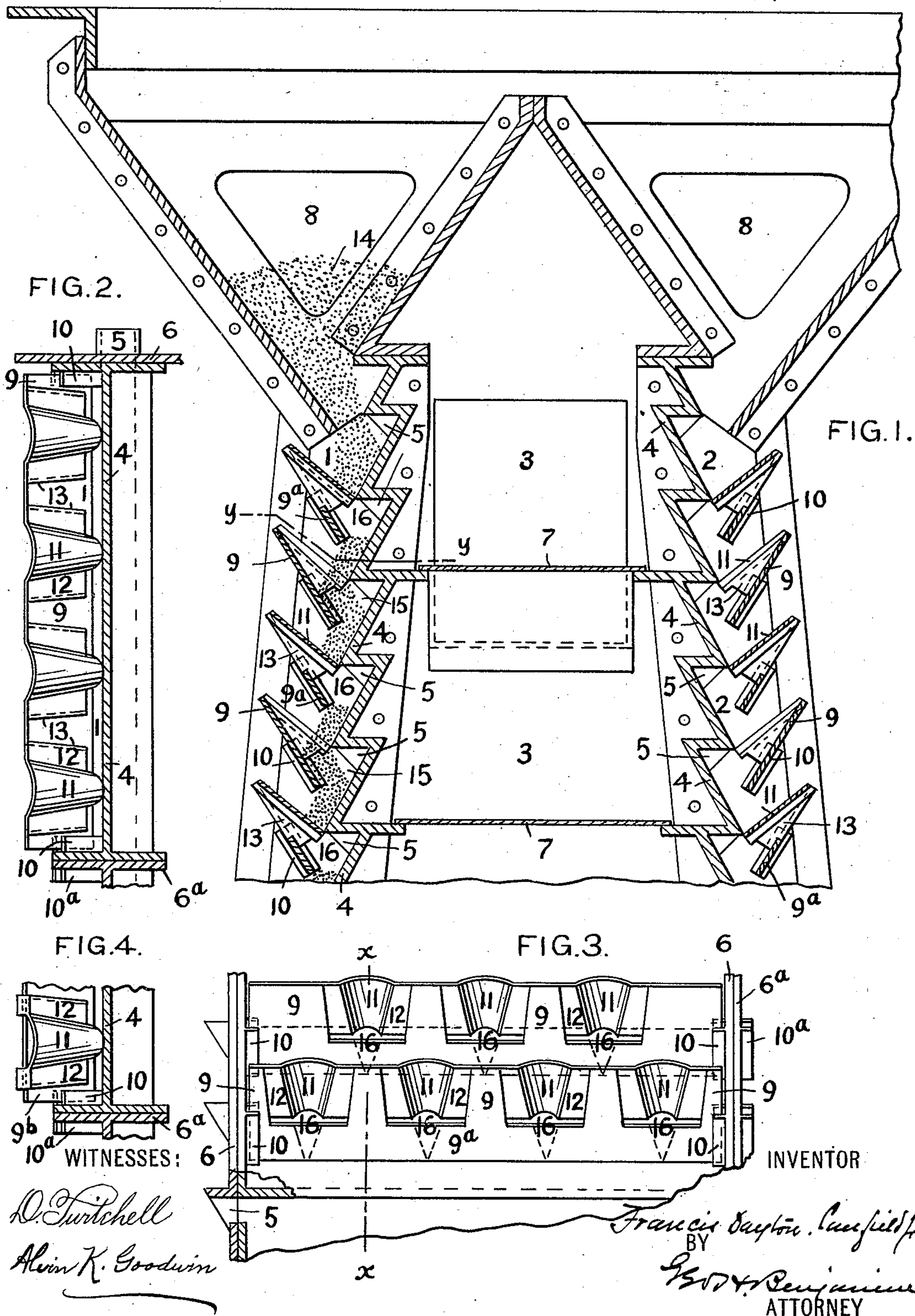


(No Model.)

F. D. CANFIELD, Jr.  
CHAR DRIER.

No. 575,801.

Patented Jan. 26, 1897.





# UNITED STATES PATENT OFFICE.

FRANCIS DAYTON CANFIELD, JR., OF YONKERS, NEW YORK.

## CHAR-DRIER.

SPECIFICATION forming part of Letters Patent No. 575,801, dated January 26, 1897.

Application filed January 3, 1896. Serial No. 574,217. (No model.)

*To all whom it may concern:*

Be it known that I, FRANCIS DAYTON CANFIELD, Jr., a citizen of the United States, residing at Yonkers, State of New York, have invented a new and useful Improvement in Char-Driers, of which the following is a specification.

This invention relates more particularly to that class of apparatus known as "char-driers" in which bone-black or animal charcoal used in sugar-refining or other processes is dried preparatory to revivifying it by kiln-burning to again fit it for use.

So far as known to me all char-driers heretofore made which allow gravitation of the char in a zigzag layer through a sinuous drying-chamber do not cause the descending char layer to be broken up or opened through and through to permit immediate and free escape of hot vapor from both sides or faces of the char layer to the atmosphere. It has heretofore been the practice to permit escape of hot vapors of drying from the outer face of the char layer through large openings communicating directly with the atmosphere and to permit escape of hot vapors arising from the inner face of the char layer through small openings made in the end walls of the drying-chamber or through small openings in the top of the walls over the reëntrant angles formed in the inner wall of said chamber. The openings mentioned for permitting the escape of vapors from the outer face of the char layer are practically sufficient for their purpose, but those provided for escape of vapors from the inner side of the char layer are not sufficient, and in practice it has been found that these vapors choke the outlets provided and tend to collect in the upper parts of the drying-chamber, thus impeding the drying process and wasting fuel. Efforts have been made to obviate these disadvantages by using blowing apparatus, which forces or draws hot air supplied from the kiln-fires directly through a solid descending layer of char confined between opposing perforated walls of a drying-chamber. This, while giving freer escape for the drying-vapors, requires expensive air-forcing machinery, undue fuel consumption, and most skilful management, thus increasing the expense of constructing and operating the drying plant.

It is the primary object of my invention to overcome all these disadvantages by providing a simple, inexpensive, fuel-saving, and automatically-operating drier which is quite fully open to the atmosphere at the outer face or wall of its drying-chamber to give free circulation of air at the outer face of the gravitating layer of char, and by means of peculiar formations of said outer wall automatically produces numerous openings through and through the descending char layer and in positions to communicate with the usual triangular lateral vapor-spaces formed or maintained in the reëntrant angles of the inner wall of the drying-chamber and at the inner face of the char, whereby free escape of drying-vapors to the atmosphere from much of the inner face or side of the char layer, and also from quite its entire outer face, is assured. This avoids choking of the vapors within the drying-chamber and promotes the most thorough and economical drying of the char by the combined influences of the waste heat from the kiln-fires and the free vapor and air circulation at both faces of the layer of char and through numerous openings made through the char and entirely without the aid of expensive auxiliary air-forcing appliances.

In connection with the automatic formation of vapor-escape openings directly through the layer of wet char to allow free and instant escape of vapors from both sides of the char layer to the atmosphere, I have so designed and arranged the vapor-escape passages or flues of the drying-chamber walls that said walls turn the more or less compacted particles of the descending char over and over again in both vertical and lateral planes, especially the latter, thereby quite fully exposing every particle of the char or bone-black to the quick-drying influences of the internal heat and the atmosphere over the whole area of the drying-chamber.

Reference is made to the accompanying drawings, forming part of this specification, and in which similar numerals indicate like parts in the several views.

Figure 1 is a cross-sectional view, taken on the line  $x x$  in Fig. 3, of the upper portion of a char-drier embodying my invention. Fig. 2 is a detail sectional plan view thereof, taken on the line  $y y$  in Fig. 1. Fig. 3 is a



detail outside face view of portion of the drier, and Fig. 4 is a detail plan view illustrating a simple modification making the invention readily applicable to existing driers of ordinary construction.

In utilizing my invention to the best advantage I prefer to construct the drier apparatus with two zigzag drying chambers or passages 1 2, arranged at opposite sides of a hot-air flue 3, located between the inner, preferably imperforate, walls 4 4 of the drying-chambers. These walls have usual zigzag construction, or are formed with reentrant angles under their inner substantially horizontal portions, and openings 5 are preferably made in the end walls 6 of the drying-chambers. These vapor-escape openings 5 are of usual form and in some driers are the only openings provided for escape of vapors from the inner face of a layer of char in the drying-chamber, said vapors being first collected in a triangular space maintained along the back of the char layer by and in the reentrant angles of the wall 4. I may or may not use these end openings 5, but I prefer to use them to facilitate escape of vapor from those portions of the char layer descending next the end wall 6. The flue 3 may receive heat from any source, preferably the waste hot products of the kiln-fires, which heat retorts, into which the dried char passes from the chambers 1 2 to be revived by burning out the saccharine residuum in the usual manner. I show the flue provided with ordinary horizontal partition-plates 7, compelling circuitous travel of the heat to the chimney-flue of the drier. The chambers 1 2 receive wet char from superposed hoppers 8 8.

The peculiarities of my invention reside mainly in a special construction of one side wall of the drying-chamber, preferably its outer wall, which is exposed to the atmosphere. Instead of making this wall of a series of flat plates set in inclined positions below each other or of vertical plates having lateral perforations and provided with interior inclined flanges, I make the wall of a series of plates 9, set in about the usual inclined position relatively to the inclined shelf portions of the opposing wall 4, but formed with novel vapor-channel or flue portions above the general plane of the plate, which is indicated by the grooved guides 10, in which the ends of the plate are fitted. In the drawings these vapor-flues 11 have a laterally-arched or concavo-convex form, and I prefer to make them broader at their outer ends than at their inner ends. The flues 11 are sustained by opposite flat side parts 12 12 with outstanding angular portions 13 13, which are connected to the plane portions of the plate 9. The flue 11 and parts 12 13 together form an open-bottomed box-like casing on the inclined wall-plate 9, the lower portion 9<sup>a</sup> of which preferably projects upward beyond the inner ends of the vapor-flues 11. Each wall-plate 9 thus supports one lateral series of parts 11

12 13, and the successively lower series of said parts have a staggered relation, as better shown in Fig. 3 of the drawings. The plates are so fitted in the drier-frame that the lower ends of the flues 11 approach quite closely to or touch the projecting angle of the opposing wall-plate 4 of the drying-chamber, as more clearly shown in Figs. 1 and 2 of the drawings.

I will explain the operation with more special reference to the left-hand drying-chamber 1 in Fig. 1, and also to Fig. 3 of the drawings, as follows: The char or bone-black or other material 14 to be dried is fed from hopper 8 into the drying-chamber 1 and fills it and gravitates through it only so fast as the dried material is removed from below, as, for instance, by falling from coolers, into which the revived char passes from the kiln on which the drier may be mounted. As the char passes through the chamber 1 the reentrant angles of the plate 4 cause lateral substantially triangular vapor-spaces 15 to be formed all across the drier. These spaces are similar to those maintained in ordinary driers of this character. It will be seen, however, that the slowly-descending layer of char as it passes each of the arched flues 11 on the plates 9 is spread or opened through and through laterally by the flue top wall, whereby an opening 16 (indicated by dotted lines in Fig. 3) is automatically produced and maintained clear through the layer of char at each flue 11. These openings 16 communicate with the vapor-passages 15 behind the layer of char. Hence there is a direct, positive, and unobstructed vapor and air circulation between the rear passages 15 and the outside atmosphere through the openings 16 of the char layer. The result is that there is no choking of the vapors within any part of the drying-chamber 1, as the vapors expelled from the char by the heat of the main flue 3 have free escape from opposite faces of the char layer, at the outer face of the drying-chamber, and over the whole area of said chamber. The drying thus is quickly, thoroughly, and automatically effected without the aid of auxiliary air-forcing apparatus, carrying air through the passages 15 only or directly through a solid layer of char guided between opposing perforated walls of a drying-chamber. The perforations and openings 16, maintained by the flues 11 in the moving layer of char, are clearly distinguishable in structure and effect from pores or interstices in a solid or unbroken more or less porous layer of char through which little or no direct or free outward circulation of vapors or air may take place. As the vapors are escaping from the inner face of the char layer through the passages 15 and the flues 11 to the atmosphere via the char-openings 16 free escape of vapor directly to the atmosphere from the outer face of the char layer is permitted at the openings formed between or within the parts 12, 13, and 9<sup>a</sup> of the plates 9 and between the sev-



eral plates. Hence the vapor and air circulation is at all times good at both faces of the char layer and over the entire area of the drying-chamber.

5 My improved process may aptly be described as passing a perforated layer or body of char or other substance between opposing drying instrumentalities, these being in this example of apparatus the heated wall 4 and  
10 hot-vapor passages 15 at one side or face of the char layer and the atmosphere at the other side or face of said layer.

The flues 11 of plates 9, while assuring free vapor and air circulation through the char-perforations 16 and rear passages 15, as above described, also by their laterally-convexed (or it may be angular) top walls perform a further important function of causing a lateral rolling or tumbling of the descending char  
20 particles, which, in connection with the usual vertical tumbling between the opposing successively lower inclined wall-plates 9 and 4, very thoroughly agitates the char and turns all particles of it into contact with the heat and atmosphere. This lateral tumbling action is facilitated by the prominent portions 12 at the sides of the flues 11, and from which parts 12 the char tumbles laterally into the spaces between the parts 13 of the plates 9. This  
30 lateral tumbling of the char particles also is facilitated by the staggering relation of the parts 11 12 13 all the way down the drying-chamber.

Obviously I am not limited to the precise  
35 form shown of wall-plates 9 for the drying-chamber, as these plates may have any form which in operation will produce the openings 16 through the descending char layer to give free circulation between the inner vapor passages or chambers 15 and the atmosphere and incidentally promote the lateral tumbling or agitation of the char particles.

Fig. 4 of the drawings illustrates how, by simply applying a series of detachable face-plate casings 11 12 13 to the flat outside wall-plates of an ordinary drier, openings like those, 16, will be produced through the descending char layer by interposition of the inner ends of the flue-forming portions 11 of the casings, between which and the plates the vapors may escape from the inner passages 15 behind the char layer. These detachable flue-casings may be hooked over the outer edges of the wall-plates, as shown, or they  
55 may be attached thereto in any other approved manner. By using these detachable face-plate flue-casings an ordinary drier may be quickly converted into a drier embodying the principal feature of my invention.

60 Figs. 2, 3, and 4 of the drawings show how additional drier-sections having end plates 6<sup>a</sup> and guides 10<sup>a</sup>, to receive other series of wall-plates 9, and having inner wall 4 may be used to build up a drier in any required number of  
65 sections.

It is obvious that the flues 11, projecting across the path of the moving layer of char

and approaching or abutting the projecting angles of an opposing reëntrant-angle-forming wall of the drying-chamber and producing and maintaining comparatively large  
70 openings 16 through and through the moving char layer, may be sustained from the outer wall-plates 9 or from the inner wall 4 of the drying-chamber or in any other manner, the  
75 attachment of the flues to the outer wall-plates 9 being preferred in practice.

I briefly summarize the advantages of this drier by stating that it dries a larger quantity of char more thoroughly in a given time and  
80 with less fuel than other apparatus known to me. A smaller drying plant is thus required, thereby saving largely first in cost, and as the char is more thoroughly acted upon by direct atmospheric influences it enters the kiln-re-  
85 torts in better condition and requires less heat to revivify it therein. Hence the life of retorts and connected coolers and their pipes is prolonged, and expense for repairs is reduced to a minimum, and the labor of firing  
90 and the removal of ashes is materially lessened, all of which features assure the most economical erection and operation of the apparatus.

I claim as my invention—

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1. A drying apparatus having one or more drying-chambers, with the outer wall of each chamber formed as a series of shelves, having vapor-escape flues which project into the space through which the descending char  
100 travels, substantially as described.

2. A drying apparatus having one or more drying-chambers, with the outer wall of each chamber formed as a series of shelves, having vapor-escape flues with convex tops con-  
105 tracted toward their inner ends, which project into the space through which the descending char travels, substantially as described.

3. A drying apparatus constructed with  
110 one or more drying-chambers, each provided with one side wall having overhanging portions forming reëntrant angles maintaining lateral spaces at one face of a layer of char or other substance passing through the drying-  
115 chamber, the opposing wall of said chamber having an open construction giving free air circulation to the char layer, combined with a series of flues having concaved lower faces and sustained in the path of the char layer  
120 with their ends next the projecting angles of the reëntrant-angle wall of the drying-chamber and maintaining openings through and through the moving char layer for free escape of vapors from the reëntrant-angle spaces of  
125 the drying-chamber walls, substantially as described.

4. A drying apparatus constructed with one or more drying-chambers, each provided with one side wall having overhanging por-  
130 tions forming reëntrant angles maintaining lateral spaces at one face of a layer of char or other substance passing through the drying-chamber, the opposing wall of said cham-



ber having an open construction, giving free air circulation to the char layer, combined with a series of flues having concaved lower faces and laterally-sloping upper faces and sustained in the path of the char layer with their ends next the projecting angles of the reëtrant-angle wall of the drying-chamber and maintaining openings through and through the moving char layer for free escape of drying-vapors from the reëtrant-angle spaces of the drying-chamber wall while laterally tumbling the char particles during their passage through the drying-chamber, substantially as described.

5. A drying apparatus having one or more drying-chambers, with the inner wall of each chamber formed as a series of reëtrant angles, and the outer wall of each chamber formed as a series of shelves having vapor-escape flues, which project into the space through which the descending char travels immediately below said reëtrant angles, substantially as described.

6. A drying apparatus having one or more drying-chambers, with the inner walls of each chamber formed of a series of reëtrant angles, and the outer wall of each chamber formed of a series of vapor-escape flues with convex tops contracted toward their inner ends, which project into the space through which the descending char travels below said reëtrant angles, substantially as described.

7. A drying apparatus having one or more chambers, with the inner walls of each chamber formed as a series of reëtrant angles, and the outer wall of each chamber formed as a series of shelves having vapor-escape flues, which project into the space through which the descending char travels, and said flues relatively staggered upon the succeeding shelves, substantially as described.

8. A drying apparatus having one or more drying-chambers provided with one inner side wall next a source of heat and having overhanging or reëtrant-angle portions maintaining lateral spaces behind a layer of char, or other substance descending through the drying-chamber, the opposing outer side wall of said chamber comprising a series of separated inclined plates giving free vapor and air circulation between them, and each provided with a series of vapor-escape flues projecting toward the inner side wall, and maintaining through the descending char layer a series of openings, establishing communication between the aforesaid inner lateral spaces behind the char layer and the atmosphere, substantially as described.

9. A drying apparatus having one or more drying-chambers provided with one inner side wall next a source of heat, and having over-

hanging or reëtrant-angle portions maintaining lateral spaces behind a layer of char, or other substance descending through the drying-chamber, the opposing outer side wall of said chamber comprising a series of separated inclined plates giving free vapor and air circulation between them and each provided with a series of vapor-escape flues projecting toward the inner side wall, and maintaining through the descending char layer a series of openings, establishing communication between the aforesaid inner lateral spaces behind the char layer and the atmosphere, said flues having concavo-convex or sloping top walls which laterally tumble the descending char particles, substantially as described.

10. The combination in a drying apparatus of a zigzag wall 4, next a source of heat, an opposing wall formed of a series of inclined shelves carrying removable vapor-escape flues 11, which when in position project into the char-space, substantially as described.

11. The combination, in a drying apparatus, of a zigzag wall 4, next a source of heat, and an opposing open wall comprising a series of inclined plates 9, having lower lateral portions 9<sup>a</sup>, and provided with vapor-escape flues 11, sustained from the plate by parts 12, 13, substantially as described.

12. The combination in a drying apparatus of a zigzag wall 4, next a source of heat, an outer wall consisting of a series of inclined shelves, and a series of vapor-escape flues which project into the char-space, mounted on said shelves, and end walls for said drying-chambers having vapor-escape openings 5, substantially as described.

13. The combination, in a drying apparatus, with inclined plates forming one wall of a drying-chamber, of detachable flues applied to said wall-plates, and maintaining vapor-escape openings through a layer of char or other substance passing through the drying-chamber, substantially as described.

14. A drying apparatus having one or more drying-chambers provided at one side wall with reëtrant angles maintaining lateral spaces behind a layer of char, or other substance passing through the drying-chamber, the opposing wall of said chamber formed of a series of inclined plates, and detachable flues applied thereto, and maintaining vapor-escape openings through the layer of char, which communicate with the lateral spaces behind the char, substantially as described.

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

FRANCIS DAYTON CANFIELD, JR.

Witnesses:

R. P. HESS,

GEO. H. BENJAMIN.