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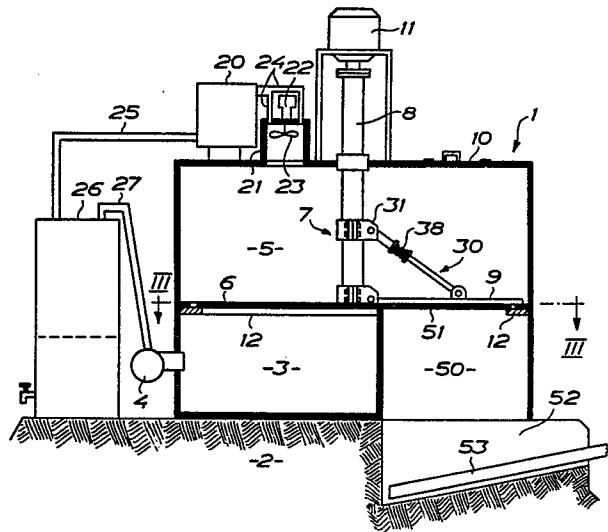
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54 **Apparatus for drying manure and similar residual products.**

57 Apparatus for drying manure or similar residual products, which apparatus includes a drying chamber (5) and a heating chamber (3) therebelow, an agitator (7) having an agitator arm for being in contact with the bottom wall (6) of the drying chamber. For purpose of assuring the application of the agitator arm (9) against the bottom wall (6) a bias means (30) is provided and/or the bottom wall (6) is supported freely at its peripheral portion.

A condensation device (20) is provided for the condensation of vapours obtained in the drying process. An expel fan (22, 23) expels said vapours to the condensation device from which condensation water and residual gas are supplied to a collecting vessel (26). From said collecting vessel (26) a conduit (27) extends to the heat chamber, the heating device of which is a burner (4) for fossile combustibles. Said residual gas is combusted in the heating chamber.



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APPARATUS FOR DRYING MANURE AND SIMILAR RESIDUAL PRODUCTS

The present invention relates to an apparatus for drying manure and similar residual products which apparatus includes a heating chamber with an associated heating device for the heating of manure in a drying chamber placed thereover and separated from the heating chamber by its bottom wall, and an agitator disposed in the drying chamber and having at least one agitator arm.

In drying apparatus of this kind which are used for the drying of e.g. manure from poultry, as fowls, for reducing the smell of the manure and for making the manure easier to handle, the arm of the agitator is to move in contact with the upper surface of the bottom wall of the drying chamber for preventing manure to be baked to the bottom wall.

When operating the drying apparatus the bottom wall will be heated and expands. Since the bottom wall is fixed to the side walls of the drying apparatus, the bottom wall be buckled and so the agitator which is relatively rigid cannot, when being moved, be applied against the entire surface of the bottom wall. Thus, in the prior art drying apparatus manure will be baked to some portions of the bottom wall and so heat transfer from the heat chamber therebelow to the drying chamber will be reduced. The baked manure will press the agitator arm upwards, and after a short while a cake of baked manure is formed over the entire bottom of the drying chamber.

Since baked manure in one phase of the drying process has a very sticky nature the agitator arm will be subjected to high stress which can result in undue deformations and rupture of the agitator arm at its fixing point to the agitator arm.

Another problem in prior art drying apparatuses is the vapours which during the heat treatment evaporate from the manure. These vapours are brought to a condensation device where the major part is condensed and the residual part is delivered to the ambient atmosphere. Although
5 the amount is small, the residual vapour part delivered to the ambient atmosphere will cause an embarrassing smell in the vicinity and in the surroundings of the drying apparatus. In prior art drying apparatus said vapours also escape from the drying chamber through bushings for the agitator shaft and through the supply opening, thereby aggravating
10 the problem of the smell.

The purpose of the invention is to obtain a drying apparatus of that kind mentioned by way of introduction, which apparatus eliminates the above mentioned drawbacks.

Thus, the drying apparatus according to the invention eliminates
15 almost entirely the problem of the smell. Moreover, in the operation of the drying apparatus a satisfactory contact is obtained for the agitator arm against the bottom wall of the drying chamber.

Said purpose is achieved by means of an apparatus for drying manure and like residual products in which apparatus the agitator arm
20 is biased against said bottom wall to provide for contact against said bottom wall during the operation of the drying apparatus and/or that said bottom wall is supported freely at its peripheral portion for eliminating buckling of the bottom wall when subjected to heat during the operation of the drying apparatus. For eliminating the problem of smell
25 the apparatus has a condensation device connected to the drying chamber for receiving and condensating vapours evaporated from the manure in the drying process, a collecting vessel connected to the outlet of the condensation device, as well as an expel fan for expelling said vapours to the condensation device. The heating device is a burner for fossile com-
30 bustibles and rest gas obtained from the condensation device is supplied to the heating chamber for combustion therein.

The invention is described in detail below with reference to the accompanying drawings.

Fig. 1 is a fragmentary section view through an apparatus accord-
35 ing to the invention for drying manure, taken along lines I-I in Fig. 3.

Fig. 2 is a top view of the agitator arm of the drying apparatus.

Fig. 3 is a cross section view of the drying apparatus in Fig. 1, taken along lines III-III in Fig. 1.

In the following description the drying apparatus according to the invention by way of non-limiting example is used for drying fowl manure. However, the drying apparatus can be used for all kinds of similar residual products, including digested sludge from sewage treatment plants.

Fig. 1 shows a prior art apparatus for drying manure, which apparatus is provided with means according to the invention. The drying apparatus, referenced 1, is made of steel and stands on a foundation 2. The drying apparatus has bottom heat chamber 3 which communicates with a heating device 4, e.g. an oil burner. Above the heat chamber a drying chamber 5 is provided separated from the heat chamber by means of its bottom wall 6 having a plain upper surface. An agitator 7 is provided with a shaft 8 centrally located in drying chamber 5 which has a preferred circular cross section shape. Agitator 7 at the lower portion of shaft 8, which is located adjacent to the bottom wall 6, has a rigid agitator arm 9 attached thereto which arm along its extension contacts the upper surface of the bottom wall 6. A motor 11 connected to shaft 8 is supported on a frame on the top of the apparatus. The motor is arranged for rotating shaft 8 and the agitator arm 9 which will stir up manure from the bottom wall and prevent manure from baking to said surface. Manure to be dried is supplied to the drying chamber through a supply opening closed by means of a door 10. Shaft 8 has a not shown guide on the bottom wall 6.

A condensation device 20 for treatment of vapours, including certain gases, evaporated from the manure under the drying process is shown on the apparatus top portion for reducing the problems of bad smell which usually exists in drying manure.

In prior art drying apparatus the horizontal bottom wall 6 is fixedly connected to the side walls of the drying apparatus. In operating the drying apparatus bottom wall 6 will expand in radial direction, thereby being buckled, showing elevated and lowered portions. Owing to this agitator arm 9, when being rotated, will not be able to contact the entire surface of the bottom wall, and the lower portions of the bottom wall will not be reached by the agitator arm.

For the discharge of dried manure from the drying chamber a discharge box 50 is provided. The discharge box is separated from the heat chamber by means of vertical walls and has a door 51 in bottom wall 6 to be maneuvered from outside the drying apparatus. A prior art dis-

charge box (not shown) has a horizontal bottom at the level of the heat chamber bottom and an opening in the side wall of the drying apparatus, from which opening dried manure can be discharged on a conveyor.

Moreover, the drying apparatus has a not shown discharge device
5 for combustion gases and may be provided with a not shown circulation means for combustion gases for obtaining a uniform temperature in the heat chamber.

According to the invention two features are proposed which can be used separately or together for eliminating the problem of manure
10 being baked to the bottom wall of the drying chamber.

In accordance with one of these features bottom wall 6 at its peripheral portion is supported freely at the side walls of the drying apparatus, said support consisting of continuous or divided flange means, preferably a continuous rim 12, protruding from the side walls. The bot-
15 tom wall 6 has a diameter which is slightly less than the diameter of the drying chamber at its bottom when the heat chamber is heated to its operating temperature which is approximately 200°C. Thus, when the drying apparatus is not in operation, viz. is not heated, there is a clearance or spacing between the peripheral circumferential edge of the bottom
20 wall and the side wall of the drying chamber, which clearance permits the bottom wall to expand freely, when subjected to heat. This expansion in radial direction is not prevented by the side walls of the drying apparatus and so the bottom wall will not be subjected to any buckling. Thus, agitator arm 9 will contact the upper surface of the bottom wall when
25 shaft 8 is rotated. For purpose of reinforcement radial ribs 14 are provided on the bottom side of bottom wall 6, said ribs comprising flat iron bars, each being spot welded at one of their narrow sides to the bottom wall. Ribs 14 are uniformly spaced around the bottom wall. In Fig. 3 three ribs 14 are shown in dashed lines.

30 For securing the positioning of bottom wall 6 such that the door 51 made therein to the discharge box 50 will be in correct position over the discharge box short radial notches 13 are made in the bottom wall around its circumference. The notches 13 cooperate with vertical shoulders 14 on the upper side of the rim 12. Said shoulders preferably have the
35 same height as the thickness of the bottom wall in order not to be of hindrance to the rotating agitator arm.

According to another feature of the apparatus according to the invention a pressure arm 30 is disposed between shaft 8 and the agitator

arm 9. Spaced from the lower portion of shaft 8 there is around the shaft clamped a collar 31 having two projecting parallel ears 32 between which an axle bar 33 is mounted. Two opposing ears 34 having an intermediate axle bar 35 are disposed on the upper side of the
5 agitator arm 9. The pressure arm 30 which in a preferred embodiment of the agitator assembly includes two sections 36, 37 and an intermediary biasing means 38 is fixed at its ends to said axle bars by means of bushings. Thus, pressure arm 30 is pivotably supported at its both ends.

10 Section 36 of the pressure arm connected to shaft 8 has a first pipe with a flange 39 at its free end. Section 37 of the pressure arm connected to the agitator arm 9 has a second pipe with a small diameter, which pipe is movably supported in said first pipe. Spaced from
15 said first pipe a stop 40 is fixed to the second pipe. The biasing means 38 is placed between stop 40 and flange 39 on the first pipe and has the shape of a pressure spring for urging agitator arm 9 against bottom wall 6.

Thus, pressure arm 30 urges the agitator arm 9, which at its point of attachment to shaft 8 is rotatably supported around a shaft 42,
20 against the bottom wall. Agitator arm 9 is made of a resistant rigid material to be substantially plane in operation.

Agitator arm 9 has two sections, viz. one radial section 43 connected to shaft 8 and an outer section 44 positioned in the same plane but somewhat angles in the direction of rotation (referenced with arrow
25 45). Owing to this a pocket 46 is formed towards which manure scraped from the bottom is gathered when agitator arm 9 is rotated in the drying chamber. Pocket 46 has a radial position over door 51 so that dried manure for the purpose of discharging is scraped down into the discharge box 50 when door 51 is open. Moreover agitator arm 9 along its forward
30 portion seen in the direction of rotation may have a longitudinal section 47 of particularly resistant material.

In the drying apparatus according to the invention, in contrary to prior art drying apparatus the discharge 50 extends below the bottom of heat chamber 3, there having a collecting pocket 52 the volume of
35 which permits reception of the entire badge of manure which in one operation cycle is dried in the drying chamber. Discharge box 50 occupies a section of heat chamber 3 separated therefrom by means of walls and has a transmission part to the collecting pocket 52. The latter has an

outwardly and upwardly sloping bottom and a conveyor 53, preferably a screw conveyor, is provided for conveying the dried manure material from the collecting pocket. Owing to this the drying apparatus can be operated substantially continuous such that the uneconomical starting phase for heating the drying apparatus to its operating temperature is eliminated.

For eliminating the problem of smell around the drying apparatus an expel fan 32 is provided to positively expel to the condensation device 20 the vapours obtained in the drying of manure. Owing to this a negative pressure or a vacuum is created in the drying chamber and so there will be no leakage of vapours to the ambient atmosphere.

In the embodiment illustrated in Fig. 1 a dome 21 is provided in the roof of the drying chamber for collecting the vapours obtained in the drying process. At least one, and preferably two discharge conduits 24 connects dome 21 to the condensation device 20 which is a conventional heat exchange assembly for cooling the vapours conveyed there-to for condensation. The empeller 23 of fan 22 is positioned in dome 21 and arranged to expel said vapours to the condensation device 20. The empeller 23 and the shaft of the empeller is made of a material, which is highly resistant to said vapours. A conduit 25 connects the output of the condensation device to a collecting vessel 26 for condensation water and residual gas. From the upper portion of collecting vessel 26 a conduit 27 extends to heat chamber 3 for the transfer of the residual gas thereto.

Conduit 27 opens to heat chamber 3 adjacent to heating device 4 which is a burner for fossile combustibles. In the embodiment illustrated in Fig. 1 the burner is a gas or oil burner 4. In this embodiment conduit 27 opens adjacent to the air inlet of the burner 4 and so the residual gas obtained in the condensation is fed through the air inlet into the heat chamber, there being subjected to combustion together with fresh air and the combustible of the burner.

Collecting vessel 26 has a large volume for serving as a buffer storage for residual gas when the burner is off.

C L A I M S

1. Apparatus for drying manure and similar residual products, which apparatus includes a heat chamber (3) having an associated heat device (4) for heating manure in a drying chamber (5) disposed there-
over and separated from the heating chamber by its bottom wall (6),
5 and an agitator (7) disposed in the drying chamber and having at least one agitator arm (9) to be moved in contact with the bottom wall (6) of the drying chamber, c h a r a c t e r i z e d in that said agitator arm (9) is biased against said bottom wall (6) to provide for contact against said bottom wall (6) during the operation of the drying appa-
10 ratus and/or that said bottom wall (6) is supported freely at its peripheral portion for eliminating buckling of the bottom wall (6) when subjected to heat during the operation of the drying apparatus.

2. Apparatus according to claim 1, the drying chamber (5) having circular sectioned shape in the horizontal plane and said agitator (7)
15 including a shaft (8) centered in the drying chamber and connected to a device (11) for rotating said shaft, c h a r a c t e r i z e d in that said shaft (8) is close to the upper surface of the bottom wall (6) and that said agitator arm (9) is attached to the lower portion of said shaft for being applied against said bottom wall, that a pressure arm (30)
20 extends from a position on said shaft spaced from the lower portion thereof to a position on the agitator arm spaced from said shaft.

3. Apparatus according to claim 2, c h a r a c t e r i z e d in that said pressure arm (30) has bias means (38) for urging the agitator arm (9) against said bottom wall (6), and that said pressure arm (30)
25 at its ends is pivotably supported for movement around axles (33, 35) which lies in planes parallel to said bottom wall (6).

4. Apparatus according to claim 3, c h a r a c t e r i z e d in that said bias means (38) includes a pressure spring provided on the pressure arm (30) between movably engaging sections (36, 37) of the
30 pressure arm.

5. Apparatus according to any one of claims 1 to 4, a discharge box (50) being provided under the drying chamber and separated therefrom, which discharge box has a door (51) in the bottom wall (6) of the dry-
ing chamber for permitting dried manure to fall down into the discharge
35 box, c h a r a c t e r i z e d in that said discharge box (50) extends below the heating chamber (3), there having a collecting pocket (52)

which at one end communicates with the outside of said apparatus for the discharge of dried manure.

5 6. Apparatus as claimed in claim 5, said bottom wall (6) being freely supported at its peripheral portion, c h a r a c t e r i z e d in that said bottom wall (6) at the side walls of the apparatus being supported by flange means (12) projecting from the side walls, that radial notches (13) are made in the bottom wall at its circumference and that shoulders (14) cooperating with said notches are provided on said flange means (12).

10 7. Apparatus according to claim 6, c h a r a c t e r i z e d in that said bottom wall (6) on its underside has uniformly distributed, radial members (14) spot welded thereto for enhancing the rigidity of said bottom wall.

15 8. Apparatus for drying manure and similar residual products, which apparatus includes a heat chamber (3) having an associated heating device for heating manure in a drying chamber (5) disposed thereover and separated from the heating chamber by means of its bottom wall (6), and a condensation device (20) which is connected to the drying chamber (5) for receiving vapours evaporated from the manure in
20 the drying process and for condensation thereof, as well as a collecting vessel (26) for condensation water connected to the outlet of the condensation device, c h a r a c t e r i z e d in that an expel fan (22, 23) is provided for expelling said vapours from the drying chamber (5) to the condensation device (20).

25 9. Apparatus according to claim 8, c h a r a c t e r i z e d in that the impeller (23) of said expel fan is positioned in a dome (21) provided at the upper portion of the drying chamber, a connecting conduit (24) to the condensation device (20) opening into said dome.

30 10. Apparatus according to claim 8 or 9, said heating device being a burner (4) for fossile combustibles, c h a r a c t e r i z e d in that a connection conduit (27) is provided for supplying residual gas obtained in the condensation device (20) into the heat chamber (3) for combustion therein.

35 11. Apparatus as claimed in claim 10, c h a r a c t e r i z e d in that said connection conduit (27) extends from the collecting vessel (23), which has a large volume for serving as a buffer storage for the residual gas, and opens adjacent to the air inlet of said burner (4).

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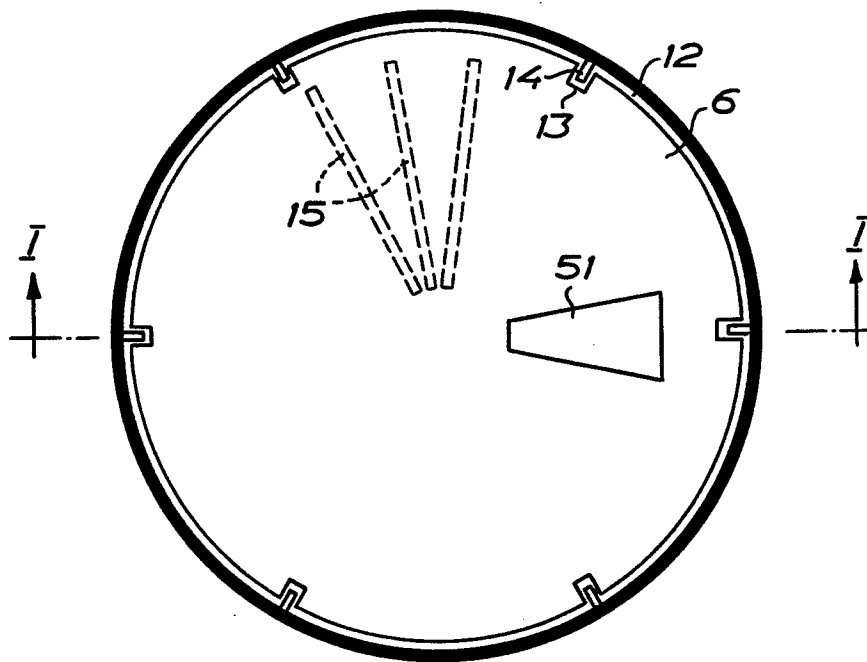


FIG. 3



DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
	<u>US - A - 1 822 486 (HERITAGE)</u> * Whole document * --	1,5	F 26 B 3/22 25/04 25/00 25/10 9/08
	<u>FR - A - 523 816 (NIESSEN)</u> * Page 1, line 52 - page 2, line 54 * --	1,5	
	<u>GB - A - 398 628 (MURPHY)</u> * Page 3, line 20 - page 4, line 74 * --	1,5	TECHNICAL FIELDS SEARCHED (Int.Cl. ³)
	<u>DE - C - 416 780 (MULLER)</u> * Whole document * --	6	F 26 B C 05 F
	<u>US - A - 3 004 347 (DOBSON)</u> * Column 1, line 50 - column 2, line 35 * --	8, 10, 11	
A	<u>GB - A - 155 493 (LOWDEN)</u> * Whole document * --	1	CATEGORY OF CITED DOCUMENTS
A	<u>GB - A - 781 154 (ORTH)</u> * Whole document * --	1	X: particularly relevant A: technological background O: non-written disclosure P: intermediate document T: theory or principle underlying the invention E: conflicting application D: document cited in the application L: citation for other reasons
A	<u>GB - A - 6318 A.D. 1915 (TORRANCE)</u> * Whole document * ----	1	&: member of the same patent family, corresponding document
<input checked="" type="checkbox"/> The present search report has been drawn up for all claims			
Place of search	Date of completion of the search	Examiner	
The Hague	30-10-1979	DE RIJCK	