Nov. 11, 1924. 1,515,431

J. F. COBB

DRYING KILN

Filed Oct. 30, 1923 3 Sheets-Sheet 1

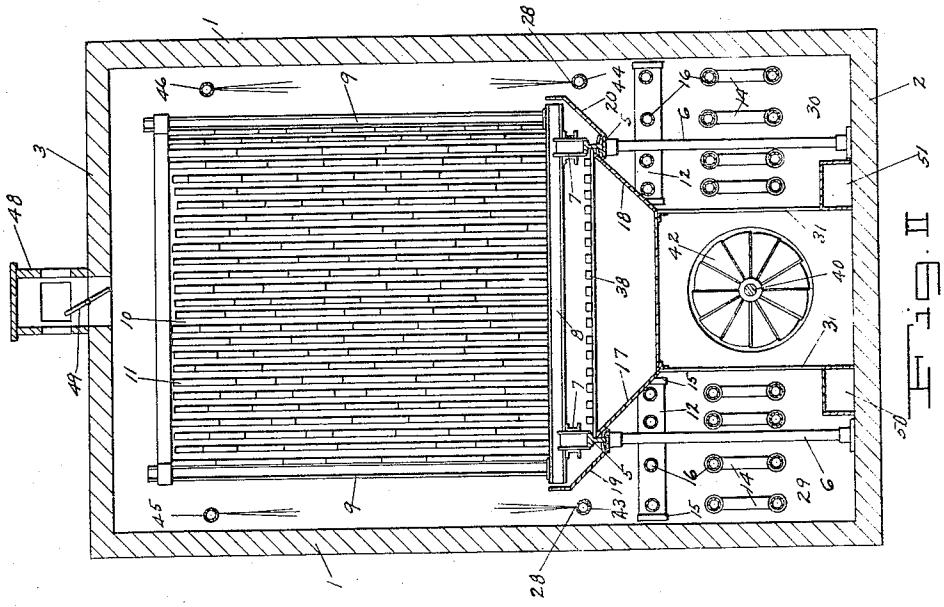


Fig. II

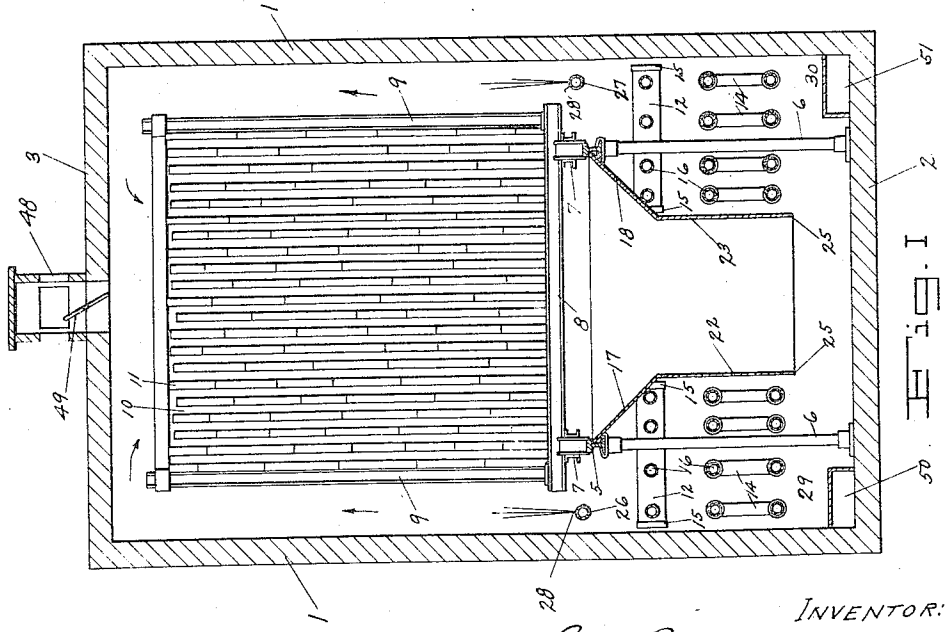


Fig. I

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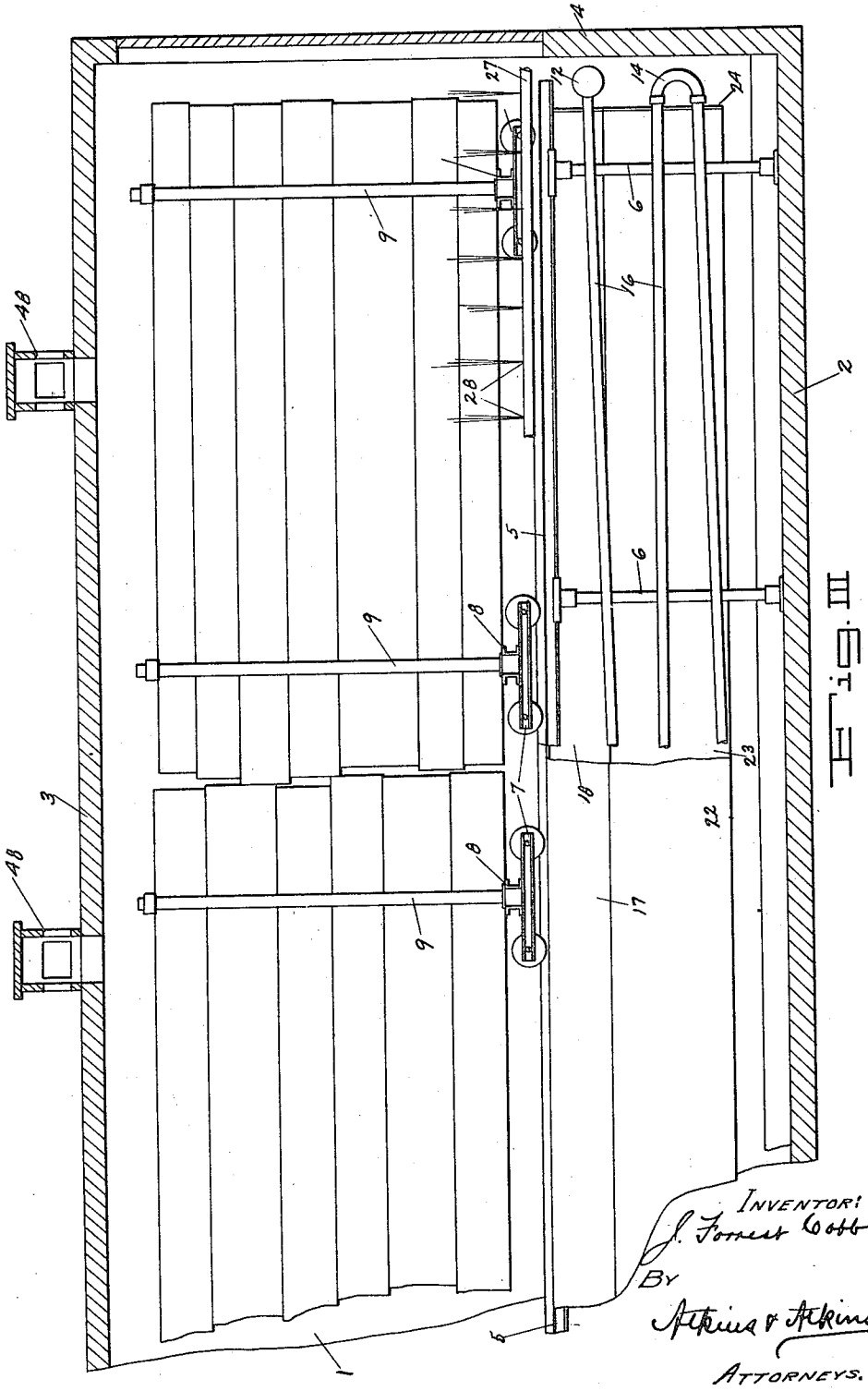


Fig. III

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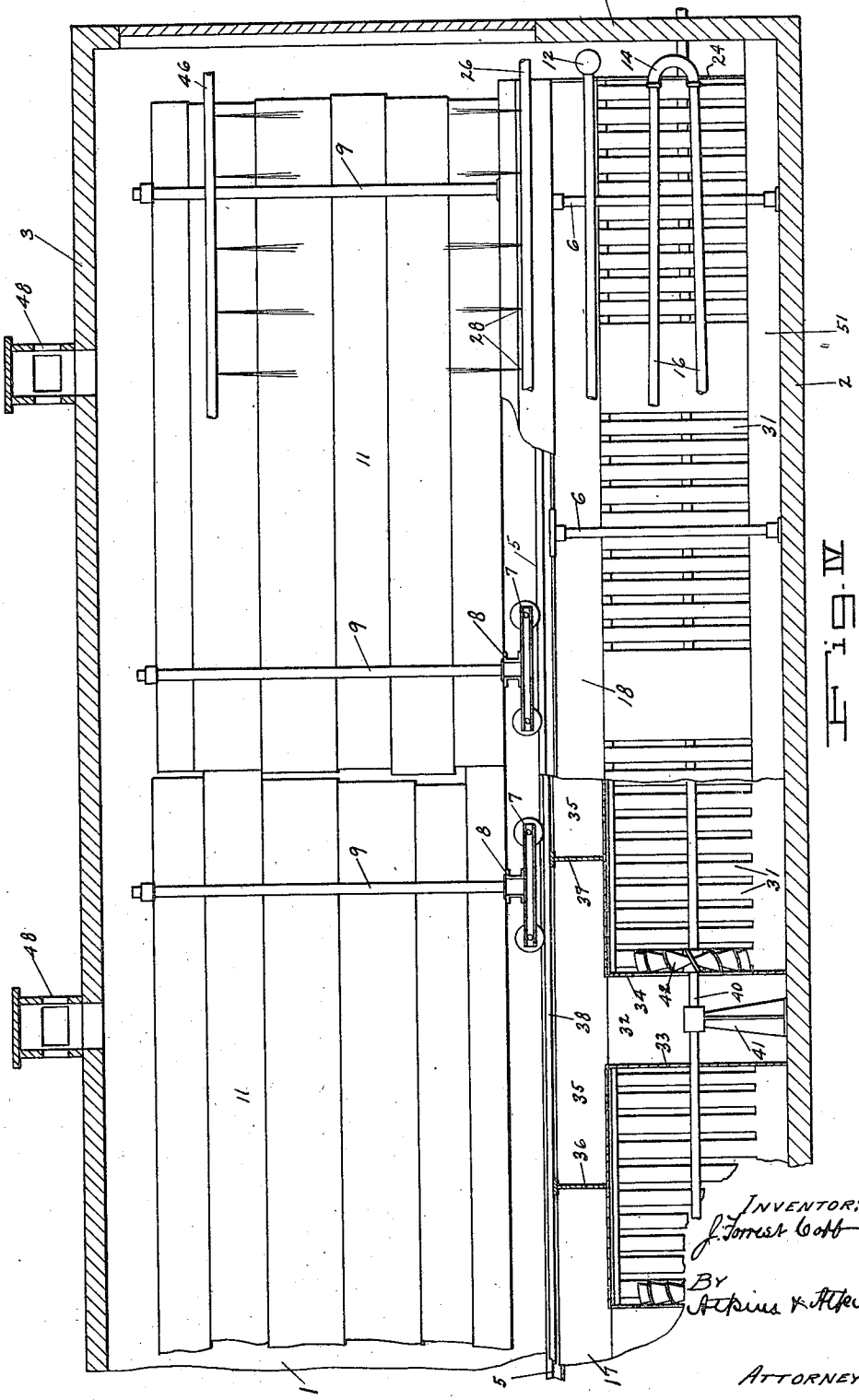


Fig. 4.

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Patented Nov. 11, 1924. 1,515,431

UNITED STATES PATENT OFFICE.

J. FORREST COBB, OF PORTLAND, OREGON.

DRYING KILN.

Application filed October 30, 1923. Serial No. 671,731.

To all whom it may concern:

Be it known that I, J. FORREST COBB, a citizen of the United States of America, and resident of Portland, in the county of Multnomah, in the State of Oregon, have invented certain new and useful Improvements in Drying Kilns, of which the following is a specification, reference being had to the accompanying drawings.

My invention relates to improvements in apparatus for the drying of substances generally, and particularly for drying lumber or the like, in closed chambers which are commonly denominated kilns.

Among the objects of my invention a most important one is to produce means for effecting forced circulation of the gaseous contents of a kiln with a high degree of efficiency combined with economy in the drying operation. For convenient brevity, said circulation is hereinafter denominated air circulation.

Besides the object just specified, my invention includes the production of certain improved means or mechanism which contribute to the attaining of that object.

What constitutes my invention will be hereinafter specified in detail and succinctly set forth in the appended claims.

In the accompanying drawings:

Figure I is a vertical transverse section of the present preferred form of my invention showing an automatic gravity-actuated means of producing forced air circulation within the kiln.

Figure II is a similar view showing a modification of my invention as shown in Figure I, wherein mechanically driven fans are employed to promote air circulation.

Figure III is a vertical longitudinal section, partially broken away, of a kiln of the type shown in Figure I, illustrating the interior apparatus of the kiln broken away to exhibit the same in different vertical planes.

Figure IV is a view similar to Figure III illustrative of the kiln shown in Figure II.

Referring to the numerals on the drawings, in each figure thereof where they appear, 1 indicates opposite side walls, 2 the floor, 3 the roof, and 4 end walls of a closed chamber united to constitute the outside walls of a kiln. Said walls may be made of any suitable and preferred material, constructed or combined in any preferred manner so as to confine within the closed chamber or kiln the gaseous circulatory medium without waste of the heat that is imparted to it.

The end walls 4, or at least one of them, are preferably made to include some form of door by which material to be dried may be conveniently introduced into the kiln and withdrawn from it.

Extending lengthwise through the kiln are tracks or rails 5 which are supported at suitable intervals within the kiln, at desired elevation above the floor 2, as by standards 6. The tracks are designed to support and carry wheeled trucks 7 which may be of any usual form preferred, and which are united in pairs preferably by cross-beams or bunks 8. Near the opposite ends of each of the members 8 are provided fixed upright stakes 9 which extend towards the roof of the kiln and within such distance therefrom as will afford ample space above the loaded trucks for air circulation between the roof 3 and the top of the load. Upon the top of the cross-beams 8 on the trucks, material to be dried is piled so as to provide at frequent intervals longitudinally continuous vertical air slits 10, my invention being especially adapted for the drying of lumber piled edgewise as shown in the drawings.

In the piling of lumber, I prefer to bring the adjacent ends of the boards 11 substantially into close juxtaposition as shown in Figures III and IV, so that, in effect, the air slits 10 are made virtually continuous from end to end of the interior of a kiln. This is done with a view to avoid the presence of unnecessary air pockets in the body of the material to be dried, whose presence might tend to interfere to some degree with the proper circulation of the gaseous drying medium within the kiln.

The height of the elevation of the tracks 5 above the floor 2 is determined by the space necessary to accommodate below them the heating and other means if employed for promoting air circulation within my kiln.

The heating means provided is preferably what is known in the art as the return bend header heating system, and which consists preferably of a series of headers 12 and return bends 14 disposed near opposite ends of the kiln respectively. In the drawings, Figures III and IV, one header 12 and one return bend 14 are shown as parts of a well known return bend heating system, of which one end only is illustrated. Illus-

tration of a complete return bend heating system is deemed unnecessary because it would simply include a similar showing of the said members 12 and 14 at the end of the system opposite to that shown in the figures last mentioned. The headers are closed at their opposite ends, respectively, as indicated at 15, and are united at intervals by return bend pipes 16. The headers and connecting pipes 16 are supplied with suitable heating medium, preferably steam, from a source not illustrated outside of the kiln, and in any preferred manner known to the art.

An important means employed for promoting air circulation consists of baffle plates 17 and 18 which are preferably relatively convergent and which extend substantially the full length of the kiln between the opposite headers 12. They are supported at intervals, as by the tracks 5 or by the heads of the uprights 6. Their transverse extent is preferably substantially equal to the distance between opposite stakes 9, they being provided as a collector for the accommodation of air currents from the slits 10 in the load piled between said stakes. The distance between the lower edges of the baffle plates should be substantially equal to the combined capacity of all the slits 10 which communicate with said space. The transverse spread of the baffle plates 17 and 18 may be supplemented, if desired, by auxiliary baffle plates 19 and 20, substantially coextensive in length with the main baffle plates, but the auxiliary plates may be employed or not at preference to suit working conditions imposed, for example, by the nature of the material to be dried. The auxiliary baffle plates 19 and 20 are shown only in Figures II and IV in connection with the type of kiln shown therein, but it should be understood that they may be employed if desired in connection with the other type of kiln shown.

The baffle plates constitute, as has been indicated, a longitudinally extended collector to a longitudinally coextensive compartment defined by lateral walls 22 and 23 and by end walls 24 which unite the baffle plates 17 and 18 and lateral walls 22 and 23.

The compartment defined by said lateral and end walls constitutes, in effect, a nozzle-like discharge member for the collector, defined as aforesaid by the baffle plates 17 and 18, and for reasons which will be hereinafter explained. The walls 22 and 23, in the type of kiln shown in Figures I and II, terminate at their lower edges 25 in a plane well elevated above the floor 2, so that the circulatory medium discharged into the said compartment may find underneath said walls ready egress into opposite sides of the kiln. Therefore, the distance between the said lower edges 25 and the floor 2 should be substantially equal to half the distance which separates the walls 22 and 23.

Extending the full length of the kiln, upon opposite sides thereof, I provide circulation accelerator pipes 26 and 27. They communicate with a source of dry steam or compressed air disposed outside of the kiln and not illustrated. They are provided at frequent intervals with jet orifices 28 which open upwardly. The pipes 26 and 27 are located adjacent to the base of the loads carried by the beams 8 and in the spaces at the opposite sides of the kilns between the sides of said loads and the adjacent side walls 1, respectively.

Description of the operation of the device as shown in Figures I and II is deemed to be herein in order, as being conducive to a better understanding of the apparatus shown in the remaining figures.

Accordingly, it is specified that in the operation of the apparatus shown in Figures I and III the bunks 8 of companion trucks are piled with lumber, for example in the spaced edgewise assemblage shown in the drawings. The kiln is then closed and heat is supplied to the heating system of the kiln. By the buoyancy imparted to the gaseous contents of the kiln through the application thereto of heat, ascending currents as indicated by arrows are generated therein upon opposite sides of the kiln, and meet in the space directly under the roof 3 thereof above the loaded trucks, whence they tend by superior gravity to descend towards the bottom of the kiln. The tendency referred to is permitted to result in air circulation by the presence of the slits 10 through which the circulatory medium descends in drying contact with the edge-piled boards which define the slits 10. In passing through said slits the air gives up some of its heat in evaporation of the water content of the lumber with the effect by becoming heavier of exerting a downward suction upon the volume of air directly below the roof 3.

Issuing from the lower ends of said slits 10 the circulatory medium strikes the baffle plates 17 and 18, and its volume is constricted to the narrower space between them which is equal to that defined between the side walls 22 and 23, with the result that an acceleration of the current is effected substantially after the manner in which the constricted nozzle of a water pipe tends to accelerate the discharge of liquid therefrom. Also the presence of the baffle plates 17 and 18, and the side walls 22 and 23, effectually separates the ascending and descending currents of the air circulation, with economy both of time and heat in the drying operation of the kiln. The presence of said members also divides the interior of the kiln, substantially as shown in Figures I and II, into two chambers 29 and 30, which

I call conditioning chambers, because they receive the air from the slits 10 after it is spent or has become moisture laden and then, by the reheating and regulation of the humidification of it, they put it in condition for repetition of its drying function in each succeeding cycle of circulation.

By the means described a constant air circulation is set up and maintained within the interior of the kiln and will continue so long as heat is supplied to the heating system. Circulation derived from such means may be in itself depended upon for the drying of the kiln contents, but the time required may be reduced by the employment of the accelerator pipes 26 and 27. That is to say, they, by discharging jets of steam through their respective orifices 28 in a direction of the ascending currents of air circulation at the sides of the kiln, effect an acceleration of the speed of circulation. Said acceleration may be employed also to special advantage in heating up quickly each fresh charge of material to be dried when it is taken into the kiln. After the initial heating is accomplished, the operation of the accelerator pipes may be interrupted in order to perfect the drying operation. The pipes 26 and 27 may also be operated intermittently so as to increase the speed of drying of material by alternating temperatures of high and low humidity, respectively.

In Figures II and IV, I show apparatus which may be substantially identical with that already described to the point of provision of the baffle plates 17 and 18.

From that point provision is made for effecting air circulation in a kiln through the employment of a mechanical agency comprising rotative fans.

In Figures II and IV, instead of imperforate side walls 22 and 23 shown in other figures suspended above the floor of the kiln, I provide side walls defined, for example, by spaced grids 31, as shown in Figure IV, and resting on the floor 2. The grids 31 are ranged in separate groups disposed along the length of the baffle plates 17 and 18, said groups being divided one from another by a space 32 of determinate capacity, defined by side walls and by a closed wall 33 on one end of said space and an opposing apertured wall 34 on the other end thereof. Above each space 32 is provided a compartment 35, communicating with said space and formed between opposing baffle plates 17 and 18 by the presence between them of opposite end walls 36 and 37. Each compartment 35 is covered by a gridded top-plate 38. It should be understood that the grids 31 and those whose presence is indicated in the term "gridded top-plate 38" are intended to designate merely perforate walls of determinable restricted capacity for the passage of a circulatory gaseous medium through the spaces between them, and that foraminous or any suitably perforated walls in each instance might be employed to the same effect instead of gridded walls.

Extending the entire length of the kiln is a drive shaft 40 carried in journal standards 41 provided at suitable intervals and preferably in certain of the spaces 32 as shown in Figure IV. The shaft 40 is rotated by any suitable mechanism, not illustrated, preferably located outside the kiln. To the shaft on the inside of each apertured wall 34 within a group of grids 31, is fixed a suction fan 42 whose diameter is, by preference, substantially equal to the diameter of the aperture of said wall as clearly shown in Figure IV. The effect of the rotation in one direction of each fan 42 is to exhaust the contents of that compartment 35 with which it communicates, while at the same time the presence of the group of grids 31 and of the gridded top-plate 38 which covers said compartment is to establish a static pressure of the circulatory medium within the group of grids in which the fan revolves with the effect of equalizing the distribution towards opposite sides of the kiln of the fan-compelled current that issues between the grids. The combined effect, in such instance, of the operation of the fans is to contribute to the speed of circulation of the circulatory medium obtained by such means only as the apparatus shown in Figures I and III. The distribution at intervals of fans 42 fixed to the shaft 40 which is common to them all, renders the movement of the circulatory medium substantially uniform throughout the entire kiln.

If desired, the direction of rotation of the shaft 40 from that already described may be reversed to advantage in some instances. In such case, ascending currents of the circulatory medium through the air slits 10 will be substituted for the descending currents through the same. Such circulation will be resisted to a slight degree only by the heating of the circulatory medium effected by the presence of the headers 12 and their complementary members. At such time, also, the operation of the accelerator pipes 43 and 44, corresponding to the pipes 26 and 27, would be temporarily interrupted, and their function supplied by reverse accelerator pipes 45 and 46, having downwardly instead of the upwardly discharging jet orifices which the pipes 43 and 44 have.

In both types of kiln shown in the drawings, I prefer to provide in the roof 3 suitable ventilators 48, each provided with a damper 49, through which exhaust of excess moisture in the interior of the kiln may be effected when desired.

Also, I prefer to provide within the respective conditioning chambers 29 and 30,

fresh air ducts 50 and 51 that are adapted, respectively, to draw air from outside the kiln, and to discharge it at the will of the operator into said chambers, for the purpose, whenever desired, of lowering the humidity of the air circulation in the kiln.

What I claim is:

1. A dry kiln comprising a chamber, and truck-supporting tracks therein, in combination with baffle plates extending below said tracks substantially the length of the chamber and spaced from the sides of the chamber, respectively, and from each other, and means for producing heated air circulation within the chamber between the baffle plates and at the respective sides thereof.

2. A dry kiln comprising a chamber, and truck-supporting tracks therein, in combination with mutually converging baffle plates extending below said tracks substantially the length of the chamber and spaced from the sides of the chamber, respectively, and from each other, and means for producing heated air circulation within the chamber between the baffle plates and at the respective sides thereof.

3. A dry kiln comprising a chamber, and truck-supporting tracks therein, in combination with baffle plates extending below said tracks substantially the length of the chamber and spaced from the sides of the chamber, respectively, and from each other, lateral walls defining a compartment open for air circulation below the baffle plates, and heating means disposed within the chamber upon opposite sides of said compartment.

4. A dry kiln comprising a chamber, and truck-supporting tracks therein, in combination with baffle plates extending below said tracks substantially the length of the chamber and spaced from the sides of the chamber, respectively, and from each other, lateral walls defining a compartment open for air circulation below the baffle plates, and heating means consisting of return bend heater systems disposed within the chamber upon opposite sides of said compartment.

5. A dry kiln comprising a chamber, and truck-supporting tracks therein, in combination with baffle plates extending below said tracks substantially the length of the chamber and spaced from the sides of the chamber, respectively, and from each other, lateral walls defining a compartment open for air circulation below the baffle plates, heating means disposed within the chamber upon opposite sides of said compartment, and means for aiding air circulation disposed within said compartment.

6. A dry kiln comprising a chamber, and truck-supporting tracks therein, in combination with heating means disposed within the chamber below the tracks and on opposite sides of the chamber, in combination with means disposed medially within the chamber for collecting the circulatory medium of air circulation promoted by said heating means and for diverting said medium towards opposite sides of the chamber.

7. A dry kiln comprising a chamber, and truck-supporting tracks therein, in combination with baffle plates extending below said tracks substantially the length of the chamber and spaced from the sides of the chamber, respectively, and from each other, means for producing heated air circulation within the chamber between the baffle plates and at the respective sides thereof, and upwardly discharging accelerator pipes located in operative relationship to the spaces between the baffle plates, respectively, and the adjacent walls of the chamber.

8. A dry kiln comprising a chamber, and truck-supporting tracks therein, in combination with baffle plates extending below said tracks substantially the length of the chamber and spaced from the sides of the chamber, respectively, and from each other, lateral walls defining a compartment open for air circulation below the baffle plates, heating means disposed within the chamber upon opposite sides of said compartment, and fresh air ducts operatviely communicating, respectively, with said heating means.

9. A dry kiln comprising a chamber, and truck-supporting tracks therein, in combination with baffle plates extending below said tracks substantially the length of the chamber and spaced from the sides of the chamber, respectively, and from each other, lateral walls defining a compartment open for air circulation below the baffle plates, heating means disposed within the chamber upon opposite sides of said compartment, and means for aiding air circulation disposed within said compartment, said means last named consisting of rotative fans mounted in said compartment.

10. A dry kiln comprising a chamber, and truck-supporting tracks therein, in combination with baffle plates extending below said tracks substantially the length of the chamber and spaced from the sides of the chamber, respectively, and from each other, lateral walls defining a compartment open for air circulation below the baffle plates, heating means disposed within the chamber upon opposite sides of said compartment, and means for aiding air circulation disposed within said compartment, said means last named consisting of rotative fans mounted in said compartment, said compartment being subdivided for the operative accommodation of each fan.

11. A dry kiln comprising a chamber, and truck-supporting tracks therein, in combination with baffle plates extending below said tracks substantially the length of the chamber and spaced from the sides of the chamber, respectively, and from each other, lat-

eral walls defining a compartment open for air circulation below the baffle plates, heating means disposed within the chamber upon opposite sides of said compartment, and means for aiding air circulation disposed within said compartment, said compartment being subdivided for the operative accommodation of each fan, and each subdivision having a determinable restricted capacity for intake and outlet of the circulatory gaseous medium within the kiln chamber whereby a static pressure of the circulative medium for equalizing its distribution is effected.

12. A dry kiln comprising a chamber, and truck supporting tracks therein, in combination with baffle plates extending below said tracks substantially the length of the chamber and spaced from the sides of the chamber, respectively, and from each other, lateral walls defining a compartment open for air circulation below the baffle plates, heating means disposed within the chamber upon opposite sides of said compartment, and means for aiding air circulation disposed within said compartment, said means last named consisting of rotative reversible fans mounted in said compartment, said compartment being subdivided for the operative accommodation of each fan, and each subdivision having a determinable restricted capacity for intake and outlet of the circulatory gaseous medium within the kiln chamber whereby a static pressure of the circulative medium for equalizing its distribution is effected.

13. A dry kiln comprising a chamber, and truck-supporting tracks therein, in combination with baffle plates extending below said tracks substantially the length of the chamber and spaced from the sides of the chamber, respectively, and from each other, lateral walls defining a compartment open for air circulation below the baffle plates, heating means disposed within the chamber upon opposite sides of said compartment, and means for aiding air circulation disposed within said compartment, said means last named consisting of rotative reversible fans mounted in said compartment, said compartment being subdivided for the operative accommodation of each fan, and each subdivision having a determinable restricted capacity for intake and outlet of the circulatory gaseous medium within the kiln chamber whereby a static pressure of the circulative medium for equalizing its distribution is effected, and of accelerator and reverse accelerator pipes having, respectively, oppositely discharging jet orifices, and being alternately operative to suit the direction of rotation of the fans.

14. A dry kiln comprising a chamber, and truck-supporting tracks therein, in combination with baffle plates extending below said tracks substantially the length of the chamber and spaced from the sides of the chamber, respectively, and from each other, lateral walls defining a compartment open for air circulation below the baffle plates, heating means disposed within the chamber upon opposite sides of said compartment, and means in operative communication with the lower portion of the kiln chamber for lowering the humidity of the air circulation therein.

15. A dry kiln comprising a chamber, and truck-supporting tracks therein, in combination with baffle plates extending below said tracks substantially the length of the chamber and spaced from the sides of the chamber, respectively, and from each other, lateral walls defining a compartment open for air circulation below the baffle plates, heating means disposed within the chamber upon opposite sides of said compartment, means in operative communication with the lower portion of the kiln chamber for lowering the humidity of the air circulation, and means in operative communication with the upper portion of the chamber for exhaust of excess moisture.

16. The combination within a chamber of truck-supporting tracks and trucks united in pairs by cross-beams with an edgewise piled load of lumber on the cross-beams disposed so as to provide vertical spaces between the load and the opposite side walls of the chamber for air circulating in one direction, and vertical slits through the body of the load for air circulation in direction opposite to that of the air circulation first named, means for producing heated air circulation through said spaces and slits, and means for collecting the air discharged from the complement of slits and distributing in circulation to the spaces aforesaid, respectively.

In testimony whereof, I have hereunto set my hand in the presence of two subscribing witnesses.

J. FORREST COBB.

Witnesses:
JOHN B. CLELAND,
JOSEPH L. ATKINS.