and the percentage moisture content of the material undergoing treatment may then be indicated by a stationary marker 92. The mercury contact-making device is secured to a frame 95 suspended from a pivot 93 and is adapted to be tilted by a cam follower 94 secured to the frame 95. The mercury contact-making device comprises a sealed glass tube 96 containing a small amount of mercury 97. Electric contacts 98 and 99 pierce, each end, respectively, of the sealed glass tube 96 and are appropriately associated with a common contact 100 so that either contact 98 or contact 99 is connected with the common contact 100 by the mercury 97 when the contact device is tilted one way or the other.

Contacts 98, 99 and 100 are connected to the binding posts 31, 32 and 28, respectively, by conductors 101, 102 and 103.

As the moisture content of the sample 11 decreases the cam 91 turns and raises or lowers the cam follower 95 to tilt the mercury contact-making device one way or the other, thereby causing the mercury 97 to alternately close the circuits through the motor 38 by connecting first contacts 98 and 100 and then contacts 99 and 100.

While I have described and illustrated an apparatus embodying a combined temperature and humidity controller in a single casing or instrument, it will be readily understood by those skilled in the art that the principles of the invention are equally applicable to an apparatus embodying a temperature controller alone or a humidity controller alone, or an independent temperature controller and an independent humidity controller.

Ordinarily, the control means will be located within the kiln, while the controlling instrumentalities will be conveniently located without the kiln. If desired, however, the control sample (11) may be suspended by a wire through an appropriate opening in the roof of the kiln and all other parts of the apparatus located outside the kiln. In any event, the change or loss in weight of the control sample (11), as the drying progresses, produces an action (movement of the contact-pointer 24, Fig. 1, or cam 91, Fig. 2) indicative of this change in weight, and that action automatically controls the setting of the temperature and/or humidity controllers so as to progressively establish and maintain the predetermined different conditions of temperature and/or humidity within the kiln called for by the drying schedule.

While the embodiment of the invention herein described and illustrated is especially suited for the drying of lumber or wood, it will be understood by those skilled in the art that this particular embodiment of the invention is equally well adapted for use in the drying of other materials requiring different conditions of temperature and/or humidity in the course of the drying operation. Furthermore, the principles of the invention are applicable to many industries and uses where different conditions of one or more operating media are required in the course of a treatment operation. Thus, in many manufacturing processes, different conditions of one or more operating media are necessary as certain characteristic changes are encountered and the apparatus of the invention may be advantageously be employed to automatically establish and maintain such different operating conditions in response to such characteristic changes.

I have explained my invention by illustrating and describing a certain specific embodi-

ment thereof, but various modifications of the details of construction and arrangement of parts in this embodiment of the invention will present themselves to those skilled in the art. I, accordingly, do not wish to be restricted to the particular form or construction disclosed herein by way of example for the purpose of setting forth my invention in accordance with the patent statutes. The terms of the appended claims are, therefore, not restricted to the precise structure disclosed, but are intended to cover all changes and modifications within the spirit and scope of the invention.

I claim:

1. In an apparatus for the treatment of materials requiring progressively different conditions of an operating medium as the material being treated undergoes characteristic changes in the course of the treatment operation, the combination of controlling instrumentalities adapted to be adjusted so as to establish and maintain different conditions of said operating medium, control means responsive to said characteristic changes in a representative sample of the material being treated, and means actuated by said control means for adjusting said controlling instrumentalities to progressively establish and maintain the different conditions of said operating medium required in the course of the treatment operation.

2. In an apparatus for the treatment of materials requiring progressively different conditions of an operating medium as the material being treated undergoes characteristic changes in the course of the treatment operation, the combination of controlling instrumentalities adapted to be adjusted so as to establish and maintain different conditions of said operating medium, movable means operatively associated with said instrumentalities and adapted when appropriately moved to adjust said instrumentalities to establish and maintain predetermined different conditions of said operating medium, control means responsive to said characteristic changes in a representative sample of the material being treated, and means actuated by said control means and operatively connected to said movable means for adjusting said controlling instrumentalities to progressively establish and maintain the different conditions of said operating medium required in the course of the treatment operation.

3. In an apparatus for the treatment of materials requiring progressively different conditions of an operating medium as the material being treated undergoes characteristic changes in the course of the treatment operation, the combination of controlling instrumentalities adapted to be adjusted so as to establish and maintain different conditions of said operating medium, control

means responsive to said characteristic changes in a representative sample of the material being treated, said control means including a series of spaced electric contacts and a cooperating movable contact member arranged to progressively engage said spaced contacts in consequence of said characteristic changes in said representative sample as the treatment operation progresses, and electromagnetic means actuated by the engagement of said movable contact member with said spaced contacts for adjusting said controlling instrumentalities to progressively establish and maintain the different conditions of said operating medium required in the course of the treatment operation.

4. In an apparatus for the treatment of materials requiring progressively different conditions of an operating medium as the material being treated undergoes characteristic changes in the course of the treatment operation, the combination of controlling instrumentalities adapted to be adjusted so as to establish and maintain different conditions of said operating medium, control means responsive to said characteristic changes in a representative sample of the material being treated, said control means including two series of alternately arranged spaced electric contacts and a cooperating movable contact member adapted to progressively engage said spaced contacts in consequence of said characteristic changes in said representative sample as the treatment operation progresses, each of said series of spaced electric contacts being included in a different electric circuit, an electromotive device arranged to be included in each of said circuits, means whereby said circuits are alternately completed and said electromotive device energized and operated by the progressive engagement of said movable contact member with said spaced contacts, and means whereby the operation of said electromotive device adjusts said controlling instrumentalities to progressively establish and maintain the different conditions of said operating medium required in the course of the treatment operation.

5. In an apparatus for the treatment of materials requiring progressively different conditions of an operating medium as the material being treated undergoes characteristic changes in the course of the treatment operation, the combination of controlling instrumentalities adapted to be adjusted so as to establish and maintain different conditions of said operating medium, movable means operatively associated with said instrumentalities and adapted when appropriately moved to adjust said instrumentalities to establish and maintain predetermined different conditions of said operating medium, control means responsive to said character-

istic changes in a representative sample of the material being treated, said control means including a series of spaced electric contacts and a cooperating movable contact member arranged to progressively engage said spaced contacts in consequence of said characteristic changes in said representative sample as the treatment operation progresses, and electromagnetic means actuated by the engagement of said movable contact member with said spaced contacts and operatively connected to said movable means for adjusting said controlling instrumentalities to progressively establish and maintain the different conditions of said operating medium required in the course of the treatment operation.

6. In an apparatus for the treatment of materials requiring progressively different conditions of an operating medium as the material being treated undergoes characteristic changes in the course of the treatment operation, the combination of controlling instrumentalities adapted to be adjusted so as to establish and maintain different conditions of said operating medium, movable means operatively associated with said instrumentalities and adapted when appropriately moved to adjust said instrumentalities to establish and maintain predetermined different conditions of said operating medium, control means responsive to said characteristic changes in a representative sample of the material being treated, said control means including two series of alternately arranged spaced electric contacts and a cooperating movable contact member adapted to progressively engage said spaced contacts in consequence of said characteristic changes in said representative sample as the treatment operation progresses, each of said series of spaced electric contacts being included in a different electric circuit, an electromotive device arranged to be included in each of said circuits, means whereby said circuits are alternately completed and said electromotive device energized and operated by the progressive engagement of said movable contact member with said spaced contacts, and means whereby the operation of said electromotive device moves said movable means and thereby adjusts said controlling instrumentalities to progressively establish and maintain the different conditions of said operating medium required in the course of the treatment operation.

7. In an apparatus for the treatment of materials requiring progressively different conditions of an operating medium as the material under treatment changes in weight in the course of the treatment operation, the combination of controlling instrumentalities adapted to be adjusted so as to establish and maintain different conditions of said operating medium, control means responsive

to changes in weight of a representative sample of the material undergoing treatment, and means actuated by said control means for adjusting said controlling instrumentalities to progressively establish and maintain the different conditions of said operating medium required in the course of the treatment operation.

8. In an apparatus for the treatment of materials requiring progressively different conditions of an operating medium as the material under treatment changes in weight in the course of the treatment operation, the combination of controlling instrumentalities adapted to be adjusted so as to establish and maintain different conditions of said operating medium, control means responsive to changes in weight of a representative sample of the material undergoing treatment, said control means including a series of spaced electric contacts and a cooperating movable contact member operatively connected to a balancing device and arranged to progressively engage said spaced contacts in consequence of the change in weight of said representative sample as the treatment operation progresses, and electromagnetic means actuated by the engagement of said movable contact member with said spaced contacts for adjusting said controlling instrumentalities to progressively establish and maintain the different conditions of said operating medium required in the course of the treatment operation.

9. In an apparatus for the treatment of materials requiring progressively different conditions of an operating medium as the material under treatment changes in weight in the course of the treatment operation, the combination of controlling instrumentalities adapted to be adjusted so as to establish and maintain different conditions of said operating medium, movable means operatively associated with said instrumentalities and adapted when appropriately moved to adjust said instrumentalities to establish and maintain predetermined different conditions of said operating medium, control means responsive to changes in weight of a representative sample of the material undergoing treatment, and means actuated by said control means and operatively connected to said movable means for adjusting said controlling instrumentalities to progressively establish and maintain the different conditions of said operating medium required in the course of the treatment operation.

10. In an apparatus for the treatment of materials requiring progressively different conditions of an operating medium as the material under treatment changes in weight in the course of the treatment operation, the combination of controlling instrumentalities adapted to be adjusted so as to establish and maintain different conditions of said oper-

ating medium, movable means operatively associated with said instrumentalities and adapted when appropriately moved to adjust said instrumentalities to establish and maintain predetermined different conditions of said operating medium, control means responsive to changes in weight of a representative sample of the material undergoing treatment, said control means including a series of spaced electric contacts and a cooperating movable contact member operatively connected to a balancing device and arranged to progressively engage said spaced contacts in consequence of the change in weight of said representative sample as the treatment operation progresses, and electromagnetic means actuated by the engagement of said movable contact member with said spaced contacts and operatively connected to said movable means for adjusting said controlling instrumentalities to progressively establish and maintain the different conditions of said operating medium required in the course of the treatment operation.

11. In an apparatus for the treatment of materials requiring progressively different conditions of an operating medium as the material under treatment changes in weight in the course of the treatment operation, the combination of controlling instrumentalities adapted to be adjusted so as to establish and maintain different conditions of said operating medium, control means responsive to changes in weight of a representative sample of the material undergoing treatment, said control means including two series of alternately arranged spaced electric contacts and a cooperating movable contact member operatively connected to a balancing device and arranged to progressively engage said spaced contacts in consequence of the change in weight of said representative sample as the treatment operation progresses, each of said series of spaced electric contacts being included in a different electric circuit, an electromotive device arranged to be included in each of said circuits, means whereby said circuits are alternately completed and said electromotive device energized and operated by the progressive engagement of said movable contact member with said spaced contacts, and means whereby the operation of said electromotive device adjusts said controlling instrumentalities to progressively establish and maintain the different conditions of said operating medium required in the course of the treatment operation.

12. In an apparatus for the treatment of materials requiring progressively different conditions of an operating medium as the material under treatment changes in weight in the course of the treatment operation, the combination of controlling instrumentalities adapted to be adjusted so as to establish and

maintain different conditions of said operating medium, movable means operatively associated with said instrumentalities and adapted when appropriately moved to adjust said instrumentalities to establish and maintain predetermined different conditions of said operating medium, control means responsive to changes in weight of a representative sample of the material undergoing treatment, said control means including two series of alternately arranged spaced electric contacts and a cooperating movable contact member operatively connected to a balancing device and arranged to progressively engage said spaced contacts in consequence of the change in weight of said representative sample as the treatment operation progresses, each of said series of spaced electric contacts being included in a different electric circuit, an electromotive device arranged to be included in each of said conduits, means whereby said circuits are alternately completed and said electromotive device energized and operated by the progressive engagement of said movable contact member with said spaced contacts, and means whereby the operation of said electromotive device moves said movable means and thereby adjusts said controlling instrumentalities to progressively establish and maintain the different conditions of said operating medium required in the course of the treatment operation.

13. In a drying apparatus of the character described provided with means for controlling the temperature and humidity conditions therein, means for producing an action indicative of changes in a varying characteristic of a representative sample of the material being dried as the drying operation progresses, and means operatively controlled by said action for establishing the conditions of temperature and humidity to be maintained within the apparatus by said temperature and humidity controlling means.

14. In a drying apparatus of the character described provided with means for controlling the temperature and humidity conditions therein, means for producing an action indicative of the loss in weight of a representative sample of the material being dried as the drying operation progresses, and means operatively controlled by said action for establishing the conditions of temperature and humidity to be maintained within the apparatus by said temperature and humidity controlling means.

15. In a drying apparatus of the character described provided with means for controlling the temperature and humidity conditions therein, means for producing within the kiln a continuous action indicative of the loss in weight of a representative sample of the material being dried as the drying operation progresses, and means operatively

controlled by said action for adjusting said temperature and humidity controlling means.

16. An apparatus for drying materials which require different conditions of temperature and humidity during the drying operation, comprising means for varying the temperature and humidity of the drying medium of the apparatus, means for producing within the apparatus an action indicative of changes in a varying characteristic of a representative sample of the material being dried as the drying operation progresses, and means operatively controlled by said action and operatively associated with said temperature and humidity varying means for establishing and maintaining predetermined different conditions of temperature and humidity of the drying medium of the apparatus as the drying operation progresses.

17. An apparatus for drying materials which require different conditions of temperature and humidity during the drying operation, comprising means for varying the temperature and humidity of the drying medium of the apparatus, means for producing within the apparatus a continuing action indicative of the loss in weight of a representative sample of the material being dried as the drying operation progresses, and means operatively controlled by said action and operatively associated with said temperature and humidity varying means for establishing and maintaining predetermined different conditions of temperature and humidity of the drying medium of the apparatus as the drying operation progresses.

18. An apparatus for drying materials which require different conditions of temperature and humidity during the drying operation, comprising means for varying the temperature within said apparatus, means for varying the humidity within said apparatus, means for producing within the apparatus a continuing action indicative of the loss in weight of a representative sample of the material being dried as the drying operation progresses, temperature responsive means within said apparatus, humidity responsive means within said apparatus, means cooperating with said temperature varying means and said temperature responsive means for maintaining the temperature within said apparatus substantially uniform, means cooperating with said humidity varying means and said humidity responsive means for maintaining the humidity within said apparatus substantially uniform, and means operatively controlled by said action and operatively associated with said last two mentioned means for adjusting the conditions of temperature and humidity to be maintained substantially uniform thereby.

19. The combination in a drying apparatus

tus having temperature varying means and humidity varying means and controllers cooperating therewith for maintaining any desired conditions of temperature and humidity within the apparatus, of control means movable in response to the loss in weight of a representative sample of the material being dried as the drying operation progresses, an electromagnetic device arranged to be actuated by said control means, and means operated by said electromagnetic device for adjusting said controllers to maintain predetermined different conditions of temperature and humidity within the drying apparatus as the drying operation progresses.

20. The combination in a drying apparatus having temperature varying means and a controller cooperating therewith for maintaining any desired condition of temperature within the apparatus, of control means movable in response to the loss in weight of a representative sample of the material being dried as the drying operation progresses, an electromagnetic device arranged to be actuated by said control means, and means operated by said electromagnetic device for adjusting said controller to maintain predetermined different conditions of temperature within the drying apparatus as the drying operation progresses.

21. The combination in a drying apparatus having humidity varying means and a controller cooperating therewith for maintaining any desired condition of humidity within the apparatus, of control means movable in response to the loss in weight of a representative sample of the material being dried as the drying operation progresses, an electromagnetic device arranged to be actuated by said control means, and means operated by said electromagnetic device for adjusting said controller to maintain predetermined different conditions of humidity within the drying apparatus as the drying operation progresses.

22. In an apparatus for drying materials which require different conditions of temperature and humidity during the drying operation, temperature and humidity controllers having temperature-setting means cooperating with means for maintaining determined conditions of temperature within the apparatus and humidity-setting means cooperating with means for maintaining determined conditions of humidity within the apparatus, an electromagnetic device, means actuated by said electromagnetic device for adjusting said temperature-setting means and said humidity-setting means, means for producing an action indicative of the loss of weight of a representative sample of the material being dried as the drying operation progresses, and means for

actuating said electromagnetic device in response to said action.

23. In an apparatus for drying materials which require different conditions of temperature and humidity during the drying operation, temperature and humidity controllers having temperature-setting means cooperating with means for maintaining determined conditions of temperature within the apparatus and humidity-setting means cooperating with means for maintaining determined conditions of humidity within the apparatus, an electromagnetic device, a temperature-adjusting means operatively connected with said temperature-setting means, a humidity-adjusting means operatively connected with said humidity-setting means, said temperature-adjusting means and said humidity-adjusting means being moved by said electromagnetic device, means for producing an action indicative of the loss of weight of a representative sample of the material being dried as the drying operation progresses, and means for actuating said electromagnetic device in response to said action.

24. In an apparatus for drying materials which require different conditions of temperature during the drying operation, a temperature controller having temperature-setting means cooperating with means for maintaining determined conditions of temperature within the apparatus, an electromagnetic device, means actuated by said electromagnetic device for adjusting the temperature-setting means, means for producing an action indicative of the loss of weight of a representative sample of the material being dried as the drying operation progresses, and means for causing said action to energize and actuate said electromagnetic device.

25. In an apparatus for drying materials which require different conditions of temperature during the drying operation, a temperature controller having temperature-setting means cooperating with means for maintaining determined conditions of temperature within the apparatus, an electromagnetic device, a temperature-adjusting means operatively associated with the temperature-setting means, said temperature-adjusting means being moved a predetermined amount in one direction each time said electromagnetic device is energized, means for producing an action indicative of the loss of weight of a representative sample of the material being dried as the drying operation progresses, and means for causing said action to energize said electromagnetic device.

26. In an apparatus for drying materials which require different conditions of humidity during the drying operation, a humidity

controller having humidity-setting means cooperating with means for maintaining determined conditions of humidity within the apparatus, an electromagnetic device, means
 5 actuated by said electromagnetic device for adjusting the humidity-setting means, means for producing an action indicative of the loss of weight of a representative sample of the material being dried as the drying
 10 operation progresses, and means for causing said action to energize and actuate said electromagnetic device.

27. In an apparatus for drying materials which require different conditions of
 15 humidity during the drying operation, a humidity controller having humidity-setting means cooperating with means for maintaining determined conditions of humidity within the apparatus, an electromagnetic device,
 20 a humidity-adjusting means operatively associated with the humidity-setting means, said humidity-adjusting means being moved a predetermined amount each time said electromagnetic device is energized, means for
 25 producing an action indicative of the loss of weight of a representative sample of the material being dried as the drying operation progresses, and means for causing said action to energize said electromagnetic device.
 30 vice.

28. The combination in a drying apparatus having temperature varying means and humidity varying means and controllers cooperating therewith for maintaining any
 35 desired conditions of temperature and humidity within the apparatus, of control means movable in response to the loss in weight of a representative sample of the material being dried as the drying operation
 40 progresses, an electric motor arranged to be periodically operated by the action of said control means, and means operated by said motor for adjusting said controllers to maintain predetermined different conditions of
 45 temperature and humidity within the drying apparatus as the drying operation progresses.

29. The combination in a drying apparatus having temperature varying means and
 50 a controller cooperating therewith for maintaining any desired condition of temperature within the apparatus, of control means movable in response to the loss in weight of a representative sample of the material being
 55 dried as the drying operation progresses, an electric motor arranged to be periodically operated by the action of said control means, and means operated by said motor for adjusting said controller to maintain predetermined different conditions of temperature
 60 within the drying apparatus as the drying operation progresses.

30. The combination in a drying apparatus having humidity varying means and a
 65 controller cooperating therewith for main-

taining any desired condition of humidity within the apparatus, of control means movable in response to the loss in weight of a representative sample of the material being
 70 dried as the drying operation progresses, an electric motor arranged to be periodically operated by the action of said control means, and means operated by said motor for adjusting said controller to maintain predetermined different conditions of humidity within
 75 the drying apparatus as the drying operation progresses.

31. The combination in a drying apparatus having temperature varying means and a controller cooperating therewith for main-
 80 taining any desired condition of temperature within the apparatus, of control means movable in response to the loss in weight of a representative sample of the material being dried as the drying operation progresses,
 85 and means actuated by said control means for adjusting said controller to progressively establish and maintain predetermined different conditions of temperature within the drying apparatus as the drying operation
 90 progresses.

32. The combination in a drying apparatus having humidity varying means and a controller cooperating therewith for main-
 95 taining any desired condition of humidity within the apparatus, of control means movable in response to the loss in weight of a representative sample of the material being dried as the drying operation progresses,
 100 and means actuated by said control means for adjusting said controller to progressively establish and maintain predetermined different conditions of humidity within the drying apparatus as the drying operation
 105 progresses.

33. The combination in a drying apparatus having temperature varying means and humidity varying means and controllers cooperating therewith for maintaining any
 110 desired conditions of temperature and humidity within the apparatus, of control means movable in response to the loss in weight of a representative sample of the material being dried as the drying operation
 115 progresses, and means actuated by said control means for adjusting said controllers to progressively establish and maintain predetermined different conditions of temperature and humidity within the drying apparatus
 120 as the drying operation progresses.

34. The combination in a drying apparatus having temperature varying means and humidity varying means and a controller cooperating therewith for maintaining any
 125 desired conditions of temperature and humidity within the apparatus, of controlling instrumentalities adapted to be adjusted so as to establish and maintain different conditions of temperature and humidity within the apparatus, movable means operatively
 130

associated with said instrumentalities and adapted when appropriately moved to adjust said instrumentalities to establish and maintain predetermined different conditions of temperature and humidity within the apparatus, control means responsive to the loss in weight of a representative sample of the material being dried, and means actuated by said control means and operatively connected to said movable means for adjusting said controlling instrumentalities to progressively establish and maintain the different conditions of temperature and humidity within the drying apparatus required in the course of the drying operation.

35. The combination in a drying apparatus having temperature varying means and humidity varying means and a controller cooperating therewith for maintaining any desired conditions of temperature and humidity within the apparatus, of controlling instrumentalities adapted to be adjusted so as to establish and maintain different conditions of temperature and humidity within the apparatus, control means responsive to the loss in weight of a representative sample of the material being dried, said control means including a series of spaced electric contacts and a cooperating movable contact member operatively connected to a balancing device and arranged to progressively engage said spaced contacts in consequence of the loss in weight of said representative sample as the drying operation progresses, and electromagnetic means actuated by the engagement of said movable contact member with said spaced contacts for adjusting said controlling instrumentalities to progressively establish and maintain the different conditions of temperature and humidity within the drying apparatus required in the course of the drying operation.

36. The combination in a drying apparatus having temperature varying means and humidity varying means and a controller cooperating therewith for maintaining any desired conditions of temperature and humidity within the apparatus, of controlling instrumentalities adapted to be adjusted so as to establish and maintain different conditions of temperature and humidity within the apparatus, movable means operatively associated with said instrumentalities and adapted when appropriately moved to adjust said instrumentalities to establish and maintain predetermined different conditions of temperature and humidity within the apparatus, control means responsive to the loss in weight of a representative sample of the material being dried, said control means including a series of spaced electric contacts and a cooperating movable contact member operatively connected to a balancing device and arranged to progressively engage said spaced contacts in consequence of the loss

in weight of said representative sample as the drying operation progresses, and electromagnetic means actuated by the engagement of said movable contact member with said spaced contacts and operatively connected to said movable means for adjusting said controlling instrumentalities to progressively establish and maintain the different conditions of temperature and humidity within the drying apparatus required in the course of the drying operation.

37. The combination in a drying apparatus having temperature varying means and humidity varying means and a controller cooperating therewith for maintaining any desired conditions of temperature and humidity within the apparatus, of controlling instrumentalities adapted to be adjusted so as to establish and maintain different conditions of temperature and humidity within the apparatus, control means responsive to the loss in weight of a representative sample of the material being dried, said control means including two series of alternately arranged spaced electric contacts and a cooperating movable contact member operatively connected to a balancing device and arranged to progressively engage said spaced contacts in consequence of the loss in weight of said representative sample as the drying operation progresses, each of said series of spaced electric contacts being included in a different electric circuit, an electromagnetic device arranged to be included in each of said circuits, means whereby said circuits are alternately completed and said electromagnetic device energized and operated by the progressive engagement of said movable contact member with said spaced contacts, and means whereby the operation of said electromagnetic device adjusts said controlling instrumentalities to progressively establish and maintain the different conditions of temperature and humidity within the drying apparatus required in the course of the drying operation.

38. The combination in a drying apparatus having temperature varying means and humidity varying means and a controller cooperating therewith for maintaining any desired conditions of temperature and humidity within the apparatus, of controlling instrumentalities adapted to be adjusted so as to establish and maintain different conditions of temperature and humidity within the apparatus, movable means operatively associated with said instrumentalities and adapted when appropriately moved to adjust said instrumentalities to establish and maintain predetermined different conditions of temperature and humidity within the apparatus, control means responsive to the loss in weight of a representative sample of the material being dried, said control means including two series of

alternately arranged spaced electric contacts and a cooperating movable contact member operatively connected to a balancing device and arranged to progressively engage said spaced contacts in consequence of the loss in weight of said representative sample as the drying operation progresses, each of said series of spaced electric contacts being included in a different electric circuit, an electromagnetic device arranged to be included in each of said circuits, means whereby said circuits are alternately completed and said electromagnetic device energized and operated by the progressive engagement of said movable contact member with said spaced contact, and means whereby the operation of said electromagnetic device adjusts said controlling instrumentalities to progressively establish and maintain the different conditions of temperature and humidity within the drying apparatus required in the course of the drying operation.

39. The combination in a drying apparatus having temperature varying means and humidity varying means and a controller cooperating therewith for maintaining any desired conditions of temperature and humidity within the apparatus, of control means movable in response to the loss in weight of a representative sample of the material being dried as the drying operation progresses, said control means including a series of spaced electrical contacts and a cooperating movable contact member, an electric motor, means whereby said electric motor is energized and rotated a predetermined number of revolutions each time said movable contact member engages one of said spaced contacts, and means operated by said motor for adjusting said controller to maintain predetermined different conditions of temperature and humidity within the drying apparatus as the drying operation progresses.

40. The combination in a drying apparatus having temperature varying means and humidity varying means and a controller cooperating therewith for maintaining any desired conditions of temperature and humidity within the apparatus, of control means movable in response to the loss in weight of a representative sample of the material being dried as the drying operation progresses, said control means including a series of spaced electrical contacts and a cooperating movable contact member, an electric motor, means whereby said electric motor is energized and rotated a predetermined number of revolutions each time said movable contact member engages one of said spaced contacts, a rotatable element operatively connected to said motor and arranged to be uniformly turned each time said motor is energized, a temperature-adjusting means and a humidity-adjusting cam operatively

associated with said rotatable element, and means operated by said means for adjusting said controller to maintain predetermined different conditions of temperature and humidity within the drying apparatus as the drying operation progresses.

41. The combination in a drying apparatus having temperature varying means and humidity varying means and a controller cooperating therewith for maintaining any desired conditions of temperature and humidity within the apparatus, of control means movable in response to the loss in weight of a representative sample of the material being dried as the drying operation progresses, said control means including two series of alternately arranged spaced electrical contacts and a cooperating movable contact member arranged to engage said contacts in sequence, each of said series of spaced electrical contacts being included in a different electric circuit, an electric motor, means adapted to alternately include said electric motor in one and then the other of said electric circuits after each of a predetermined number of revolutions of the motor, said electric circuits being alternately completed and said electric motor energized and rotated said predetermined number of revolutions each time said movable contact member engages one of said spaced electrical contacts, and means operated by said motor for adjusting said controller to maintain predetermined different conditions of temperature and humidity within the drying apparatus as the drying operation progresses.

42. The combination in a drying apparatus having temperature varying means and a controller cooperating therewith for maintaining any desired conditions of temperature within the apparatus, of controlling instrumentalities adapted to be adjusted so as to establish and maintain different conditions of temperature within the apparatus, movable means operatively associated with said instrumentalities and adapted when appropriately moved to adjust said instrumentalities to establish and maintain predetermined different conditions of temperature within the apparatus, control means responsive to the loss in weight of a representative sample of the material being dried, and means actuated by said control means and operatively connected to said movable means for adjusting said controlling instrumentalities to progressively establish and maintain the different conditions of temperature within the drying apparatus required in the course of the drying operation.

43. The combination in a drying apparatus having temperature varying means and a controller cooperating therewith for maintaining any desired conditions of tem-

perature within the apparatus, of controlling instrumentalities adapted to be adjusted so as to establish and maintain different conditions of temperature within the apparatus, control means responsive to the loss in weight of a representative sample of the material being dried, said control means including a series of spaced electric contacts and a cooperating movable contact member operatively connected to a balancing device and arranged to progressively engage said spaced contacts in consequence of the loss in weight of said representative sample as the drying operation progresses, and electromagnetic means actuated by the engagement of said movable contact member with said spaced contacts for adjusting said controlling instrumentalities to progressively establish and maintain the different conditions of temperature within the drying apparatus required in the course of the drying operation.

44. The combination in a drying apparatus having temperature varying means and a controller cooperating therewith for maintaining any desired conditions of temperature within the apparatus, of controlling instrumentalities adapted to be adjusted so as to establish and maintain different conditions of temperature within the apparatus, movable means operatively associated with said instrumentalities and adapted when appropriately moved to adjust said instrumentalities to establish and maintain predetermined different conditions of temperature within the apparatus, control means responsive to the loss in weight of a representative sample of the material being dried, said control means including a series of spaced electric contacts and a cooperating movable contact member operatively connected to a balancing device and arranged to progressively engage said spaced contacts in consequence of the loss in weight of said representative sample as the drying operation progresses, and electromagnetic means actuated by the engagement of said movable contact member with said spaced contacts and operatively connected to said movable means for adjusting said controlling instrumentalities to progressively establish and maintain the different conditions of temperature within the drying apparatus required in the course of the drying operation.

45. The combination in a drying apparatus having temperature varying means and a controller cooperating therewith for maintaining any desired conditions of temperature within the apparatus, of controlling instrumentalities adapted to be adjusted so as to establish and maintain different conditions of temperature within the apparatus, control means responsive to the loss in weight of a representative sample of the material being dried, said control means includ-

ing two series of alternately arranged spaced electric contacts and a cooperating movable contact member operatively connected to a balancing device and arranged to progressively engage said spaced contacts in consequence of the loss in weight of said representative sample as the drying operation progresses, each of said series of spaced electric contacts being included in a different electric circuit, an electromagnetic device arranged to be included in each of said circuits, means whereby said circuits are alternately completed and said electromagnetic device energized and operated by the progressive engagement of said movable contact member with said spaced contacts, and means whereby the operation of said electromagnetic device adjusts said controlling instrumentalities to progressively establish and maintain the different conditions of temperature within the drying apparatus required in the course of the drying operation.

46. The combination in a drying apparatus having temperature varying means and a controller cooperating therewith for maintaining any desired conditions of temperature within the apparatus, of controlling instrumentalities adapted to be adjusted so as to establish and maintain different conditions of temperature within the apparatus, movable means operatively associated with said instrumentalities and adapted when appropriately moved to adjust said instrumentalities to establish and maintain predetermined different conditions of temperature within the apparatus, control means responsive to the loss in weight of a representative sample of the material being dried, said control means including two series of alternately arranged spaced electric contacts and a cooperating movable contact member operatively connected to a balancing device and arranged to progressively engage said spaced contacts in consequence of the loss in weight of said representative sample as the drying operation progresses, each of said series of spaced electric contacts being included in a different electric circuit, an electromagnetic device arranged to be included in each of said circuits, means whereby said circuits are alternately completed and said electromagnetic device energized and operated by the progressive engagement of said movable contact member with said spaced contact, and means whereby the operation of said electromagnetic device adjusts said controlling instrumentalities to progressively establish and maintain the different conditions of temperature within the drying apparatus required in the course of the drying operation.

47. The combination in a drying apparatus having temperature varying means and a controller cooperating therewith for maintaining any desired conditions of tem-

perature within the apparatus, of control means movable in response to the loss in weight of a representative sample of the material being dried as the drying operation progresses said control means including a series of spaced electrical contacts and a cooperating movable contact member, an electric motor, means whereby said electric motor is energized and rotated a predetermined number of revolutions each time said movable contact member engages one of said spaced contacts, and means operated by said motor for adjusting said controller to maintain predetermined different conditions of temperature within the drying apparatus as the drying operation progresses.

48. The combination in a drying apparatus having temperature varying means and a controller cooperating therewith for maintaining any desired conditions of temperature within the apparatus, of control means movable in response to the loss in weight of a representative sample of the material being dried as the drying operation progresses, said control means including a series of spaced electrical contacts and a cooperating movable contact member, an electric motor, means whereby said electric motor is energized and rotated a predetermined number of revolutions each time said movable contact member engages one of said spaced contacts, a rotatable element operatively connected to said motor and arranged to be uniformly turned each time said motor is energized, a temperature-adjusting means operatively associated with said rotatable element, and means operated by said means for adjusting said controller to maintain predetermined different conditions of temperature within the drying apparatus as the drying operation progresses.

49. The combination in a drying apparatus having temperature varying means and a controller cooperating therewith for maintaining any desired conditions of temperature within the apparatus, of control means movable in response to the loss in weight of a representative sample of the material being dried as the drying operation progresses, said control means including two series of alternately arranged spaced electrical contacts and a cooperating movable contact member arranged to engage said contacts in sequence, each of said series of spaced electrical contacts being included in a different electric circuit, an electric motor, means adapted to alternately include said electric motor in one and then the other of said electric circuits after each of a predetermined number of revolutions of the motor, said electric circuits being alternately completed and said electric motor energized and rotated said predetermined number of revolutions each time said movable contact member engages one of said spaced electrical con-

tacts, and means operated by said motor for adjusting said controller to maintain predetermined different conditions of temperature within the drying apparatus as the drying operation progresses.

50. The combination in a drying apparatus having humidity varying means and a controller cooperating therewith for maintaining any desired conditions of humidity within the apparatus, of controlling instrumentalities adapted to be adjusted so as to establish and maintain different conditions of humidity within the apparatus, movable means operatively associated with said instrumentalities and adapted when appropriately moved to adjust said instrumentalities to establish and maintain predetermined different conditions of humidity within the apparatus, control means responsive to the loss in weight of a representative sample of the material being dried, and means actuated by said control means and operatively connected to said movable means for adjusting said controlling instrumentalities to progressively establish and maintain the different conditions of humidity within the drying apparatus required in the course of the drying operation.

51. The combination in a drying apparatus having humidity varying means and a controller cooperating therewith for maintaining any desired conditions of humidity within the apparatus, of controlling instrumentalities adapted to be adjusted so as to establish and maintain different conditions of humidity within the apparatus, control means responsive to the loss in weight of a representative sample of the material being dried, said control means including a series of spaced electric contacts and a cooperating movable contact member operatively connected to a balancing device and arranged to progressively engage said spaced contacts in consequence of the loss in weight of said representative sample as the drying operation progresses, and electromagnetic means actuated by the engagement of said movable contact member with said spaced contacts for adjusting said controlling instrumentalities to progressively establish and maintain the different conditions of humidity within the drying apparatus required in the course of the drying operation.

52. The combination in a drying apparatus having humidity varying means and a controller cooperating therewith for maintaining any desired conditions of humidity within the apparatus, of controlling instrumentalities adapted to be adjusted so as to establish and maintain different conditions of humidity within the apparatus, movable means operatively associated with said instrumentalities and adapted when appropriately moved to adjust said instrumentalities to establish and maintain predeter-

mined different conditions of humidity within the apparatus, control means responsive to the loss in weight of a representative sample of the material being dried, said control means including a series of spaced electric contacts and a cooperative movable contact member operatively connected to a balancing device and arranged to progressively engage said spaced contacts in consequence of the loss in weight of said representative sample as the drying operation progresses, and electromagnetic means actuated by the engagement of said movable contact member with said spaced contacts and operatively connected to said movable means for adjusting said controlling instrumentalities to progressively establish and maintain the different conditions of humidity within the drying apparatus required in the course of the drying operation.

53. The combination in a drying apparatus having humidity varying means and a controller cooperating therewith for maintaining any desired conditions of humidity within the apparatus, of controlling instrumentalities adapted to be adjusted so as to establish and maintain different conditions of humidity within the apparatus, control means responsive to the loss in weight of a representative sample of the material being dried, said control means including two series of alternately arranged spaced electric contacts and a cooperating movable contact member operatively connected to a balancing device and arranged to progressively engage said spaced contacts in consequence of the loss in weight of said representative sample as the drying operation progresses, each of said series of spaced electric contacts being included in a different electric circuit, an electromagnetic device arranged to be included in each of said circuits, means whereby said circuits are alternately completed and said electromagnetic device energized and operated by the progressive engagement of said movable contact member with said spaced contacts, and means whereby the operation of said electromagnetic device adjusts said controlling instrumentalities to progressively establish and maintain the different conditions of humidity within the drying apparatus required in the course of the drying operation.

54. The combination in a drying apparatus having humidity varying means and a controller cooperating therewith for maintaining any desired conditions of humidity within the apparatus, of controlling instrumentalities adapted to be adjusted so as to establish and maintain different conditions of humidity within the apparatus, movable means operatively associated with said instrumentalities and adapted when appropriately moved to adjust said instrumentalities to establish and maintain predetermined

different conditions of humidity within the apparatus, control means responsive to the loss in weight of a representative sample of the material being dried, said control means including two series of alternately arranged spaced electric contacts and a cooperating movable contact member operatively connected to a balancing device and arranged to progressively engage said spaced contacts in consequence of the loss in weight of said representative sample as the drying operation progresses, each of said series of spaced electric contacts being included in a different electric circuit, an electromagnetic device arranged to be included in each of said circuits, means whereby said circuits are alternately completed and said electromagnetic device energized and operated by the progressive engagement of said movable contact member with said spaced contact, and means whereby the operation of said electromagnetic device adjusts said controlling instrumentalities to progressively establish and maintain the different conditions of humidity within the drying apparatus required in the course of the drying operation.

55. The combination in a drying apparatus having humidity varying means and a controller cooperating therewith for maintaining any desired conditions of humidity within the apparatus, of control means movable in response to the loss in weight of a representative sample of the material being dried as the drying operation progresses, said control means including a series of spaced electrical contacts and a cooperating movable contact member, an electric motor, means whereby said electric motor is energized and rotated a predetermined number of revolutions each time said movable contact member engages one of said spaced contacts, and means operated by said motor for adjusting said controller to maintain predetermined different conditions of humidity within the drying apparatus as the drying operation progresses.

56. The combination in a drying apparatus having humidity varying means and a controller cooperating therewith for maintaining any desired conditions of humidity within the apparatus, of control means movable in response to the loss in weight of a representative sample of the material being dried as the drying operation progresses, said control means including a series of spaced electrical contacts and a cooperating movable contact member, an electric motor, means whereby said electric motor is energized and rotated a predetermined number of revolutions each time said movable contact member engages one of said spaced contacts, a rotatable element operatively connected to said motor and arranged to be uniformly turned each time said motor is energized, a humidity-adjusting means oper-

actively associated with said rotatable element, and means operated by said means for adjusting said controller to maintain predetermined different conditions of humidity within the drying apparatus as the drying operation progresses.

57. The combination in a drying apparatus having humidity varying means and a controller cooperating therewith for maintaining any desired conditions of humidity within the apparatus, of control means movable in response to the loss in weight of a representative sample of the material being dried as the drying operation progresses, said control means including two series of alternately arranged spaced electrical contacts and a cooperating movable contact member arranged to engage said contacts in sequence, each of said series of spaced elec-

trical contacts being included in a different electric circuit, an electric motor, means adapted to alternately include said electric motor in one and then in the other of said electric circuits after each of a predetermined number of revolutions of the motor, said electric circuits being alternately completed and said electric motor energized and rotated said predetermined number of revolutions each time said movable contact member engages one of said spaced electrical contacts, and means operated by said motor for adjusting said controller to maintain predetermined different conditions of humidity within the drying apparatus as the drying operation progresses.

In testimony whereof I affix my signature.

JOHN BERCHMANS WELCH.

5 actively associated with said rotatable element, and means operated by said means for adjusting said controller to maintain predetermined different conditions of humidity within the drying apparatus as the drying operation progresses.

10 57. The combination in a drying apparatus having humidity varying means and a controller cooperating therewith for maintaining any desired conditions of humidity within the apparatus, of control means movable in response to the loss in weight of a representative sample of the material being dried as the drying operation progresses, 15 said control means including two series of alternately arranged spaced electrical contacts and a cooperating movable contact member arranged to engage said contacts in sequence, each of said series of spaced elec-

20 trical contacts being included in a different electric circuit, an electric motor, means adapted to alternately include said electric motor in one and then in the other of said electric circuits after each of a predetermined number of revolutions of the motor, 25 said electric circuits being alternately completed and said electric motor energized and rotated said predetermined number of revolutions each time said movable contact member engages one of said spaced electrical 30 contacts, and means operated by said motor for adjusting said controller to maintain predetermined different conditions of humidity within the drying apparatus as the drying operation progresses. 35

In testimony whereof I affix my signature.

JOHN BERCHMANS WELCH.

Certificate of Correction.

It is hereby certified that in Letters Patent No. 1,583,376, granted May 4, 1926, upon the application of John Berchmans Welch, of New Orleans, Louisiana, for an improvement in "Apparatus for Drying and the Like," errors appear in the printed specification requiring correction as follows: Page 2, line 11, for the word "woods" read *wood*; page 5, line 93, for the word "start" read *star*; page 6, line 60, strike out the word "be," first occurrence; page 7, line 105, claim 6, for the misspelled word "represenative" read *representative*; page 10, line 115, claim 25, for the word "cam" read *means*; page 16, line 6, claim 52, for the word "cooperative" read *cooperating*; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 20th day of July, A. D. 1926.

[SEAL.]

M. J. MOORE,
Acting Commissioner of Patents.

Certificate of Correction.

It is hereby certified that in Letters Patent No. 1,583,376, granted May 4, 1926, upon the application of John Berchmans Welch, of New Orleans, Louisiana, for an improvement in "Apparatus for Drying and the Like," errors appear in the printed specification requiring correction as follows: Page 2, line 11, for the word "woods" read *wood*; page 5, line 93, for the word "start" read *star*; page 6, line 60, strike out the word "be," first occurrence; page 7, line 105, claim 6, for the misspelled word "represenative" read *representative*; page 10, line 115, claim 25, for the word "cam" read *means*; page 16, line 6, claim 52, for the word "cooperative" read *cooperating*; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 20th day of July, A. D. 1926.

[SEAL.]

M. J. MOORE,
Acting Commissioner of Patents.