

May 18, 1937.

J. I. STEEL

2,081,098

DRY KILN

Filed March 10, 1932

3 Sheets-Sheet 1

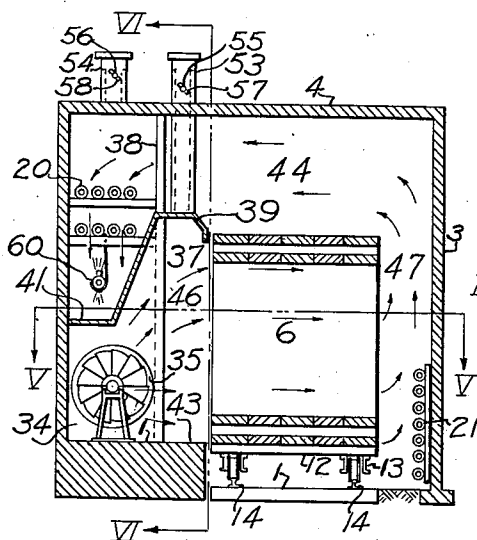


Fig I

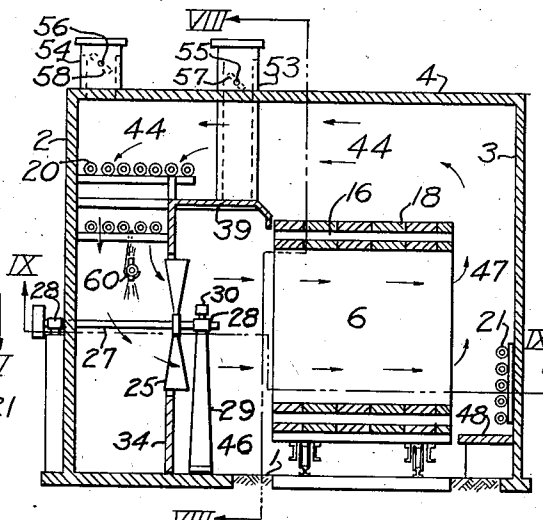


Fig II

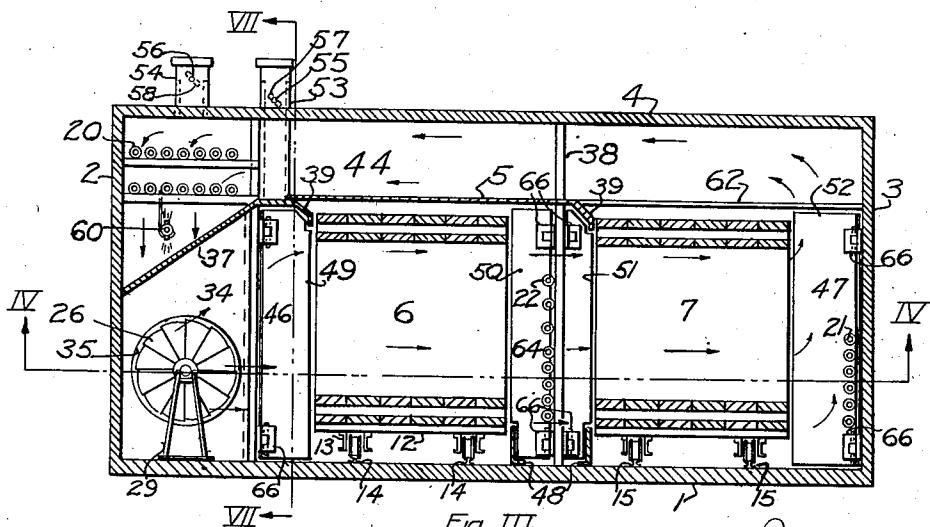


Fig III

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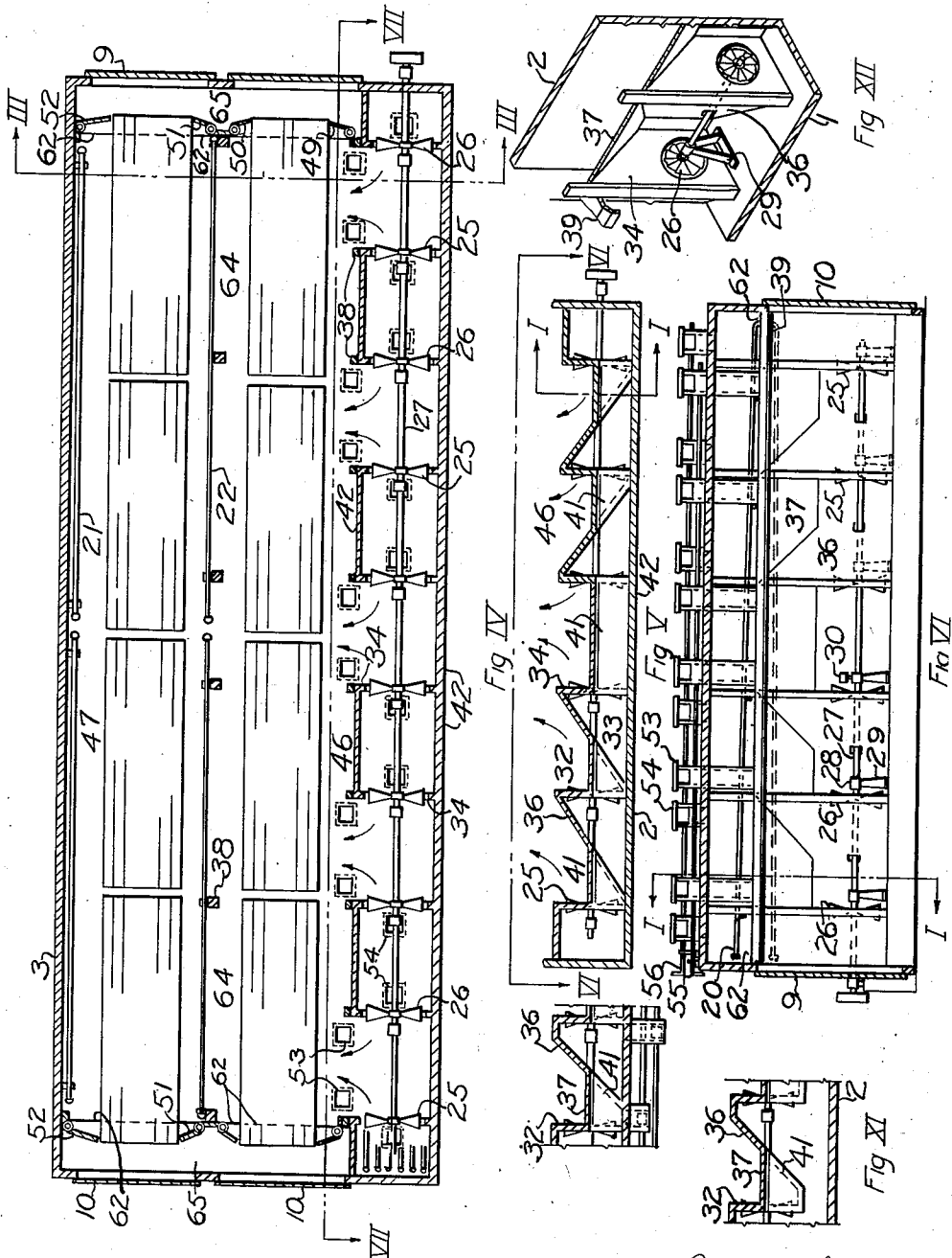
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3 Sheets-Sheet 2



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3 Sheets-Sheet 3

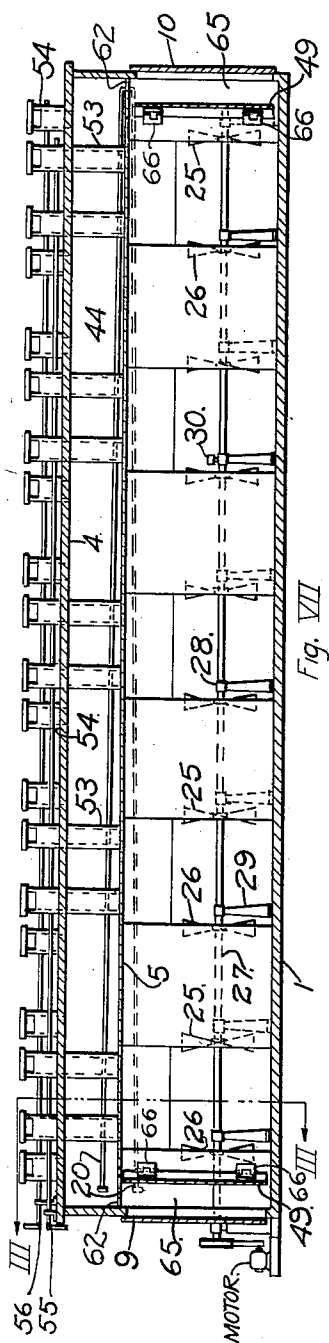


Fig. VII

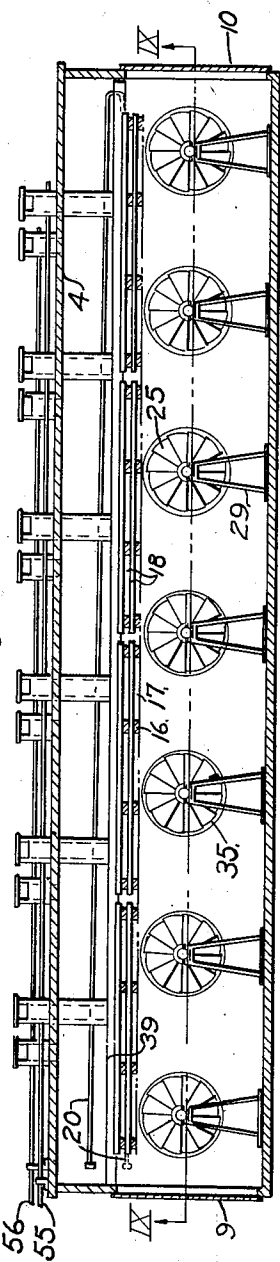


Fig. VIII

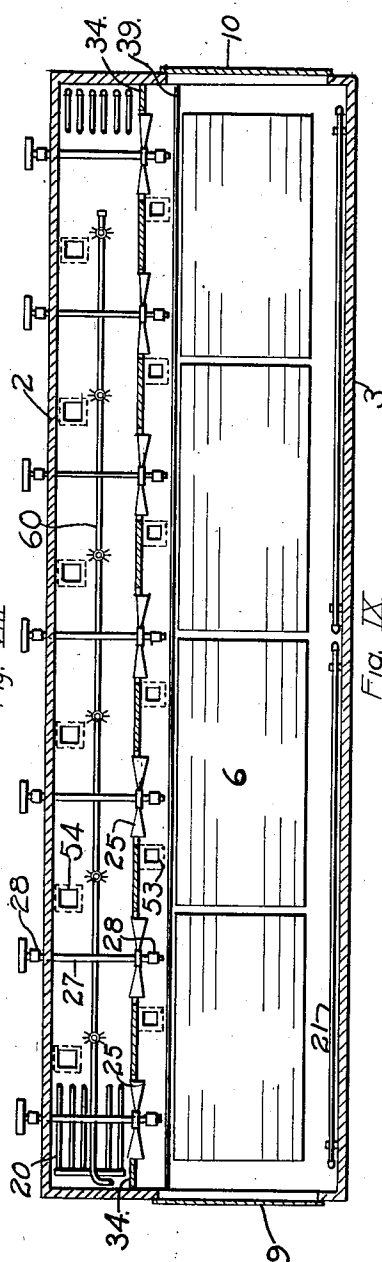


Fig. IX

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UNITED STATES PATENT OFFICE

2,081,098

DRY KILN

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Moore Dry Kiln Company of Oregon, a corpo-
ration

Application March 10, 1932, Serial No. 598,006

14 Claims. (Cl. 34—46)

My invention relates to improvements in dry kilns in general, and particularly of the internal fan type in which the circulation of the atmosphere within the kiln is effected substantially transversely across stock loads stacked therein, by the rotation of one or more power driven rotary fans operably mounted within the kiln on a partition at one side of the material to be dried.

An object of my invention is to provide a reversible air circulating system mounted on a partition at one side of the stock to be dried, eliminating the usual excavation for an air circulating system below the stock loads and also eliminating the necessity of building a supporting structure for an air circulating system above the stock loads.

Another object of my invention is to provide an air circulatory system within a kiln in which large fans can be mounted on sturdy supports as of concrete bases, for example, on the ground at substantially the same level as the stock loads, providing a more effective and economical kiln circulating equipment.

Another object of my invention is to provide a partition extending from the floor of the kiln upwardly to a position where it may make substantial closure of the vertical space between its upper edge and a stock load on a track in the kiln, and to operably mount fans on this partition for recirculating a drying medium transversely through the stock load, returning it in a space above both the load and the partition.

Another object of my invention is to provide novel means for operatively mounting the fans in a kiln, wherein the result of an exceedingly stable and durable kiln structure is arrived at with due regard to economy and whereby the functional efficiency of the kiln, both in regard to uniformity of the drying operation, its regulation and control is materially enhanced.

Another object of my invention is to provide a more uniform circulation in a kiln having a side circulatory air system.

Another object of my invention is to provide a novel and efficient circulatory air system for directing circulation within a kiln and particularly for the distribution of circulation to give more uniform drying condition throughout the kiln.

Another object of my invention is to distribute the heating system or units of the heating system within a kiln so as to give more uniform drying of the stock.

Another object of my invention is to provide in a kiln a closure means for insulating the circulat-

ing atmosphere and the stock loads, from the doors of the kiln and for preventing air from passing around the ends of the stock loads.

A fan duct system in an interior corner of a kiln for producing cross circulation is old in the art as in Rankin #1,815,798, however, this application includes novel apparatus not included in the Rankin patent.

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

In the accompanying drawings wherein my invention is illustrated in present preferred form of embodiment,

Figure I is a transverse vertical section of a single track dry kiln, embodying my invention.

Figure II is a transverse vertical section of a kiln having a modified circulatory system to that shown in Figure I.

Figure III is a transverse vertical section of a kiln having a different circulatory system and having two tracks therein.

Figure IV is a plan view taken above the floor along the line IV—IV of Figure III.

Figure V is a partial plan view showing a modified air circulatory system from that illustrated in Figure IV.

Figure VI is a vertical longitudinal section taken along the lines VI—VI of Figures I and V.

Figure VII is a longitudinal vertical section taken along the lines VII—VII of Figures III and IV.

Figure VIII is a longitudinal vertical section of one of my kilns taken along the line VIII—VIII of Figure II.

Figure IX is a plan view of one of my kilns taken along the line IX—IX of Figures II and VIII.

Figure X is a partial plan view of a section of a modified form of partition, of that shown in Figure V.

Figure XI is a partial plan view of a section of the partition 36, of Figure X moved out from the wall 2.

Figure XII is a partial perspective view of a modified form of partition, of that shown in Figures V and X.

Referring to the numerals on the drawings, 1 indicates the floor of the kiln; 2 and 3 the side walls; 4 the roof of the kiln and 5 the partition ceiling shown in Figure III. In some cases the top layer of the stock loads 6 and 7 may function as the partition ceiling or the extension thereof, as in Figures I and II, for example.

The kiln is equipped with doors 9 and 10, one of which is preferably at each end of the kiln. In some cases, doors may be at one end of the kiln only and in this case the other end would be closed.

The stock loads 6 and 7 are supported by bunks 12 which are carried on trucks 13, rollably mounted on tracks 14 and 15 extending through the kiln. The tracks are carried on suitable supports, preferably resting on solid ground.

Stock loads 6 and 7 are preferably stacked having stickers 16 between layers of material to be dried, providing interstices 17 open for transverse circulation across the loads between the layers 18. The stock, when lumber, for example, is preferably stacked edge to edge between stickers on the stock loads.

A distinctive feature of my invention is to be found in the air circulating system of the apparatus. The air circulating system comprises preferably a series of rotary fans 25 and 26 mounted on a partition which extends longitudinally substantially the full length of the kiln and extends from the floor 1, to a position adjacent to the top corner, or corners of one or more stock loads when placed on the track 14, for example. See Figure I.

The partition above referred to, may be a vertical wall, or it may be one of any preferred form, such, for example, as a wall illustrated in Figures IV, V and IX.

In Figures IV, V and XII, I illustrate preferred forms of my air circulating system in which the fans are mounted in the partition made up of housing plates 34, diagonal walls 36, sloping partitions 37, posts 38, baffles 39, partition ceiling 5 and shelf 41, which by its zigzag effect forms compartments 32 and 33, which are disposed respectively on its opposite sides. It is understood, however, the compartments 32 and 33 may be of any desired shape. The zigzag effect of the partition is made up of transverse fan housing plates 34, preferably vertical, which preferably extend transversely of the kiln having an opening 35 suitable for the accommodation of a rotary fan, and the diagonal wall 36. The fan housing plates rest on the floor 1 of the kiln and have fan openings spaced at any suitable intervals from 4 to 10 feet, for example. The diagonal wall 36 preferably extends, for example, from the left side of one fan housing plate 34 to the right side of the next adjacent housing plate, or vice versa. The fan housing plates have preferably substantial vertical extensions, extending upwardly to connect with the diagonal wall 36, and the sloping partition 37, which latter has a baffle 39 extending close to the top corner of a stock load.

In other words, the partition may be made up of a continuous wall including the fan housing plates 34 and their upward extensions, the diagonal walls 36, the sloping partition 37, the partition ceiling 5 when used, and the baffle 39, extending substantially the full length of the kiln, providing compartments 32 and 33 alternately disposed on its two sides, having a fan opening suitable for the accommodation of a rotary fan between adjacent compartments, so that when the fan is rotating, kiln atmosphere is exhausted from a compartment on one side of the partition and delivered into a compartment on the opposite side of the partition.

The recirculation space 44 extends over the top of the partition above the partition ceiling 5, and the stock load or loads, and connects on one side of the partition with the compartments 33 and

with the plenum chamber 47 between the stock load 7 and the side wall 3.

The diagonal wall 36 may be in one or more planes. In some cases the side wall 2 of the kiln forms a part of the diagonal wall particularly if it is more than one plane, as illustrated in Figures X and XII. It rests on the floor 1, is associated with the fan housing 34, and may extend upwardly therefrom as the sloping partition 36 and baffle 39, between the floor 1 and the top edge or edges of one or more stock loads 6 or 7.

Roof supporting posts 38 or other members when located adjacent to one of the side walls of the kiln may be incorporated as a part of the partition, and serve as a support for the partition ceiling, but may extend above the top of the partition to support the roof 4 of the kiln when desired. The posts 38 at the ends of the kiln also provide supports for the end closure members.

The top of the partition is preferably provided with baffles 39 for making substantial closure of the space between the partition and the top corners of the stock load 6 or 7.

In double track kilns, I may extend the top edge of the partition over the top of a stock load 6, on the track 14, which extension I call the partition ceiling 5, to make substantial closure with the top edge, or corner of the stock load, or loads 7, on the track 15. It is understood that this extension may extend over the top of the stock loads on several tracks in multiple track kilns, preferably to make substantial closure with the top edges or corners of the stock load or loads on the track most remote from the fans. However, when desired, in multiple track kilns the partition may extend to the top corner of the stock load 6 on track 14, and baffles may be employed between stock loads as described in my co-pending application Serial No. 595,052.

In Figures I, V and XI, I illustrate a shelf 41 connecting with the diagonal wall 36, the sloping partition 37 and one of the fan housing plates 34. In Figure I the upwardly extending sloping partition 37, which is a part of the partition, joins the fan housing and also the diagonal wall along a substantially horizontal line above and substantially medial to the fan, preferably along a line substantially over and parallel to the shaft on which the fans are mounted. When this design is used the shelf 41, which is shown as being triangular in Figure V, but may be trapeziform as shown in Figures X and XI, forming a partial top to the compartments 32 and extending between the fan housing plate 34, the diagonal wall 36, and the sloping partition 37, one shelf 41 being disposed between each pair of fans. The diagonal wall 36 is illustrated in one plane in Figure V, but it may be in the form of a zigzag wall in three planes, for example, in Figures X and XII, in which designs one plane of the wall may be a part of the side wall 2 of the kiln.

Attention is called to the large inlet and outlet areas for the fans through the compartments 32, which is made possible by the general position of the diagonal wall 36 and the sloping partition 37, which are features of my invention.

By employing the diagonal wall 36 and the sloping partitions 37 shown in Figures I, III, V and VI, I increase the height of the outlet area of the compartment 32 until it is substantially the same height as the plenum chamber 46. In Figure V the longitudinal vertical cross sectional areas of the plenum chamber 46 and the corresponding outlet area of the compartments 32 are substantially the same between fans. In Figure

IV the outlet areas of the compartments 32 are likewise substantially the same height as the plenum chamber 46. In Figure VIII where transverse shafts are employed, the compartments 32 and the plenum chamber 46 are substantially identical in area. In this design I preferably set the center plane of fans on the plenum chamber side of the partition to permit a tangential or partially centrifugal throw off of air from the tips of the fan blades. This gives more uniform distribution from the spaced fans throughout the plenum chamber 46 against the side of the stock loads 6, the full length of the kiln when the fans are delivering air in this direction.

In the above designs of partitions right and left hand fans may be used respectively, at opposite ends of the kiln. In Figures V and VI right hand fans 25 are preferably employed in series at one end, and left hand fans 26 in series at the other end of the kiln. At the division section of the partition, between right and left hand fans, I preferably provide a longitudinal wall 42 which is shown to be identical with the side wall 2 of the kiln in Figure V. In this division section the shelf 41 is also shown as a rectangle.

Another modified form of partition is that illustrated in Figures III, IV and VII showing right and left hand fans opposed in pairs, providing compartments 32 and 33 respectively on opposite sides of the partition. In this design, the compartments 32 and 33 are substantially rectangular in cross section, there being one compartment only between any two adjacent fans. In this modification the sloping partition 37, the walls 42, the fan housing plates 34, the partition ceiling 5 and the baffle 39, make up the partition which extends from the floor of the kiln to make substantial closure with the top edge or top corners of the stock loads 6 or 7. In this design some of the walls 42 are shown identical with the side wall 2 of the kiln.

If desired, the walls 42, or the diagonal partition 36 in other designs, may extend to any preferable height, before connecting with the sloping partition 37, i. e. the vertical location of partition 37 may be varied as desired.

The above designs of partitions for air circulatory systems which I have described may be set at any preferable distance from the side wall 2 or 3 of the kiln. In Figure IV the half of the walls 42, which are a part of the partition, are formed by the side wall 2 of the kiln. In Figure V only a very small part of the partition is formed by the side wall 2 of the kiln. It is understood that in these variations the partition may be set at any desired distance from the kiln walls 2 or 3, so that the partition may be in part, integral with, or entirely separate from the side walls of the kiln 2 or 3. If a space is provided between them to provide larger air circulation areas, it is continuous with the recirculating space 44.

It is understood that the floor of the kiln on which the track rails 14 and 15 are laid, and the floor of the fan system may be at different levels; however, they are preferably at substantially the same level. In some cases, however, the floor 1 of the circulatory system may be elevated slightly above the floor on which the tracks are laid. This elevated floor may be extended as at 43 in Figure I to form a closure member at the bottom of the stock loads 6. When the floors are at the same level, a baffle 48 is provided as shown in Figure III.

In some installations, for instance in Figures II, VII and IX, the partition is shown as a sub-

stantially vertical wall 34 extending substantially the full length of the kiln in substantially one plane extending from the floor 1 upward to make substantial closure, by means of the baffle 39, or by means of the partition ceiling 5 and the baffle 39 in some multiple track kilns, with the top corner, of a stock load. In this design one compartment 32 is continuous with the plenum chamber 46 on one side of the partition, and the compartment 33 on the opposite side connects through the recirculating space 44 above both the partition and the stock loads, with the plenum chamber 47. The recirculating space 44 is provided above the partition ceiling 5 in multiple track kilns, as in the other designs described above.

In these embodiments the partition preferably extends from the floor of the kiln upward to form substantial closure with the top corner of one or more of the stock loads 6 or 7, and has openings provided in said partition to accommodate one or more rotary fans of any preferable design; such, for example, as disc type or centrifugal type fans. In Figure VIII, the vertical wall is in substantially one plane and the fans are set on a series of transverse shafts, instead of being on one longitudinal shaft, as may be done.

In these different embodiments, however, the operation of the kiln is substantially the same. A plenum chamber 46 connecting with compartments 32 is formed between the partition and the stock loads adjacent to the fan system. The fans may blow directly toward the stock load 6 through the plenum chamber 46, and exhaust kiln atmosphere from the opposite side of the partition through the recirculating space from the opposite plenum chamber 47 on the opposite side of the kiln adjacent to the wall 3 of the kiln; or the circulation may move in the reverse direction. The plenum effect of the chambers 46 and 47 is provided by the stock load, which is provided with interstices 17 for the passage of air through them.

It is to be understood that the fan system is reversible and the circulation may be driven in either direction.

The heating system is an essential feature of my invention. I preferably employ a heating system in one or more units in a single track kiln. Two units are illustrated in Figure I. However, if only one heating unit is used it is preferably located above the circulatory system at 20. When two units are used, one unit is preferably located above the circulatory system at 20 and another unit is preferably located on the side wall of the kiln at 21 opposite to the circulatory system, preferably adjacent to the lower portion of the stock load.

In multiple track kilns I preferably provide three units of the heating system, for instance, as illustrated in Figure III. One is located above the circulatory system at 20; another unit 21 is located on the side wall 3 of the kiln opposite the circulatory system, and a third unit 22 is located between the stock loads. This third unit, located between the stock loads, preferably has more heating surface at its lower portion adjacent to the lower portion of the stock load than at the top portion, and it may be divided into one or more units if desired. The particular location of the heating pipes is important and depends upon the position of the fans. The above described positions of the heating pipes are essential for this kiln having fans located at one side of the stock loads.

The pipes 20 are preferably located so that the recirculating atmosphere will pass through them 75

in each circuit of recirculation before passing through any of the stock loads within the kiln in each circuit of circulation. The heating pipes 21 located along the wall on the opposite side of the tracks from the circulatory system, heat the area adjacent to this wall and prevent a localized cooler temperature due to heat loss through the wall 3, and thus aid in effecting uniform drying.

The circulatory system preferably comprises rotary driven fans 25 and 26 operatively mounted on a shaft or shafts 27 carried in suitable bearings 28 mounted on bearing stands 29 supported by the floor 1. The bearings may be supplied with lubricant through the oil cups 30.

The fan shaft or shafts 27 are driven preferably by any suitable driving means, such as for instance, an electric motor not illustrated. The fans are preferably reversible and means are provided for reversing their direction of rotation at will.

An essential feature of my invention consists in the manner in which the compartments 32 communicate with the plenum chamber 46 of the kiln. The compartments 32 being substantially the full height of the stock load permit a more open communication and uniform distribution of the kiln atmosphere when it is circulated from the fan system against the sides of the stock loads through the plenum chamber 46. No matter whether the compartments 32 and 33 are rectangular in shape as in Figure IV, triangular trapeziform in shape, as in Figures V and XI respectively, they are preferably open to the plenum chamber 46 substantially the full height of the stock load.

Referring to Figures IV and V, it will be noted that when the fans are rotating in one direction they deliver air from the compartment 32 into the plenum chamber 46. The discharge from the different fans distributed along the length of the kiln coalesce in the plenum chamber 46 to provide a continuous movement of circulating atmosphere from the fans, across the stock loads, from whence it passes into the plenum chamber 47, and then returns above the stock load through the recirculation space 44 and into the compartment 33 in continuous recirculation. Upon reversal, the fans suck air in one continuous movement in the opposite direction across the stock loads and from the plenum chamber 46, through the fans, deliver it into the compartment 33, and thence into the recirculating space 44. In this direction of movement the atmosphere moves around three corners before entering the plenum chamber 47 on the opposite side of the load from the partition. In turning three corners, as described, a current of atmosphere merges into one coalesced movement passing through the stock load or loads from the plenum chamber 47.

In Figure V, I illustrate the circulatory system as right hand and left hand fans mounted on the partition in series at opposite ends of the kiln and as blowing kiln atmosphere toward the center when they are discharging into the compartments 32 and the plenum chamber 46. In Figure V it will be noted that the outlet areas of the compartments 32 are substantially the same as the inlet areas of the plenum chamber 46.

Uniform distribution of circulation across the stock loads when the fans are blowing across the plenum chamber 46, is essential because of the close proximity between the fans and the

stock loads. I therefore consider the particular design shown in Figure V as desirable for effecting uniform circulation across the stock loads. In Figure V the discharge outlet from one compartment 32 is substantially continuous with the outlet of the adjacent compartment 32 between end fans, when the fans are blowing air into the plenum chamber 46.

When the fans are blowing in the reverse direction the air must turn three corners before it enters the plenum chamber 47. In turning these three corners the flow of atmosphere becomes very uniform and the manner of discharge of the fans into the compartments 33, or the recirculating space 44 is not essential.

In Figures II and IX, where the fans are mounted on transverse shafts, I show the center of the plane of rotation of the fans as set about midway the height of the stock loads 6, beyond the partition, into the plenum chamber 46 in order to provide centrifugal throw-off of air into the plenum chamber 46, and to effect more uniform air circulation against the stock loads when the fans are blowing in this direction.

Particular attention is called to the ventilating system which comprises ducts 53 and 54 in communication respectively with the compartments 32, or the recirculating space 44, through the partition ceiling 5 or the partition, and with the compartment 33, or the recirculating space 44, one duct being a fresh air intake communicating with one compartment on the suction side of the partition, and the other duct acting as an air outlet, communicating with another compartment on the delivery side of said partition. The ventilating ducts 53 and 54 are alternately respectively used as fresh air inlet and outlet ports, depending upon the direction of fan rotation. I preferably provide inlet and outlet port dampers or covers 57 and 58 for the ducts, which are preferably operated simultaneously by the damper rods 55 and 56 respectively, to open or close the inlet of fresh air to, or the outlet of atmosphere from, the two sides respectively of the partition.

I preferably provide one operating system for the dampers or covers of the ports comprising the damper rod 55, which operates the dampers in the ports, communicating with the compartments on one side of the partition and a separate damper rod 56 which operates the dampers in the ports communicating with the compartments on the opposite side of partition. In some cases the fresh air inlet or outlet ducts or ports for the compartments may be through the floor 1, or the side wall 2, of the kiln, as in Figure X, instead of through the roof 4; however, I preferably provide one inlet and one outlet both controllable, for each of the compartments 32 and 33 respectively. Upon reversal of circulation the function of the intake and outlet ports is reversed; that is, the inlet ports become the outlet ports and the outlet ports become the inlet ports.

Reference is made to other patent applications Serial No. 492,026, and No. 595,052, which are drawn to cover control features of heating systems, circulating systems and ventilating systems, which may be considered to be partially described, and illustrated in the drawings of this application.

I provide the usual and any preferred form of spray system for humidifying the kiln atmosphere comprising spray pipes 60 located within the kiln at any desired position, fed by live

steam, for example, from a source not illustrated, subject to automatic control if desired.

I preferably provide an individual baffle system for each load, one or more floor baffles 48 at the bottom of the stock loads.

In multiple track kilns shown, for example, in Figures III, IV and VII, I preferably provide a passageway 64 between loads 6 and 7 on tracks 14 and 15 respectively, for example, in which heating pipes 22 are located. The passageway 64 is preferably closed at the top by the baffles 39 which are an extension of the partition ceiling 5, or are supported by the posts 28 at or above the tops of the stock loads.

At the ends of the kiln I preferably provide a series of closure members for closing the ends of plenum chambers 46 and 47 and the ends of the passageway 64 between loads. These closure members provide a space 65 between the ends of the stock loads and the doors at each end of the kiln. These closure members insulate the stock loads and the circulating atmosphere from the cooling effect of the doors by means of the space 65, and therefore effect more uniform drying.

The closure members comprise preferably closure plates 49, 50, 51 and 52 and the lintel extensions 62. The closure plates 49, 50, 51 and 52 may be hinged or otherwise movable. The lintel extension 62 is preferably fixed in position.

The closure plate 49, which may be hinged or otherwise movable, is placed in a plane parallel to the tracks 14 at either end of the kiln when material to be dried is being charged into or discharged from track 14, or it may be moved to make substantial closure of the space between the partition and the stock load 6 on the track 14 so that the outer edge of the closure plate may substantially contact the side or the end of the stock load adjacent to the door 9 or 10 of the kiln.

The closure plate 50 may be hinged as on hinges 66, or otherwise movable and may be moved to open or close the ends of the passageway 64 between the posts 28 and the stock loads 6 on the track 14. The top of the closure plate 50, also makes substantial contact at its top edge with the partition ceiling 5, or the lintel extension plate 62.

The closure plate 51 may be hinged or otherwise movable and may be moved to open or close the ends of the passageway at either end of the kiln between the post 28 and the stock load 7 on the track 15. The top of the closure plate 51 also makes substantial contact with one edge of the lintel extension plate 62.

The closure plate 52 is hinged or otherwise movable and may be moved to open or close the ends of the plenum chamber 47 between the ends of the stock load 7 on the track 15, and the side wall 3 of the kiln. The top of the closure plates 51 may make substantial closure contact with the lintel extension 62.

The lintel extension 62, is an extension plate on the inside of the lintel 63 above the door 9 or 10 and may be used at each end of the kiln above the track 14, and also 15, if the partition ceiling 5 is not used. This lintel extension 62 is preferably fixed in position, being slightly above the tops of the stock loads, and permits substantial closure of the ends of the plenum chambers 46 and 47, and the passageway 64 by the closure plates 50 and 51, and with the top of the ends of the stock loads and also by the closure plates

49 and 50 if the partition ceiling 5 is not used. See Figures III, IV and VI.

These closure members substantially close off the space 65 between the doors and the loads at one or two ends of the kiln and insulate the loads and the circulating atmosphere from the heat loss through and around the kiln doors. They also act as directing means of air circulation from the fans through, instead of around the ends of the stock loads.

A function of the closure members at the ends of the plenum chambers is to confine the air discharged longitudinally along the diagonal walls 36 by the several fans. When closures are not used the movement of air discharged by the fans tends to be around the ends of the loads at the ends of the kiln instead of transversely through the loads.

Assuming a kiln to be built along the lines in substantial conformity to those illustrated in the drawings and to be equipped with operating mechanism practically equivalent to that illustrated, if it is assumed that the kiln is supplied with material to be dried represented by stock loads 12 and 13, that the door or doors 9 and 10 are closed, and that the pipes 20, 21 and 22 are heated, and the fans are set in rotation by any suitable means, such as for example, an electric motor not illustrated, the drying operation is ready to start. The stock loads preferably move in the kiln at right angles to the air flow through them and it is understood the operation of the kiln may be of the charge or progressive method.

Each fan, as has been specified, operates upon the gaseous contents of two contiguous compartments 32 and 33, upon one compartment with suction effect and upon the other compartment with pressure effect.

Bearing in mind that the direction of rotation of the fans is reversible and that consequently one compartment may be at one time the suction side of the partition and upon reversal of rotation of the fan, it will be converted to the pressure side thereof, it will be understood that all the fans operate in unison to effect a substantial uniformity of suction on one side of the partition within the kiln and to exert a corresponding pressure on the other side of said partition, whereupon one plenum chamber 46 of the kiln in operation may be on the suction side and the opposite plenum chamber 47 may be connected with the pressure side of the partition. The applicability of the names just indicated depends, as has just been pointed out, upon the direction of rotation of the complement of fans. In either direction of circulation within the kiln, atmosphere moves through the stock loads and through the fan system in continuous suction, passing through the heating coils before and after passing through the stock loads in each direction of circulation. The excess of moisture is ventilated by the intake of fresh air and the outlet of spent air from the kiln. However, the fresh air inlet and air outlet ducts may be controlled by dampers by hand or automatically to maintain a predetermined condition of humidity.

An important feature of my invention is the relationship of the fans and the compartments 32 to the passageway 46 or to the stock load. In the different embodiments of my invention the sloping walls 37 and the partition walls 36 or their equivalent, which make up the partition, forming one side of the compartment 32, or the plenum chamber 46 in Figures V and IX for example, permit a flow of atmosphere discharged

from the fans, into the plenum chamber 46 the full height of the stock load, and the full length of the kiln between fans. In Figure III and IV and XI for example, the compartments 32 are also the full height of the stock load. Assuming that the kiln is in operation, a continuous circuit of recirculation passes continuously through the stock loads and through the fans.

The fresh air intake ports may be used to take in fresh air on one side of the partition and to exhaust kiln atmosphere from the other side of the partition, and the spray system may be used to increase humidity as by spraying moisture into the circulating atmosphere when desired.

The same effect can be obtained by using a series of fans on transverse shafts located at one side of the stock load as illustrated in Figure IX. It will be seen that the results are substantially the same and that the partition between compartments 32 and 33 in this case will be in substantially one plane, whereas the partition may be formed in part by a zigzag wall in other embodiments of my invention.

In the drawings, arrows indicate one direction of air flow within the kiln.

The side air circulatory system in a dry kiln provides increased internal cubic area which increases the proportion of atmospheric content of the kiln as compared with its stock content. This provides a more efficient and more uniform drying kiln.

I preferably provide fans, the centers of which are located at or below the middle of the stock loads. The lower part, close to the floor, of the kiln, usually contains the coolest and highest humidity atmosphere and by locating the fans and part of the heating pipes low in relation to the loads I am able to continuously circulate the air from the lower portion of the kiln and effect as rapid a drying of the lower parts of the stock loads as the upper parts, which latter in the average kiln tends to dry slightly faster. The heating pipes located near the floor of the kiln, aid in drying the bottom parts of the stock loads.

It is understood that this invention is not limited to the exact design and form illustrated and described. Modifications of the structures herein described and mechanical equivalents are self-evident to those skilled in the art; therefore, it is to be understood that the invention includes within its scope 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 dry kiln having a trackway therein, suitable for receiving stock loads of material to be dried, plenum chambers on opposite sides of stock loads when placed on said trackway, a partition forming one side of one of said plenum chambers on one side of said kiln and in part spaced from one of the side walls thereof, said partition extending substantially the full length of the kiln in the form of a zigzag in horizontal cross section taken at fan level, said partition extending from the floor upwardly to make substantial closure of the top of one of said plenum chambers, between said partition and a stock load, fans operatively mounted on one longitudinal shaft and in openings provided in said partition, said partition forming intercommunicating compartments, one on each side of said partition for each fan the compartments on the side of the partition adjacent to the track, having

outlets substantially co-extensive with the adjacent plenum chamber.

2. In a dry kiln, a stock load therein, a plenum chamber on two sides of said stock load, a partition spaced from said stock load and spaced in part from one of the side walls of said kiln, two series of compartments, one series between the partition and said wall, forming openings at their top sides coextensive with the recirculating space above said partition, and the other series of said compartments being between said partition and the plenum chamber, between the partition and the stock load coextensive with the said plenum chamber, the lower edge of said partition forming a zigzag resting on the floor, the upper edge of said partition forming a substantially straight baffle, substantially contacting said stock load, closing the top of one of said plenum chambers, said recirculating space above the top edge of said partition communicating with said compartments and said plenum chamber on the side of the stock load opposite to the side having the partition, heating means in said kiln, two controllable air ducts extending from the outside to the inside of said kiln, one duct opening into the plenum chamber on one side of said partition, and the other duct opening into the recirculating space on the other side of said partition, a plurality of fans operatively mounted on one longitudinal shaft, operatively mounted in openings respectively provided in said partition between adjacent compartments on opposite sides of said partition, means of rotating said fans whereby tempered atmospheric recirculation is effected transversely within said kiln substantially as specified.

3. The combination with a kiln, having a trackway therein for receiving stock loads of material to be dried, a longitudinally disposed series of reversible fans operatively mounted on one shaft in a zigzag partition forming compartments on its opposite sides thereof and at one side of said stock load, and spaced from said load and from said wall, a plenum chamber on each of two sides of said loads, the outlets of said compartments being substantially co-extensive with said plenum chamber between the partition and the stock load, a recirculating space between said partition and one kiln wall and communicating with the plenum chamber on the opposite side of the kiln, controllable ventilating ports for said fans connecting the outside of the kiln with the recirculating space on one side of said partition, and controllable ports with ducts extending across said recirculating space connecting the outside of the kiln with the plenum chamber on the load side of said partition, whereby tempered transverse recirculation may be effected within said kiln by enforced fresh air and exhaust of atmosphere into and from the kiln in either direction of fan rotation.

4. The combination with a dry kiln, a plurality of trackways therein for receiving stock loads of material to be dried, a longitudinally disposed series of reversible fans mounted on one longitudinal shaft, operatively mounted in openings provided in a zigzag partition at one side of the kiln, and spaced from the adjacent load and from said wall, a plenum chamber on each of two sides of said loads, a recirculating space between said partition and one kiln wall and communicating above the loads with the plenum chamber on the opposite side of the kiln, a passageway between loads on adjacent tracks, a heating system in said recirculating space for tempering the circulating

atmosphere, a heating system in said passageway having greater heating capacity adjacent to the bottom of said stock loads, and a heating system adjacent only to the bottom of said stock load

5 on the side of the kiln opposite said partition, whereby the bottom of the loads in the kiln may be supplied individual heat in one direction of fan rotation.

5. The combination with a dry kiln having a trackway therein for receiving stock loads of material to be dried, a plenum chamber on each of two sides of said loads, a zigzag partition on one side of said kiln extending from the medial portion toward both ends substantially the full
10 length of the kiln between the floor of the kiln and the adjacent top edge of the stock load, right and left hand fans operatively mounted in series at the two ends respectively, in openings of said partition on a longitudinal shaft, said
15 partition defining a series of paired compartments disposed on its opposite sides, each pair of compartments being separated by a fan, the sum of the outlets of said compartments on the load side of said partition being co-extensive with
20 the plenum chamber between the partition and the load, closure members between one side wall and the partition, to the side end edges of the end stock loads and means of rotating said shaft whereby, when the fans are rotating in one direction, kiln atmosphere is delivered as one continuous blast against the side of the stock loads
25 and by each fan toward the center of the kiln without passing around the ends of the loads.

6. The combination with a dry kiln having a trackway therein for receiving stock loads of material to be dried, a plenum chamber on each of two sides of said loads, a zigzag partition on one side of said kiln extending from the medial portion toward both ends, substantially the full
40 length of the kiln between the floor of the kiln and the adjacent top edge of the stock load, right and left hand fans operatively mounted in series at the two ends respectively on a longitudinal shaft, said partition defining a series of
45 paired compartments disposed on its opposite sides, a controllable ventilating port from each side of said partition communicating with the outside of the kiln, a fan separating each pair of compartments, the sum of the outlet areas of
50 said compartments on the load side of said partition being co-extensive with the plenum chamber between the partition and the load, closure members between one side wall and the partition, to the side end edges of the end stock loads,
55 and means of rotating said shaft whereby when the fans are rotating in one direction, tempered kiln atmosphere is delivered as one continuous blast against the side of the stock loads and by each fan toward the center of the kiln without
60 passing around the ends of the loads.

7. The combination with a dry kiln, a trackway therein suitable for receiving stock loads of material to be dried, plenum chambers on opposite sides of a stock load when placed on said
65 trackway, a partition forming one side of one of said plenum chambers on one side of said kiln, said partition extending substantially the full length of the kiln in substantially one plane from the floor upwardly, and having a lateral baffle
70 extension to make substantial closure with the top of one of said plenum chambers between said partition and a stock load, a fan operatively mounted with one of its faces in an opening provided in said partition, said fan being substantially
75 tially on the load side of said partition, whereby

centrifugal throw-off of air from the ends of the fan blades effects greater uniformity of air distribution when the fan is blowing against said load.

8. The combination with a dry kiln, a track way therein suitable for receiving stock loads of material to be dried, plenum chambers on opposite sides of a stock load when placed on said track way, a partition forming one side of one of said plenum chambers on one side of said kiln,
10 said partition extending substantially the full length of the kiln in substantially one plane from the floor upwardly, and having a lateral baffle extension to make substantial closure with the top of one of said plenum chambers between said
15 partition and a stock load, a series of fans operatively mounted, each with one of its faces in an opening provided in said partition, a controllable fresh air port and a ventilating port for each of said fans, said fans being substantially
20 on the load side of said partition, whereby centrifugal throwoff of air from the ends of the fan blades effects greater uniformity of drying when the fans are blowing against said load.

9. The combination with a dry kiln, a plurality of trackways therein for receiving stock loads of material to be dried, a longitudinally disposed series of reversible fans mounted on one longitudinal shaft, operatively mounted in openings provided in a partition at one side of the kiln,
30 and spaced from the adjacent load and from said wall, a plenum chamber on one side of each of said loads, a recirculating space between said partition and one kiln wall and communicating above the loads with the plenum chamber on the opposite side of the kiln, a passageway between loads on adjacent tracks, a heating system in said recirculating space for tempering the circulating atmosphere, a heating system in said
35 passageway having greater heating capacity adjacent to the bottom of said stock loads, whereby the bottom of the loads in the kiln may be supplied individual heat.

10. In a dry kiln having a trackway therein, suitable for receiving stock loads of material to be dried, chambers on opposite sides of stock loads when placed on said trackway, a partition forming one side of one of said chambers on one side of said kiln and in part spaced from one of the side walls thereof, said partition extending
50 substantially the full length of the kiln in the form of a zig-zag in horizontal cross section taken at fan level, said partition extending from the floor upwardly to make substantial closure of the top of one of said chambers, between said
55 partition and a stock load, heating means in part above said partition, fans operatively mounted on one longitudinal shaft, and in the openings provided in said partition, said partition forming inter-communicating compartments, one on each side of said partition for each fan, the compartments on the side of the partition, adjacent to the track having outlets substantially co-extensive with the adjacent chamber, the compartments on the other side
60 of the partition having outlets substantially co-extensive with said heating means.

11. In a dry kiln having a door therein, suitable for receiving stock loads of material to be dried, chambers on opposite sides of stock loads
70 when placed on said trackway, a partition forming one side of one of said chambers on one side of said kiln and in part spaced from one of the side walls thereof, said partition extending substantially the full length of the kiln in
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the form of a zig-zag in horizontal cross section taken at fan level, the zigzag being reversed at one end as compared with the other end, said partition extending from the floor upwardly to make substantial closure of the top of one of said chambers, between said partition and a stock load, right and left hand fans operatively mounted on one longitudinal shaft at opposite ends respectively, and in the openings provided in said partition, said partition forming intercommunicating compartments, one on each side of said partition for each fan, the compartments on the side of the partition, adjacent to the track having outlets substantially co-extensive with the adjacent chamber, said fans discharging air longitudinally in either direction of their rotation, and closure members between the end of a stock load and the partition of the last compartment at one end of the kiln to prevent the circulating medium from passing around the end of the loads at the ends of the kiln.

12. The combination with a dry kiln, a plurality of trackways therein for receiving stock loads of material to be dried, a longitudinally disposed series of reversible fans mounted on one longitudinal shaft, operatively mounted in openings provided in a zig-zag partition at one side of the kiln, and spaced from the adjacent load and from said wall, a plenum chamber on each of two sides of said loads, a recirculating space between said partition and one kiln wall and communicating above the loads with the plenum chamber on the opposite side of the kiln, a passageway between loads on adjacent tracks, a heating system in said recirculating space for tempering the circulating atmosphere, a heating system in said passageway having greater heating capacity adjacent to the bottom of said stock loads, and a heating system on the side of the kiln opposite said partition, whereby the bottom of the loads in the kiln may be supplied individual heat in one direction of fan rotation.

13. The combination with a dry kiln, a plurality of trackways therein for receiving stock loads of material to be dried, a longitudinally disposed series of reversible fans mounted on one longitudinal shaft, operatively mounted in

openings provided in a zigzag partition at one side of the kiln, said partition being spaced from the adjacent load and from said wall, the zigzag being reversed at one end as compared with the other end, right and left hand fans mounted in series in openings provided in the two ends respectively of said partition, said fans discharging air longitudinally in each direction of their rotation, a plenum chamber on each of two sides of said loads, closure members at an end of each of said chambers to prevent air passing around the end of the end loads, a recirculating space between said partition and one kiln wall and communicating above the loads with the plenum chamber on the opposite side of the kiln, a passageway between loads on adjacent tracks, a heating system in said recirculating space for tempering the circulating atmosphere, a heating system in said passageway, and a heating system adjacent only to the bottom of said stock load on the side of the kiln opposite said partition, whereby the bottom of the loads in the kiln may be supplied individual heat in one direction of fan rotation.

14. The combination with a dry kiln, a plurality of trackways therein for receiving stock loads of material to be dried, a longitudinally disposed series of reversible fans mounted on one longitudinal shaft, operatively mounted in openings provided in a zigzag partition at one side of the kiln, and spaced from the adjacent load and from said wall, a plenum chamber on each of two sides of said loads, a recirculating space between said partition and one kiln wall and communicating above the loads with the plenum chamber on the opposite side of the kiln, a passageway between loads on adjacent tracks, a heating system in said recirculating space for tempering the circulating atmosphere, a heating system in said passageway between loads, and a heating system adjacent only to the bottom of said stock load on the side of the kiln opposite said partition, whereby the bottom of the loads in the kiln may be supplied individual heat in one direction of fan rotation.

JOSEPH I. STEEL.