

May 12, 1936.

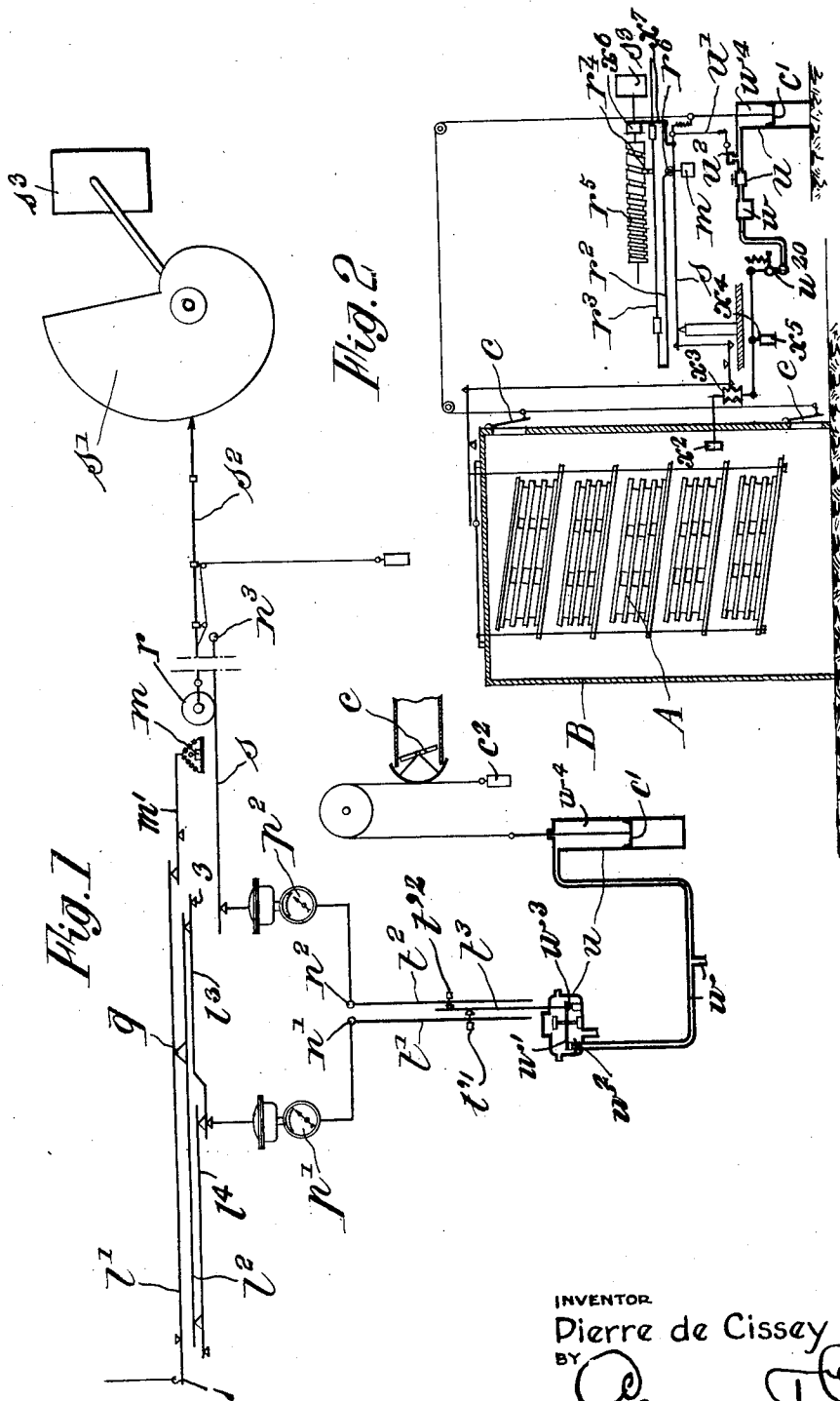
P. DE CISSEY

2,040,729

APPARATUS FOR DRYING WOOD AND THE LIKE

Filed Jan. 5, 1933

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

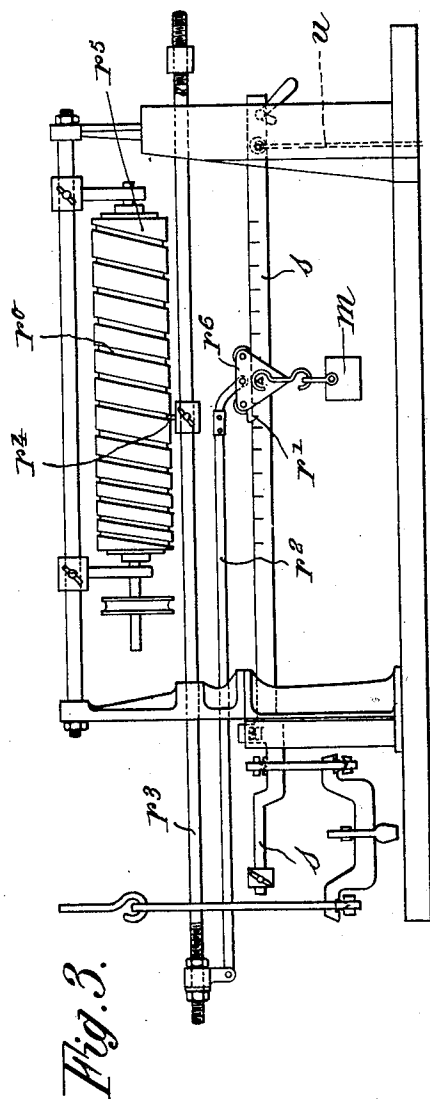


Fig. 3.

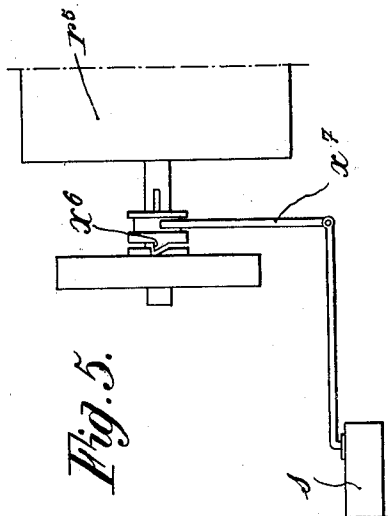
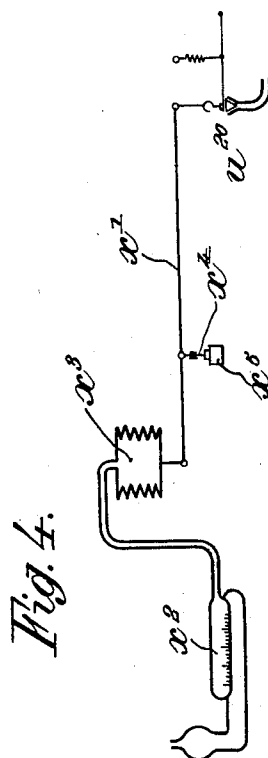


Fig. 5.



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APPARATUS FOR DRYING WOOD
AND THE LIKE

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11 Claims. (Cl. 34—19)

The present invention relates to apparatus for drying wood and the like.

Up to the present time the only procedures for controlling the drying of wood have consisted in

- (1) measuring the humidity of the air in the drying kiln and regulating the amount of moisture in the air so as to control the rate of evaporation or (2) placing small samples in the drying kiln and examining the latter at regular intervals. Neither of these procedures yields very accurate results since the rate of drying of a given wood species varies with its age, origin and other factors and since there is no assurance that drying takes place in the main wood pile at the same rate and in the same way as in the sample.

One of the objects of the present invention is to provide apparatus for accurately controlling and measuring the rate of evaporation of moisture from the wood being dried in a kiln.

- Another object is to provide a drying assembly wherein a wood pile being dried in a kiln is mounted on a balance and variations in the rate of evaporation therefrom are compensated by varying the section of the air inlet controlling the access of air to the kiln.

- Still another object is to provide an additional control for the air inlet to the kiln operating to change the adjustment thereof in accordance with the amount of moisture in the air inside the kiln.

A further object is to provide means for varying the rate of drying wood inside a kiln as a function of the time that the wood remains therein.

- Still further objects will appear in the course of the detailed description now to be given with reference to the accompanying drawings, in which:

Figure 1 represents, diagrammatically, one illustrative embodiment of the invention;

- Figure 2 shows, in diagrammatic section, a second possible form of the invention;

Figure 3 is an enlarged detail, in elevation, of part of the assembly shown in Figure 2;

- Figure 4 illustrates, diagrammatically, a hygrometric control adapted to function with either of the structures shown in Figures 1 and 2;

Figure 5 represents, in elevation, a clutch assembly operative to periodically actuate the time control mechanisms in Figures 1 and 2.

- The invention is based on a very simple operating principle. The wood pile to be dried is supported on the platform of a balance whose arm tends to move angularly as the wood pile loses weight by evaporation. A weight just counterbalancing the weight of the wood pile is slidably

mounted on the balance arm and is displaced therealong by a time control assembly. If, at any time, the balance arm moves out of equilibrium, a relay coupled thereto acts to open or close the air inlet (and outlet, if desired) controlling the rate of flow of air through the drying kiln in which the wood pile is placed. Should the humidity of the air inside the wood kiln become too low (or too high) a hygrometric control may superpose its action on the balance control of the air inlet and outlet to vary the adjustment of the latter. Finally, if the rate of evaporation from the wood pile becomes excessively slow means are provided for temporarily throwing out of action the time controlled device acting on the balance arm.

The invention is, of course, not limited to the particular form described in the preceding paragraph. Thus, if a kiln of the so-called continuous type be used, the rate at which the wood pile loses water by evaporation may be measured by a balance, the latter acting to control the rate at which the wood pile is displaced through the kiln. Similarly the temperature of the kiln or the rate of flow of drying gases therethrough (be it intermittent or continuous) may be varied in the same way to yield the same result.

In Fig. 1, I have shown a first embodiment of my invention which includes a balance arm l^1 adapted to support the weight of a wood pile, and two pressure transmitters and indicators p^1 and p^2 which transmit, against suitable resilient resistance, the forces exerted by the weight of the wood and the weight acting on lever s to two bent levers t^1 and t^2 pivoted at n^1 and n^2 respectively. Between these levers t^1 and t^2 there is interposed a third lever t^3 adapted to pivot about its lower end. Levers t^1 and t^2 bear against said lever t^3 through two abutments t'^1 and t'^2 carried by the two first mentioned levers respectively. A weight m acts, through a lever m^1 , on balance arm l^1 so as to balance the tare.

The weight of the wood pile is transmitted, through levers l^1 , l^2 , l^3 , l^4 (levers l^1 , l^3 and l^4 being pivoted at 1, 3 and 4 respectively) to indicator p^1 . A knife-edge q adapted to slide along lever l^2 makes it possible to modify the leverage thereof, so that the initial number marked by indicator p^1 on the dial thereof can be chosen at will.

On the other hand, a balance arm s , pivoted at n^3 , is subjected to the action of a weight r adapted to slide therealong. The position of said weight r along arm s is controlled by a cam s^1 acting on said weight r through a rod s^2 and actu-

ated by a clockwork mechanism s^3 on the drawing. Balance arm s acts on indicator p^2 .

All these members are arranged in such manner that the respective actions of the weight of the wood pile and of weight r tend to move lever t^3 in opposite directions.

Said lever t^3 operates a pneumatic control device u which controls, through any suitable means, for instance a cable v , a shutter c through which the amount of air flowing through the drying kiln is controlled. Naturally the rate of drying will vary in accordance with the flow of air.

For example, w may be a pipe connected to a source from which air under constant pressure is continuously supplied. w^1 is a valve connected to lever t^3 and moving towards or from mouth w^2 of pipe w about fulcrum w^3 as lever t^3 swings in one direction or the other. Pipe w is also connected to cylinder w^4 . A piston c^1 in cylinder w^4 is connected to valve c so that movement of the piston turns the valve against the action of weight c^2 . Now the position of piston c^1 will vary with changes in pressure, which will in turn depend on the amount of air which escapes through valve w^1 and therefore on the position of lever t^3 .

The hereinabove described assembly operates in the following manner: The profile of cam s^1 is chosen so that the rate of drying follows a predetermined schedule; this schedule must be determined by experience, depending on the type of wood being dried and the purpose for which it is intended; the object of the present invention being to provide an apparatus by which automatic drying according to any desired schedule chosen by the operator may be accomplished; as the wood pile dries transmitter p^1 tends to oscillate lever t^1 , but, since, at the same time, weight r has moved along balance arm s under the action of cam s^1 and rod s^2 , balance arm s will act on transmitter p^2 so as to tend to oscillate bent lever system t^2 ; if the loss in weight of the wood pile takes place at the same rate as proportionate displacements of weight r , levers t^1 and t^2 will react equally in opposite directions on control lever t^3 and pressure relay u will have no action on port or ports c ; on the contrary, should the rate of evaporation differ in either direction from the rate of drying corresponding to the movement of weight r along arm s , the actions transmitted through levers t^1 and t^2 to lever t^3 will cease to balance each other and lever t^3 will be caused to pivot in one direction or the other according as the drying has occurred too quickly or too slowly. The pivoting displacement of lever t^3 will operate relay u and, through it, shutter c , thus increasing or reducing the rate of flow of air through the drying kiln in order to rectify the rate of drying and to bring it into accordance with the rate of variation chosen in advance.

It is to be noted that, if indicator p^1 is properly adjusted, it will show directly the real proportion of water remaining in the wood pile. Thus, assuming that the wood before drying contains water in an amount equal to 60% of the weight of the dry wood, a dial having 160 graduations may be mounted on the indicator so that the latter reads 160 at the beginning of the drying operation; when this indicator reads 100, the wood no longer contains water; with the wood itself removed, the reading will be 0. Similarly, indicator p^2 may be graduated to indicate the proportion of water which the wood should contain theoretically were the drying operation

properly carried out, this indicator being responsive to displacements of the balance arm under the action of movable weight r . Obviously, indicator p^2 (and, rigorously speaking, indicator p^1) may be eliminated from the assembly without affecting its operation, this instrument (or instruments) serving to indicate the progress of the drying operation.

In the variant represented in Figs. 2 and 3, the hereinabove described assembly is modified so that the weight of a wood pile A contained in a kiln B is transmitted directly via a Roman balance to balance arm s and elements r^6 and m are combined to slide along the balance arm under the action of a pair of pivotally connected rods r^2 and r^3 displaced laterally by a finger r^4 clamped in position on rod r^3 and engaging in a cam groove r^0 formed in a rotatable cylinder r^5 . Groove r^0 has a shape corresponding to the rate of drying desired. Tare m may be pivotally connected to element r^6 . As in the case of cam s^1 (Figure 1), cylinder r^5 is driven by any convenient form of clock work. In this form of apparatus, rupture of equilibrium between the wood pile and balance arm s results in a displacement of a rod u^1 controlling pressure relay u acting on ports c . Obviously, cam r^5 may be replaced by a cam of the type of s^1 shown in Figure 1 and conversely. If desired, weight carrier r^6 may be provided with an index r^1 moving along suitable graduations provided on bar s .

Inasmuch as elements s^1 and r^5 operate as a function of the time without regard to variation of humidity in the kiln, it is desirable to couple a hygrometric control to the assembly shown in Figures 1 and 2 so that the movement of ports c is further modified in accordance with variations in the humidity of the air inside the kiln. A control of this kind, represented in Figure 4, consists of a wet and dry bulb thermometer type of psychrometer x^2 of conventional design (the dry bulb may be eliminated if the temperature of the kiln is thermostatically controlled) connected to a bellows x^3 reacting on a lever x^1 to actuate an auxiliary valve u^{20} connected to pipe w helping to control the action of relay u . It will at once be seen that the psychrometer will respond to variations in the humidity of the air in the kiln to throw the mechanism above described out of action when drying takes place at a rate different from that corresponding to the rate of displacement of weight r , for instance when it takes place too slowly.

In this case I provide a clutch x^6 interposed between the clockwork mechanism above referred to (located on the left hand side of clutch x^6 in Fig. 5) and cam cylinder r^5 . This clutch is controlled by a bent lever x^7 one branch of which rests on arm s . When drying takes place at a rate that is exaggeratedly slow, it is easy to understand that arm s is very much inclined, thus giving lever x^7 the necessary displacement for disengaging clutch x^6 .

Figure 5 represents an auxiliary device acting to arrest the movement of weight r when the rate of drying takes place more slowly than a predetermined rate. The device consists of a bent lever x^7 responsive to movements of balance arm s to actuate a clutch x^6 functioning stop (or start) rotation of cam cylinder r^5 (or cam s^1).

The invention is not to be taken as limited to the particular combinations shown in any single figure of the drawings. Thus, the balance assemblies shown in Figures 1 and 2 may be used interchangeably and with or without indicators. Sim-

ilarly, the hygrometric control shown in Figure 4 may be applied to either of the assemblies represented in Figures 1 and 2. Relay *u* may, obviously, be replaced by any equivalent device.

What I claim is:—

1. An apparatus for controlling the rate of drying of a mass of material placed in a drying kiln, which comprises in combination, a movable member, means for acting on said member in one direction of its movement with a force proportional to the actual weight of the mass of material in the kiln, means for acting on said member in the opposite direction with a force which decreases in accordance with a predetermined rate of variation as a function of the time, and means controlled by movement of said member for varying the conditions of drying in said kiln so as to tend constantly to balance the opposed forces acting on said movable member.

2. An apparatus for controlling the rate of drying of a mass of material placed in a drying kiln, which comprises in combination, a movable member, means for transmitting to said member a force proportional to the weight of said mass, a movable weight adapted to act on said member in a direction opposite to that of said force, means for moving said weight in accordance with a predetermined rate of displacement as a function of time so as to vary the action of said weight on said member, and means controlled by movement of said member for varying the conditions of drying in said kiln so as to tend constantly to balance the opposed forces acting on said member.

3. An apparatus for controlling the rate of drying of a mass of material placed in a drying kiln, which comprises in combination, a movable member, means for transmitting to said member a force proportional to the weight of said mass, a pivoted lever connected to said movable member, a weight movable along said lever to act therethrough on said member in a direction opposite to that of said force, means for moving said last mentioned weight along said lever in accordance with a predetermined rate of displacement as a function of time, and means controlled by movement of said member for varying the conditions of drying in said kiln so as to tend constantly to balance the opposed forces acting on said member.

4. An apparatus for controlling the rate of drying of a mass of material placed in a drying kiln, which comprises in combination, a movable member, means for transmitting to said member a force proportional to the weight of said mass, a pivoted lever connected to said movable member, a weight slidable along said lever to act through it on said member in a direction opposite to that of said force, means for moving said weight along said lever in accordance with a predetermined rate of displacement as a function of time, means for controlling the rate of flow of drying air passing through said kiln, and means controlled by movement of said member for actuating the last mentioned means so as to tend constantly to balance the opposed forces acting on said member.

5. An apparatus for controlling the rate of drying of a mass of material placed in a drying kiln, which comprises in combination, a movable member, means for transmitting to said member a force proportional with the weight of said mass, a pivoted lever connected to said movable member, a weight slidable along said lever to act through it on said member in a direction oppo-

site to that of said force, a cam, means for moving said cam, connecting means interposed between said cam and the last mentioned weight so as to move the latter along said lever in accordance with a predetermined rate of displacement as a function of time, means for controlling the rate of flow of drying air passing through said kiln, and means controlled by movement of said member for actuating the last mentioned means so as to tend constantly to balance the opposed forces acting on said member.

6. An apparatus for controlling the rate of drying of a mass of material placed in a drying kiln, which comprises in combination, a movable member, means for transmitting to said member a force proportional to the weight of said mass, means to indicate said force, a pivoted lever, means for connecting said lever to said movable member, a weight slidable along said lever so as to act through it on said member in a direction opposite to that of the above mentioned force, a cam, means to indicate the force exerted by said weight on said movable member, means for moving said cam, connecting means interposed between said cam and said weight for moving the latter along said lever in accordance with a predetermined rate of displacement as a function of time, means for controlling the rate of flow of drying air passing through said kiln, and means controlled by movement of said member for actuating the last mentioned means so as to tend constantly to balance the opposed forces acting on said organ.

7. An apparatus for controlling the rate of drying of a mass of material placed in a drying kiln, which comprises in combination, an oscillating lever, means for transmitting to said lever a force proportional to the weight of said mass, a weight slidable along said member acting thereon in a direction opposite to that of said force, means for moving said weight along said lever in accordance with a predetermined rate of displacement as a function of time, and means controlled by movement of said lever for varying the conditions of drying in said kiln to tend constantly to balance the opposed forces acting on said organ.

8. An apparatus for controlling the rate of drying of a mass of material placed in a drying kiln, which comprises in combination, an oscillating lever, means for transmitting to said lever a force proportional to the weight of said mass, a weight slidable along said lever acting thereon in a direction opposite to that of said force, means for moving said last mentioned weight along said lever in accordance with a predetermined rate of displacement as a function of time, means for controlling the rate of flow of drying air passing through said kiln, and means controlled by movement of said lever for actuating said last named means to tend constantly to balance the opposed forces acting on said lever.

9. An apparatus for controlling the rate of drying of a mass of material placed in a drying kiln, which comprises in combination, an oscillating lever, means for transmitting to said lever a force proportional to the weight of said mass, a weight slidable along said lever acting thereon in a direction opposite to that of said force, a cylinder substantially parallel to said lever provided with a groove winding around its periphery according to a predetermined curve, means for rotating said cylinder around its axis at a

predetermined rate, a projection carried by said weight engaging said groove, means for controlling the conditions of drying in said kiln, and means controlled by movement of said lever for actuating said last named means to tend constantly to balance the opposed forces acting on said lever.

10. In an apparatus as set forth in claim 1, said last means including a relay, and hygrometer means responsive to the humidity in

said kiln for acting on said relay to provide additional control of said last means.

11. An apparatus as set forth in claim 2 including means operatively connected with said movable member for temporarily rendering inoperative said means for moving said second named weight with respect to said member when the difference of the forces acting on said movable member exceeds a predetermined value.

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