(No Model.) 2 Sheets—Sheet 1.

H. C. ZAPPERT.

DRYING KILN FOR LUMBER.

No. 488,412. Patented Dec. 20, 1892.

Fig. II.

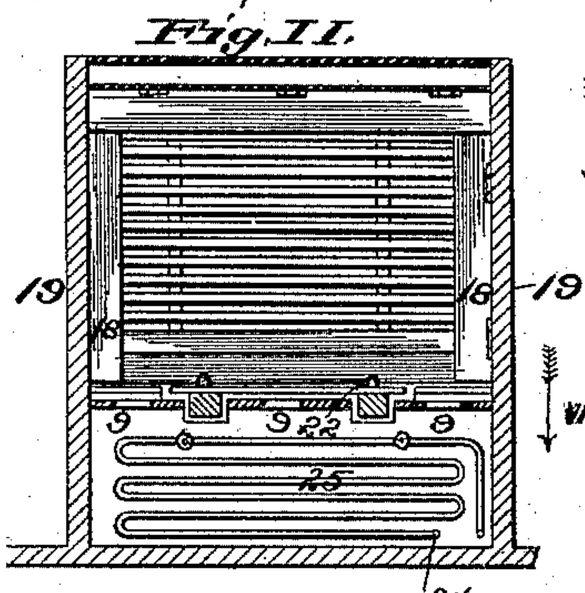
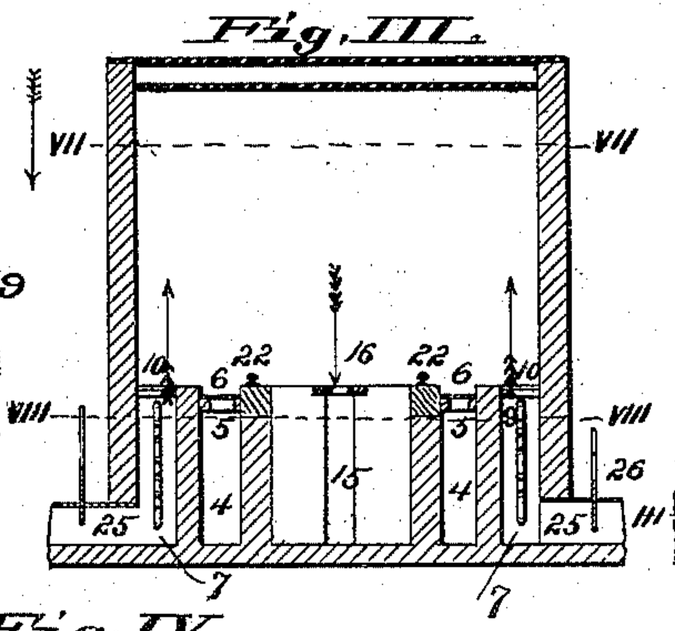


Fig. III.



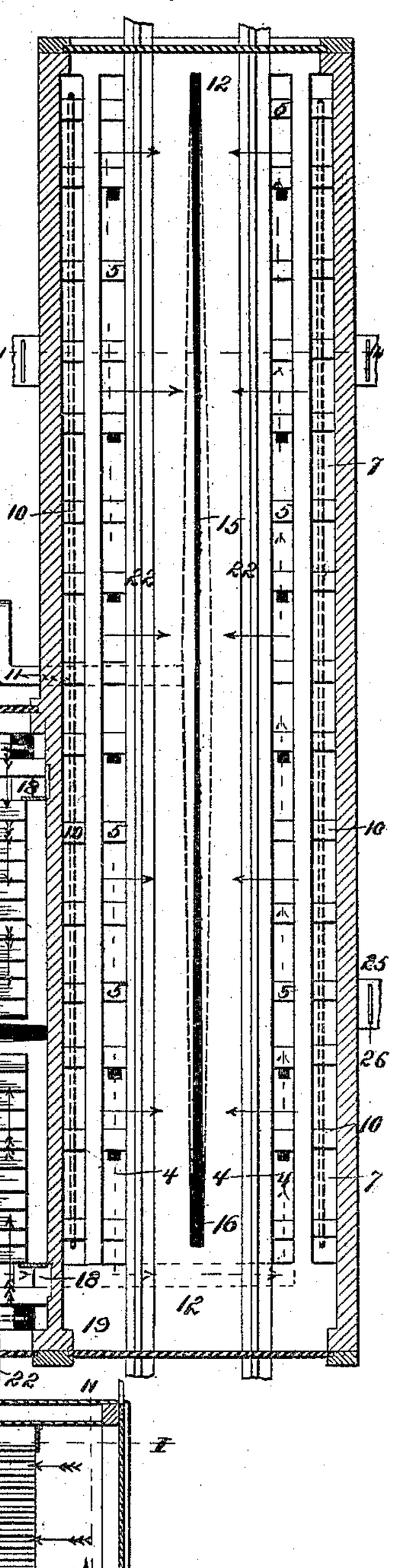


Fig. IV.

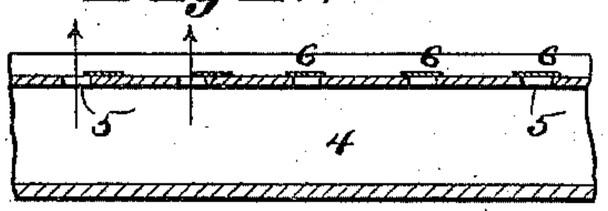


Fig. I.

Fig. V.

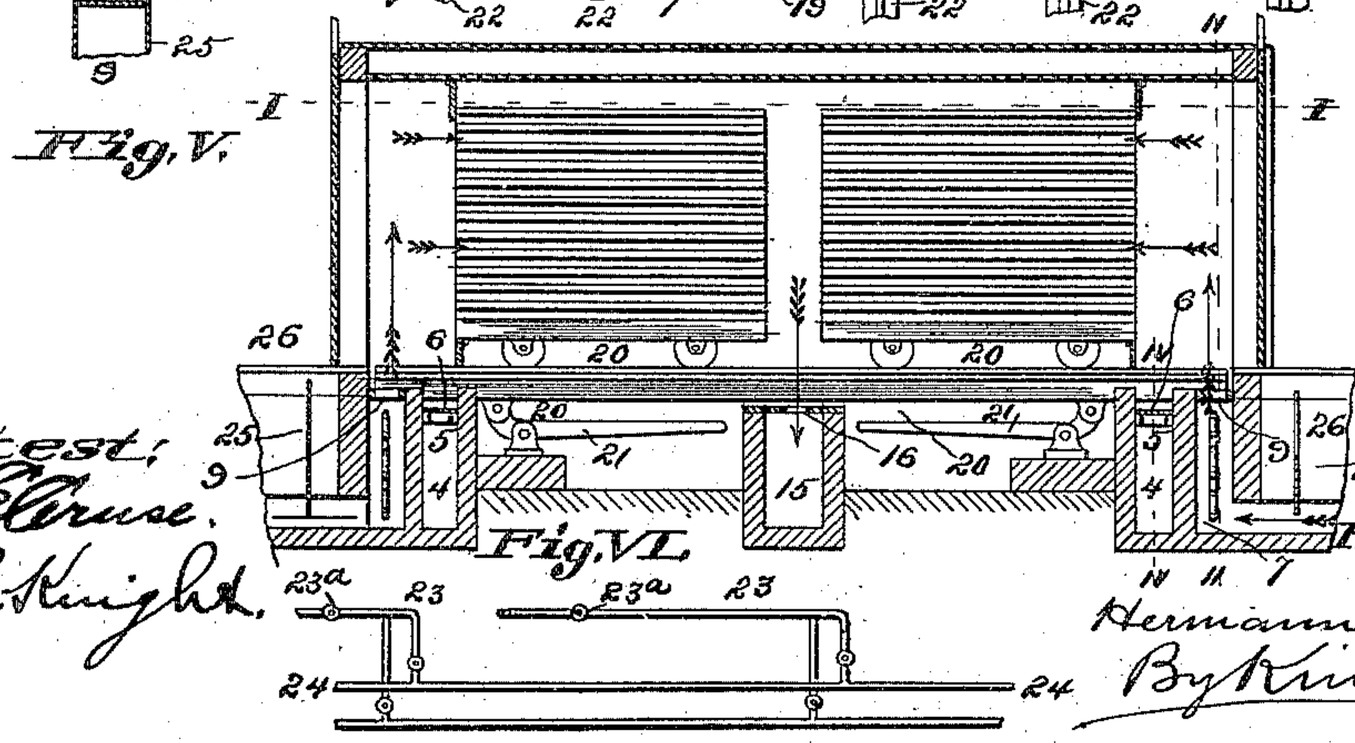


Fig. VI.

Attest:
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Wm. E. Knight.

Inventor:
Hermann C. Zappert.
By Knight Bros.
Attys.

(No Model.) 2 Sheets—Sheet 2.

H. C. ZAPPERT.

DRYING KILN FOR LUMBER.

No. 488,412. Patented Dec. 20, 1892.

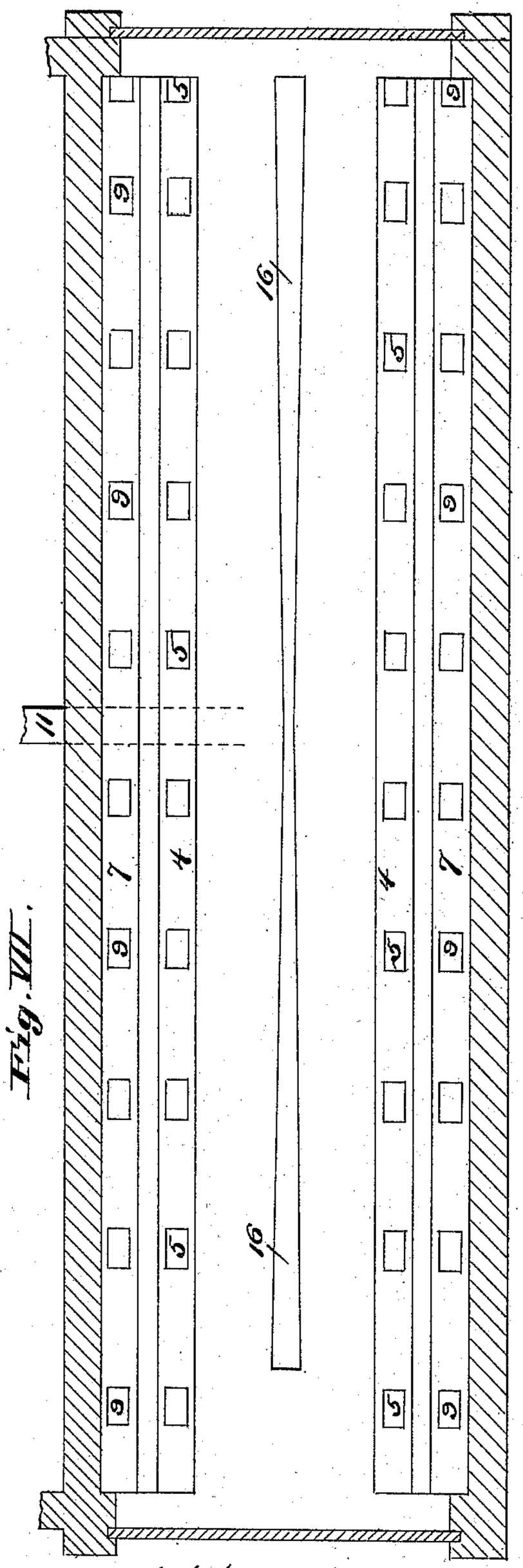

Fig. III.

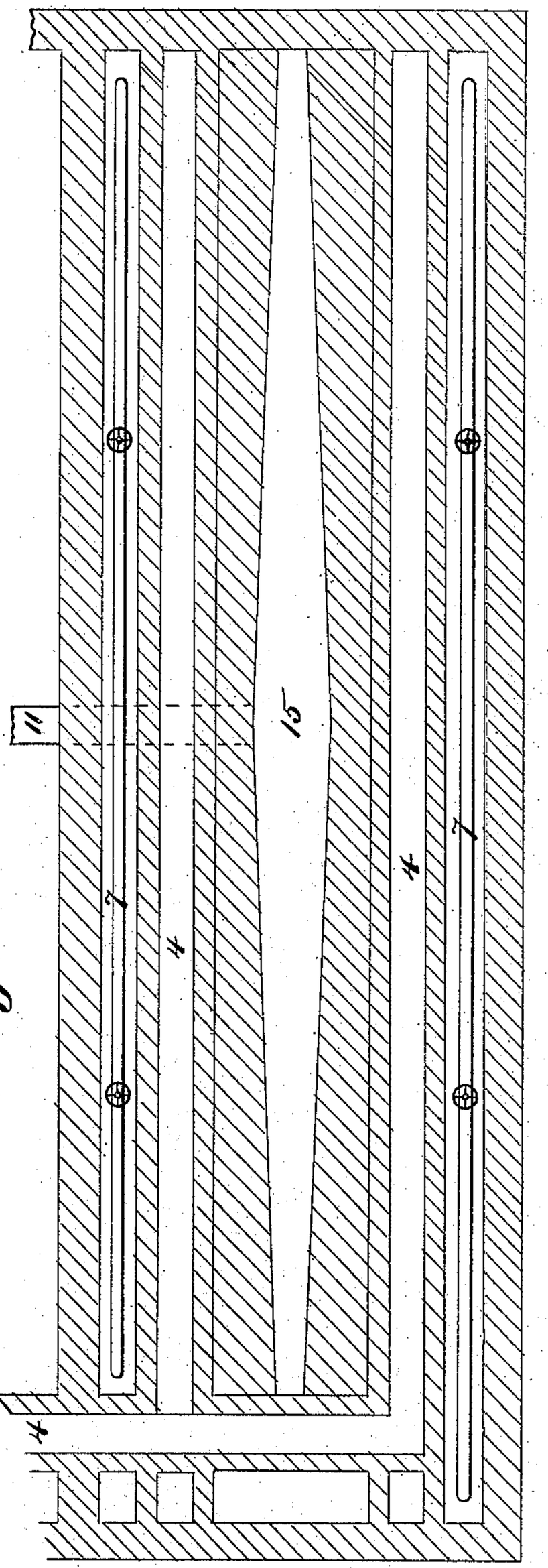

Fig. IV.

Attest:
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Inventor:
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UNITED STATES PATENT OFFICE.

HERMANN C. ZAPPERT, OF ST. LOUIS, MISSOURI.

DRYING-KILN FOR LUMBER.

SPECIFICATION forming part of Letters Patent No. 488,412, dated December 20, 1892.

Application filed April 12, 1892. Serial No. 428,884. (No model.)

To all whom it may concern:

Be it known that I, HERMANN C. ZAPPERT, of the city of St. Louis, in the State of Missouri, have invented a certain new and useful Improvement in Drying-Kilns for Lumber, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming part of this specification.

My invention relates to improvements in the construction of drying kilns for lumber.

The first object I have in view is to construct the kiln in such a way that the suction process for which I made an application October 31, 1891, can be practically applied to the best advantage.

I stated in my specifications that I maintain a continued and uninterrupted current of either cold or heated air under the normal air pressure, through the piling openings of a lumber pile. The described means to effect this evenly throughout the whole kiln forms one part of my invention. I have found by a long practical experience that the application of any drying process for lumber will give different results at different times even in the same locality. In cold, damp weather for instance the artificial heat produced by steam coils would be objectionable and dry hot air produced by a hot air furnace would be used in preference to great advantage. In dry, hot weather the reverse would be the case. Further it is often required by the saw and planing mill men and furniture manufacturers to dry various kinds and sizes of lumber in the same kiln at the same time: for instance, it may be necessary to dry one inch green cotton wood, half inch air dry poplar, three inch green oak and one inch green sap gum at the same time in the same kiln. Even if the kiln would be divided in four compartments yet different conditions would have to be created for every kind of lumber. Sap gum when green contains about sixty per cent. of moisture and is liable to "blue" within one hour after the sawing and is materially injured in value unless it is dried in a very short time. To do this dry hot air is needed circulating with great force and velocity through the lumber. In the next compartment where half inch air dry poplar has to be seasoned, a weak current of air without any artificial heat would be required, otherwise the lumber would be bent out of shape. Again three inch green oak requires a current of air of about 75° Fahrenheit throughout the whole process, and one inch green cotton wood requires a forced current of warm air at a temperature of 90° for the first ten hours and then very dry air of about 150° with very little circulation for the remainder of the time. I have devised means for all these requirements. I can use very hot dry air in one compartment and moist air heated by steam coils in the next and unheated air in the third. I can regulate the force of the current for each compartment independent from the others. It is further provided in the construction that either one or all compartments can be operated, and I have further devised means to turn two or three or all compartments into one if needed.

Another very important point is to obtain an even drying of all parts of the lumber through the whole kiln in the same time. If, for instance, a kiln is charged with one hundred thousand feet of one inch yellow pine it is of great importanee that the whole quantity should be evenly dried within a certain time, so that the whole kiln could be emptied and refilled. My construction provides for this.

Another difficulty generally experienced in the operation of a lumber dry kiln is to ascertain with exactness how much of the drying has been effected in a given time, and further to find with certainty when the drying is completed. The only reliable test is the difference in weight before and after the drying, but this test could not give satisfatory results unless the whole pile is weighed. To do this in an easy, practical way I use the floor of the kiln as a platform for a scale which is constructed underneath. Tables have been computed which show how much a certain kind of lumber weighs when green, when shipping dry, and when perfectly dry. One thousand feet board measure of one inch green oak weigh about six thousand pounds, when shipping dry five thousand pounds, when perfectly dry four thousand pounds. The weighing, as will be seen, can be done in the kiln without removing the lumber and the progress of drying can be ascertained at any

time with exactness, which is of great importance to the millman; he can easily find when the drying is completed and he can give an absolute guarantee that the lumber is either shipping or perfectly dry.

Figure I is a horizontal section of a three-compartment kiln taken part at I—I, Fig. V, and part at I—I, Fig. IV. Fig. II is a vertical section taken at II—II, Fig. V. Fig. III is a vertical section taken at III—III, Fig. I. Fig. IV is a vertical section taken IV—IV, Fig. V. Fig. V is a vertical section taken taken at V—V, Fig. I, showing the arrangement of the scale. Fig. VI is an elevation showing the arrangement of the main supply steam pipe for the coils of the various compartments. Fig. VII is an enlarged detail horizontal section taken at VII—VII, Fig. III. Fig. VIII is an enlarged detail horizontal section taken at VIII—VIII, Fig. III.

1 is a hot air furnace of any suitable description. The hot air is drawn from the furnace by an exhaust fan or blower 2 passing from the furnace first into a main duct 3 and from thence into the hot air ducts 4 underneath the floor of the kiln near each side or end. The ducts 4 have, at top, openings 5 which communicate with the drying compartment or compartments. The openings have dampers 6.

7 is a duct running parallel with the ducts 4. In the duct 7 are steam coils for each compartment supplied with steam by the main supply pipe. The duct 7 has openings 9 communicating with the compartment above it.

10 are dampers controlling the openings 9.

11 is a suction duct extending from the fan 2 underneath the floor and running through the middle of the main compartment 12 of the kiln. Another suction duct 11^a runs in like manner under the compartment 13. Both suction ducts communicate with the suction opening of the fan or air pump 2. The inner end of each suction duct 11 communicates with a duct 15 beneath the floor of the kiln and extending from end to end of each compartment. The duct 15 is largest at the middle, where it joins the duct 11 and tapers regularly from that point to the ends of the compartment. The duct 15 communicates with the interior of the compartment by a long and narrow aperture 16, or a series of apertures extending the whole length of the duct 15 and decreasing in width from the ends to the middle, so that the passage of air through the aperture 16 shall be substantially equal at all points; for it will be seen that the suction will be greater the nearer the mouth of the suction duct 11 and that this is counterbalanced by the greater facility for the passage of air through the aperture where the width is greater. As the air enters the duct 15 along its whole length it will be seen that the volume of moving air will increase toward the middle hence the propriety of making the duct larger in cross-section as it approaches the middle. Tiles may be laid over any part of the aperture 16 to check or stop the entrance of air at any point, for instance in a compartment not in use or in one requiring a small amount of circulation in the air.

17 is a partition wall made of folding sections, and which is used to separate one chamber from another. The partitions are shown in extended and in folded condition in Fig. I.

18 are folding screens hinged to the walls at 19 and so arranged that the air current coming for either duct 4 or 7 can only pass through the piling openings of the lumber, the said screens extending from the walls to the lumber.

20 is the scale platform forming the bottom of a compartment and supported on the scale beams 21, so that the weight of the lumber upon the platform may be ascertained at any time and thus the condition of the lumber as to dryness determined.

22 are rails on which loaded trucks may be run into the compartments.

23 are steam coils in the ducts 7 for heating the air in said ducts. 24 are steam pipes leading from the coils to a steam generator, not shown. The ducts 7 have air inlets 25 governed by dampers 26 by which atmospheric air is admitted to the ducts 7.

I will now describe the process of drying in four supposed cases:—In the first case, where no artificial heat is needed neither the furnace nor steam coils are used. After the lumber has been placed in the kiln and the screens 18 put in position; the fan is started and atmospheric air drawn through the kiln from either of the ducts 4 or 7 or both. The air passes through the piles of lumber in the spaces left open by the piling sticks and is drawn through the aperture 16, ducts 15, 11 or 11^a or both to the fan and discharged. By the action of the fan a partial vacuum would be formed within the kiln which may be varied by means of the dampers 26 if the ducts 7 are used for the admission of air or by dampers 3^a in the duct 3, if the ducts 4 are used for the admission of air. The dampers 10 or 6, as the case may be, are so placed that the air enters the compartment equally all along the sides and the relative width of the aperture 16 throughout its length is such that the air is exhausted equally at all points along it, so that the circulation of air is equal at all points of the compartment. In the second case where steam heat would be used throughout the whole kiln the steam would be turned on on the steam coils 23 but the furnace would not be used. The steam coils would be supplied with cocks 23^a by which steam would be allowed to escape when needed. In the third case where dry hot air would be used, the air would be drawn through the furnace 1 and the ducts 3 and 4.

In cases where the compartments contain material requiring different treatment the steam heat or furnace heated air may be shut off from any compartment of the kiln and at-

mospheric air drawn through that compartment while steam or furnace heated air may be drawn through either or all of the other compartments.

It is important that there should be means for heating the interior of the kiln by a steam coil and also by a furnace because the heating by steam may be readily regulated to produce the exact temperature required but cannot be used to produce the high temperature often required. Thus the steam heater is often used in the beginning of the process to produce a temperature of less than 200° and the furnace in the completion of the process to raise the temperature to 300° or over.

To define more clearly the conditions under which steam heat and hot air respectively can be most advantageously used in the separate cases I give the following explanation. There are certain kinds of lumber as gum, cotton-wood, maple, yellow pine, which cannot be dried successfully unless the temperature is raised from about 80° at the beginning of the process to about 260° or more at the finish of it. For instance, cotton wood staves can be reduced to about half their weight by applying 80° of heat with a strong suction, but to dry them so perfectly that all the shrinkage is taken out, they require at least 270° to 280° of heat, at the finish. The temperature cannot be produced by steam coils unless the steam is super-heated which is very often inconvenient and always dangerous. Therefore it is necessary to heat the lumber with steam coils at the beginning, and then to use hot air produced by a furnace at the finish of the process. Moreover in a kiln of six or more compartments, as many different kinds of lumber may have to be dried at the same time, some of this, as oak, walnut and hickory, require no more than about 80° of heat during the whole process of drying, whereas the others, as gum, cotton wood, &c. as already explained require about 270° at the finish. It would be impossible or at least very difficult to create and maintain these conditions if only one source of heat would be applied. If a steam coil alone would be used it would heat all compartments to about the same temperature, and the same would happen if a hot furnace alone would be used. But to produce 80° in one room and 270° in the next &c. it is evidently necessary to use the combination of steam coil and hot air furnace. In room N. 1, where 80° are needed the steam coil would be used, whereas the hot air furnace would come in operation in the next room where 270° are needed. The proper meaning of the compartment kiln is to season various kinds of lumber requiring different treatment at the same time in the same kiln and this is a great advantage to the sawmill men and manufacturer. Otherwise he would be compelled to build as many kilns as the number of different kinds of lumber he has to dry. In a kiln as described with the combination of the steam coils and hot air furnace with separate heating ducts for each, it would be easy to accomplish the desired result.

I claim as my invention:—

1. The combination, in a lumber drier, of a duct extending beneath one side of the compartment containing the lumber and discharging into said compartment and a receiving duct beneath the floor of the compartment with a receiving aperture varying in width and a suction duct communicating with the receiving duct in proximity of the narrowest part of the receiving aperture.

2. The combination, in a lumber drier, of a suction duct, a receiving duct in communication with the suction duct and tapering from the point of communication and an aperture extending lengthwise of the receiving duct and connecting the same with a compartment for the lumber, substantially as set forth.

3. In a lumber drier, a receiving duct lessening in section toward the ends, a suction duct in connection with the wider part of the receiving duct, and an aperture giving communication between the receiving duct and the drying compartment and decreasing in width toward the suction duct, substantially as, and for the purpose set forth.

4. The combination, in a lumber drier, of a drying compartment, two air-supply ducts extending endwise beneath one side of the compartment and having damper governed openings forming means of communication with the compartment, a steam coil in one of the ducts, a receiving duct running beneath the compartment at a distance from the air supply ducts with an aperture receiving air from the compartment, and a suction duct in communication with the receiving duct and with the exhausting device, substantially as set forth.

HERMANN C. ZAPPERT.

Witnesses:
WM. A. LANGE,
SAML. KNIGHT.