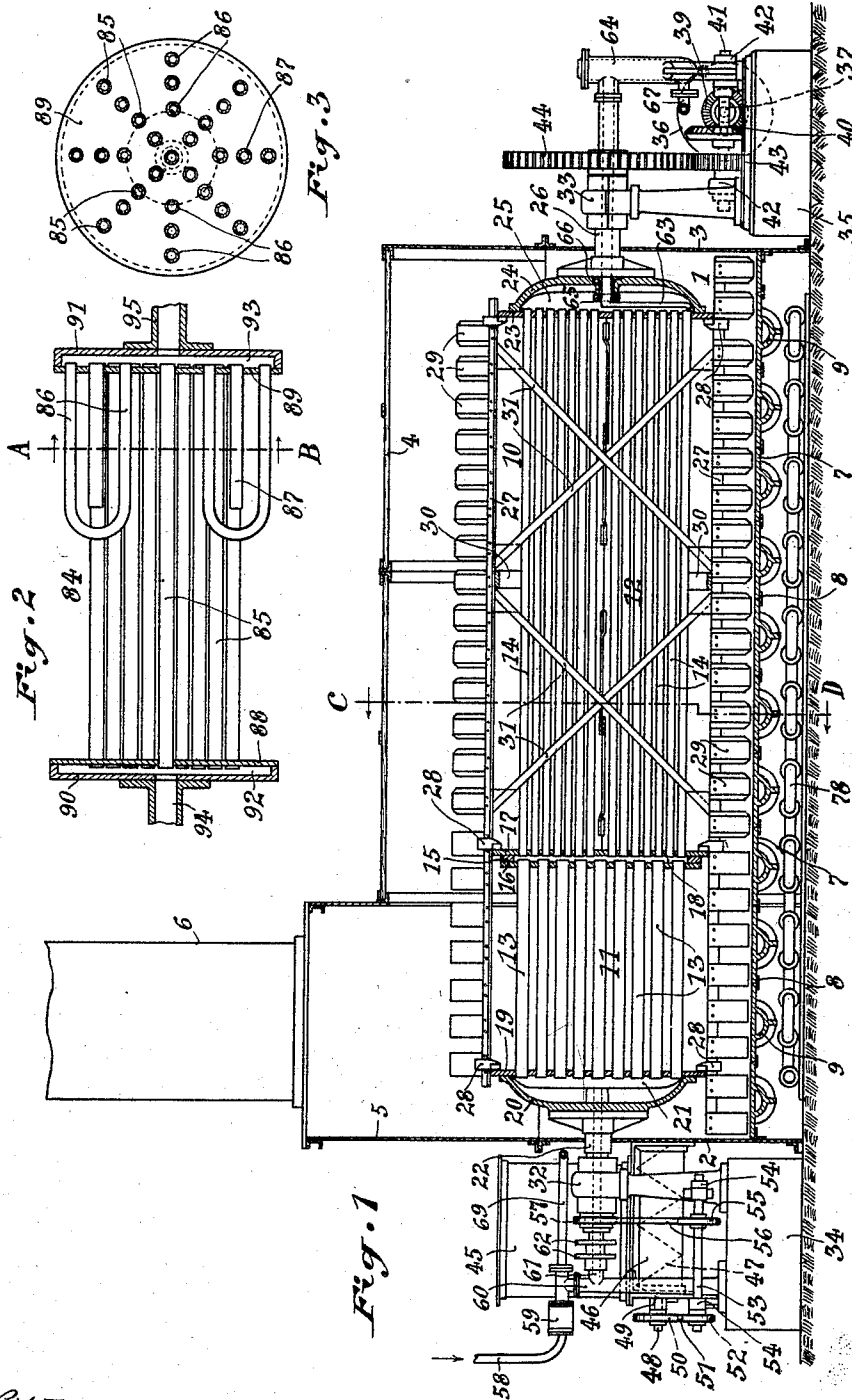


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TROUGH DRIER FOR DRYING BREWERY WASTES AND THE LIKE.
APPLICATION FILED NOV. 3, 1910.

1,006,266.

Patented Oct. 17, 1911.

2 SHEETS—SHEET 1.



Witnesses:
Katherine Koch
Daniel Holmgren.

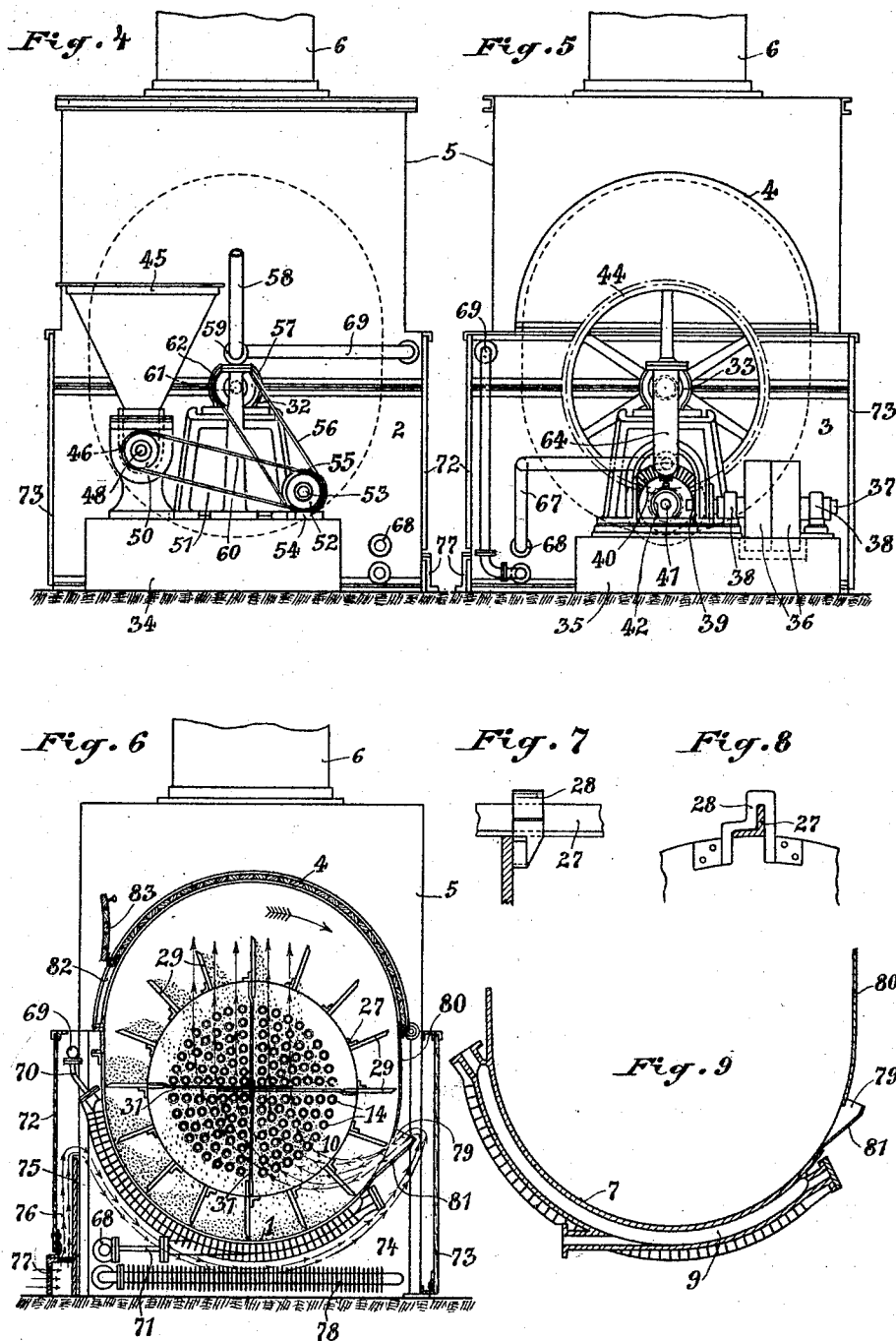
Inventor:
Friedrich Ernst Otto
by his attorneys
Greene & Juniper
per [Signature]

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UNITED STATES PATENT OFFICE.

FRIEDRICH ERNST OTTO, OF MEERANE, GERMANY, ASSIGNOR TO THE FIRM OF PHÖNIX-WERK G. M. B. H., OF MEERANE, GERMANY.

TROUGH-DRIER FOR DRYING BREWERY-WASTES AND THE LIKE.

1,006,266.

Specification of Letters Patent.

Patented Oct. 17, 1911.

Application filed November 3, 1910. Serial No. 590,443.

To all whom it may concern:

Be it known that I, FRIEDRICH ERNST OTTO, a subject of the King of Saxony, residing at Meerane, in the Kingdom of Saxony, Empire of Germany, manufacturer, have invented certain new and useful Improvements in Trough-Driers for Drying Brewery-Wastes and the Like; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My present invention relates to devices for making wet and resinous brewery-wastes adapted for cattle-food, and particularly to that class thereof known as trough-driers.

To produce from brewery-wastes (such as dregs, chilling sediments, yeast) and the like, a nutritious and easily digestible food for cattle, it is not only necessary to remove the high percentage of water leading to the formation of lumps, but also to withdraw the hop-resin introduced by the hops employed in the manufacture of beer. The devices hitherto employed for drying such wastes could not fulfil these conditions rationally on account of the drying-drums employed, whose tubes were spaced equally wide apart from each other throughout the whole length of the drum, thus taking no account of the fact that the wastes are far bulkier in their wet state than when partially or wholly dried, and besides this they were not provided with means for judiciously applying external heat to that part of the trough where the material naturally collects during the drying-process. The results obtained by means of such drying-devices were for these reasons most unsatisfactory since the drying of the material was not only incompletely but also very uneconomically executed. This unsatisfactory state of things was principally caused by the fact, that the material in its wet and bulky state could not pass quickly enough through the narrow spaces left between the tubes of the drying-drum to prevent it from getting sometimes partially overheated, whereas it passed these spaces too quickly to be effectively operated upon when in a more or less dried state. As other reasons for the failures of the older drying-devices may be pointed out the unsuitable application of external heat to the trough, the inadequate ventilation of the in-

terior of the drying-device, the unsatisfactory removal of the water of condensation, and so forth.

The object of my present invention is to provide a trough-drier, by means of which not only all these drawbacks will be avoided, but also new advantages gained.

To carry my invention into practical effect I employ a drying-drum mainly consisting of two divisions or chambers, in one of which the tubes are arranged wide enough apart from each other to let the wet and bulky material pass easily between and over said tubes without sticking, whereas in the other division or chamber the tubes are spaced closer to provide an exceptionally large heating-surface for the partially dried material, the drying of which is further energetically promoted by heating-bodies placed upon the outside of the trough opposite the zone where the material naturally collects during the drying-process. The heat radiated by said heating-bodies in a direction away from the trough I utilize for heating a current of air to be passed through the drying-drum in an upward direction to meet the drying-material falling downward between the tubes of said drum in order to substantially accelerate the drying-process. To obtain the best results possible I further build the trough up of segments of which each is shaped to simultaneously act as a heating body. Furthermore I construct the drying-drum in such a manner that the shovel-carriers are made selfsustaining and thus prevent the shovels from coming into contact with the bottom of the trough, by means of which not only the life of the drier is lengthened but also much power is saved.

Other advantages gained by my invention will be more particularly pointed out in the specification.

In this manner a trough-drier is provided wherein the material to be dried finds everywhere a passage between the tubes of the drying-drum most suitably adapted to the bulk it has at the time being, and wherein the material is not only heated at the most suitable point at the proper moment but also most thoroughly aired, so that brewery wastes and the like can be quickly and economically transformed into usable cattle-food.

In the accompanying drawings:—Figure 1 is a vertical longitudinal sectional view of

my trough-drier. Fig. 2 is a longitudinal sectional view of a modification of the drying-drum. Fig. 3 is a cross-sectional view taken on line A—B of Fig. 2. Fig. 4 is a front-elevation and Fig. 5 is a rear-elevation of said trough-drier. Fig. 6 is a cross-sectional view taken on line C—D of Fig. 1, indicating the mode of operation of my new trough-drier. Figs. 7 and 8 are detail-views of the connection between the shovel-carriers and the drying-drum. Fig. 9 is a longitudinal sectional view of a trough-segment and the lateral air-inlet.

The trough 1 is closed at its ends by the walls 2 and 3 and is partly closed by the arched cover 4 and partly by the angular chamber 5 which carries the chimney 6. All parts are preferably detachably put together in any suitable manner and yet form a tight and rigid structure. The trough is built up of segments 7 which are connected with each other by means of the cover-plates 8. Each segment is shown in Fig. 1 as being provided with a ribbed heating-body 9 which preferably forms an integral part of the segment carrying it.

Within the trough 1 is arranged the drying-drum 10 broadly consisting of the divisions or chambers 11 and 12, of which the first is intended to reduce the wet bulky wastes to a comparatively small volume, whereas the second chamber is destined to produce the finished dry product. The chamber 11 might therefore be called the fore-drying-chamber and the chamber 12 the finish-drying-chamber. According to the different purposes of these chambers their construction differs fundamentally from each other, inasmuch as the tubes 13 of chamber 11 are large in diameter and spaced far apart in order to leave wide passages between them for the wet and bulky wastes, whereas the tubes 14 of the chamber 12 are of a smaller diameter and spaced closer together than the tubes 13 to let the partially dried wastes pass between them without sticking and yet compel them to come into intimate contact with the surface of the tubes 14, which on account of their great number form an exceptionally large and effective heating-surface. Both chambers are united by means of the ring 15 placed between the head-plate 16 of the chamber 11 and the head-plate 17 of the chamber 12 thus forming a distributing-chamber 18, which gives the heating-medium coming through the tubes 13 a chance for uniformly entering the tubes 14 of the chamber 12. To the head-plate 19 of the chamber 11 is secured the hood 20 which forms an admission-chamber 21 and carries the tubular journal 22, through which the heating-medium enters the admission chamber. In a similar manner the head-plate 23 carries a hood 24 which forms a collecting-chamber

25 and carries the tubular journal 26. To the circumference of the head-plates 16, 17, 19 and 23 of the drying-drum 10 are secured the shovel-carriers 27 by means of the clamps 28 in the manner shown on a larger scale in Figs. 7 and 8. These carriers are spaced equidistant from each other and serve for the attachment of the shovels 29. To prevent the shovels from bearing upon the bottom of the trough 1 while at work the carriers are made self-sustaining. This I most effectively accomplish by connecting them first to one or more rings 30 arranged intermediate the ends of the tubes 14 and then brace the carriers by diagonally arranged braces 31. The latter are arranged in pairs and these are again placed at right angles to each other, as indicated in Figs. 1 and 6.

The drying-drum 10 is by means of its journals 22 and 26 revolvably supported in the bearings 32 and 33, of which the former is carried by the elevated foundation 34 and the latter by a similar foundation 35. Motion is imparted to the drum by means of the belt-pulleys 36 seated on the shaft 37, which is journaled in the bearings 38 and carries the bevel-wheel 39 meshing with the bevel-wheel 40. The latter is secured to the shaft 41 journaled in the bearings 42 and carrying the pinion 43 which meshes with the spur-wheel 44 seated upon the tubular journal 26, see Figs. 1 and 5.

The brewery-wastes or the like to be dried are thrown into the hopper 45 whence they drop into the trough-shaped casing 46 of the feed-screw 47. The latter is provided with a stub-shaft 48 which is journaled in the bearing 49 secured to the head of the casing 46. The stub-shaft 48 is provided with a pulley 50 connected by means of a belt, chain, or rope 51 to a similar pulley 52 seated upon the shaft 53. The latter is journaled in the bearings 54 and receives its motion from the journal 22 of the drying-drum by means of the pulley 55, the belt, chain, or rope 56 and the pulley 57 seated upon said journal 22. Any wastes or the like thrown into the hopper will thus be gradually forced by the feed-screw into the trough 1 and then taken hold of by the shovels 29 which by means of their peculiar arrangement upon the drying drum will gradually carry them toward the end-wall 3, whereby the wastes will be alternately taken upward by the shovels 29 and thrown off again in the manner indicated in Fig. 6. This constant raising and dropping of the wastes brings the latter repeatedly into contact with the heated tubes of the drying-drum, whereby not only the liquid portion of the wastes will be evaporated but also the hop-resin of the latter driven off in form of gases, so that the otherwise useless wastes will be transformed into nutritious

and easily digestible cattle-food. The heating medium necessary for this transformation, usually steam, passes by way of the pipe 58 into the steam-trap 59, thence into the T-shaped head of the standard 60 into the latter which it leaves by way of the branch-pipe 61 to pass through the stuffing-box 62 into the tubular journal 22. By the latter the heating-medium is led into the admission-chamber 21 to pass in succession through the tubes 13, the distributing-chamber 18 and the tubes 14 to enter the collecting-chamber 25. That part of the heating-medium which reaches this chamber will pass out by way of the angular stationary outlet-pipe 63, one leg of which passes through the tubular journal 26 and is connected with the condensing-pot 64, whereas the other leg reaches downward into the pit of the collecting-chamber 25 and below the lowest point of the tube or tubes 14 which at the time being may be nearest to the bottom of the trough 1. To suspend the stationary pipe 63 concentrically in the journal 26 a ball-bearing 65 is provided and secured to the face of the inner end of the hub of the hood 24 which so to say forms a continuation of the journal 26. The friction of the pipe 63 is thus reduced to a minimum. To prevent any part of the heating-medium from passing out between the pipe 63 and the hub of the hood 24 a packing 66 is provided, as shown in Fig. 1. Besides these advantages the arrangement of the stationary pipe 63 makes it possible, that any water of condensation which may collect in the pit of the hood 24 during the time the trough-drier is out of use will be blown out through the pipe 63 as soon as a fresh supply of the heating-medium is passed through the tubes of the drying-drum. Any part of the drying-medium and the water of condensation which reaches the condensing-pot 64 will be led on by the pipe 67 to the drain-pipe 68 which runs parallel with the trough 1 and passes out through the wall 2, whence it may be led to any suitable point.

To obtain the very best drying results it is not sufficient to throw the material to be dried repeatedly upon the tubes of the drying-drum and let it drop down between them, because the effect would be that the material on coming into contact with the inside of the trough 1 would stick to it and this all the more forcibly, the wetter the material is. Besides cooling the material off each time it comes into contact with the trough a considerable force would have to be exercised by the shovels to remove it from the inner surface of the trough, for which reasons the drying-process would be retarded and an exceptionally high driving-force necessitated. To avoid this the heating-bodies 9 of the segments 7

are provided and arranged exactly where the material comes into contact with the trough 1 on leaving the drying-drum and while being raised by the shovels 29, see Fig. 6. These heating-bodies receive the heating-medium by way of the feed-pipe 69 which is connected with the T-shaped head of the standard 60 and runs parallel with the trough 1 to pass out through the wall 3 whence it may be led to any suitable point. Each of the heating-bodies 9 is on the one hand connected to the feed-pipe 69 by means of a thin yielding pipe 70 and on the other hand by a similar pipe 71 to the drain-pipe 68, see Fig. 6. These separate connections between the pipes 68 and 69 with each heating-body 9 assure not only a certain degree of free motion of the heating-bodies in regard to said pipes, but also simplify the exchange of a faulty segment or heating-body considerably and besides this any water of condensation which may collect in any of the heating-bodies can immediately escape, so that it can neither collect in said heating-bodies nor obstruct the entrance of the heating-medium or absorb any part of its heating-power. To still further increase the drying-capacity of my trough-drier I employ a current of heated air to aid the drying-process in the following manner:—At both sides of the trough 1 the removable side-walls 72 and 73 are erected to form a compartment 74 of U-shaped cross-section. Within this compartment an auxiliary-wall 75 is provided near the wall 72 to form a channel 76, the lower end of which communicates with the atmosphere by means of the perforated or slotted tubular casing 77. The air drawn upward through the channel 76, which by the way extends over the whole length of the trough 1, passes over and between the heating-bodies 9 beneath the bottom of the trough 1 toward the wall 73, whereby it is heated not alone by the heat radiating from the heating-bodies 9, but also by the ribbed heating-coil 78 which is preferably connected with the feed-pipe 69 as indicated in Fig. 5. The air thus heated moves toward the wall 73 and then enters the trough 1 through the lateral air-inlet 79 whereby it takes a downward course partly on account of its initial downward direction and partly on account of the draft created by the motion of the shovels in the direction indicated by the feathered arrow in Fig. 6. This downward direction of the current of air is, however, soon reversed to let it pass upward through the spaces left between the tubes of the drying-drum in form of many thin streamlets, as clearly illustrated in Fig. 6. Since the material to be dried passes between said tubes in the opposite direction, it follows that the air and the particles of said material must come into an intimate

contact with each other so that the drying effect of the heated air is the most intensive imaginable. After the air has reached the space above the drying-drum it is drawn by the draft of the chimney 6 upward and with it any vapors formed during the drying-process. The current of air indicated in Fig. 6 by a series of arrows is considerably influenced by the shape of the lateral air-inlet, which is formed by the lower edge of the partition-wall 80 and the upwardly edge projecting extension 81 of the segments 7 in such a manner as to prevent any of the material to be dried from leaving the trough during the drying-process. Said extension may consist of a single piece and be attached in any suitable manner to the walls 2 and 3 as well as to the partition-wall 80 and to the segments 7. It is evident that the partition-wall and the extension might also be built up of parts corresponding in number with the segments 7 employed and therefore be cast integrally with the latter.

The operation of my new trough-drier is as follows:—The heating-medium is first admitted to the drying-drum 10 to heat the tubes of the latter and to drive out any water of condensation which may have collected in the pit of the hood 24 during the time the drier was out of use. Simultaneously herewith the heating-medium is admitted to the heating-bodies 9 and to the heating-coil 78, whereupon the drying-drum is set in rotation. The material to be dried, such as brewery-wastes and the like, is then thrown into the hopper 45 to be pushed by the feed-screw 47 into the trough 1 where it is immediately taken hold of by the shovels 29 to be alternately raised and thrown down again. As hereby every particle of the material is gradually brought into intimate contact not only with the heated tubes of the drying-drum 10 but also with the externally heated collecting-zone of the material on the inside of the trough 1 and besides this with a highly heated current of air, the drying-process is accomplished both thoroughly and quickly. Simultaneously herewith the hop-resin is gasified and completely removed by the effective ventilation of the drier. To remove the finished product the drying-drum is either rotated very slowly or fully brought to a standstill so that the finished product can be removed through the opening 82 provided in the cover 4. The opening 82 is during the drying-process closed by the hinged door 83, see Fig. 6.

For smaller trough-driers and certain materials the simple drying-drum 84 illustrated in Figs. 2 and 3 can be advantageously employed and is in such cases arranged within the trough in such a manner that the left-hand ends of the tubes 85 receive the wet material where the arrangement of the tubes offers the most space for

its reception, whereas the right-hand end of the drying-drum is intended for the finish-drying of the material, to which end it is provided with a series of U-shaped tubes 86 as well as with tubes 87 closed at their free end and arranged between the legs of the U-shaped tubes, by which arrangement an exceptionally large heating-surface is provided. The tubes of this modification of the drying-drum are seated in the head-plates 88 and 89, with which the flanged covers 90 and 91, corresponding in every way with the hoods 20 and 24 of the drying-drum 10, are connected to form the admission-chamber 92 and the collecting-chamber 93. To the covers 90 and 91 the tubular journals 94 and 95 are secured. It will be seen that this modification corresponds with the drying-drum 10 not only in this respect that it consists of two different divisions and shows the other peculiarities of construction of it in a modified form, but also therein that in its action it corresponds therewith, inasmuch as the material is reduced in bulk in the division which affords the greatest free space to the material, and is finished in the division which possesses the greatest heating-surface. To the head-plates 88 and 89 shovel-carriers of the kind shown in Figs. 1 and 6 may be secured by means of clamps in the manner indicated in Figs. 7 and 8, which carriers and their connection with the drying-drum have been for simplicity's sake omitted in Figs. 2 and 3.

I claim:—

1. A trough-drier for drying brewery-wastes and the like, comprising a trough, a rotary drying-drum arranged within said trough, external heating-means for heating the collecting-zone of the material to be dried from outside, and means for leading a current of air over said external heating-means and introducing it in its heated state laterally into said trough.

2. A trough-drier for drying brewery-wastes and the like, comprising a trough having a lateral air inlet, a drying drum composed of a series of tubes and revolvably arranged within said trough, means for rotating said drying-drum, heating-means arranged upon the outside of said trough opposite the collecting-zone of the material to be dried in said trough, means for passing a current of air over said external heating means and introducing it through the lateral air-inlet of said trough into the latter, and means for admitting the heating-medium to said drying-drum and to said external heating-means.

3. A trough-drier for drying brewery-wastes and the like, comprising a covered trough having a lateral air inlet, a drying-drum composed of tubes arranged to form a fore-drying-division and a finish-drying-division communicating with each other,

means for rotating said drying-drum, external heating-means adapted to impart heat to the material to be dried while being moved over its collecting-zone, a compartment encompassing the lower part of said trough and said external heating-means and adapted to admit air to said external heating-means and to conduct it in its heated state to the lateral air-inlet of said trough, and means for admitting the heating-medium simultaneously to said drying-drum and to said external heating-means.

4. In a trough-drier of the character described, the combination with the trough, of a drying-drum arranged within said trough and consisting of a foredrying-division, a finishdrying-division communicating with said foredrying-division, an admission-chamber carrying one tubular-journal of said drying-drum, a collecting-chamber carrying the other tubular journal of said drying-drum, carriers spaced apart from the tubes of said foredrying-division and said finish-drying-division and shovels secured to said carriers and arranged upon the circumference of said drying drum.

5. In a trough-drier of the character described, the combination with the trough, of a drying-drum arranged within said trough and consisting of a foredrying-division composed of a few wide-spaced tubes of a large diameter to form wide passages between them, a finishdrying-division communicating with said foredrying-division and composed of many narrow-spaced tubes of a small diameter to form a large heating-surface, an admission-chamber admitting the heating-medium to said foredrying-division and carrying one tubular journal of said drying-drum, a collecting-chamber carrying the other tubular journal of said drying drum, an angular stationary outlet-pipe sustained by a ball-bearing within said collecting-chamber and reaching with one of its legs below the lowermost tube of the finish-drying-division while its other leg is connected with a condensing-pot, shovels mounted on carriers connected with both

divisions of said drying-drum, and means for making said shovel-carriers selfsustaining.

6. In a trough-drier of the character described, a trough consisting of segments, each provided opposite the collecting-zone of the material to be dried with a ribbed heating-body connected for the reception of the heating-medium by a yielding pipe to a common feed-pipe and by a second yielding pipe to a common drain-pipe for the removal of the condensing-water; and provided with a lateral air-inlet having its throat directed inward and downward to prevent the material to be dried from leaving the trough during the drying-process.

7. In a trough-drier of the character described, the combination with the trough having ribbed heating bodies, of a compartment encompassing the lower part of said trough and said ribbed heating-bodies, and a ribbed heating-coil arranged in said compartment below and in juxtaposition of said heating-bodies to aid in heating a current of air passed over said heating-bodies and subsequently introduced into said trough.

8. In a trough-drier of the character described, the combination with the trough and the drying-drum revolubly arranged therein and having a tubular journal, of a hopper for the reception of the material to be dried, an open ended trough-shaped feed-screw casing communicating with said hopper and with the interior of said trough, a feed-screw arranged within said casing for pushing the material into said trough, means for rotating said feed-screw, means for leading the heating-medium to the tubular journal, and means for forming a fluid-tight connection between said tubular journal and said means for admitting the heating-medium.

Signed by me at Chemnitz, Germany, this 21st day of October 1910.

FRIEDRICH ERNST OTTO.

Witnesses:

WM. WASHINGTON BONN SWECK,
WILLIAM J. KONJETSEY.