Feb. 4, 1930. M. L. MUELLER 1,745,375

AIR CIRCULATING SYSTEM FOR LUMBER DRYING KILNS

Filed Nov. 14, 1928 3 Sheets-Sheet 1

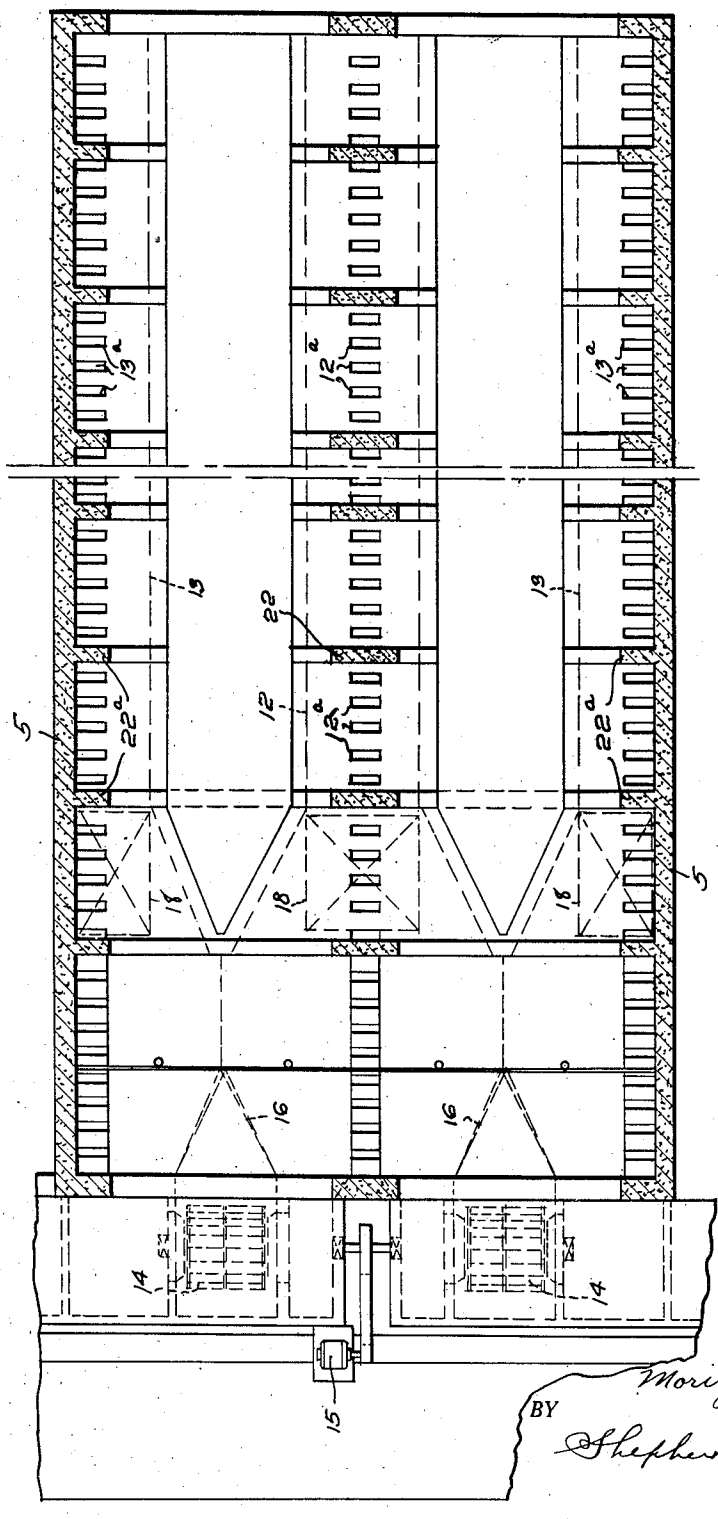

Fig. 1.

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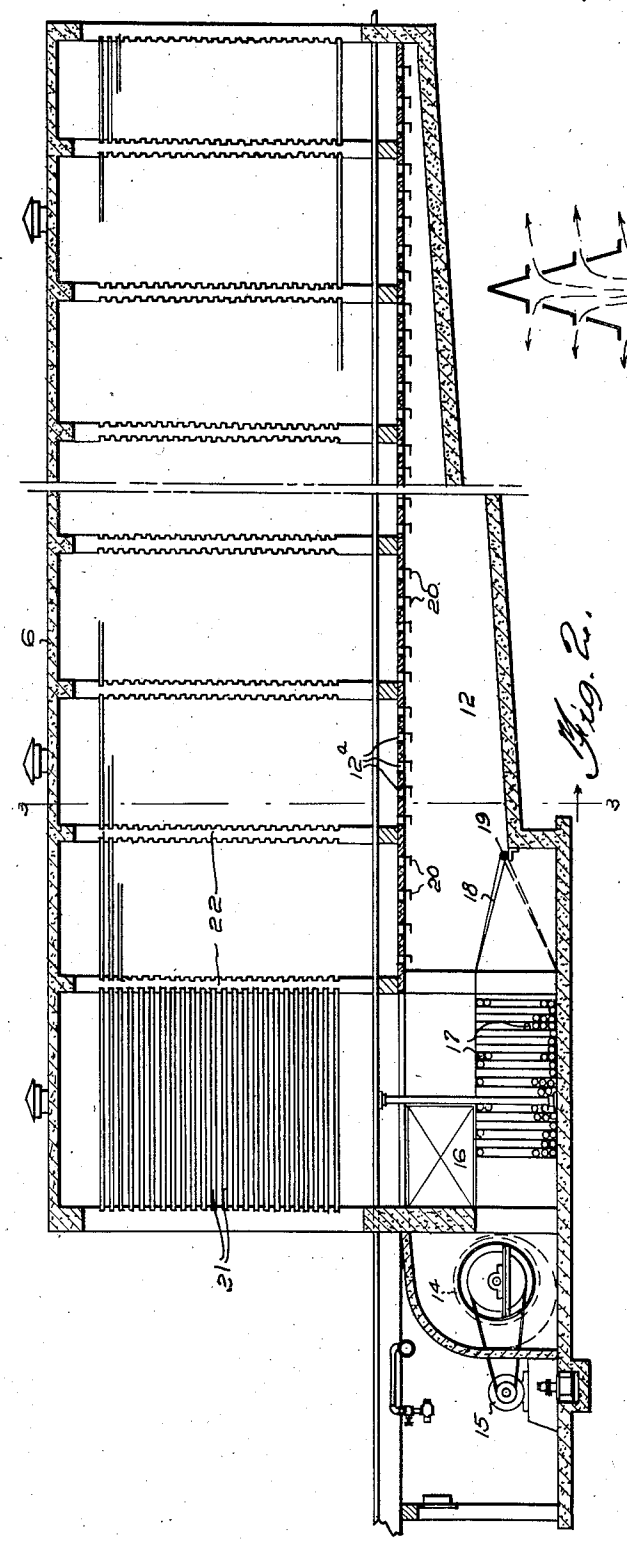

Fig. 2.

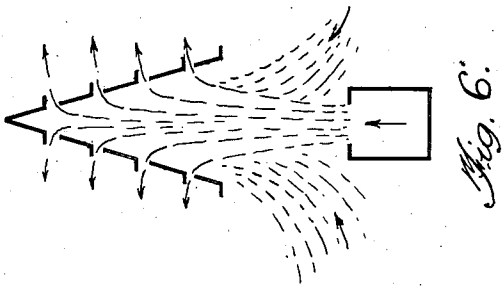

Fig. 6.

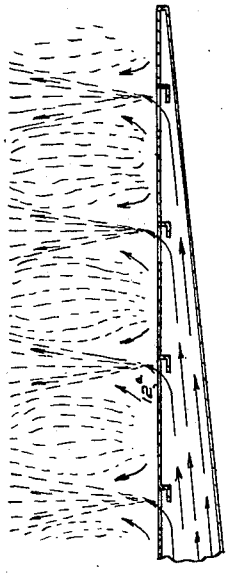

Fig. 5.

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AIR CIRCULATING SYSTEM FOR LUMBER DRYING KILNS

Filed Nov. 14, 1928 3 Sheets-Sheet 3

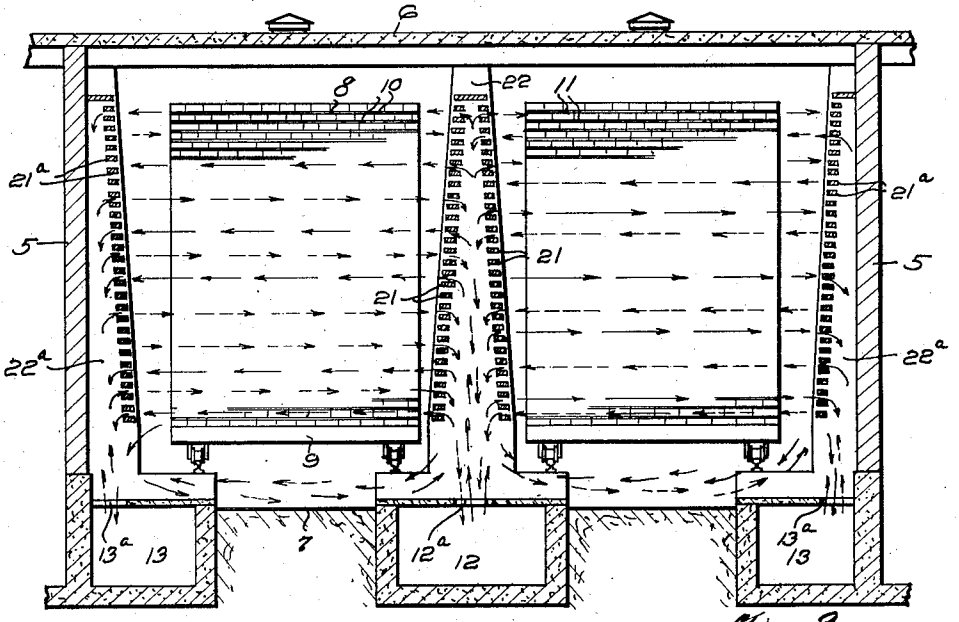

Fig. 3.

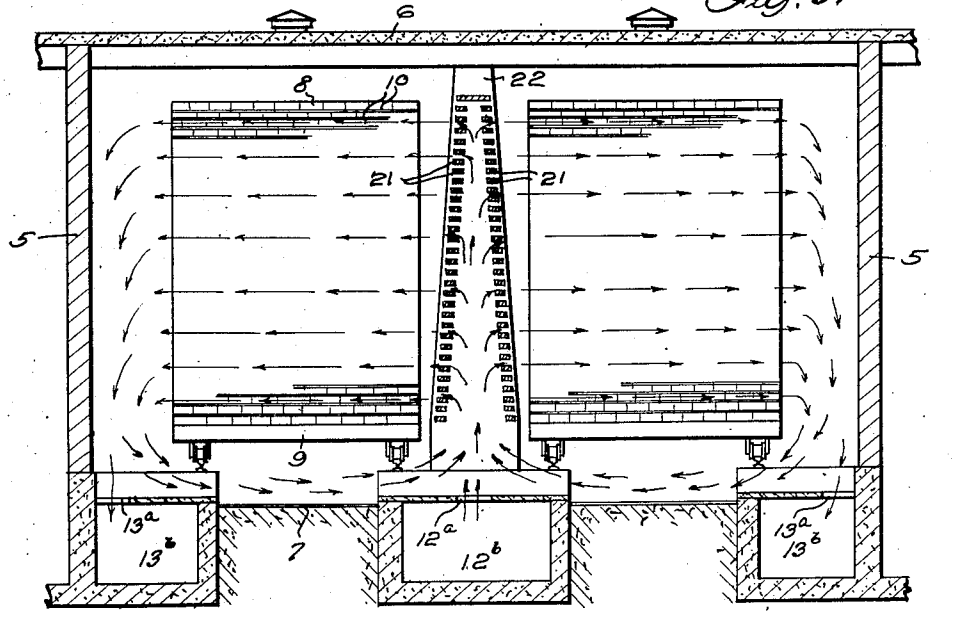

Fig. 4.

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1,745,375

UNITED STATES PATENT OFFICE

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AIR-CIRCULATING SYSTEM FOR LUMBER-DRYING KILNS

Application filed November 14, 1928. Serial No. 319,349.

This invention relates to lumber drying kilns and air circulating systems for the same, and it has for its object to provide a novel type of kiln construction which will combine with marked economy, in construction of the kiln, very high efficiency in the drying of the lumber. The means by which these results are achieved will be more particularly pointed out in the detailed description which follows.

In the accompanying drawings,

Fig. 1 is a horizontal sectional view through the kiln of the present invention;

Fig. 2 is a vertical sectional view;

Fig. 3 is a transverse vertical sectional view upon line 3–3 of Fig. 2;

Fig. 4 is a transverse sectional view illustrating a slightly modified form of the invention, and

Figs. 5 and 6 are diagrammatic views illustrating the induced air flow, hereinafter described.

Like numerals designate corresponding parts in all of the figures of the drawings.

The kiln comprises side walls 5, roof 6 and floor 7. The lumber 8 is piled longitudinally upon trucks 9, the several courses of lumber being separated from each other by strips 10, so that a great number of transverse air channels 11 are formed through the piles of lumber. A central air duct 12, and a pair of side air ducts 13 extend longitudinally and substantially the full length of the kiln. The upper faces of these ducts lie at substantially at the same level throughout, while the bottoms of said ducts are inclined uniformly upward toward the rear end of the kiln. The ducts are provided with elongated rectangular ports 12^a—13^a, in their upper sides. In the structure illustrated in Fig. 4, the air flow is from a central duct 12^b, which is the pressure duct, the air being returned to the fan or blower, hereinafter described, through the side ducts 13^b, which, in this case, are the suction ducts. The structure illustrated in Fig. 4 constitutes a non-reversing type of kiln. That is to say, the air flow is always in the same direction.

In the structure illustrated in Fig. 3, flow of the air is maintained, for a predetermined length of time, from the central duct 12 to the side ducts 13, as indicated by the full line arrows, and then the direction of flow of the air is reversed, as indicated by the dotted line arrows, so that the central duct becomes the suction duct, and the side ducts become the pressure ducts.

The particular means for setting up a flow of air in the air ducts is not of the essence of the invention, since the means employed are conventional ones in the art, consisting in the particular embodiment illustrated, of blowers or fans 14, which are driven by a suitable prime mover, such as an electric motor 15. Reversing dampers 16 serve to direct the air into either air duct 12 or the ducts 13, as the case may be. Further, conventional air conditioning instrumentalities, such as the steam pipes indicated at 17, may be disposed in the path of travel of the air. In like manner, humidifying or other conventional air conditioning means may be employed, at will, and in accordance with the well known practices in the art. Suction control dampers 18 are pivoted at 19, and are moved to elevated position in those ducts that are under suction, in which case the return or suction air is conducted to the intake end of the fan without contacting with the steam coils 17, while, when a duct is under pressure its corresponding damper 18 will drop and the air will be heated or otherwise conditioned in its passage over the steam coils.

Referring to Fig. 2, it will be seen that the outlet ports of the ducts, there designated 12^a, have deflectors 20, arranged in such manner as to trap a given quantity of air and discharge it through said ports. This construction, in conjunction with the tapering of the duct toward its rear end results in discharging from the ports 12^a or 13^a, as the case may be, streams of air which are elongated transversely of the kiln, said streams of air being of uniform volume and velocity throughout the length of the kiln.

By referring to the diagrammatic Figures 5 and 6, it will be seen that these transversely elongated air jets draw into themselves air from the interior of the kiln, from all points

around said jets, and the ports 12ª—13ª are so designed and so spaced with relation to each other, that substantially all of the air in the length of the kiln is set in motion. Assuming that the duct 12, in Fig. 3, is being utilized as a pressure duct, the air discharged therefrom enters the central diffuser, which consists of a large number of spaced slats or equivalent elements 21, which extend between and are supported by longitudinally spaced posts 22, of the kiln. The spaces between the two rows of slats of the several diffusers are upwardly convergent ones, and the air is directed laterally from between these slats and through the openings 11 in the piles of lumber. The upward convergence of the rows of slats of the diffusers results in the maintenance of a uniform pressure throughout the height of the diffusers, so that the air discharged from said diffusers will be of uniform volume and velocity throughout the height of the piles of lumber. In like manner, slatted elements 21ª are supported between the posts 22ª at the sides of the kiln, in Fig. 3, so that when the air flow is reversed and the ducts 13 become pressure ducts, the air may be diffused by these side diffusers in the manner described, and as indicated by the dotted line arrows. Since the air flow is always in one direction in the structure illustrated in Fig. 4, no side diffusers are employed in the construction there shown. When the air is flowing from the central duct 12, in Fig. 4, it is diffused and uniformly discharged through the piles of lumber, and some of it is returned to the blowers through the suction ducts 13. It is important to note, however, that, as indicated by the arrows, some of the air flows across the kiln, beneath the lumber trucks, and is drawn into and commingled with the air flowing from the ports 12ª. This feature of induced air flow is one of the important features of the invention. The location of the ducts; the size and proportions of the ports therein; the size, shape and location of the diffusers, and the amount of space left between the tops of the ducts and the lowermost slats of the diffusers, all have a definite coactive relation to each other, with the end in view of bringing about the flow through the piles of lumber of a far greater volume of air than actually passes through the fan, and of setting in motion practically all of the air in the kiln, so that there will be no inert bodies of air in contact with the lumber at any point whatever. By moving a large volume of air through the lumber in the manner described, by maintaining uniform velocity and volume of the air jets throughout the length of the kiln, as a result of the tapering of the longitudinal ducts, and by maintaining uniform velocity and volume of the air streams discharged from the diffusers, as a result of the upward tapering of the spaces within said diffusers, I am able to secure uniform drying of the lumber throughout the length and height of the pile, to a degree never heretofore approached in any construction with which I am familiar.

The manner in which the jets from the pressure ducts bring about a movement of a much larger volume of air than is actually handled by the blowers, is illustrated in Figs. 5 and 6. The air leaving the pressure duct is in the form of a series of jets of air, at a uniform velocity. These jets are rectangular in shape, with the long dimensions of adjoining jets parallel. The spacing between the jets is such as to favor the natural stream line of the air, and by referring to Figs. 4 and 5, it will be seen that there is considerable space left between the jets and the diffusing chamber. This arrangement brings about the most efficient induced air flow, because of the following principles:

When a jet of air, at considerable velocity, is discharged into a space where the air is relatively inert, the air of the jet tends to drag on to itself the directly adjoining air, thereby transmitting some of its own velocity to the adjoining air and, in turn, partly losing its own velocity. Since the transmission of the velocity of the jet to the extraneous air is accomplished through friction between the two, the efficiency of the action is dependent upon the contact area of said gases. For example, two jets of air, one having a small exposed area and the other having a large exposed area, and both of equal velocity will create induced movement of adjoining air in proportion to the area of the exposed surfaces.

By using rectangular ports as illustrated, set relatively close together, I am able to secure the maximum area per running foot of duct. To create the greatest induction effect the velocity of the jets must be maintained without interference as long as possible, and the adjoining air must be allowed to move with the least possible obstruction. It will be noted that a considerable space is left between the top of the air duct and the bottom of the diffusing chamber, and that a considerable open space is left on each side of the air duct. This permits adjoining air to approach the zone of induction created by the jets, with the least possible resistance.

The proper drying of lumber requires the following conditions:

a. A uniform distribution of air to both faces of the lumber, throughout its full length,

b. All such air to be of equal temperature and humidity at all points.

Economical handling and loading of lumber requires that the lumber be piled in a solid load or unit, with no effort required to build any special flues by the piling of the lumber for the conduct of drying air.

The most economical construction of kilns

is that employing two walls per chamber, for two tracks of lumber, instead of three walls, as where one track is located alone in a chamber; the present arrangement gives the advantage of cheap loading and cheap building expense, in combination with uniform distribution of air, heat, and humidity.

Since the induced air becomes intimately mixed with the air from the ducts as it passes into and through the diffusers, and through the lumber piles, it follows that the whole air content of the kiln quickly becomes a homogeneous one with respect to humidity, temperature, etc. Since the primary function of lumber drying kilns is to carry off the moisture from the lumber, it follows that the moving of a very large volume of air through the lumber; insuring that the condition of this air is uniform throughout the length and height of the piles of the lumber, with respect to temperature, humidity, etc., and insuring that no body of inert air is lying in contact with the lumber at any point in the length or height of the pile, is best calculated to accomplish the desired result of drying the lumber uniformly in the minimum length of time.

While I have illustrated the slats 21ª as lying horizontally, it is to be understood that this may be adjusted to discharge the air at a slight angle, either upwardly or downwardly, as may be desired. In such case, the air would strike the edges of the courses of the several piles of lumber and be deflected by said edges into the channels between the said several courses in the manner described in my co-pending application, Serial No. 301,324, filed on the 22nd day of August, 1928.

It is to be understood that the patent is not limited to any particular specific embodiment of the same, but is intended to cover the principles recited therein.

Consequently, it is to be understood that the invention includes within its purview whatever changes fairly come within either the terms or the spirit of the appended claims.

Having described my invention, what I claim is:

1. In a lumber drying kiln, a substantially horizontal pressure duct having ports in its upper face for the discharge of air upwardly therefrom, and a hollow diffuser disposed thereabove for receiving said discharged air, said diffuser having perforated side walls through which the air is discharged in a substantially horizontal direction, and said diffuser being located a sufficient distance above the pressure duct to permit of a lateral inflow of air by induction into the air streams from the pressure duct ports.

2. In a lumber drying kiln, a pressure duct having ports in its upper face for the discharge of air upwardly therefrom, and a hollow diffuser disposed thereabove for receiving said discharged air, said diffuser having perforated side walls through which the air is discharged in a substantially horizontal direction, the interior of said diffuser tapering upwardly, and said diffuser being located a sufficient distance above the pressure duct to permit of a lateral inflow of air by induction into the air streams from the pressure duct ports.

3. In a lumber drying kiln, a pressure duct having ports in its upper face for the discharge of air upwardly therefrom, and a hollow diffuser disposed thereabove for receiving said discharged air, said diffuser having perforated side walls through which the air is discharged in a substantially horizontal direction, the interior of said diffuser tapering upwardly and the interior of the pressure duct being uniformly constricted rearwardly so that uniformity of volume and velocity is maintained with respect to the air discharged from said diffuser, and duct, said kiln carrying a trackway for the reception of trucks of lumber, said trucks being so located with respect to the diffuser that when trucks of lumber, flat piled in spaced courses, are run upon said tracks, the air discharged from the diffusers will be directed between said courses of lumber.

4. A kiln construction comprising the two side walls creating a common chamber therebetween, a pair of tracks in said common chamber, for the reception of piles of lumber on trucks, central diffusers arranged between the said tracks, and a pressure duct discharging air upwardly into said diffusers, and said diffuser being located a sufficient distance above the pressure duct to permit of a lateral inflow of air by induction into the air streams from the pressure duct ports.

5. A kiln construction comprising the two side walls creating a common chamber therebetween, a pair of tracks in said common chamber for the reception of piles of lumber on trucks, central diffusers arranged between the said tracks, and a pressure duct discharging air upwardly into said diffusers, said diffusers comprising upwardly constricted interiors defined by perforated side walls, and said tracks being so located with respect to the diffusers that when trucks of lumber, flat piled in spaced courses, are run upon said tracks, the air discharged from the diffusers will be directed between the courses of lumber.

6. A kiln construction comprising two side walls creating a common chamber therebetween, a pair of tracks in said common chamber for the reception of piles of lumber on trucks, central diffusers arranged between the said tracks, and a pressure duct discharging air upwardly into said diffusers, said diffusers comprising upwardly constricted interiors defined by slatted side walls, the lowermost of said slats being spaced from the duct a sufficient distance to permit induced air to be drawn into the lower ends of said constricted

spaces by the action of the air discharged from the duct.

7. A kiln construction comprising the two side walls creating a common chamber therebetween, a pair of tracks in said common chamber for the reception of piles of lumber on trucks, central diffusers arranged between the said tracks, and a pressure duct discharging air upwardly into said diffusers, the lower portion of said diffusers being disposed a sufficient distance above the duct to permit the jets discharged from said duct to entrain induced air.

8. A kiln construction comprising the two side walls creating a common chamber therebetween, a pair of tracks in said common chamber, for the reception of piles of lumber on trucks, central diffusers arranged between the said tracks, and a pressure duct discharging air upwardly into said diffusers, additional ducts at the sides of the kiln having ports in their upper faces, and diffusers located above said ports and extending substantially throughout the height of the lumber on the trucks and said tracks being so located with respect to the diffusers that when trucks of lumber, flat piled in spaced courses, are run upon said tracks, the air discharged from the diffusers will be directed between the courses of lumber.

9. A reversible kiln construction of the character described, comprising a single chamber having a pair of longitudinally extending trackways therein adapted to receive piles of lumber on trucks, central diffusers extending substantially throughout the length of the kiln between said trackways, additional diffusers extending substantially throughout the length of the kiln at the sides thereof, ducts extending substantially throughout the length of the kiln beneath each set of diffusers, and means for creating air flow in said ducts in one direction or the other, at will, said ducts being provided with ports in their upper faces through which air may be discharged into or received from the interiors of said diffusers, the central diffusers functioning when the air flow is in such direction as to cause the central duct to become a pressure duct, and the side diffusers functioning when the air flow is in such direction as to cause the side ducts to become pressure ducts.

10. A reversible kiln construction of the character described, comprising a single chamber having a pair of longitudinally extending trackways therein, adapted to receive piles of lumber on trucks, central diffusers extending substantially throughout the length of the kiln between said trackways, additional diffusers extending substantially throughout the length of the kiln at the sides thereof, ducts extending substantially throughout the length of the kiln beneath each set of diffusers, means for creating air flow in said ducts in one direction or the other, at will, said ducts being provided with ports in their upper faces through which air may be discharged into or received from the interiors of said diffusers, central diffusers functioning when the air flow is in such direction as to cause the central duct to become a pressure duct, and the side diffusers functioning when the air flow is in such direction as to cause the side ducts to become pressure ducts, the interiors of said diffusers tapering upwardly, as and for the purposes set forth.

11. A reversible kiln construction of the character described, comprising a single chamber having a pair of longitudinally extending trackways therein, adapted to receive piles of lumber on trucks, central diffusers extending substantially throughout the length of the kiln, between said trackways, additional diffusers extending substantially throughout the length of the kiln at the sides thereof, ducts extending substantially throughout the length of the kiln beneath each set of diffusers, means for creating air flow in said ducts in one direction or the other, at will, said ducts being provided with ports in their upper faces through which air may be discharged into or received from the interiors of said diffusers, the central diffusers functioning when the air flow is in such direction as to cause the central duct to become a pressure duct, and the side diffusers functioning when the air flow is in such direction as to cause the side ducts to become pressure ducts, the interiors of said diffusers tapering upwardly, as and for the purposes set forth, and the interiors of said air ducts tapering uniformly rearwardly, as and for the purposes set forth.

12. A kiln of the character described, comprising two side walls enclosing a single chamber, a pair of trackways in said chamber, a series of posts disposed longitudinally of the chamber between the trackways, diffusers located between said posts, comprising members presenting a multiplicity of openings in their side faces, with an upwardly constricted space therebetween, a central air duct extending longitudinally beneath said diffusers, and a pair of side ducts at the opposite sides of the kiln, all of said ducts having ports formed in their upper faces, said diffusers being located a sufficient distance above the ports of the air ducts to permit of a lateral inflow of air by induction into the air streams from said ports, and said trackways being so disposed with respect to the diffusers that when trucks of lumber, flat piled in spaced courses, are run upon said trackways, the air discharged from said diffusers will be directed between the courses of lumber.

13. A kiln of the character described, comprising two side walls enclosing a single chamber, a pair of trackways in said chamber, a series of posts disposed longitudinally

of the chamber between the trackways, diffusers located between said posts, comprising members presenting a multiplicity of openings in their side faces, with an upwardly constricted space therebetween, a central air duct extending longitudinally beneath said diffusers, and a pair of side ducts at the opposite sides of the kiln, all of said ducts having ports formed in their upper faces, and a row of diffusers along the opposite sides of the kiln, above the side ducts, the interiors of which are upwardly constricted.

14. A kiln of the character described, comprising two side walls enclosing a single chamber, a pair of trackways in said chamber, a series of posts disposed longitudinally of the chamber between the trackways, diffusers located between said posts, comprising members presenting a multiplicity of openings in their side faces, with an upwardly constricted space therebetween, a central air duct extending longitudinally beneath said diffusers, and a pair of side ducts at the opposite sides of the kiln, all of said ducts having ports formed in their upper faces, and a row of diffusers along the opposite sides of the kiln, above the side ducts, the interiors of which are upwardly constricted, said air ducts being uniformly tapered rearwardly, and means for setting up circulation of air through said ducts in either direction, said diffusers being spaced a sufficient distance above the ducts to permit of the drawing of induced air into said diffusers by the action of the air discharged from the ducts into the diffusers.

In testimony whereof I affix my signature.

MORITZ L. MUELLER.