April 17, 1934. J. F. COBB ET AL 1,955,374

DRY KILN

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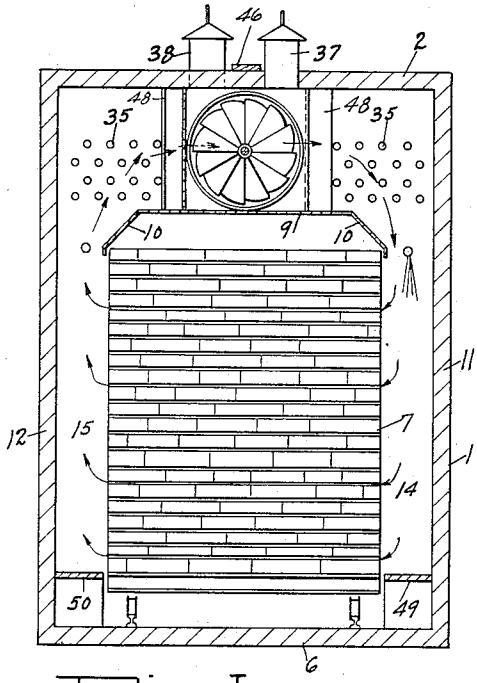


Fig. I

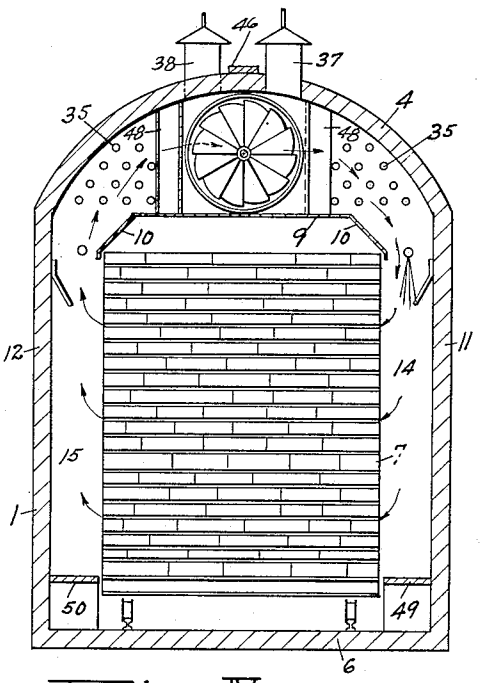


Fig. IV

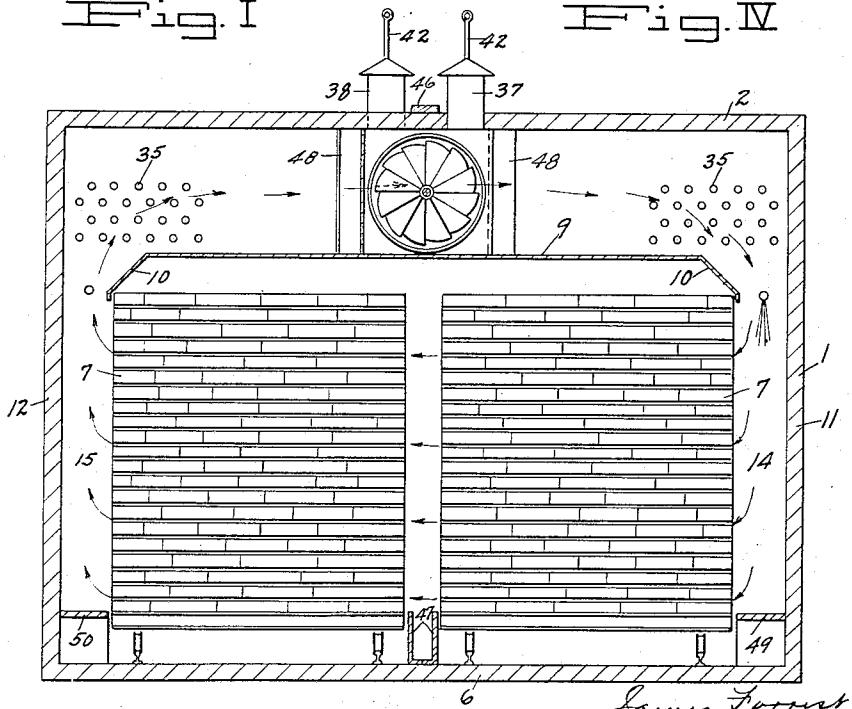


Fig. II

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DRY KILN

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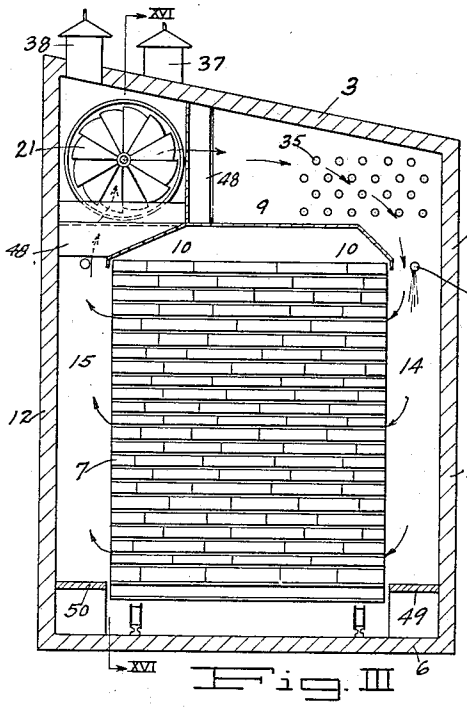


Fig. III

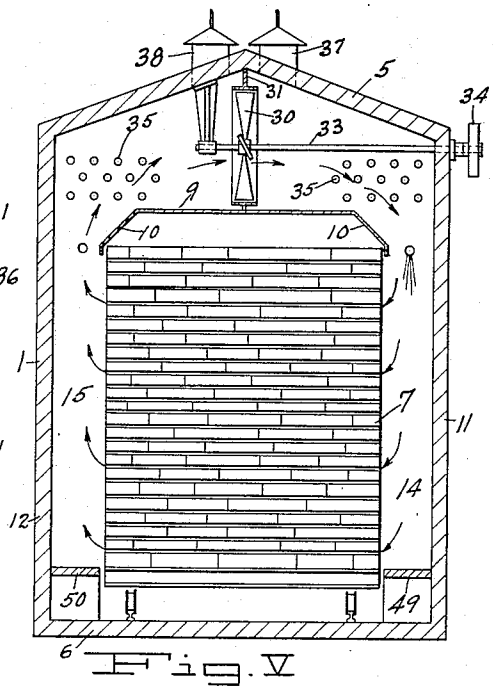


Fig. V

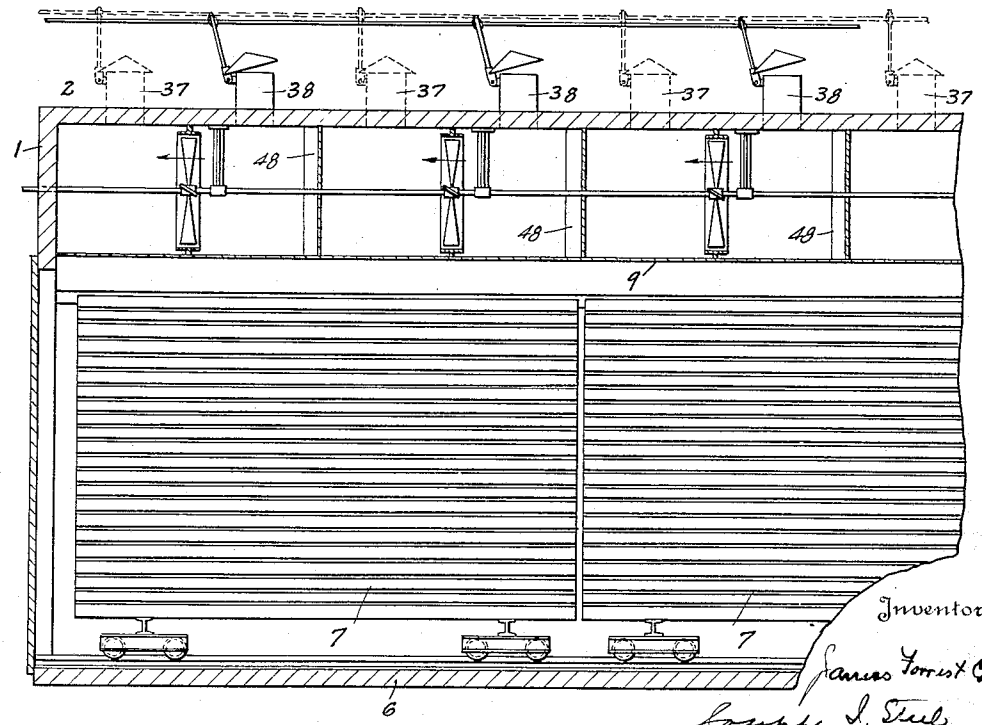


Fig. VI

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DRY KILN

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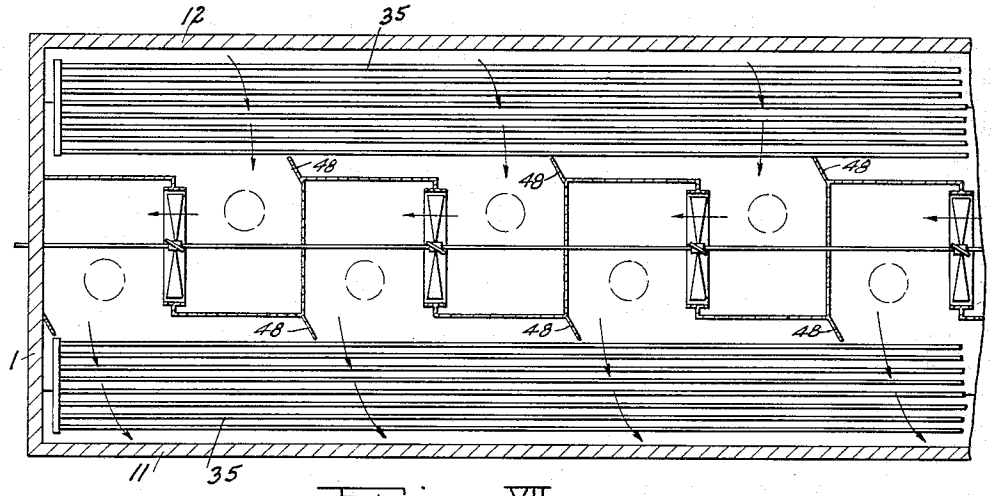


Fig. VII

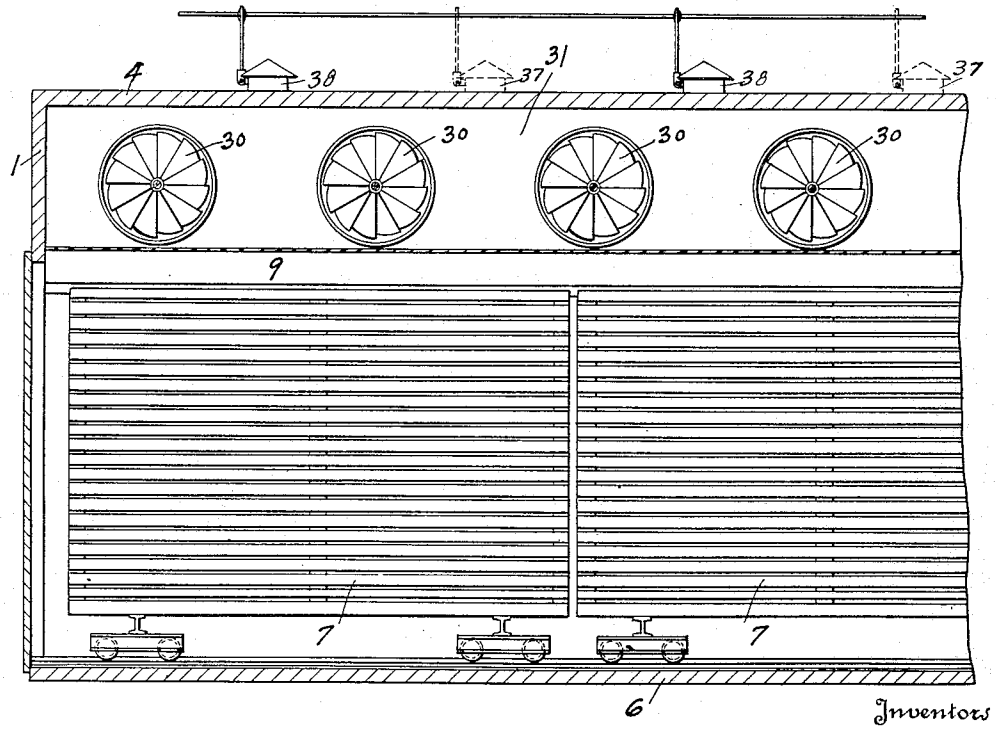


Fig. VIII

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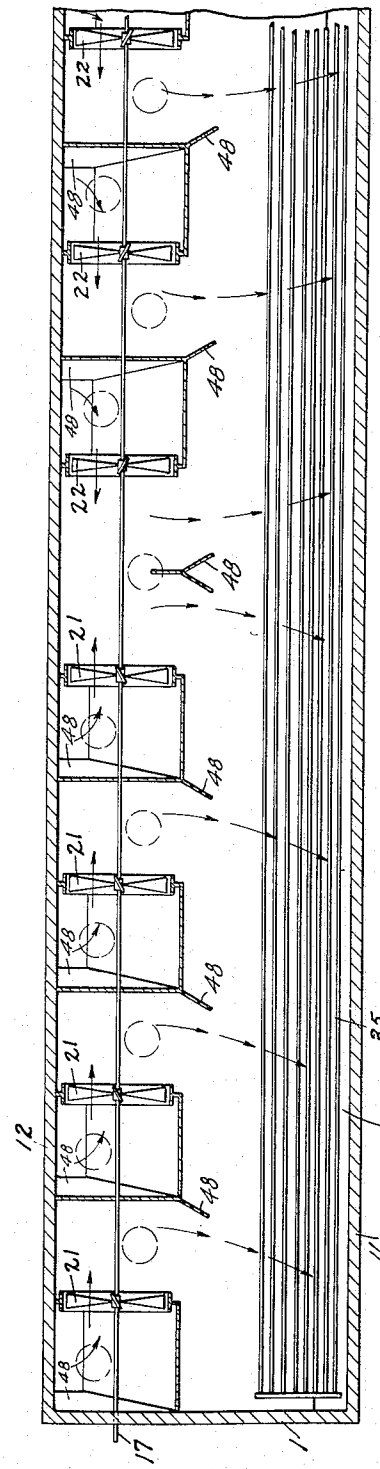


Fig. IX

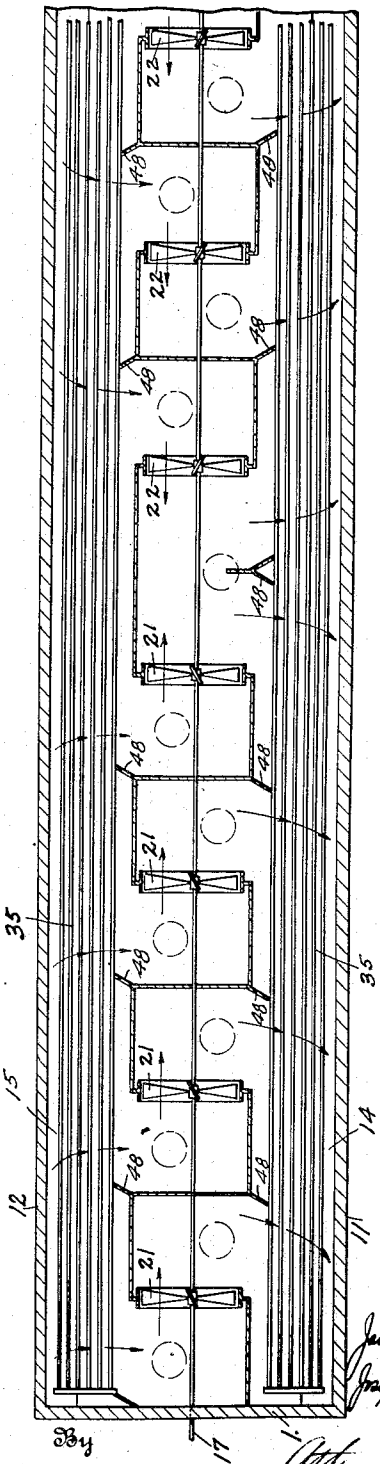


Fig. X

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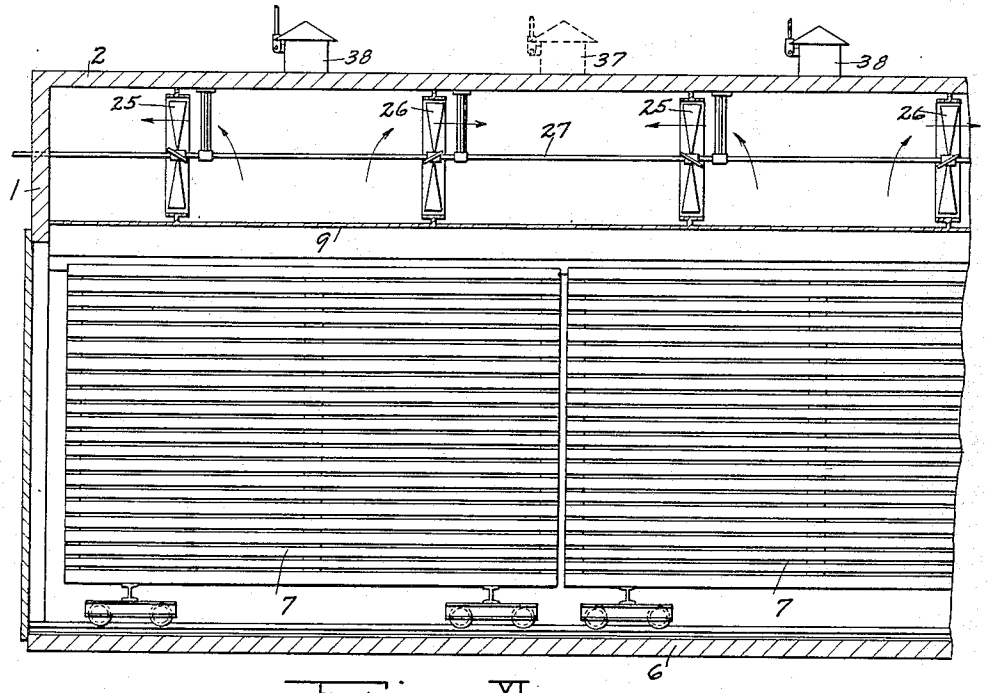


Fig. XI

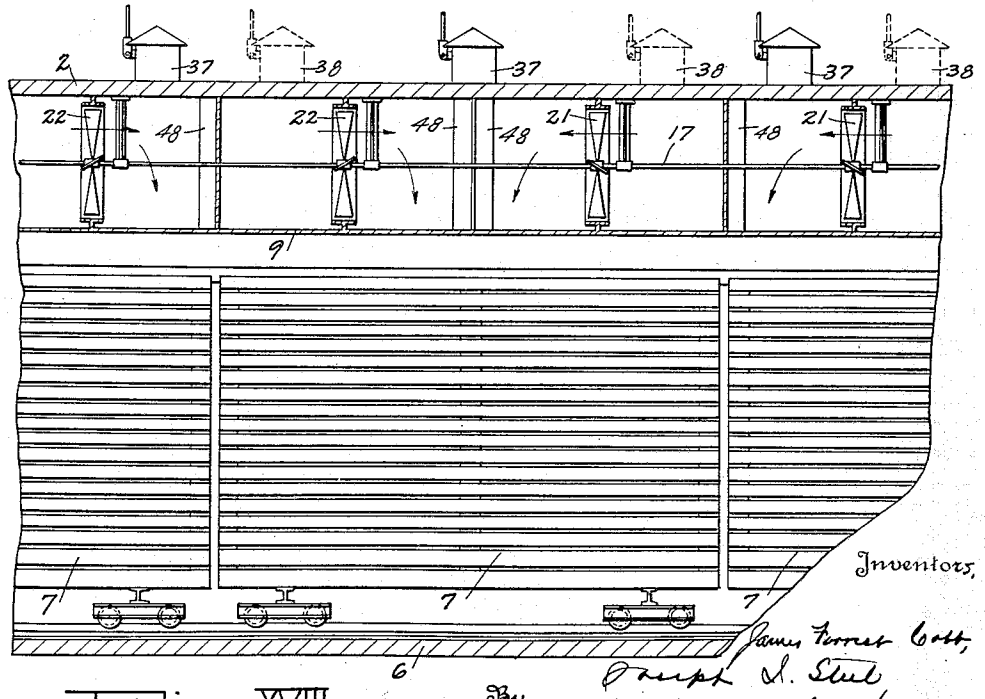


Fig. XVIII

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DRY KILN

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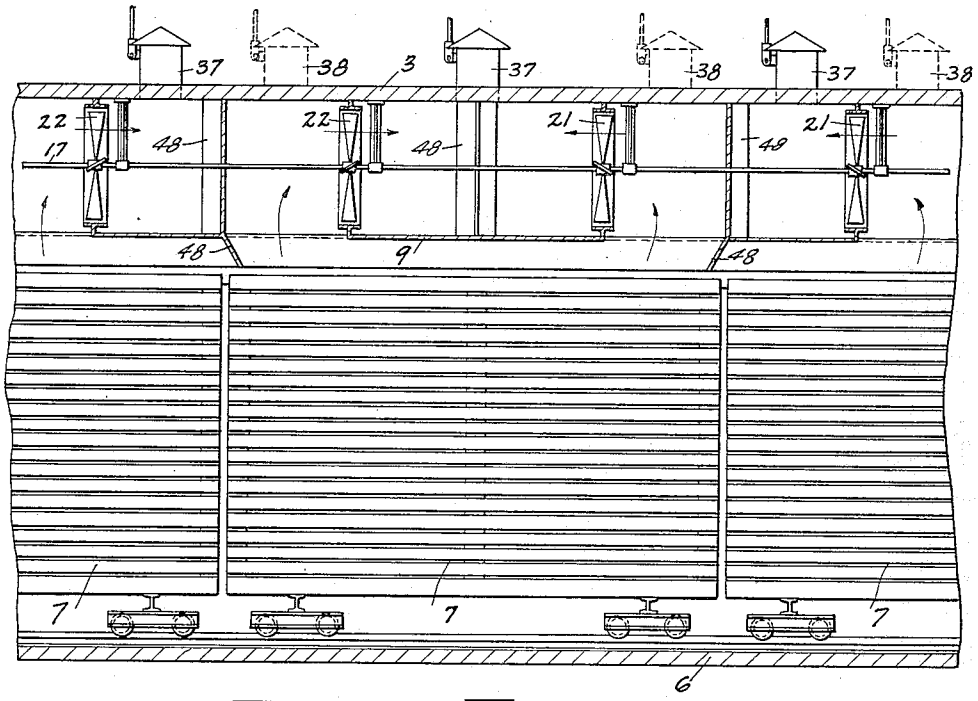


Fig. XII

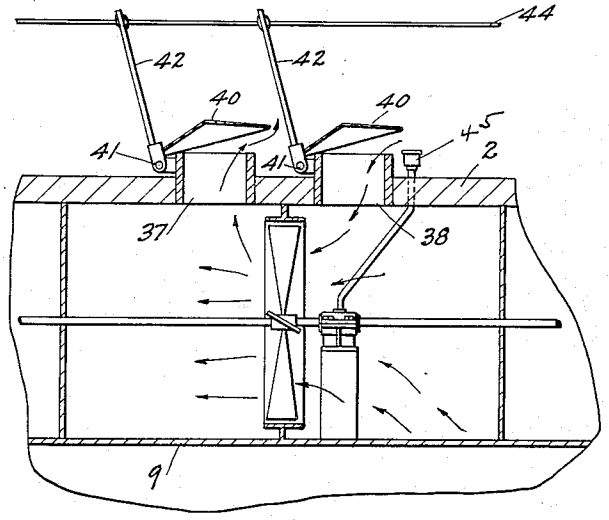


Fig. XVII

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April 17, 1934. J. F. COBB ET AL 1,955,374

DRY KILN

Filed Nov. 20, 1929 9 Sheets-Sheet 7

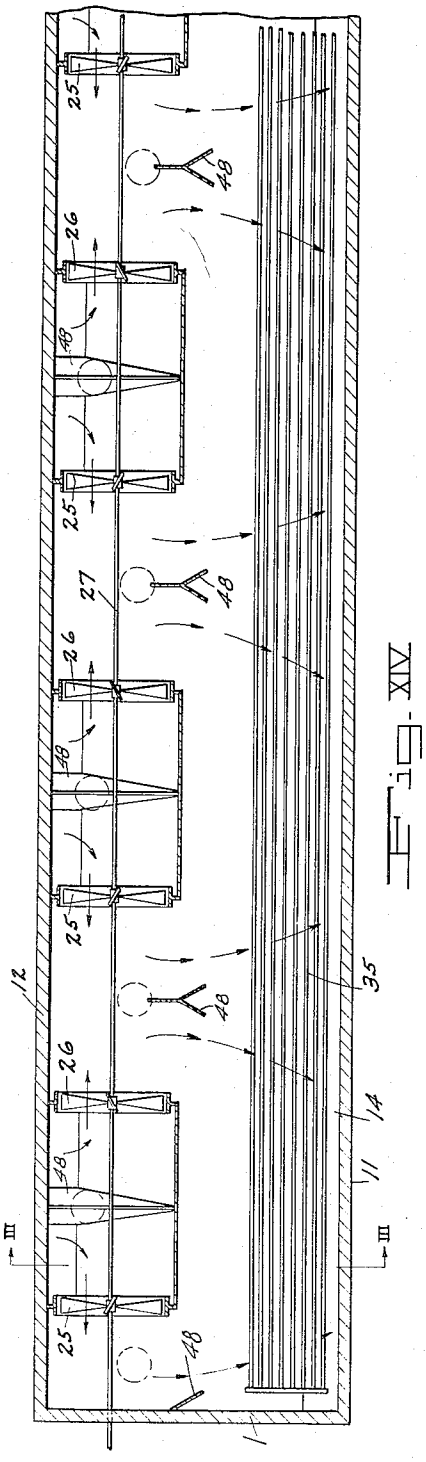


FIG. XIV

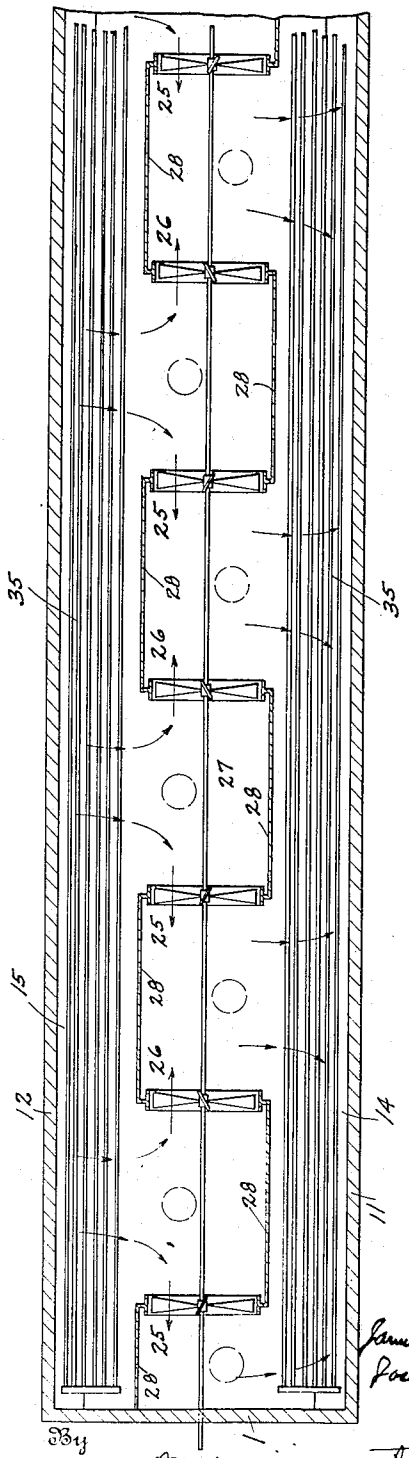


FIG. XIII

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DRY KILN

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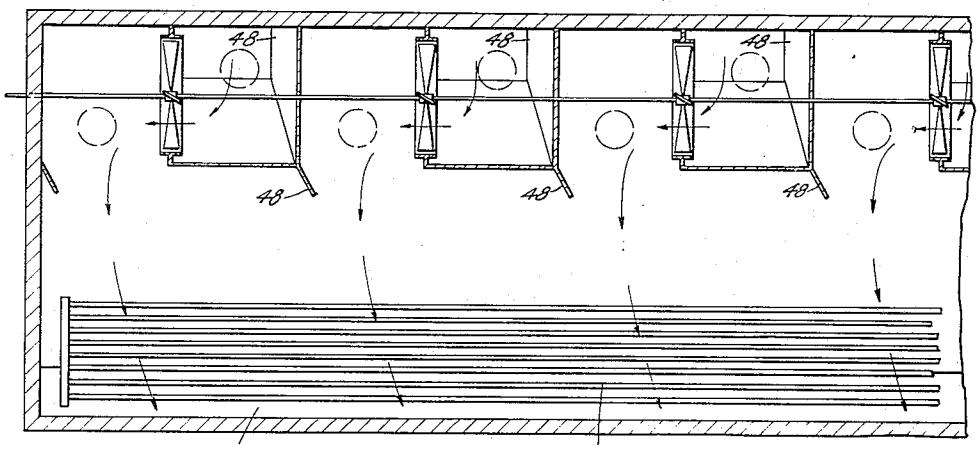


Fig. XV

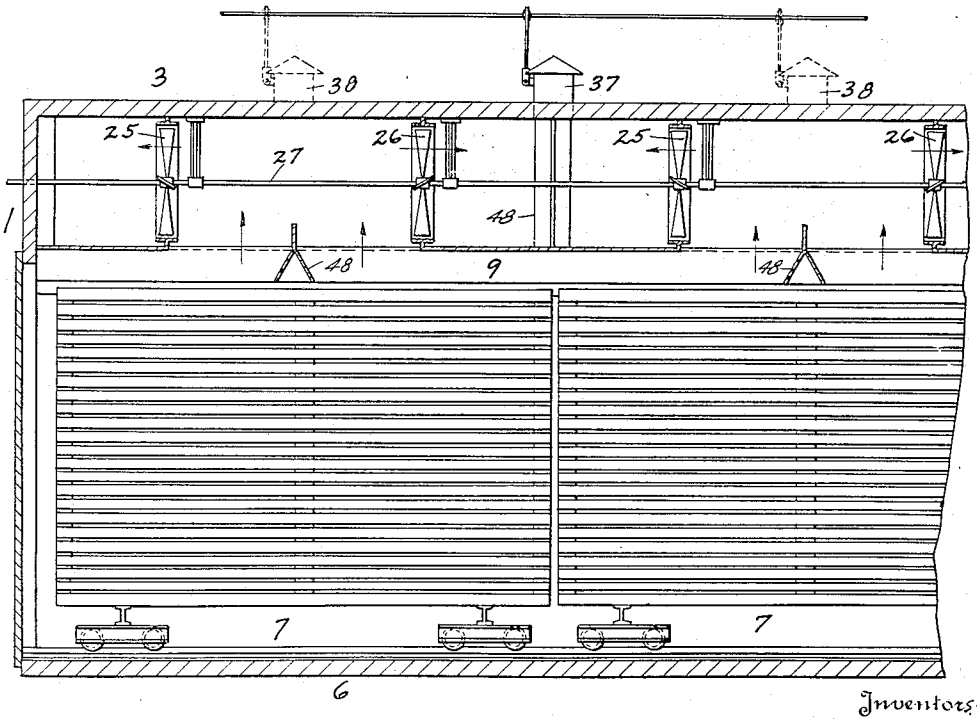


Fig. XVI

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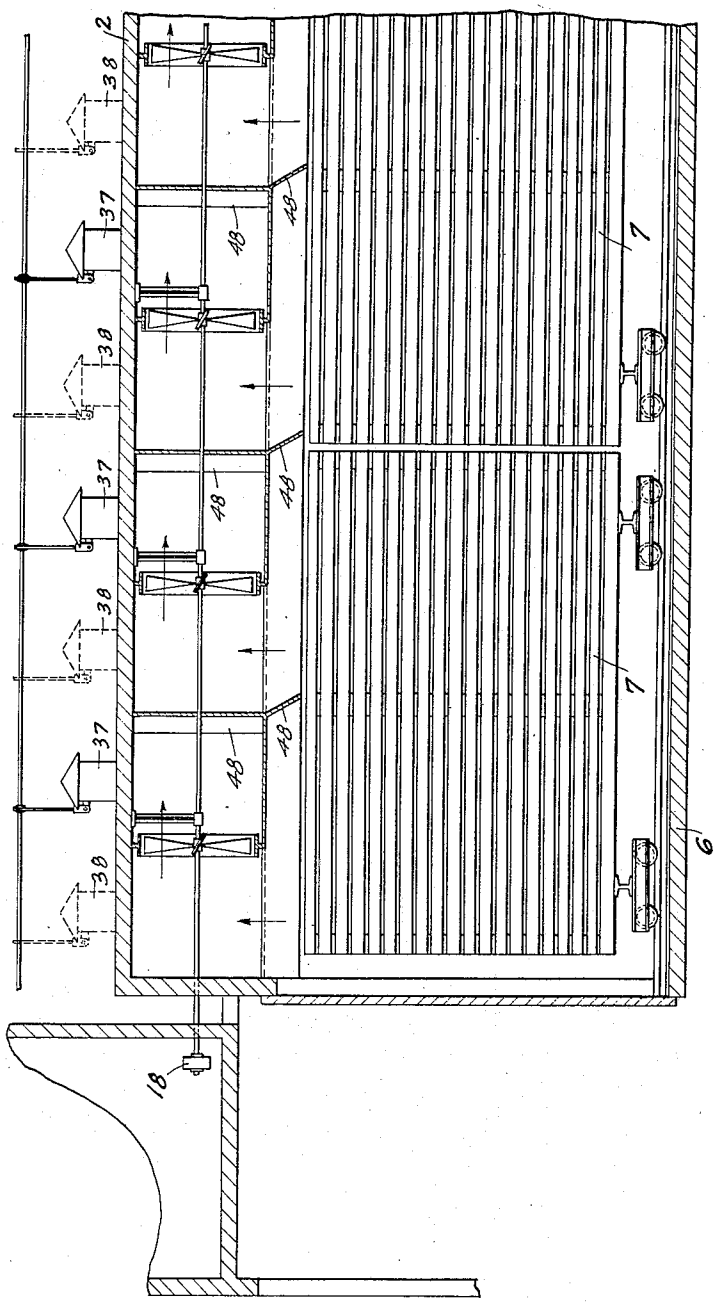


Fig. XIX

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UNITED STATES PATENT OFFICE

1,955,374

DRY KILN

James Forrest Cobb and Joseph I. Steel,
Portland, Oreg.

Application November 20, 1929, Serial No. 408,576

4 Claims. (Cl. 34—46)

This invention relates generally to the art of kiln drying and to dry kilns, and has for its object the production of improvements in each.

The invention herein described is not limited to a cross-circulation kiln, nor to one in which the circulating medium is forced transversely across the stock loads. We employ a fan system which may be not only disposed in any position of operative relationship to the loads in the kiln, but which, by being disposed in close proximity to an outside wall of the kiln, is put into direct communication with the outside atmosphere. Such disposition of the fan system may be, for convenience, in order to distinguish it from a system in which the fans are located underfoot,—that is to say in a plane disposed below the bottom of the stock load of the kiln,—denominated for convenience in a single term generally, an overhead fan system.

The advantages of our present invention are too numerous to be listed in full, but it is deemed to be proper, in this general statement, to point out some of them as follows.

The overhead fan system, as comprehended by the foregoing language of the general statement, is applicable to either a single-track kiln or to a multiple track kiln. Such fan system may be of any suitable and preferred type, and may be disposed overhead, in the broad sense in which that term is herein employed, either medially of the kiln or substantially at either side of the kiln. Whether it be so disposed medially or laterally, the fan system may include a plurality of fans divided into series whereof each series as a whole or in part makes delivery positively or, in effect in one direction or, by reversal of rotation, in opposite directions through the stock loads.

An important distinctive feature of our present invention, in all forms of embodiment, is in the opportunity it affords for direct means of ventilation as distinguished from indirect means of ventilation, or such as necessitate the employment of elaborate or extended duct systems for the introduction of fresh air into the kiln and the discharge of spent air from the kiln.

In view of the foregoing introductory statement, some of the new and useful advantages derived from our invention are selected from among others, and are specified below.

The above indicated overhead installation of fans eliminates, for instance, the need of excavation for a pit below the tracks. This excavation is costly, and in many cases impracticable, due to presence of water in the earth that would have a tendency to seep into a kiln pit, if excavation were employed. Moreover, kiln building costs may be, by our invention, reduced on account of requiring less material for the kiln walls as well as on account of elimination of excavation.

Those fresh air ducts which have been heretofore normally placed in the lower part of the kiln, as, for example, in the corners of each kiln in a battery of kilns, are, by our present invention, eliminated, thus giving more room alongside the fans for installing and taking care of the fan system and of the heating system.

The direct means of ventilation of a kiln afforded by our invention, through the location, above referred to, of vents and fresh air ports, preferably located in close proximity to the fans, permits the taking in of a greater volume of fresh air and the outlet of a greater volume of air than by indirect means of ventilation, because the vents and fresh air ports, respectively, are thus located at points of the kiln circulation of maximum suction and maximum total pressure.

Furthermore, the location of vents and fresh air ports in close proximity to each fan permits inspection of the fans, the shaft, and the bearings in the kiln from the roof of the kiln, for instance, at any time, even though the kiln is in active operation.

The vents and fresh air ports, aforesaid, may be operatively disposed on a single control line, whereby the opening and closing of vents and fresh air ports may be effected simultaneously. This is, generally speaking, an advantage, although in some cases it may be advisable to provide means for opening the vents without opening the fresh air ports. This is true in respect to drying stock at high humidities and high temperatures where a large amount of ventilation is not needed, because, in such case, steam and heat economy can be effected by using the minimum intake of fresh air and outlet of spent air.

By disposition of vents and fresh air ports at points of maximum suction and pressure, a quick cooling of the kiln prior to final steaming may be effected by opening wide the fresh air ports and vents for the purpose of effecting a quick changing of the air in the kiln by means of the fan system. It should be observed in this regard, that reversal of circulation by reversal of the direction of rotation of the fans in no way affects the operation from a ventilating standpoint, because the vents and fresh air ports are usually equal in number. They may be, nevertheless, of unequal number, if required, in order to suit

special drying conditions. In such case, there might be some slight variation of the result obtained by reversal of circulation, but no interruption of circulation.

The overhead fan system permits more effectively the preventing in the operation of short circuiting, both above the loads and below the loads. When insufficient volumes of air are recirculated, that condition may be remedied by the placing of sprays or steam jets, disposed, if desired, at the sides of the stock loads, and by variation at will of the direction of discharge of the sprays or steam jets. By turning the outlet openings thereof so that the force of the spray or jet will be directed straight down or toward the load to guide the circulation to one or more points on the load, the result may be effected of accomplishing faster drying at such point or points. For instance, if it should appear that the bottom of the load were drying slower than the top, the force of a steam spray may be directed toward the slow drying spot to accelerate the circulation through that part and by that means increase the drying rate. Sprays, when used for this purpose, are located on both sides of the load, so that they may be, by adjustment, made alternately effective for promoting circulation in either direction.

If the insufficiency of the volume of air in recirculation, alluded to in the last preceding paragraph, is the result of an insufficient direction of the current or currents of circulation rather than actual lack of said volume, that condition may be remedied by the placing of adjustable deflector plates 53 attached to the side walls of the kilns, as hereinafter indicated.

By aid of our invention, not only the fans, bearings, and shaft may be, as aforesaid, inspected from the roof, for example, while the kiln is in operation, but also means of lubrication may be provided on the roof, for instance, instead of inside the kiln, so that the lubricant may be supplied from outside the kiln to a bearing at any time, even while the kiln is in operation.

By aid of their overhead disposition, the fans cause initial circulation of the air at the top of the kiln interior where, by natural convection, the temperature tends to be higher than at the lower part of the kiln. A substantially complete stoppage of air circulation at top and bottom of the loads is sometimes desirable, although, generally, baffle control, instead of stoppage of air, should be provided, because a certain amount of air may be required to pass under the load or above the load to prevent a stagnation of circulation at these points or a slower drying of the top or of the bottom courses of the loads.

The operating room, in overhead fan systems, is located overhead, and attention is directed to the fact that the space allowed between the operating room and the kiln permits the escape of the moist air leaking out from the kiln doors.

In some of the figures of the drawings (see Figure IV, for instance), a hip or arched roof construction is shown for the reason that such construction will permit using lower walls and a consequent reduction of building costs. A hip or arched roof construction restricts, to be sure, the space at the side of the fan duct for the heating system, but in many cases this space is not required, and such construction has an advantage of preventing eddies or stagnation of air in corners of the kiln.

In double track kilns of our present types, each load should be individually baffled at corners of the load at its top and bottom, as shown in Figure II, for example. The fan ducts and the kiln ceiling are, in such instance, located in close proximity to the heating coils. Consequently, the circulating atmosphere, when moving in either direction, in most cases, passes through the coils before coming in contact with the fan ducts or ceiling. These ducts and the ceiling are also heated by direct radiation from the heating coils, and are hotter than the circulating atmosphere which passes through the stock loads. The result is a tendency to prevent the fan ducts, baffles, circulating equipment and ceiling from acting as condensers of kiln vapors, and reduces consequent deterioration of the parts last named.

The fan shaft bearings are preferably disposed in hangers supported from the kiln roof, though they may be carried by supporting devices provided below the roof, if desired.

What constitutes our invention will be hereinafter described in detail and succinctly defined in the appended claims.

In the accompanying drawings which constitute a part of this specification,

Figure I is a vertical cross section of one form of embodiment of our present invention in a single-track kiln.

Figure II is a view similar to the last preceding, showing a double-track kiln.

Figure III is a view similar to Figure I, but illustrating a modified lateral disposition within the kiln of the fan system, and a modification of the kiln roof.

Figure IV is a view similar to the last, but showing a further modification of the kiln roof and a fan system disposed medially therein.

Figure V is an illustration in part of a modification of the subject matter of Figure IV, but designed to show a different modification of the fan system from any one shown in any of the preceding figures.

Figure VI is a medial longitudinal vertical section, partially broken away, taken in a plane substantially diametrical to the fan shaft in either Figure I or Figure II.

Figure VII is a floor plan of Figures I or II, disregarding their transverse dimensions, and showing diagrammatically the fan system superposed above the floor in either instance.

Figure VIII is a view, similar to that of Figure VI, showing in longitudinal vertical section the fan system illustrated in Figure V.

Figure IX is a partially diagrammatical plan view of a fan system (laterally disposed in the kiln) of a distinct specific type showing the fans thereof divided into two series of oppositely discharging (right and left hand) fans, as contemplated in Figure III.

Figure X is a view similar to that of the last preceding figure, but showing a medially disposed fan system, as shown in Figures I, II, and IV.

Figure XI is a partial longitudinal vertical section of the subject matter of Figure XIII.

Figure XII is a partially diagrammatic vertical longitudinal section of a portion of a kiln having a fan system as shown in Figure IX.

Figure XIII is a view corresponding to Figure X, but showing a fan system of the type comprising units of oppositely discharging paired fans, as shown in the application for patent aforementioned, but without deflectors.

Figure XIV shows oppositely discharging

paired fans, the same as Figure XIII, except the showing of deflector baffles and the fan system disposed laterally as in Figures III and IX.

Figure XV is a view similar to that of Figure VII, but showing a floor plan of the subject matter of Figure III.

Figure XVI is a partial vertical longitudinal section, partly diagrammatic, of the subject matter of Figure XIV.

Figure XVII is a detail vertical section, partly in elevation, showing, in general, the relationship of a single fan to the vents, lubricators and fresh air ports which, by our invention, are provided.

Figure XVIII is a partial vertical section similar to Figure XII of the subject matter of Figure X.

Figure XIX is a partial vertical section of Figure XV, designed to show a modification of the subject matter of Figure VI.

Referring to the numerals on the drawings, 1, wherever it appears, indicates a kiln structure or outside enclosing building defining a circumscribed space for the circulation of a gaseous drying medium. Such building may be made of any suitable materials, and of such shape, size, and dimensions as may be preferred with due regard to the presence of controlling conditions. A plurality of such buildings may be constructed in what is known in the art as battery assemblage, when due consideration of economy of space and cost may dictate. Each building may be provided with a roof of any usual or suitable form as may be preferred, such, for example only, as a flat roof 2, shown for instance in Figures I and II, a shed roof 3, shown in Figure III, an arched roof 4, shown in Figure IV, or a gable roof 5, shown in Figure V.

The bottom 6 of the kiln may, in accordance with our invention, be laid directly upon the ground on which it rests, and is designed and adapted to carry load supporting members, which consist usually of tracks on which wheeled trucks, carrying stock loads 7, built so as to be permeable for the passage of air through them, travel into and out of the kiln, as is usual in kiln charging and discharging operations.

Above the tops of the loads 7 there is preferably provided a floor 9, extending substantially from end to end of the kiln interior and having on its opposite sides longitudinally disposed eaves 10, constituting baffles.

The floor 9 is, in effect, an overhead protective covering for the loads. In double-track kilns, (see Figure II for example) the floor 9 covers a plurality of loads that are disposed side by side, and the eaves 10 extend towards the respective corners of laterally adjacent loads. Each floor 9 may be, by any suitable means, supported from above or from below within the kiln structure 1. Upon the outer sides of each load or laterally disposed series of loads, just referred to, the load or loads, between themselves and the side walls 11 and 12 of the kiln structure, define vertical lateral passage ways 14 and 15 which extend the length of the floor 9, that is to say substantially the full length of the kiln interior, and connect with the chambers on opposite sides of the partition or vertical walls 28 or 31.

Above the floor, preferably in juxtaposition thereto and supported thereby or by any other suitable means preferred, is disposed a fan system that is preferably of the internal fan type, comprising a plurality of fans, each constituting a source for generating the aforesaid circulation of the gaseous medium.

As has been specified in general terms, the fan system may be any one preferred of a considerable range of varieties, and may be disposed lengthwise of the kiln, either medially therein or in either of the upper corners thereof.

Of the many different varieties of fan systems that may be employed, we prefer to use the fan system shown in Figures V and VIII, but any other suitable or adaptable fan system may be employed if desired.

Of the fan systems just above specified, two forms are shown in Figures IX and X, for instance. These fan systems comprehend, for example, a succession of fans that are preferably mounted on a common shaft 17, which is provided with means for operative connection to a source of driving power not illustrated. The fans shown in the figures last named are preferably right hand fans and left hand fans, 21 and 22, respectively, that are disposed in oppositely discharging relationship. Each of said series of fans, through a zig-zag fan duct, makes delivery of a current of air circulation from compartments on different sides of the duct, in alternating succession, while the fans at the inner end of each series preferably discharge a current of air from one of said fans, with deflecting effect upon the two currents, substantially from the plane in which they meet.

The deflecting effect indicated in the last preceding sentence is also accomplished by a succession of a series of oppositely discharging pairs of fans in a zig-gaz duct, as illustrated in Figures XIII and XIV for example. In those figures, one of each set of paired fans is a right hand fan and the other a left hand, indicated by the numerals 25 and 26, respectively. In the instant example, all the fans are preferably mounted on a driven common shaft 27, and each set of paired fans is separated by wall sections 28, located upon different sides of the shaft with deflecting effect upon the impinging currents of air discharged from the paired fans.

The effect of impingement of air currents from the paired fans, separated as specified by alternately disposed wall sections 28, is substantially indicated in Figures IX and X, since the same effect is produced therein.

In Figures V and VIII, a device is shown in which a similar effect of transverse circulation is produced by a succession of fans 30 and of partitions 31 corresponding to the wall sections 28 disposed in alternating order and in substantially the same plane, separating the space above the stock loads into chambers communicating with the lateral passageways 14 and 15. The fans 30 are driven, preferably, each by an individual shaft 33 having means of operative connection, as for example a pulley 34, with a source of driving power, not illustrated.

In most forms of embodiment of our invention, heating means, for example coils of steam pipes 35, communicating with a source of heat supply not shown, are preferably provided at the upper ends of the lateral passages 14 and 15. However, sprays, for example steam jets, may be, at discretion, employed for supplying heat and aiding circulation, and in Figure III only one coil 35 is shown in one of the lateral passages and in both passages a steam spray 36 is employed, the spray being adjustable for the pur-

pose of imparting direction to the current of circulation.

In all forms of embodiment of our invention, provision is made of direct means of ventilation with reference to the fans of the fan system employed.

Such direct means of ventilation, made possible by our invention, consists of a vent 37 and a fresh air port 38, that are complementary in effect. That is to say, a vent 37 and a fresh air port 38 in the roof or other available wall of the kiln may be provided for the fans and preferably for each individual fan of the fan system, the former on the pressure side of the fan and the latter on the suction side thereof. Reversibility of circulation being contemplated as a part of our invention, and being obtainable by the employment of reversibly rotative fans, it follows that the vents 37 and ports 38 are interchangeable in function. Consequently, upon reversal of the direction of rotation of the fans, the vents 37 become the ports 38, but so long as such rotation continues in one direction, the identity of the vents and ports is constant.

The vents 37 and the ports 38 may be individually controllable, and preferably are so, in order to meet varying conditions that may be present in use, but they are also preferably provided with means for actuating all of them in a single manipulation. Such means, for example, may consist in providing all the vents and ports each with a cover 40 hinged to the kiln roof, as indicated at 41 for example, and each provided with a lever arm 42 on each cover for raising or lowering the cover on its hinge 41. A line or rod 44 connected to all the arms 42 may, by its longitudinal movement, simultaneously actuate all the arms 42. If desired, one or more of the arms and the member 44 may be temporarily disconnected at will, with the result of cutting off the member so disconnected from actuation by the member 44. Also, by opening any one of the covers 40 the fan and bearings adjacent thereto may be rendered easily visible through the kiln roof, or other wall, even while the fan system is in operation.

Furthermore, each shaft bearing within the kiln is connected with suitable means of lubrication operatively disposed on the outside of the kiln for the purpose of supplying a lubricant at any time. An oil cup 45 on the roof is shown in Fig. XVII as an example of such means. A walkway, extending substantially the full length of the kiln between the lines of vents 37 and ports 38, may be provided for the convenience of an attendant.

Baffle plates 48, adapted to be adjusted at will for direction or distribution of circulation, may be employed at discretion. In double-track kilns, closure members 47, as shown in Figure II for instance, are necessary to compel flow of circulation through laterally disposed stock loads, from one passage way, 14 or 15, to the other.

In respect to the means of baffle control, it is proper to observe that because the fans are blowing in one direction or the other, there may be a tendency towards longitudinal circulation. This longitudinal circulation may be prevented by the use of deflective plates 48 which are placed in front of the fans in each direction of circulation, except in some cases where the fans are opposed in pairs. These deflective plates are adjustable for changing the exact transverse extent of the deflected current. The purpose of these deflective plates 48 is to distribute the air in a transverse circuit of circulation so that it will be distributed uniformly through the stock loads and produce uniform drying throughout the kiln. These deflective plates are to be distinguished from the closure members 10 above and those below the loads which tend to prevent the air from short circuiting under or over the loads. Both the closure members and the deflective plates serve a distinct and useful purpose in our kiln and we consider their arrangement one of the objects of our invention.

Walkways 49 and 50, with like closure effect, are used on the kiln bottom 6, and are preferably made demountable in any preferred manner so as to facilitate, upon any occasion that demands it, their removal and subsequent replacement at will.

In view of the foregoing specification, the operation of our kiln may be briefly outlined as follows.

The result of the operation of each type of fan system hereinbefore described, is, at points of the kiln that are severally in close proximity to the several fans and preferably each to an individual fan, to produce a maximum suction and a maximum total pressure for each fan as has been specified. In operative proximity to those points, respectively, a pair of vents 37 and fresh air ports 38 is located. Said pair of vents and ports collectively afford, preferably through direct communication with each individual fan, and by their varied mode of manipulation as specified, means of ventilation to the kiln.

That is to say, fresh air derived from the air ports 38 is driven, by the cooperation of the several fans of the fan system, into heating contact with the coils of steam pipes 35, and after it has been heated by such contact, the air is driven through the spaces provided in the stock loads into effectual drying contact with the stock to be dried that constitutes said loads. The course of the circulation of heated air derived from the fans is guided and directed by the provision, at discretion, of means adapted for the purpose, such as sprays, baffles, or the like. After the heated air has, in the course of its circulation through the kiln, become spent, that is to say loaded with moisture to the desired relative amount, by absorption from the drying stock, it finds outlet from the kiln through the vents 37.

The current of circulation is, in ordinary course, continuous, the volume of the inlet of fresh air and that of the outlet of spent air being proportionate, but subject to manipulative control, substantially for and in the manner previously specified. The cross circulation of the heated air through the stock loads may be further explained, in respect to the fan systems described and illustrated. The said fan systems include that identified in Figure X, for example; that identified in Figure XIII, for example; and that identified likewise in Figures V and VII. Other figures of the drawings show the subject matter of the four figures aforesaid, but they have been already described, and reference to the said four figures is deemed to be all sufficient for the purpose of identification only of the several fan systems, by way of example.

The system illustrated in Figure XIII constitutes a formal variation of that shown in Figure VII. It accomplishes, in effect, the same results as that accomplished by the said zigzag fan duct system, by the employment of equivalent means, namely, opposite delivering or counteracting paired fans.

In the two fan systems referred to in the last two preceding paragraphs, all the fans of each system are mounted on a common shaft, and effect discharge, singly or in pairs, alternately on different sides of the shaft.

In Figure V, a fan system is shown, in which each of the fans is driven by an individual shaft, each fan being disposed, in effect, in the same plane, and each discharging in the same direction.

In respect to the various types of fan systems, of those illustrated, for example, in Figure XIII, the individual fans, in the manner already specified, make alternate air delivery in opposite directions, determinable by the direction of rotation of the common shaft which drives them (which is reversible at will) and by the pitch of the fan blades. Consequently, each fan sucks air from one side of the partition or vertical wall 28 or 31 and delivers air to the other side thereof.

The fans of the fan system illustrated, for example, in Figures V and VII preferably, as previously indicated, make delivery in one direction, but, in operation, each fan has its suction side and its pressure side. A port 38 communicates with the suction side of each fan and a vent 37 communicates with the pressure side thereof. The disposition of the individual fans, in each fan system, permits the vents 37 and ports 38 to be alined, in close proximity one to another, as illustrated, for example, in Figure XVII.

In respect to the location of vents 37 and ports 38, it should be observed that due to the rotation of the fans, air which is sucked in through a fresh air port 38 will not be discharged easily through the ventilator vent 37 on the opposite side of the fan, because fresh air collected by the blades of the fan will be discharged in greatest proportion from the bottom instead of the top of the fan. This will result in effectually preventing the taking in of fresh air through the port 38 on one side of the fan and its direct discharge through the next adjacent vent 37 on the other side. The discharge of spent air from the kiln being through the vent 37 will permit any desired reduction of the relative humidity in the kiln.

The overhead fan system, whatever be the type preferred, may be disposed, at discretion, in various relative positions within the kiln structure 1. In Figures I, II, IV, and V, the fan system is shown as disposed medially of the kiln above the stock loads. In Figure III it is shown, by way of example, on one side of the kiln. In the instances just mentioned, the fan system is located directly under the horizontal wall or roof 2, but it might be located to some advantage, in respect to local conditions of installation, in operative proximity to vents 37 and ports 38, set in either of the side walls of the kiln structure 1.

In the usually preferred type of fan system employed, the fans will deliver above the floor 9 fresh air derived from the ports 38 to heating coils 35, whence the air passes through the stock loads 7, by way of one or the other of the two passage ways 14 or 15, depending upon the direction of rotation of the fans. The remaining passage way serves to conduct the air, moisture laden from drying contact with said stock loads 7, to the vents 37, through which, in controllable volume, it is discharged into the open air.

Fresh air taken in at the fan on the suction side of the fan system is by the rotation of the fan discharged at some point or points around its periphery, with the result of mixing it with the general air flow. A further mixing is desirable, however, and it is one of the objects of our invention to discharge the currents against the side walls of the kiln and thereby obtain a deflection of the currents in thin strata down the side of the stock load below the top section substantially at the point where normally the air flow through the interstices of the load is weakest.

In order to obtain the advantages of thorough mixing of the fresh air with the circulating medium and proper deflection of the air as mentioned above, an angular roof construction in effect substantially as shown in the drawings, Figures I and II, as contradistinguished from the arched roof having stream line effect which prevents proper deflection of the air currents as above indicated, gives best results.

The continuing circulation effected by the fan system within the kiln through the stock loads is due to coaction of pressure upon the circulatory medium in one of the passage ways and of suction thereon in the other of the passage ways. The power of suction cannot be distributed over the side of the load throughout the height, being most effective adjacent to the throat on the suction side of the fan. The result is a tendency to pull a greater volume of air transversely across the upper portion of the load than across the bottom portion thereof. For this reason, it is important to effect greater uniform distribution through the loads on the air delivery side of the loads by deflected currents of air directed against the side wall of the kiln. At the point of impact each of the air currents tends to mushroom and move down the side wall of the kiln instead of being drawn across the top of the loads by the suction from the opposite side of the load.

It is by deflection that we are enabled to distribute circulation effectively through the medial and bottom portions of the load; and this deflection through the throat on the delivery side against the side wall which is one of the main objects of our invention, is accomplished by application to the mushroom portion of the air current of power of suction to impart to it positive directive effect sufficient to attain the object in view.

Direction of air currents for affecting circulation is not new in the art, but it has been attempted prior to our invention, by the expedient of tapering the side wall of the kiln. The result is not satisfactory for the reason that constriction of the capacity of the kiln by tapering its side walls, reduces the volume of the circulative medium that may reach the remoter portions of the loads, thereby interfering with the efficiency of circulation.

Our invention, on the contrary, is applicable to the usual rectangular shape of kiln without deleterious effect upon the rate of movement or uniform volume of flow of the circulatory medium within the kiln.

It will be noted that in Figure IV showing an arched roof construction it is found advisable to use a deflector plate 53 to reduce the space between the load and the wall and to increase the velocity of and to deflect the circulatory currents to the substantial middle portion of the stock loads where the normal flow of circulation is weakest. This auxiliary baffle or deflector plate 53 is preferably used with arched roof construction or other types of roofs which would, without said plate, effect a stream line flow of circulation, down the side wall of the kiln.

Also, on the discharge side of the fan, the

heated air, unless moving at high velocity down the wall, has the normal tendency, on account of its relative buoyancy, to move across the tops of the stock loads.

When stream lined roofs,—such as an arched roof,—are used, the impelled currents of air circulation are thicker in extent and move at a lower velocity down the side walls of the kiln. For this reason, and also due to the suction pull from the opposite side of the load, they move across the top section of the loads.

One of the objects of our invention is to overcome the disadvantages of both of these systems and to cause a greater volume of air to pass through the center and bottom of the stock loads, and it is to accomplish this purpose that the air currents are directed through the throats against the side walls of the kiln where they spread out as a thin sheet moving at greater velocity. The suction of the fan system from the opposite side of the stock load at the upper corner coacts in moving the air across the stock loads.

This discharge against the side walls of the kiln with deflection of the currents, because of greater turbulence of the kiln atmosphere, causes a more thorough mixing of the fresh air taken through the fresh air port 38, for instance in Figure I, than would be possible by use of the stream line or arched roof construction. A more complete mixing of the fresh air taken in at ports spaced at intervals along the roof with the circulating medium of the kiln before it enters the stock loads, is, by the means substantially as just mentioned, effected.

Another important object of our invention is accomplished by the employment of deflector baffles 48, 9 and 10, which may be either horizontal or vertical, or both, depending upon the form of embodiment of our invention. The longitudinally disposed eaves of the floor 9 constitutes baffles for aiding in the direction of the flow in the manner just indicated, as well as for offering protective overhead covering for the kiln loads against condensation or roof leakage. The baffles 48, particularly aid in the further mixing of air currents by distributing them longitudinally within the kiln. But their principal function is distribution of the cross circulating currents, particularly imparting to the currents a slight longitudinal flow. They serve both the function of effecting further mixing and uniformity of distribution of the air currents longitudinally within the kiln on the delivery air side of the loads.

Figures III, IV, and V, have, in effect, arched or stream lined roofs, and it should be understood that in order to accomplish the purposes of our invention, we preferably use, in addition to the baffles shown, the longitudinal deflector 53 to accomplish the proper distribution across the loads.

The floor is not a necessary part of applicants' invention. It serves to protect the top of the loads and also serves as a closure baffle between the passage ways on opposite sides of the fans, but it should be understood that any suitable closure baffle may be used with equivalent results from a drying standpoint. These closure baffles may be at the corners of the loads or above the loads.

An essential feature of our invention, however, is the formation of throats on opposite sides of the kiln which may be formed at the tops of the passage ways 14 and 15 by the top corners of the loads spaced apart from the walls of the kiln. In such case the corner of the load would act as a lateral edge of the floor 9.

In Figure XIX, the operating or control room 55 is located beyond the end wall of the kiln with a space 56 between the room and the kiln wall. This space is above the doors of the kiln and acts as a chimney to permit waste vapors to pass out instead of flowing under the floor of the operating room, where it would condense and drip.

In Figures V and VII the fans 30 are preferably right hand and left hand alternately to effect a neutralization of the fan throw which, if all fans were of the same pitch of blade, would tend to pile up circulation at one end of the kiln. This right and left hand arrangement contributes to uniform transverse circulation which is desired.

It should also be observed that the ports 38 are superposed above the fan shaft bearings, as shown, for example, in Figure XVII, and that they afford convenient means for inspection of the fans, shaft and bearings while the kiln is in active operation.

The baffles for remedying insufficiency of air volume referred to in the forepart of the specification, are indicated at 53 in Figure IV of the drawings, it being understood that said baffles extend substantially from end to end of the kiln interior.

What we claim is:

1. In an internal fan kiln, the combination of its enclosing structure having a door, a rotary fan shaft within said kiln adjacent to the roof thereof, an operating room therefor providing a space between one of its walls and said kiln structure above said door, the said fan shaft extending from said operating room into said kiln structure, a fan within said kiln on said shaft, driving means in said operating room operatively connected to said shaft, the said space between the operating room and the kiln structure providing means for venting waste vapor which may escape from the kiln about said door.

2. A dry kiln of the character described, having a roof, a substantially vertical partition beneath said roof dividing the space there-beneath above a stacked stock load within said kiln, into two longitudinally disposed chambers, the chambers comprising compartments communicating with passageways respectively on opposite sides of said stock load, a plurality of reversible fans operatively mounted in suitable openings provided for them respectively in said partition, each of said fans communicating with a compartment on each side of said partition, an individual vent and air port through said roof in close proximity to and substantially equi-distant from the vertical axis of each fan, the vents communicating with compartments respectively on one side of said partition and the air ports communicating with compartments respectively on the opposite side of said partition, and controllable means for opening and closing said vents and air ports, whereby each fan in each direction of its rotation may effect intake of fresh air into said kiln and ventilate used atmosphere from said kiln.

3. In a dry kiln, the combination of a roof, a plurality of substantially vertical side walls, a vertical partition extending longitudinally within the kiln, substantially vertical transverse wall sections associated therewith and providing a pair of communicating compartments each having one side open, the open sides of adjacent compart-

ments opening toward adjacent sides, respectively, of the kiln, the roof and one side wall forming two sides, respectively, of each compartment, a series of reversible fans operatively mounted in openings provided for them, respectively, in said transverse wall sections, an individual vent and air port for each fan open to the outside atmosphere through the roof, a vent and an air port being on opposite sides of and in close proximity to the vertical axis of each fan, the vents communicating with compartments on one side of said vertical partition and the air ports communicating with the compartments on the opposite side thereof, and controllable means for opening and closing each of said vents and air ports, whereby each fan in each direction of its rotation may effect intake of fresh air into said kiln and ventilate used atmosphere from said kiln.

4. A dry kiln of the character described having a roof, a substantially vertical partition beneath said roof dividing the space there beneath, above a stock load stacked within said kiln into two longitudinally disposed chambers communicating with passageways respectively on opposite sides of said stock load, a plurality of reversible fans operatively mounted in suitable openings provided for them respectively in said partition each of said fans communicating with the chamber on each side of said partition an individual vent and air port for each fan through said roof, in close proximity to and substantially equi-distant from the vertical axis of each fan, the planes of rotation of said fans being parallel with the plane of said partition, the vents communicating with the chamber on one side of said partition and the air ports communicating with the chamber on the opposite side of said partition, and controllable means for opening and closing said vents and air ports whereby each fan in each direction of its rotation may effect intake of fresh air into said kiln and ventilate used atmosphere from said kiln.

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