

Feb. 12, 1924.

1,483,424

F. E. FINCH ET AL

DRIER

Filed May 21, 1921

5 Sheets-Sheet 1

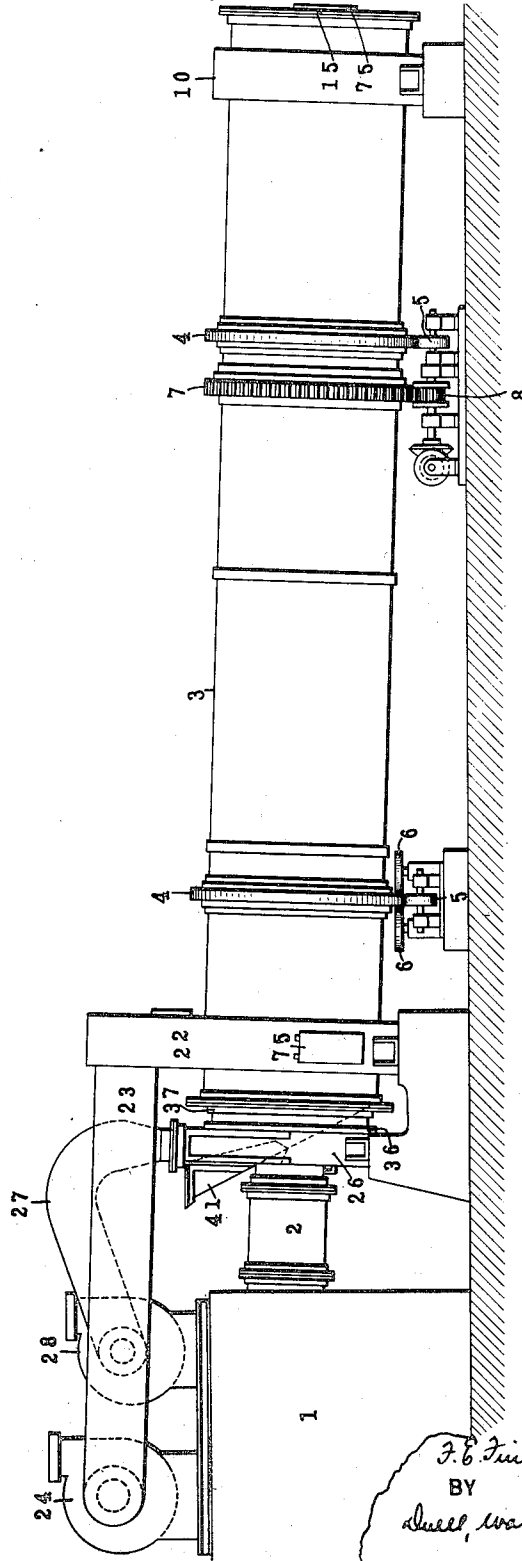


Fig. 1

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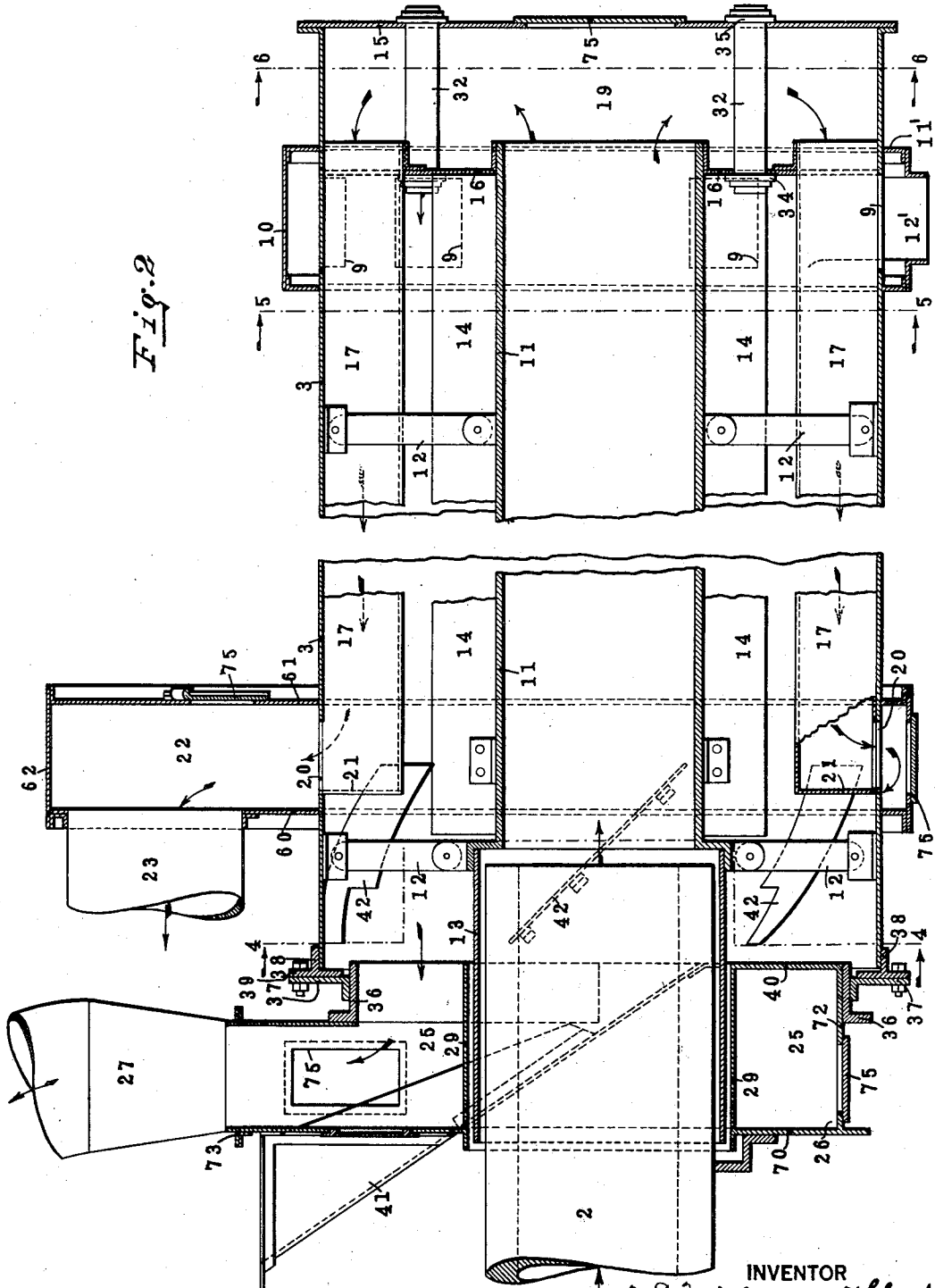
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Filed May 21, 1921

5 Sheets-Sheet 2

Fig. 2



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5 Sheets-Sheet 3

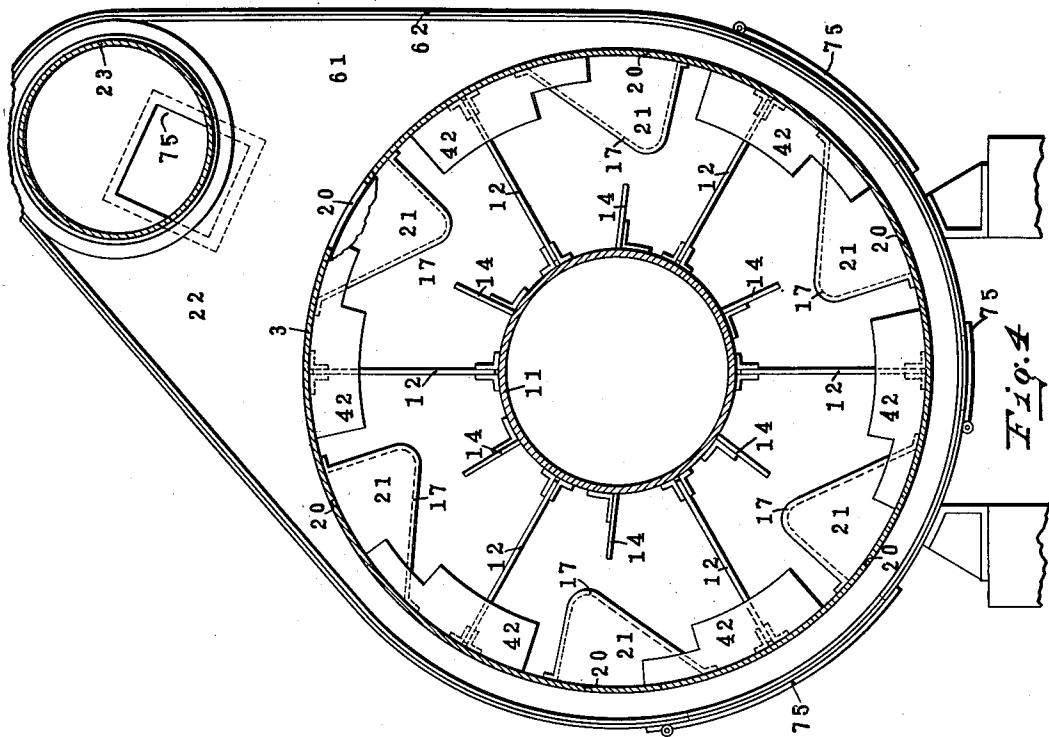


Fig. 4

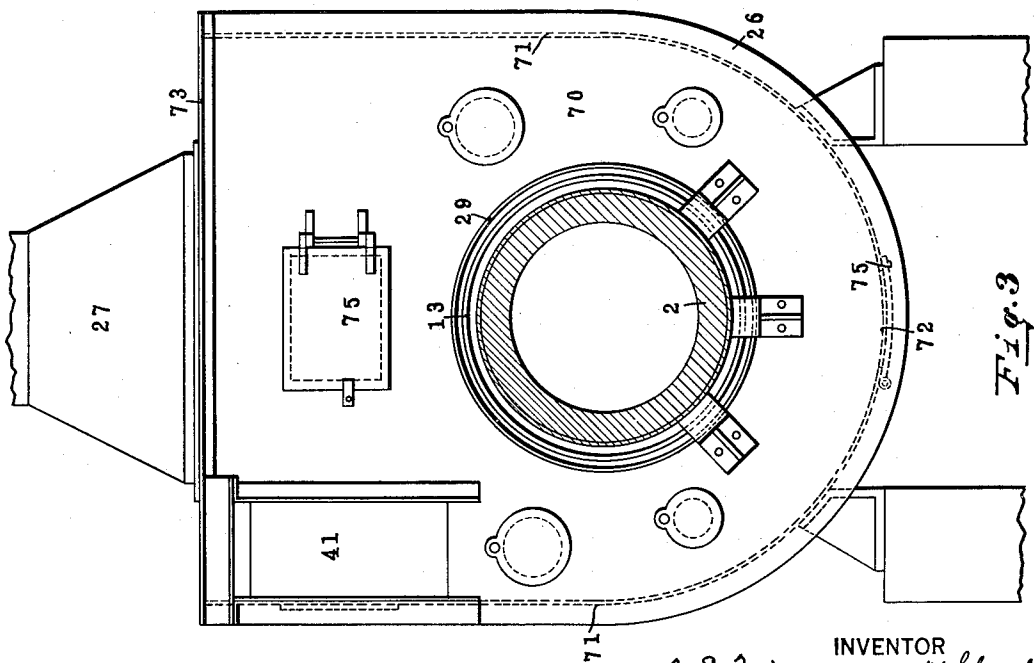


Fig. 3

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DRIER

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5 Sheets-Sheet 4

Fig. 6

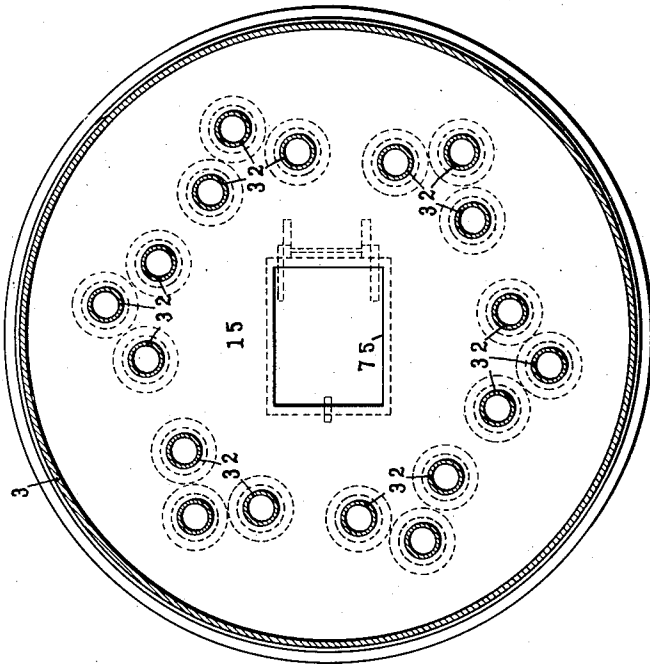
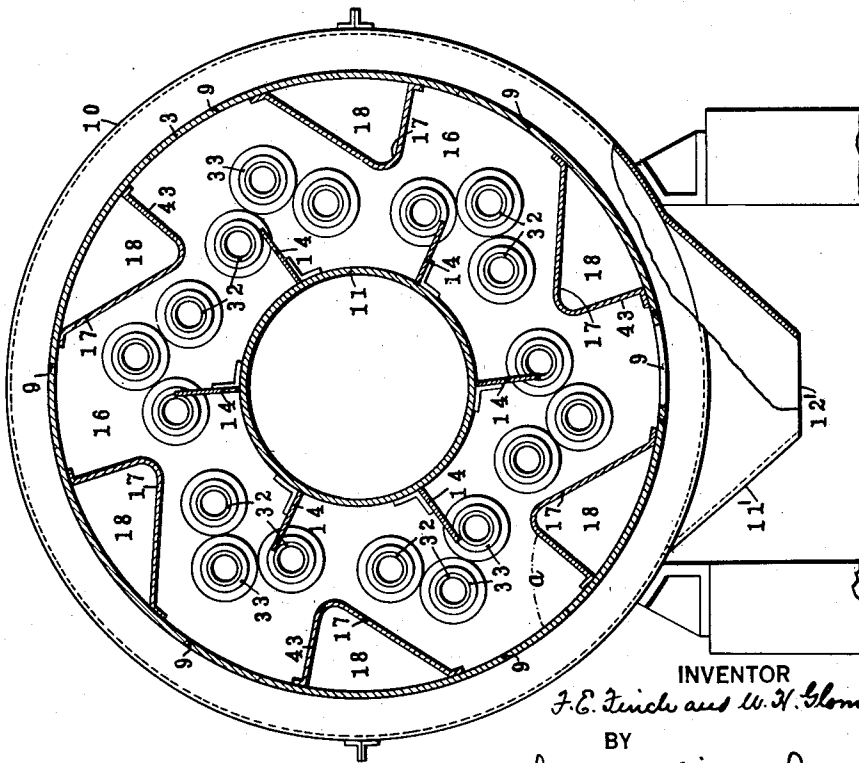


Fig. 5



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DRIER

Filed May 21, 1921

5 Sheets-Sheet 5

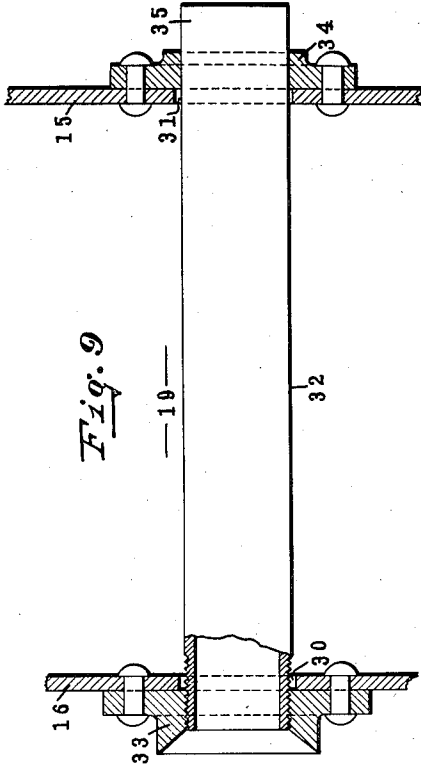


Fig. 9

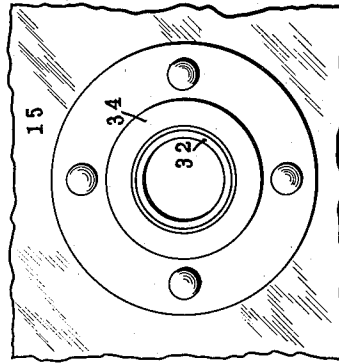


Fig. 10

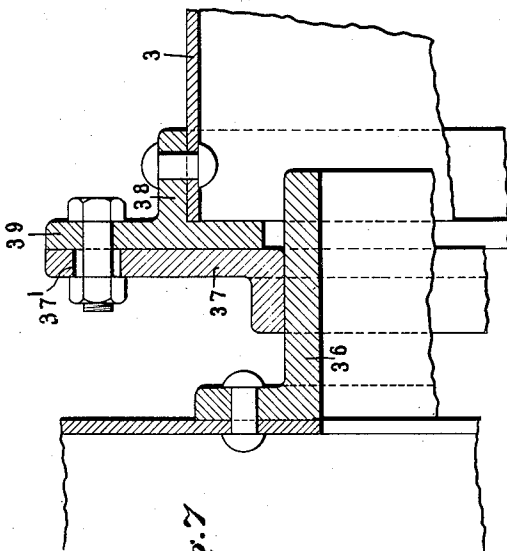


Fig. 7

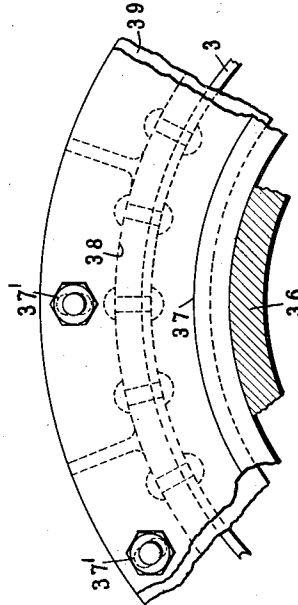


Fig. 8

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UNITED STATES PATENT OFFICE.

FRANCIS E. FINCH, OF NEW YORK, N. Y., AND WALTER H. GLOMB, OF YORK, PENNSYLVANIA, ASSIGNORS TO RUGGLES-COLES ENGINEERING COMPANY, OF YORK, PENNSYLVANIA, A CORPORATION OF NEW JERSEY.

DRIER.

Application filed May 21, 1921. Serial No. 471,324.

To all whom it may concern:

Be it known that we, FRANCIS E. FINCH and WALTER H. GLOMB, citizens of the United States, residing at New York and York, in the counties of New York and York and States of New York and Pennsylvania, have invented certain new and useful Improvements in Driers, of which the following is a full, clear, and exact description, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to driers and with respect to its more specific features to driers which are of the rotary type and in which the medium for heating the drier circulates therein out of contact with the material to be dried.

One of the objects of the invention is the provision of a practical apparatus of the character referred to adapted to utilize the heat to practical advantage and with high efficiency and to control the heating circuit relative to the moisture extracting circuit.

Another object of the invention is the provision of a simple and efficient apparatus of the character described adapted to effect the rapid removal of moisture, steam, saturated air, etc., from the drying chamber.

Another object of the invention is the provision of a practical apparatus of the character referred to wherein provision is made for keeping down the temperature of those portions of the apparatus which may be subjected or adjacent to high temperatures.

Another object of the invention is the provision of a practical structure of the character referred to which is convenient to assemble and substantial and simple in operation.

Another object of the invention is the provision of an apparatus of the character described which is gas-tight for all practical purposes under varying degrees of temperature.

Other objects will be in part obvious and in part pointed out hereinafter.

The invention accordingly consists in the features of construction, combinations of elements and arrangement of parts which will be exemplified in the construction hereinafter set forth, and the scope of the ap-

plication of which will be indicated in the following claims.

In the accompanying drawings forming part of this specification wherein similar reference characters refer to similar parts throughout the several views,

Fig. 1 is an elevation of a drier embodying the invention;

Fig. 2 is a fragmentary longitudinal section of the device;

Fig. 3 is a front end view of the drier partly in section;

Fig. 4 is a cross-sectional view taken on the line 4-4 of Fig. 2;

Fig. 5 is a similar section taken on the line 5-5 of Fig. 2;

Fig. 6 is a similar section taken on the line 6-6;

Fig. 7 is a sectional detail of the joint between the drum and the hood;

Fig. 8 is a front view of a portion of Fig. 7;

Fig. 9 is a detail view, partly in section, of one of the air conduits and associated parts; and

Fig. 10 is an end view of an air tube and its support.

The drawings illustrate an embodiment of the invention comprising an indirect heat drier, intended for use where the nature of the material to be dried is such that it is advisable to keep the heating medium out of direct contact with the material to be dried.

Referring now more specifically to the drawings, the general arrangement of the apparatus may be first set out. On a suitable foundation, as the ground or other substantial base, may be placed the device for generating the heating medium to be utilized. In the present embodiment a furnace 1 is employed, the products of combustion passing from the furnace through a horizontally disposed pipe, or flue 2 and thence to the drier. The current of the heating medium, in the present instance products of combustion from the furnace 1, may be established through the drier by any practical device as, for instance, by means of a stack or chimney. But, as will hereinafter appear, in the present exemplification a rotary exhaust fan is placed in the heating circuit for this purpose.

The numeral 3 indicates a rotatable dry-

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ing drum, cylindrical in cross-section and substantially horizontally disposed, the longitudinal axis of the drum inclining slightly so that the material to be dried will progress therethrough as the drum rotates. This drum may be provided with encircling bands 4-4 fixed thereto and serving as bearings with which the anti-friction rollers 5 cooperate to support and permit ready rotation of the drum. One of the bands may be engaged at its sides by the thrust rollers 6 to maintain the longitudinal position of the drum. Rotation of the drum may be effected by providing it with an encircling gear 7 which may be driven from a pinion 8, the latter in turn being driven by any suitable source of power. Adjacent its rear end the drum 3 may be provided in its longitudinal wall with a series of openings 9 (Figs. 2 and 5) through which the dried material is discharged as the drum rotates. Surrounding the drum and in registry with the discharge openings 9 is a hood or casing 10 which may be fashioned beneath the drum into a hopper, as indicated at 11', having an opening 12' through which the dried material may be delivered.

Within the drum 3 is a central horizontal flue, or pipe 11 which, by means of the links 12 pivoted to the flue 11 and to brackets on the inner wall of the drum is suspended in the drum so as to rotate therewith. The link suspension described permits slight longitudinal movement of the flue 11 relative to the drum under the varying temperatures present. At its front end where the gases from the furnace enter, the drum is open and the flue 11 extends forwardly through the open end of the drum, being provided with an extension 13 which, as illustrated, is of larger diameter than the main portion of the flue 11. The flue 2 coming from the furnace extends into extension 13, and, in the present embodiment, through the open end of the drum, and the flue 2 may be spaced from the inner surface of the extension 13 as illustrated in order to permit air from the atmosphere to enter between the two so as to be drawn into the central flue under the influence of the draft. Longitudinally disposed on the exterior of the flue 11 are fins 14 which assist in advancing and cascading the material to be dried.

In the present embodiment the drum 3 includes a drying chamber and a heating chamber, or flue. The rear end of the drum is closed by a transversely disposed head 15. Spaced from the head 15 is another transversely disposed head 16. The central portion of the head 16 is apertured for the reception of the rear end of the central flue 11, so that the gases from the central flue enter the chamber between the two heads. At its outer periphery the inner

head 16 is slotted or cut away at a plurality of points for the reception of the rear ends of certain auxiliary flue sections 17. Each flue section 17 includes a channeled plate lying against the inner wall of the drum at one side of the head 16 with its channeled face facing the inner wall as will be clearly understood by reference to Figs. 2 and 5. The auxiliary flue sections are fastened at their edges to the inner wall of the drum and cooperate with said wall to form auxiliary flues 18 (Fig. 5), these auxiliary flues extending longitudinally of the drum and receiving the gases from the chamber, or flue 19 provided between the heads 15 and 16.

In the longitudinal wall of the drum 3 are ports 20 through which the gases in the auxiliary flues 18 emerge from the drum. The flue sections 17 are headed over at their front ends 21 (Fig. 2) the auxiliary flues 18 being thereby closed at their front ends so as to divert the gases through the gas ports 20. The ports 20 are placed at a distance from the front end of the drum and, as the drum rotates, discharge the hot gases into a stationary hood 22 resting on the foundation which provides an annular chamber surrounding the drum and in registry with the gas ports 20. As illustrated the hood 22 comprises front and rear metal plates 60 and 61 having concentric openings through which the drum 3 passes, with a close fit, a cross plate 62 being fastened to the outer edges of the plates 60 and 61. Leading from the side of the upper extended portion of the hood 22 is a discharge pipe or flue 23 which communicates with a rotary exhaust fan 24, shown as being supported upon the top of the furnace. The exhaust fan may be driven by any suitable means and discharges the products of combustion into the air or into a suitable chimney. By the foregoing construction it will be observed that the heating gases circulate in the drier out of contact with the material to be dried and that the current or draft of these gases is established by the fan 24 specially pertaining to the gas circuit. It will be further observed that upon the establishing of the current of hot gases, air from the atmosphere may be drawn between the flue extension 13 and the flue 2 into the central flue 11 so as to mix with the products of combustion in the central flue and raise the temperature in the central flue by combining with any unconsumed inflammable gas in the latter. Air may enter in excess of that needed to complete combustion, and thereby tend to keep the temperature in the flues from rising so high as to burn out the flue parts.

For the purpose of drawing off moisture, steam and other gases and vapors in the drying chamber, there is provided a con-

duit which registers with the front open end of the drum. In the present embodiment this conduit comprises an annular chamber 25 confronting the open end of the drum (Fig. 2) and formed in a hood 26 which surrounds the centrally disposed flues 2 and 13. This hood comprises a front piece or plate 70, side, bottom, and top walls, 71, 72 and 73, the front piece 70 having a central opening through which extends the flue 2. Access to the interior of this hood, to the hood 22 and to the chambers 19, is permitted by providing suitably covered openings at various desirable points, as for instance indicated by the numeral 75.

The annular chamber 25 is of large diameter, being of transverse dimension but little smaller than that of the drum, so that there is relatively free communication between the drying chamber and the chamber in the hood 26 for the discharge of air and moisture from the drying chamber. At its upper part the hood 26 communicates with a discharge pipe 27 leading to a rotary exhaust fan 28, the operation of which fan establishes a current through the drying chamber and the hood 26 to the fan. For convenience in referring to the composition of this current it may be designated the air current or air draft to distinguish it from the heating current or gas draft. It will be observed that, in the present embodiment, the means for establishing the air current is separate from the means for establishing the draft or current of gas, the independence of the two permitting variation of one relative to the other as may be desired. In order to provide for the ready expansion and contraction of the flue members 2 and 13, the inner annular wall 29 of the hood 26 may be spaced from the extension 13 as is illustrated in Fig. 2.

In order to effectively and rapidly sweep the moisture, steam, etc., from all parts of the drying chamber, air is permitted to enter the rear end of the drying chamber at various points over its cross-section so that upon operation of the exhaust fan 28 air currents will be established throughout substantially the full cross-section of the drum. To this end the heads 15 and 16 are apertured at various points, as for instance indicated at 30 and 31, Fig. 9, the apertures 30 and 31 being in longitudinal alignment with each other and receiving air conduits or pipes 32 extending between the heads 15 and 16 across the heating chamber or flue 19, the air conduits 32 at one end receiving air from the atmosphere and at the other end delivering the air into the drying chamber. The air passing through the conduits 32 will be heated by the surrounding hot gases in the flue 19 and consequently there will be less

tendency to suddenly chill the drying chamber than if the air were drawn cold into such chamber. In order that the air conduits 32 may be removed and replaced, one end of such conduit has threaded engagement with an air conduit support 33 riveted to the inner face of the head 16 and having an aperture registering with the aperture 30, the wall of the aperture in the conduit support 33 being screw-threaded to cooperate with the threads on the conduit, 32. At the outside of the head 15 apertured conduit supports 34 are riveted, and the air conduits 32 have close sliding engagement with the supports 34, and may extend a short distance in rear of the support 34 to provide a portion 35 which may be grasped or to which a tool may be applied so as to manipulate the conduit 32, as for instance, in order to apply and remove it.

In order as far as possible to form a gas-tight joint between the front end of the drum 3 and the chamber 25 in the hood 26 a stationary cylindrical bearing ring 36 is engaged by a sealing ring 37. In the present embodiment the ring 36 may be formed as a part of or connected to one of the walls of the front hood 26, the inner surface of the sealing ring 37 engaging the outer surface of the ring 36. To the end of the drum 3 is riveted a ring 38 having a transversely disposed flange 39 against the front face of which is removably held a sealing ring 37. The stationary ring 36 is concentric with the axis of the drum 3 and is of substantial longitudinal extent so as to permit the sealing ring 37 to move axially or longitudinally thereon as the drum expands and contracts under variations of temperature. The radial flange of the sealing ring may be slotted where the bolts pass through as at 37', to permit the drum and sealing ring to have relative transverse movement, should the axis of the drum take up an eccentric position.

A stationary member or barrier 40 is placed at the bottom of the annular chamber to prevent material delivered to the lower wall of the drum from bounding or flowing into the hood at this point. At one side of the hood 26 is a feed chute 41 for the supply of material to be dried. This chute passes through the annular chamber of the hood 26 at a sufficiently steep inclination to effect a feeding of the material, and at its lower end the chute 41 discharges the material beyond the barrier 40. The material falling from the chute 41 may be lifted by the flights or buckets 42 which are fastened to the inner wall of the drum between its front end and the front end of the flues 18. As the flights assume an upper position consequent upon rotation of the drum 3 they discharge or cascade the lifted material across the drying chamber, some of which material may fall

upon the central flue 11 and be thence discharged by rotation of the flue 11 assisted by the fins 14.

The flue sections 17 may also operate as flights or buckets for cascading the material. In order to augment the efficiency of their operation in this respect each of said sections includes a wall 43 extending generally radially of the drum so as to provide a properly inclined surface from which the lifted material will slide and cascade as the drum rotates.

In operation the fans 24 and 28 establish currents of the heating gases and of the "air" through the heating flues and the drum respectively as hereinbefore explained, the products of combustion constituting the heating gases coming from the furnace 1. The drying drum is caused to rotate by suitably operating the pinion 8, the rotation of the drum being in a direction to cause the lifting flights 42 and the flue sections 17 to lift the material fed to the drum through the chute 41. As the drum rotates the material will be gradually lifted by the flights and the flue sections and when these members arrive at the upper portion of their rotary path the material will drop or cascade therefrom through the heated atmosphere in the drum, some of the material falling upon the central flue 11 and thence to the bottom of the drum, the material advancing as it cascades in consequence of the inclination of the axis of the drum. Where first entering the drum the material will contain the greatest amount of moisture and as the heating gases will be hottest at the front end the moisture will be rapidly extracted from the material at this point. Also on account of the greater amount of moisture present the adjacent parts of the apparatus, as for instance, the front end of the flue 11 and of the drum 3 will not be raised to such a temperature as to destroy them, i. e. burn them out. As the material treated progresses through the drum and becomes drier and drier it meets portions of the heated atmosphere in the drum and of the drum parts which are of relatively lower temperature consequent upon the gases having previously given up some of their heat in the antecedent drying so that at these advanced points in the drum the material treated has a less moisture content and is more apt to burn or be otherwise deleteriously affected. The temperature at such advanced points will not be sufficiently high to damage the material. During the drying operation air entering through the conduits 32 will be heated by the gases in the chamber 19 and will enter the drying chamber at various points of the cross-section of the drum so that currents will be established throughout the full vol-

ume of the drying chamber and directly from one end of the drum to the other so that the drying chamber will be efficiently swept of the vapors extracted from the material treated. Furthermore, in consequence of the air entering through the conduits 32 being relatively hot the atmosphere in the drum will not be chilled, nor will the auxiliary flues nor the central flue be chilled with consequent reduction of temperature of the gases therein. The heating gases emerge from the drum at a point in rear of and so relatively remote from the sealing ring 37 as not to substantially injuriously affect the sealing function of the ring 37 at the front end of the drum. Also because the "air," that is, the various vapors in the drying chamber, is relatively cool it tends to keep down the temperature of the parts adjacent the sealing ring as it emerges from the drum into the hood at the front end thereof. The provision of the auxiliary flue sections 17 enables a large portion of the heat circuit to be inexpensively yet efficiently constructed and repaired and the operation of the flue sections as cascading elements enables separate lifting flights to be largely dispensed with, all of which makes for economy in construction and efficiency in practical operation. By the provision of the explained construction for sealing the front end of the drum renewal of the sealing means may be readily effected should unfortunate operative conditions render it necessary. The heat circuit and the air circuit are independent of each other and independently established so that one may be modified relative to the other as conditions may require. More or less air may be drawn into the air circuit by varying the speed of the fan 24 and similar variation is possible for the heat circuit by varying the speed of the fan 28. Thus the temperature conditions in the drier are largely under control, it being possible to largely increase the heating effect by reducing the speed of the air circuit fan.

It is to be understood that the discharge hood for the dried material, indicated at 10, and the discharge hood for the heating gases indicated at 22, may be provided with suitable devices for sealing the joint between the respective hoods and the drier shell 3. Each wall of these hoods may have applied thereto a flanged sealing ring similar to the sealing ring 37, which like the ring 37 may have radial movement to accommodate eccentricity of the shell.

Thus by the above described construction are accomplished among others the objects hereinbefore referred to.

As many changes could be made in the above construction and many apparently widely different embodiments of this inven-

tion could be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the language used in the following claims is intended to cover all of the generic and specific features of the invention herein described, and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.

Having described our invention, what we claim as new and desire to secure by Letters Patent is—

1. In an apparatus of the character described, in combination, a rotatable drum open at one end, a conduit registering with the upper portion of said open end, a stationary member disposed to close the lower portion of said open end, a stationary cylindrical bearing ring concentric with the axis of said drum, and a sealing ring removably connected to and rotatable with said drum adapted to bear on said bearing ring, said bearing ring surrounding said stationary member and forming a wall of said conduit.

2. In an apparatus of the character described, in combination, a rotatable drum open at one end, a central flue extending through said opening, a hood including an annular chamber surrounding said flue and in communication with said drum, a stationary barrier between the lower portion of the open end of said drum and said annular chamber, and two rings, one a bearing ring and the other a sealing ring, carried respectively by said hood and said drum, and adapted the one to bear on the other as the drum rotates, said sealing ring being movably held in bearing position.

3. In an apparatus of the character described, in combination, a rotatable drum open at one end having gas ports in its longitudinal wall, a hood surrounding said drum and in registry with said ports, a central flue extending through said opening, and a second hood including an annular chamber surrounding said flue and in communication with said drum.

4. In an apparatus of the character described, in combination, a rotatable drum open at one end having gas ports in its longitudinal wall, a hood surrounding said drum and in registry with said ports, a central flue extending through said opening, a second hood including an annular chamber surrounding said flue and in communication with said drum, and a stationary barrier between said drum and said annular chamber.

5. In an apparatus of the character described, in combination, a rotatable drum

open at one end having gas ports in its longitudinal wall, a hood surrounding said drum in registry with said gas ports, a gas flue extending through said opening, a second hood surrounding said gas flue and in communication with said drum, a stationary bearing ring, and a sealing ring removably fastened to said drum and bearing on said bearing ring.

6. In an apparatus of the character described, in combination, a rotatable drum open at one end having gas ports in its longitudinal wall, a hood surrounding said drum in registry with said gas ports, a gas flue extending through said opening, a second hood surrounding said gas flue and in communication with said drum, a stationary bearing ring, and a sealing ring removably fastened to said drum and bearing on said bearing ring the inner annular wall of said second hood being spaced from the adjacent flue.

7. In an apparatus of the character described, in combination, a rotatable drum open at one end having gas ports in its longitudinal wall, a hood surrounding said drum in registry with said gas ports, a gas flue extending through said opening, a second hood surrounding said gas flue and in communication with said drum, auxiliary flues in said drum adapted to lead gas from said gas flue to said gas ports out of contact with the material to be dried, and means adapted to establish a current of air from said drum through said second hood.

8. In an apparatus of the character described, in combination, a rotatable drum open at one end having gas ports in its longitudinal wall, a hood surrounding said drum in registry with said gas ports, a gas flue extending through said opening, a second hood surrounding said gas flue and in communication with said drum, auxiliary flues in said drum adapted to lead gas from said gas flue to said gas ports out of contact with the material to be dried, means adapted to establish a current of air from said drum through said second hood, and means separate from said last mentioned means, adapted to establish a current of gas from said gas flue through said first mentioned hood by way of said auxiliary flues and said gas ports.

9. In an apparatus of the character described, in combination, a drum, a flue coaxially disposed therewithin for the accommodation of heated gases and a conduit comprising a bent sheet attached to the wall of the drum and co-operative therewith to form a return flue for such gases.

10. In an apparatus of the character described, in combination, a drum, a flue coaxially disposed therewithin for the accommodation of heated gases, and a conduit

comprising a bent sheet attached to the wall of the drum and co-operative therewith to form a return flue for such gases, said sheet being also adapted to agitate the loose material in the drum.

11. In an apparatus of the character described, in combination, a drum including a drying chamber and a heating flue, and air conduits extending across said flue and opening into said drying chamber.

12. In an apparatus of the character described, in combination, a drum including transversely disposed heads dividing the same into a drying chamber and a heating chamber, and air conduits in said heating chamber and opening into said drying chamber.

13. In an apparatus of the character described, in combination, a drum closed at one end, a transversely disposed head spaced from the closed end of said drum, heating flues in the drum at one side of said head communicating with the space between said closed end and said head, and conduits passing through said space and said head.

14. In an apparatus of the character described, in combination, a drum including transversely disposed heads spaced apart, said heads having apertures in alignment with each other, and an air conduit in alignment with said apertures, having threaded connection with one of said heads and having a manipulative portion exposed adjacent the other head.

15. In an apparatus of the character described, in combination, a drum including transversely disposed heads spaced apart, said heads having apertures in alignment with each other, air conduit supports fastened to each head having apertures registering with the apertures in said heads, respectively, and air conduits extending between and removably mounted in said supports.

16. In an apparatus of the character described, in combination, a drum including transversely disposed heads spaced apart, said heads having apertures in alignment with each other, air conduit supports fastened to each head having apertures registering with the apertures in said heads, respectively, one of said supports being threaded, and an air conduit extending between said heads having threaded engagement with said threaded support and sliding engagement with the other support.

17. In an apparatus of the character described, in combination, a rotatable drum having transverse heads spaced apart thereby providing a drying chamber and a heating chamber, a plurality of flue sections co-operative with the inner wall of said drum in the drying chamber to form a plurality of auxiliary flues in communication with said heating chamber, ports in the longitudinal wall of said drum in communication with

said auxiliary flues, respectively, said flue sections including walls extending generally radially of said drum to form lifters for the material to be treated, and a hood surrounding said drum and in registry with said ports.

18. In an apparatus of the character described, in combination, a rotatable drum having transverse heads spaced apart thereby providing a drying chamber and a heating chamber, the opposite end of said drying chamber being open, a plurality of flue sections co-operative with the inner wall of said drum in the drying chamber to form a plurality of auxiliary flues in communication with said heating chamber, ports in the longitudinal wall of said drum in communication with said auxiliary flues, respectively, said flue sections including walls extending generally radially of said drum to form lifters for the material to be treated, and a hood surrounding said drum and in registry with said ports, a heating flue extending into the open end of said drying chamber and opening into said heating chamber, a second hood opposite the open end of and in communication with said drying chamber, and surrounding said heating flue.

19. In an apparatus of the character described, in combination, a rotatable drum having transverse heads spaced apart thereby providing a drying chamber and a heating chamber, the opposite end of said drying chamber being open, a plurality of flue sections co-operative with the inner wall of said drum in the drying chamber to form a plurality of auxiliary flues in communication with said heating chamber, ports in the longitudinal wall of said drum in communication with said auxiliary flues, respectively, said flue sections including walls extending generally radially of said drum to form lifters for the material to be treated, a hood surrounding said drum and in registry with said ports, a heating flue extending into the open end of said drying chamber and opening into said heating chamber, a second hood opposite the open end of and in communication with said drying chamber, and surrounding said heating flue, and conduits extending across said heating chamber and supported by said heads adapted to lead air to said drying chamber.

20. In an apparatus of the character described, in combination, a rotatable drum having transverse heads spaced apart thereby providing a drying chamber and a heating chamber, the opposite end of said drying chamber being open, a plurality of flue sections co-operative with the inner wall of said drum in the drying chamber to form a plurality of auxiliary flues in communication with said heating chamber, ports in the longitudinal wall of said drum in com-

munication with said auxiliary flues, respectively, said flue sections including walls extending generally radially of said drum to form lifters for the material to be treated, a hood surrounding said drum and in registry with said ports, a heating flue extending into the open end of said drying chamber and opening into said heating chamber, a second hood opposite the open end of and in communication with said drying chamber, and surrounding said heating flue, a bearing ring supported by said second hood, and a removable sealing ring rotatable with said drum and bearing on said bearing ring.

21. In an apparatus of the character described, in combination, a rotatable drum having transverse heads spaced apart thereby providing a drying chamber and a heating chamber, the opposite end of said drying chamber being open, a plurality of flue sections co-operative with the inner wall of said drum in the drying chamber to form a plurality of auxiliary flues in communication with said heating chamber, ports in the longitudinal wall of said drum in communication with said auxiliary flues, respectively, said flue sections including walls extending generally radially of said drum to form lifters for the material to be treated, a hood surrounding said drum and in registry with said ports, a heating flue extending into the open end of said drying chamber and opening into said heating chamber, a second hood opposite the open end of and in communication with said drying chamber, and surrounding said heating flue, conduits extending across said heating chamber and supported by said heads adapted to lead air to said drying chamber, a bearing ring supported by said second hood, and a removable sealing ring rotatable with said drum and bearing on said bearing ring.

22. In an apparatus of the character described, in combination, a rotatable drum having transverse heads spaced apart thereby providing a drying chamber and a heating chamber, the opposite end of said drying chamber being open, a plurality of flue sections cooperative with the inner wall of said drum in the drying chamber to form a plurality of auxiliary flues in communication with said heating chamber, ports in the longitudinal wall of said drum in communication with said auxiliary flues, respectively, said flue sections including walls extending generally radially of said drum to form lifters for the material to be treated, a hood surrounding said drum and in registry with said ports, a heating flue extending into the open end of said drying chamber and opening into said heating chamber, a second hood opposite the open end of and in communication with said drying chamber, and surrounding said heating flue, conduits extending across said heating

chamber and supported by said heads adapted to lead air to said drying chamber, said drum having openings in its longitudinal wall adjacent said heating chamber for discharge of dried material, and a third hood surrounding said drum in registry with said discharge openings.

23. In an apparatus of the character described, in combination, a drum, flues for conducting a heating medium from said drum out of contact with the material to be dried, means for introducing air to the interior of said drum outside said flues, means for heating such air as it is introduced into the drum and separate discharge means for the heating medium and for the air.

24. In an apparatus of the character described, in combination, a drum having one or more material discharge openings, means for admitting air to the interior of said drum, including ports adjacent and separate from said discharge openings and means for heating such air on its admission into said drum.

25. In an apparatus of the character described, in combination, a rotatable drum having one or more material discharge openings, a stationary bearing therefor, a sealing ring connecting said drum and said bearing, flues for conducting a heating medium through said drum out of contact with the material to be dried, bucket means including said flues adapted to elevate the material within said drum, means for admitting air into the interior of said drum including inlet ports in the drum wall separate from said material discharge openings, discharge means for heating medium and separate discharge means for the air.

26. A source of heat, a rotatable drum having a central longitudinal flue in communication with said source of heat, and having a plurality of return flues communicating with said central flue at the rear end of said drum, a stationary discharge hood adjacent the front end of said drum communicating with said return flues, means for admitting air to the interior of said drum around said central flue and a second stationary discharge hood adjacent the front end of said drum adapted to communicate with the interior thereof.

27. A source of heat, a rotatable drum having a central longitudinal flue in communication with said source of heat, and having a plurality of return flues communicating with said central flue at the rear end of said drum, a stationary discharge hood adjacent the front end of said drum communicating with said return flues, means for admitting air to the interior of said drum around said central flue, a second stationary discharge hood adjacent the front end of said drum adapted to communicate with the

interior thereof and suction means connect-
ed to said hoods adapted to create drafts
through said flues and through said drum.

28. A source of heat, a rotatable drum
5 having a central longitudinal flue communi-
cating with said source of heat and having
a plurality of return flues communicating
with said central flue at the rear end of said
10 drum, said return flues terminating in ports
in the wall of said drum adjacent the front
end thereof, a stationary annular hood sur-
rounding said drum over said apertures, a
stationary drum-closing hood surrounding
15 said central flue and adapted to communi-
cate with the interior of said drum and suc-
tion means for creating drafts through said
hoods.

29. A source of heat, a rotatable drum
having a central longitudinal flue communi-
20 cating with said source of heat and having
a plurality of return flues communicating
with said central flue at the rear end of said
drum, said return flues terminating in aper-
25 tures in the wall of said drum adjacent the
front end thereof, a stationary annular hood
surrounding said drum over said apertures, a
second stationary annular hood surrounding
said central flue and adapted to communi-
30 cate with the interior of said drum, means
for delivering material to be dried into said
drum, means for discharging the dried ma-
terial from the rear end of said drum in-
cluding apertures in the wall of said drum
35 and a third annular hood surrounding said
drum over said discharge apertures adapted
to receive the dried material.

30. A substantially horizontally disposed
rotatable drum, a central longitudinal flue
adapted to convey a heating medium
40 through said drum, a plurality of return
flues communicating with said central flue
at the rear end thereof, means for deliver-
ing material to be dried into said drum at
the front end thereof, a plurality of inclined
45 flights fixed to the inner surface of said
drum adjacent the entrance thereto, a plu-
rality of longitudinal fins fixed along said
central flue; said flights, said fins and said
return flues being adapted to elevate the ma-
50 terial as said drum is rotated, thereby to as-
sist the progress of the material through
said drum, and means for discharging the
dried material from the rear end of said
drum.

31. In an apparatus of the character de- 55
scribed, in combination, a drum having a
passageway for a heating medium, means
adapted to establish a draft through the in-
terior of said drum including tubes com-
60 municating with the interior and exterior of
said drum and passing through said pas-
sageway, and sealing rings connecting said
drum and said tubes and adapted to permit
relative expansion and contraction thereof.

In testimony whereof we affix our signa- 65
tures in the presence of two witnesses.

FRANCIS E. FINCH.
WALTER H. GLOMB.

Witnesses:

J. W. ANDERSON,
M. A. CASHIN.