(No Model.) 2 Sheets—Sheet 1.

L. PINE.

DRYING KILN.

No. 489,717. Patented Jan. 10, 1893.

Fig. 1.

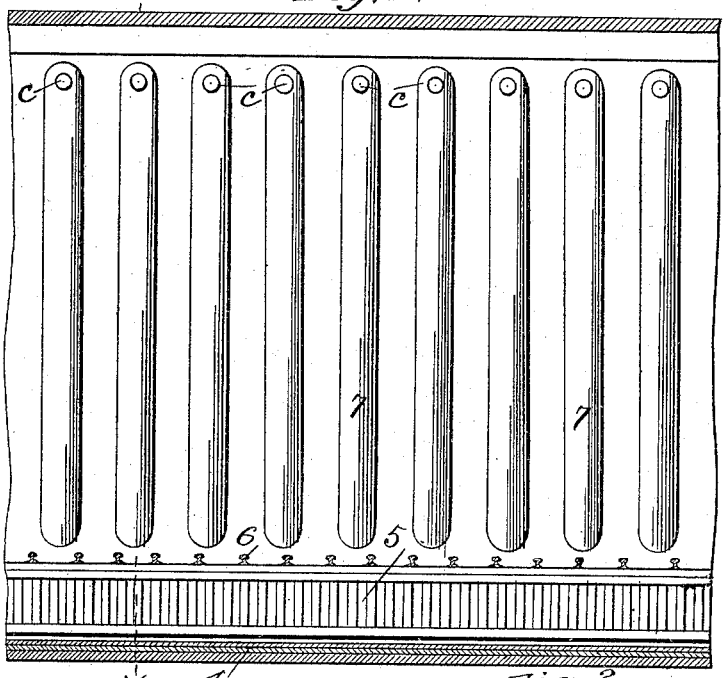
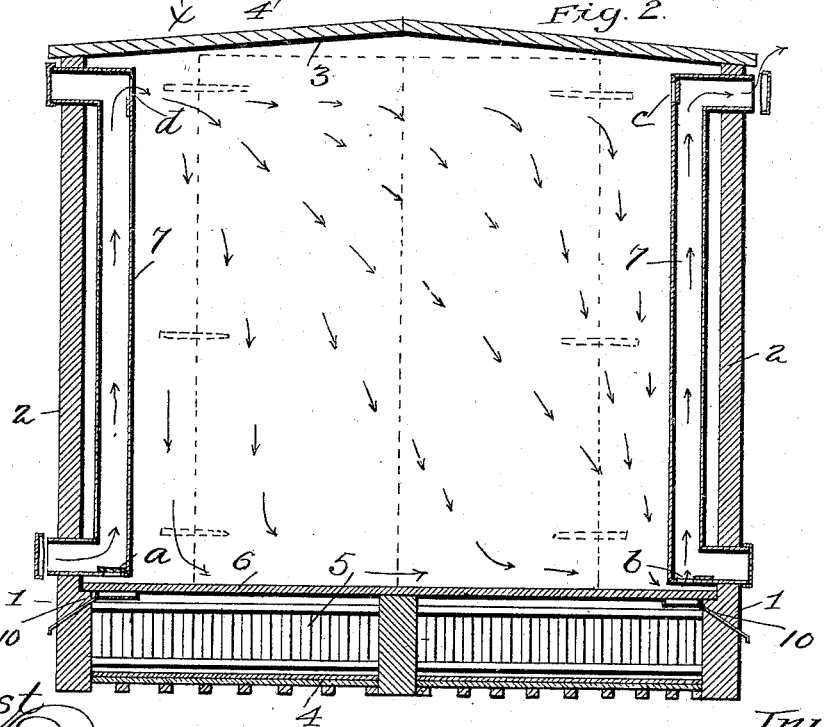


Fig. 2.



Attest
Walter Donaldson
F. L. Middleton

Inventor
Leighton Pine
by Ellis Spear.
Atty.

(No Model.)

2 Sheets—Sheet 2.

L. PINE.

DRYING KILN.

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Fig. 3.

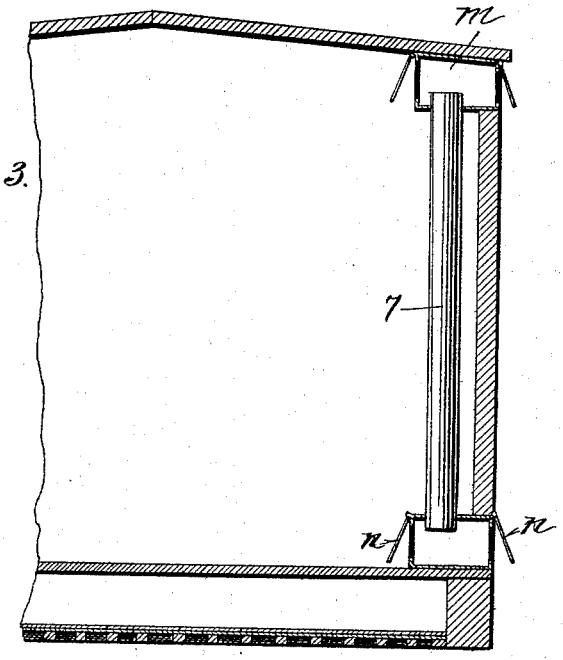
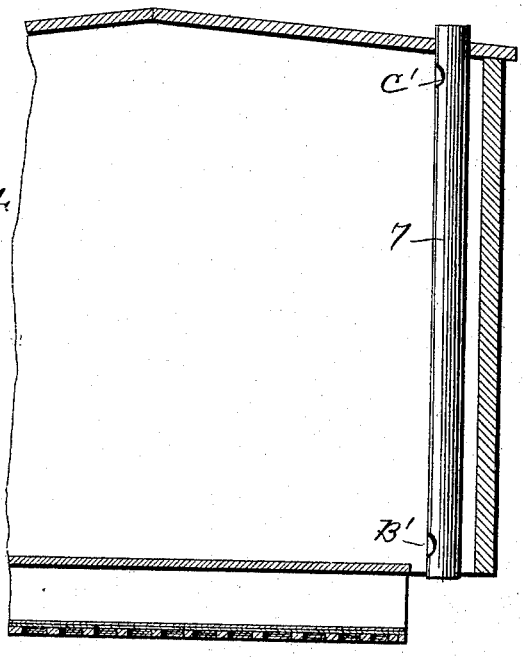


Fig. 4.



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UNITED STATES PATENT OFFICE.

LEIGHTON PINE, OF SOUTH BEND, INDIANA.

DRYING-KILN.

SPECIFICATION forming part of Letters Patent No. 489,717, dated January 10, 1893.

Application filed February 1, 1892. Serial No. 419,971. (No model.)

To all whom it may concern:

Be it known that I, LEIGHTON PINE, a citizen of the United States of America, residing at South Bend, in the county of St. Joseph and State of Indiana, have invented certain new and useful Improvements in Drying-Kilns, of which the following is a specification.

The invention referred to in the foregoing petition is an improvement in kilns for drying lumber, laths, shingles, and other materials.

My invention is illustrated in the accompanying drawings in which

Figure 1 shows a side elevation of the inside of a part of the kiln. Fig. 2 is a transverse vertical section on line *x*—*x* of Fig. 1, and Figs. 3 and 4 are similar transverse sections showing modifications, of the condenser pipes.

In the drawings above mentioned 1, 1, indicate foundations for the building which may be of any suitable materials, but I prefer to use bricks laid in cement or mortar, and of sufficient dimensions to support the superstructure. The side walls of the kiln are shown at 2, and while these may be made of other materials I prefer to use bricks and mortar in the usual manner both at the sides and ends, these walls being preferably twelve inches in thickness. The roof rafters are indicated at 3 sufficiently heavy to support the sheathing and outside roofing materials which are preferably tar and gravel, though other materials may of course be used. The rafters should be tightly ceiled with preferably dressed and matched lumber. A double board floor is indicated at 4, in which I prefer to place tarred paper between the boards to prevent the penetration of the dampness, and also to lay the floor upon strips of about three by four inches to keep it from direct contact with the ground. Supports for the lumber or other material are shown at 6. These I prefer to make of railroad rails laid across the kiln with their ends resting upon the foundation and center wall as shown. When laid in the manner shown they can be moved to or from each other to accommodate them to the lengths of lumber or other materials to be dried. Between the floor and these supports is a space for applying heat and as a ready means for this purpose I have shown steam pipes 5 arranged in any suitable manner for the circulation of live or exhaust steam as may be desired.

Within the kiln and preferably near the sides so as not to interfere with the placing of the materials to be dried, are pipes 7, having communication at their upper and lower ends with the atmosphere. These pipes are shown as being arranged vertically but they may be arranged at an inclination from the vertical line provided the inclination is not varied to so great an extent as to interfere with the circulation of air hereinafter described.

In the form shown in Fig. 2 the communication with the atmosphere outside of the kiln is by means of elbows extending directly outward from the top and bottom. The length of the pipes will depend upon the height of the kiln above the foundation walls but they should be long enough to allow a space about eight inches between their lower ends and the supports for the lumber, and they should reach to within twelve inches of the under side of the roof rafters. I prefer to make the pipes of galvanized sheet iron of about twenty gage and cylindrical and I make the number of them, depending on the material to be dried, and the time in which it is desired to dry it, and while the diameter of the pipes may vary, for general lumber drying I prefer to make them twelve inches in diameter with elbows of the same size, and to locate them about twenty four inches from center to center of each pipe. In the lower ends of the pipes are holes *a*, *b*, located as shown in Fig. 2 and about eight inches in diameter. These holes are provided with covers fitted to be placed upon them from the inside of the pipes, and similar holes *c*, *d*, are provided at the top of the pipes. The openings at the top and bottom of each pipe are provided with covers adapted to close them against the admission or passage of air.

I locate suitable troughs or conductors at 10 under the pipes 7, 7, to catch the condensation of moisture from the lumber or other material to be dried, and to conduct it outside the kiln. The shape and size of these conductors are unimportant, so long as they fill the object mentioned.

Presuming a kiln to be built in accordance with the foregoing specifications, and filled with lumber to be dried, the pipes 7, 7, are operated as follows. First, holes *a*, *b*, *c*, *d*, are

stopped with the covers, which can be done by handling them from the outside through the elbows of pipes 7, 7. The covers that fit over the outside openings of pipes 7, 7, must be removed that the top and bottom elbows may communicate with the outside air. Steam being admitted to the pipes 5, 5, located below the lumber, the air in the kiln, as well as the lumber, becomes heated, and this warm air surrounding the pipes 7, 7, heats them and thus the air inside of the pipes is made to rise and pass out of the top elbow to the outer atmosphere. More air passes into the pipes through the bottom elbow, and thus a constant circulation through the pipes is maintained as long as the kiln and its contents are kept warm. The greater the heat inside the kiln the more rapid will be the circulation of air through the pipes, and this circulation keeps the pipes cooler than the air inside the kiln. The warm air inside the kiln becomes saturated with moisture from the lumber to be dried, and this moisture is condensed on the pipes, and runs down the sides of the pipes, or drips into conductors located below, and is conveyed outside the kiln. This action is continued until the moisture from the lumber ceases to condense, which may be in twenty-four hours or longer after the steam has been admitted to the pipes 5, 5, depending on the amount of moisture in the lumber when it was put in the kiln. After the condensation has ceased to drip from the conductors at the outside of the kiln, the lower outer openings of pipes 7, 7, are closed with suitable covers on one side of the kiln, and the upper outer openings of like pipes on the opposite side are also closed, the other outside passages being open.

Presuming that the pipes 7, 7, on right hand side of kiln, as shown in Fig. 2, have been closed at their lower ends with outside covers, then holes *b* at the lower ends of said pipes 7, 7, must be opened by removing their covers. This can be done before putting the covers on the lower outside openings of the same pipes. The pipes 7, 7, at left hand side of the kiln must have their upper outside openings closed with covers and the holes *d* must be opened by removing the covers. The covers of holes *b*, *d*, may remain in the stopped elbows of their respective pipes, taking care that they do not interfere with the openings from which they have been removed. The upper ends of the pipes 7, 7, on the right hand side are left open, as are also the lower ends of like pipes at the left hand side of the kiln. Ventilation of the kiln now commences, by air being drawn from bottom of the kiln through openings *b* in pipes 7, 7, at right hand side, which passes up through said pipes and escapes into the outside air through the open end elbows at the top. Air also passes up through pipes 7, 7, at the left hand side of the kiln and escapes into the kiln through openings *d* at top of said pipes. The more rapid the ventilation of the kiln the more rapidly will the lumber it contains be dried, and the results are entirely within the control of the operator who may open and close all or only a portion of pipes 7, 7, as just described. The better way will be to use only about one-third the number of pipes to ventilate the kiln for the first twelve hours after condensation has ceased to drip through the conductors at the outside; then use another third for about twelve hours, and then use the full number of pipes 7, 7, for full ventilation. This gradual change and increase of ventilation will not injuriously affect the contents of the kiln, even in severe winter weather. This process of drying lumber produces the desired result in the shortest time possible with safe work, and the combination of the actions of condensation and ventilation will dry lumber without checking it, honeycombing, case hardening, warping, discoloring or injuring it in any other manner.

Lumber dried by this process will remain as straight after having been resawed as though it had been dried in the open air.

It is obvious that the pipes 7, 7, can be used to ventilate the kiln as soon as it is filled with lumber or other materials, by arranging the openings as already explained without using said pipes as condensers; also that said pipes can be used as condensers only, without ventilating the kiln by keeping the openings *a*, *b*, *c*, *d*, closed, but better results are secured by first employing the action of condensation, and finishing by gradual ventilation of the kiln, as previously explained. Some of the pipes 7, 7, can be used as condensers and others be used at the same time as ventilators and thus both methods of drying can be going on at the same time. It is also obvious that the pipes 7, 7, at the sides of the kiln may be arranged in different ways [for instance as shown by Figs. 2 and 3] without conflicting with the spirit of this invention, which is, the use of pipes inside of a dry kiln for the purpose of condensation and ventilation, singly or combined, as previously explained.

In Fig. 3 the pipe 7 enters a box *m*, which has openings and doors or covers *n*, one to the kiln and the other to the outside air. In Fig. 4 the same effect is produced by extending the kiln over the foundations on the sides and running the pipe 7 directly down through and also directly through the roof, orifices with covers being provided as at B′, C′.

If preferred the materials to be dried may be loaded on cars and then be put into the kiln, and one or more cars may be taken out of the kiln, after the material has been dried, and other cars be put in to keep the kiln full, thus securing a continuous operation.

I am aware that it is not new to ventilate dry kilns, and that the principle of condensation has been used in such kilns by making the sides of metal with one face exposed to the open air; also by using pipes inside the

kiln, and causing cold water to circulate through them; also by using a fan and condenser combined, the duty of the fan being to draw the air from the kiln, force it through a condenser, and return it to the kiln, after having been heated by steam pipes.

I do not claim either of the above processes, but I claim the arrangement of pipes as explained, and equivalent modifications of them, for the purposes named. By this improvement, hot air is the only motive power employed, and it causes a circulation of cold air to pass through pipes 7, 7, which keeps the pipes cool and causes them to act as condensers. It also draws the wet heavy air from the bottom of the material to be dried and forces it outside of the kiln. It also draws the cold air from the outside into the kiln regulating the ventilation of the same and all under control of the operator as previously explained.

I claim as my invention—

1. The combination in a kiln of a series of pipes each of which has an upper and lower valved opening leading to the outside air, the said openings with their valves being independent of each other and the said pipes having also the upper and lower independent openings leading to the interior of the kiln, and having independent valves, substantially as described.

2. The combination in a kiln of a series of pipes along one side, having upper and lower openings leading to the outside air and upper and lower valved openings leading to the interior of the kiln and a second series of pipes along the opposite side of the kiln having upper and lower openings leading both outside and inside the kiln, substantially as described.

3. In a kiln a pipe or pipes located within the kiln, and provided with openings to the outside at the upper and lower ends, and also provided with openings at the upper and lower ends to the inside, with suitable covers for said openings substantially as described.

4. In a kiln a series of pipes having openings at their upper and lower ends both to the outside and inside, with suitable covers for said openings, whereby circulation may be maintained, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

LEIGHTON PINE.

Witnesses:
FRANK P. CARMANY,
SAMUEL F. ALLEN.