Jan. 2, 1940. E. ALTENKIRCH 2,185,760

DRYING METHOD AND APPARATUS

Filed March 9, 1934

Fig. 1.

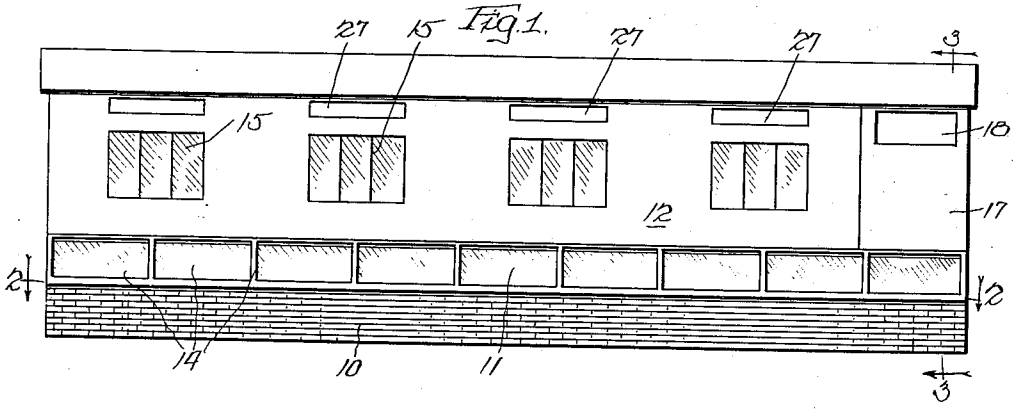


Fig. 2.

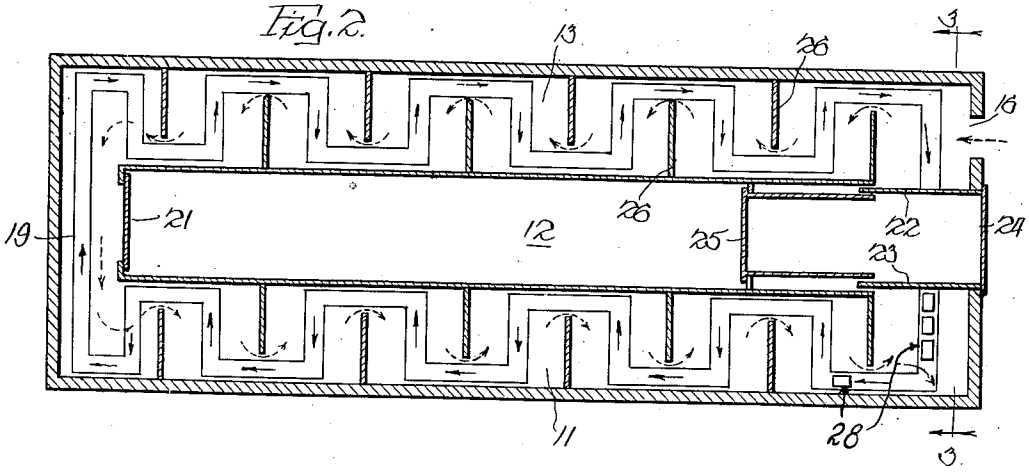
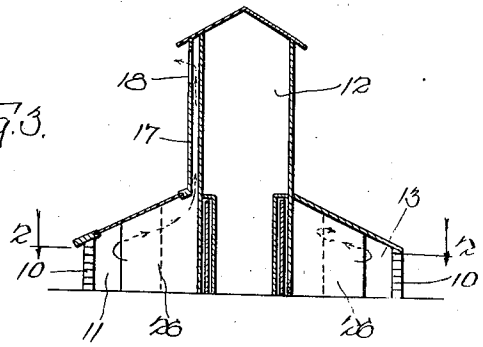


Fig. 3.



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Patented Jan. 2, 1940 2,185,760

UNITED STATES PATENT OFFICE

2,185,760

DRYING METHOD AND APPARATUS

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Application March 9, 1934, Serial No. 714,739
In Germany March 10, 1933

12 Claims. (Cl. 34—24)

This invention relates to apparatus for drying air and various materials, as for example lumber and agricultural products.

Lumber and like products can be dried by exposing them to the heat of the sun. As ordinarily carried out the process is slow and not reliable because the partial pressure of the water vapor in the air to which the lumber is exposed is not properly controlled. If the moisture in the air is relatively high, the moisture content in the wood remains high, or, under some conditions, the wood absorbs moisture from the air.

It is an object of the present invention to provide means for drying air, lumber or like products in which the moisture content of the air is controlled.

It is a further object of the invention to utilize wood as a drying medium to remove moisture from the air before it passes over the material to be dried. If wood itself is the medium being dried or the material undergoing treatment, it may act as an agent to be dehumidified part of the time and as an absorption agent to control the moisture content in the air which flows over wood which is being dried, at other times.

It is a further object of the invention to provide apparatus for drying substances such as wood, which is capable of operating with only a small difference in temperature and with heat input at a low temperature. Although the heat input in thermal units may be greater with such an apparatus than that which would be necessary if the heat were supplied to the apparatus at a higher temperature, this is of no importance if waste heat or the heat of the sun is used.

Other objects and advantages reside in certain novel features of the arrangement and construction of parts as will be apparent from the following description taken in connection with the accompanying drawing in which:

Figure 1 is a side view of a building constructed in accordance with the principles of the invention, the view being taken from the side.

Figure 2 is a plan or cross-sectional view of the building of Figure 1 the cross-section being taken on the line 2—2 of Figure 1, and

Figure 3 is a vertical cross-sectional view of the building of Figures 1 and 2, the view being taken on the line 3—3 of these figures.

Referring to the drawing in detail it will be seen that a foundation 10 supports a framed structure having three compartments designated 11, 12 and 13 respectively. The chamber 11 is on the south side of the building, while the chamber 13 is on the north side of the building. The chamber 12 may be considerably higher than the chambers 11 and 13, as shown.

The roof of the chamber 11 may be made of glass as shown at 14, the construction being similar to that used on greenhouses. Thus when the sun is shining, the chamber 11 will be at a higher temperature than the chamber 13. The south wall of the chamber 12 may also be provided with the number of windows as indicated at 15 these serving to admit sun into the chamber 12.

Aside from doors, there are no openings in the building except at the east end of the chambers 11 and 13, and in the south wall of the chamber 12, near the roof. As shown in Figures 1 and 2 the building is open to the atmosphere by means of the opening 16 at the east end of the chamber 13 while the east portion of the south wall of the chamber 11 is provided with a sort of chimney 17 connected to the atmosphere through the opening 18. The chambers 11 and 13 are in open communication at the west end of the building as shown at 19. Material may be conveyed from either chamber 11 or 13 into the chamber 12 through the door 21 at the west end of chamber 12, while the sliding doors 22, 23 at the east end of chamber 12 provide means for conveying material from chamber 13 into chamber 11 or into chamber 12. Doors 24 and 25 are also provided for bringing dried material out of chamber 12 to the outside of the building. Material to be dried can be brought from the outside into the chambers 11 or 13, through the doors 24, 22 and 23.

It will be apparent from the arrangement illustrated, particularly as shown in Figure 2, that with this arrangement of doors, the chamber 12 may be completely sealed off from the chambers 11 and 13, or the chambers may be placed in communication for the conveyance of material from one to the other as desired. Thus, if it is desired to deliver or remove material from chamber 12 from outside of the building, only doors 24 and 25 are opened. If it is desired to transfer material between chamber 12 and either of the chambers 11 or 13, door 25 and doors 22 or 23 are opened. If material is to be transferred between chambers 11 and 13, doors 22 and 23 are opened. And if material is transferred between the outside and either of the chambers 11 and 13, door 24 and one or the other of doors 22 and 23 are opened.

Means is provided in the chambers 11 and 13 for causing the air flowing therethrough to travel in a tortuous path. In the arrangement shown

this consists of vertical partitions 26 which are arranged in staggered relation and cause the air to flow back and forth horizontally. Other forms of deflectors could be used for causing the air to flow in any desired path.

With the arrangement illustrated, with doors 21, 22 and 23 closed, air will be circulated through the chambers 11 and 13 due to natural convection, when the sun is shining into the south chamber 11. The air will enter the building through the east end of the chamber 13 and flow westwardly through this chamber, then through passage 19 into the chamber 11 and after flowing eastwardly through the chamber 11 will pass out of the building through the chimney 17 and opening 18. While natural convection currents are desirable for economy of operation, it is of course within the purview of the invention to provide fans or blowers or other circulating means for causing the air to circulate through the building.

Lumber or other material which it is desired to be de-humidified is placed in the room 11 and gives up its moisture to the air in the south room 11 of the building. However, unless the air entering the chamber 11 is of the proper humidity, the drying process is uncertain and is not carried out expeditiously and efficiently. In accordance with the present invention it is proposed to cause the lumber or other material being treated to pass through the chamber 13 as well as the chamber 11 so that the material in chamber 13 can absorb moisture from the air entering this chamber through the opening 16 and thus de-humidify the air before it comes in contact with the lumber or material undergoing drying in chamber 11. Thus if lumber is the material being treated it may be continuously or periodically supplied to the chamber 11 at the east end either from outside the building through the door 24 and the sliding door 23, or from the chamber 12 through the doors 25 and 23 or from the chamber 13 through the doors 22 and 23. In any event the lumber will be circulated in a clockwise direction as viewed in Figure 2, through the chambers 11 and 13. The length of time necessary for full treatment will vary with the material and with atmospheric conditions and may be anywhere from a few hours to several weeks. In any case, however, the material will give up moisture to the air as it is heated in the chamber 11 and will absorb moisture from the air as it passes through the chamber 13. If operated as described above, however, the moisture content in the air leaving the building through the chimney 17 will always have a higher moisture content than the air entering the building through the opening 16 at the east end of the chamber 13, and the moisture content of the lumber will be gradually decreased.

In Figure 2 the direction of air circulation has been indicated by dotted arrows, while the direction of movement of the lumber or other material to be dried is indicated by arrows in heavy lines. As the material circulates as indicated by the heavy arrows some may be removed from the west end of the chamber 11 as it reaches the proper degree of dryness through the door 21 into the chamber 12. Chamber 12 may act as a storeroom or as a room in which the material may be predried, before being subjected to the drying process described above, the drying in chamber being effected by the sun shining through the windows 15 and the flow of air in and out of the chamber 12 through vents 27 near the roof.

While the arrangement illustrated is of particular advantage where the same material is used for removing moisture from the air in the room 13 as is being treated in the room 11, the arrangement may be advantageously employed otherwise and the material to be dried may pass merely from the east end of the room 11 to the west end thereof and be conveyed into the storeroom 12 while the wood or other absorbing material is circulated through the rooms 11 and 13 as described above. Various kinds of conveyors may be used to convey the material through the rooms and it is contemplated to use machine driven automatic conveyors as well as trucks or other devices for handling materials. On Figure 2, trucks are diagrammatically illustrated at 28.

If the wood to be dried has large surfaces compared to its volume it may be dried comparatively rapidly, the time for carrying out the process varying from only a few hours to several months depending on the character of the material. If large pieces with relatively small surfaces have to be dried it is advantageous to arrange it in such a way to expose as large a surface as possible to the air. Thus where logs are being dried or are used as the absorbing medium, they may be piled crisscross.

Many other materials can be dried in the arrangement illustrated. Goods which can be dried quickly may be moved at a higher speed than the absorbing material. Goods which would be spoiled by exposure to the sun radiation in the room 11 may be dried in the room 13 or in the room 12. In fact the materials to be dried can be subjected to air of almost any degree of dryness since the moisture content of the air varies in different parts of the building. Material such as agricultural products can be dried without being subjected to high temperatures which are likely to spoil their taste.

While only one embodiment of the invention has been shown and described herein it is obvious that various changes may be made in the arrangement and construction of parts without departing from the invention or the scope of the annexed claims.

I claim:

1. Apparatus for continuously drying a substance with the aid of dry air, comprising two chambers, means for conveying absorbing material through said chambers in a closed cycle, means for conveying the substance to be dried through one of said chambers and means for moving air through said chambers in counterflow to the movement of said absorbing material.

2. Apparatus for drying a substance, comprising a first chamber having absorbing material therein, a second chamber having absorbing material therein, means for maintaining the material in the first chamber at a relatively high temperature and the material in the second chamber at a relatively low temperature, means for moving air over the material in both chambers and means for moving the substance to be dried through the first chamber in counterflow to the flow of air in the first chamber.

3. Apparatus for drying a substance, comprising a first chamber containing absorbing material, a second chamber containing absorbing material, means for maintaining the material in the second chamber at a lower temperature than the material in said first chamber, means for passing air through said chambers and means for moving the substance to be dried through said first chamber.

4. Apparatus for drying a substance compris-

ing two chambers, means for circulating air through said chambers, means for maintaining said chambers at different temperatures, means for conveying absorbing material through said chambers in a closed cycle in counterflow to the flow of air therethrough and for conveying the substance to be dried through the warmer chamber in the same direction as the movement of the absorbing material therein.

5. Apparatus for drying a substance comprising two chambers, means for circulating air through said chambers, means for maintaining said chambers at different temperatures, means for conveying absorbing material through said chambers in a closed cycle in counterflow to the flow of air therethrough and for conveying the substance to be dried through the warmer chamber at a different speed than that of the movement of the absorbing material therein.

6. The method of drying material which includes the steps of first partially drying a certain amount of the material by subjecting it to heat in the presence of air having an ordinary moisture content, then using some of the partially dried material to dry a quantity of air and finally drying the remainder of the material to a high degree of dryness by subjecting the same to heat in the presence of the dried air.

7. The method of drying a substance which includes the steps of subjecting the substance to heat to obtain an initial degree of dryness, then cooling the dried substance and subjecting it to a body of air to cause the substance to absorb moisture from the air and thereby obtain a quantity of dried air, then again drying the substance by subjecting it to heat and finally, subjecting the substance to heat while passing a quantity of the previously dried air thereover.

8. The method of drying material which includes the steps of first partially drying a quantity of the material by exposing it to the heat of the sun in the presence of air having a moisture content substantially the same as that of atmospheric air, then using part of the partially dried material to dry a quantity of atmospheric air by cooling this part of the material and passing atmospheric air thereover to cause this part to absorb moisture from the atmospheric air and finally drying the remainder of the material to a high degree of dryness by subjecting the same to the heat of the sun in the presence of the dried air.

9. Apparatus for drying a substance comprising means for moving absorbent material in a cycle through a heated chamber and a cooled chamber, means for causing air to pass from the atmosphere through the cooled chamber, then through the heated chamber and then back to the atmosphere and means supporting the substance being dried in the heated chamber so that it is exposed to the air passing therethrough, the arrangement being such that the absorbent material is alternately activated in the heated chamber and caused to absorb moisture from the air in the cooled chamber so as to dry the air in the cooled chamber thereby enabling the substance being dried to be exposed to dry air in the heated chamber.

10. Apparatus for drying solid material by the aid of solar heat comprising a building having a relatively high elongated central chamber and a relatively low chamber on the opposite sides thereof, a passageway interconnecting said low chambers near one end of the same, said chambers being so disposed that said high chamber shields one of said low chambers from the heat of the sun during the major portion of the day and leaves the other low chamber exposed to the sun so that said other chamber is heated by the sun to dry solid material therein, an air inlet to said shielded chamber and an air outlet to the atmosphere from the upper portion of said heated chamber, and absorbent material in said shielded chamber for pre-drying air passing therethrough and to said sun-heated chamber so that the solid material in said last named chamber can be dried to a higher degree of dryness.

11. Apparatus for drying solid material by the aid of the heat of the sun comprising an elongated building divided into a plurality of chambers including a chamber shielded from the heat of the sun, a material receiving and storing chamber, and a sun-heated material drying chamber, an air inlet to said shielded chamber, an air outlet from the upper portion of said heated chamber, an air passageway between said shielded and heated chambers at a point remote from said air inlet and outlet whereby air heated by the sun in said heated chamber flows out through said outlet and causes other atmospheric air to enter through said inlet and flow through said shielded chamber into the heated chamber to dry material therein, and absorbent material in said shielded chamber to pre-dry the air flowing therethrough.

12. Apparatus for drying solid material by the aid of solar heat and pre-dried atmospheric air comprising a unitary building having an air pre-drying chamber provided with an elongated passageway, means for supporting moisture absorbent material in said passageway so that atmospheric air passing thereover will be dehumidified and dried, means interposed between said chamber and the sun to shield said chamber from the heat of the sun during that portion of the day in which the sun is most effective, a material drying chamber in said building exposed directly to the heat of the sun and having one wall thereof constructed and positioned in such manner as to transmit a large amount of the sun's heat to the interior thereof, means within said sun-heated chamber for supporting material to be dried in such manner as to be heated by the sun through said one wall which transmits the sun's heat, a passageway for conducting pre-dried air from said air drying chamber to said sun heated chamber in substantially the same condition as when it leaves said pre-drying chamber, an air supply inlet to the pre-drying chamber and an air outlet from said sun heated chamber, said inlet and said outlet being at points remote from said passageway interconnecting said pre-drying and sun-heated chambers, and an upstanding flue heated by the sun and connected at its lower end to said air outlet whereby when said flue is heated air flows by thermosyphonic action through said inlet, through said pre-drying chamber, through said connecting passageway, through said sun-heated chamber and then through said flue to the atmosphere.

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