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(54) **Device for drying a water-containing mixture**

Vorrichtung zur Trocknung eines wasserhaltigen Gemisches

Dispositif pour sécher un mélange aqueux

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EP 2 096 394 B2

Description

[0001] The present invention relates to a device for drying a water-containing mixture comprising at least one body which can be moved along a closed orbital path and is situated in the mixture during a first part of the orbital path and is situated outside the mixture during a second part of the orbital path. The present invention relates in particular to a device for drying slurry.

[0002] Many operating processes and agricultural activities produce sludge or manure waste (slurry) which has to be transported away and processed. However, the mixture to be transported away contains a great deal of water, so in order to reduce the transportation and processing costs significantly the water content of the mixture will be reduced by thickening this mixture.

[0003] During thickening, a large part ($\pm 70\%$) of the water which is present in water-containing mixtures, such as for example manure, slurry, sludge, industrial effluents, and the like, is separated off. This results in an increase in the solids content and a considerable reduction in the volume of the mixture.

[0004] Many techniques are already known for thickening water-containing mixtures. Thus, gravitational thickening techniques are known, in which the water is separated off by means of the force of gravity. Another known technique is flotation thickening. The flotation thickener comprises a tank into which small air bubbles are blown in order thus to create a separation between the solids and the water which is present.

[0005] A third technique is mechanical thickening, in which the water is separated off by means of mechanical forces, as a result of which higher solids contents can be achieved compared to the techniques mentioned earlier. The present invention relates in particular to such mechanical thickeners.

[0006] A number of (drying) devices are known for mechanically thickening water-containing mixtures. Thus, an endlessbelt screen or thickening table, in which the mixture to be thickened is poured onto a movable endless belt, are known. Due to the screening action of the belt, the mixture can be drained, as it were.

[0007] With another method of mechanical thickening, the mixture to be thickened is poured into a container. This container is provided with a number of perforated conveyor belts which are situated next to one another and partly extend into the mixture. Thickening is achieved by conveying the mixture away from the mixture by means of the conveyor belts and subsequently drying the mixture by passing an air flow through the perforations. However, this thickening procedure has the drawback that the conveyor belts are subjected to high wear. In addition, the various components (e.g. shafts, roller bearings) of the device can be damaged or soiled by the mixture to be thickened, as a result of which these components become jammed and have to be replaced on a regular basis.

[0008] BE 401889 discloses the preamble of claim 1.

Another device is known from FR 2 874 605. FR-A-2 645 042 describes a device for drying a water-containing mixture, comprising a trough and one or a number of series of parallel discs driven in rotation by horizontal shafts. The discs are half-immersed in the product to be dried.

[0009] It is an object of the present invention to provide an alternative device for drying and thus thickening water-containing mixtures.

[0010] The object of the invention is achieved by providing a device for drying a water-containing mixture according to claim 1.

[0011] This device has the advantage that, in use, only the plate-shaped entraining elements come into contact with the water-containing mixture, as a result of which downtime as a result of damaged or soiled components can be reduced to a minimum.

[0012] This invention furthermore offers the advantage that a large number of plate-shaped entraining elements can be provided in the device, as a result of which, on the one hand, a large amount of mixture to be dried can be entrained and, on the other hand, a large drying surface is created in the second part of the orbital path. In this way, mixtures can be dried (thickened) much more quickly.

[0013] In order to achieve an improved drying effect, the device, in a preferred embodiment, comprises ventilation means for generating an air flow directed at the device in order to dry the entrained mixture during the second part of its orbital path. Preferably, the generated air flow is heated. Preferably, the temperature of the generated air flow is between 20 and 130°C.

[0014] In particular, the plate-shaped entraining elements extend substantially along the central rotation axis.

[0015] According to a particular embodiment of the invention, according to the present invention said body comprises two side walls, with each plate-shaped entraining element being connected to both side walls. Said entraining elements are preferably fixedly arranged between both side walls.

[0016] In a more preferred embodiment, said body is provided in a housing, said housing comprising an inlet and outlet for the air flow generated by the ventilation means. In this manner, the generated air flow is, as it were, forced across the entraining elements which are situated in the second part of their orbital path, in order to achieve an optimum drying effect in this manner.

[0017] The device furthermore comprises drive means for the body, in particular for the rotor. The drive means preferably consist of asynchronous motors.

[0018] According to the present invention, said device comprises a storage container for the water-containing mixture.

[0019] In order to further illustrate the characteristics of the present invention and to indicate additional advantages and particulars, a more detailed description of the device according to the present invention will now be given. It will be clear that nothing in the following description can be interpreted as a limitation of the protection

for this invention which is claimed in the claims.

[0020] In the present description, reference numerals are used to refer to the attached drawings, in which:

- **Fig. 1** is a perspective view of the device according to the present invention;
- **Fig. 2** is a front view of the device according to the present invention; and
- **Fig. 3** is a cross section of the device viewed along A.

[0021] The device (1) according to the present invention and as illustrated in the attached figures is a drying device for water-containing mixtures. This device (1) can in particular be used for drying (thickening) manure, slurry, sludge, industrial effluents, and the like.

[0022] The mixture to be dried is poured into a storage container (7), which may be carried out both continuously or batchwise. In order to now dry the mixture, the device (1) comprises a body (2) which can be moved along a closed orbital path and is situated in the mixture during a first part of the orbital path and is situated outside the mixture during a second part of the orbital path. It is obvious that it is also possible to achieve the effect of the invention by providing two or more of such bodies (2) next to one another.

[0023] The movable body (2) is in particular a rotor which is rotatable about a central axis (8) and which comprises a number of fixedly arranged plate-shaped entraining elements (3) which are designed to entrain the mixture to be dried from the first part to the second part.

[0024] The plate-shaped entraining elements (3) extend along approximately the entire length of the device (1) in a direction along the rotation axis. As the entraining elements (3) have a certain width (preferably variable between 0.5 and 2 m), they will also partly extend (see Fig. 3) in the direction of the central axis (8).

[0025] When the movable body (2) is rotated, the plate-shaped entraining elements (3) will be immersed one by one and at least partly (first part) into the mixture provided in the storage container (7). Preferably, the entraining elements (3) are completely immersed in the mixture provided in the storage container (7). As a result of the immersion, part of the mixture will cling to the elements (3) and be carried along to the second part, where the entrained mixture can dry.

[0026] The device (1) is furthermore provided with ventilation means (not shown) for generating an air flow (L) directed at the device (1) in order to dry the mixture carried along by the entraining elements (3) during the second part of its orbital path. This air flow is preferably a hot air flow and may, for example, emanate from an electrical group, flue gasses from a chimney, air from a stable, etc. In order for the air flow to pass over the surface of the entraining elements, the rotor is provided in a housing (5) (see Fig. 1), said housing (5) comprising an inlet and outlet for the air flow (L) generated by the ventilation means.

[0027] The rotor is arranged in such a manner that only

the plate-shaped entraining elements (3) come into contact with the mixture. As a result thereof, downtime as a result of damaged or soiled components can be reduced to a minimum.

[0028] In particular, the rotor comprises two circular side walls (4) situated opposite one another. As can be seen in Figs. 1 and 2, one end of the plate-shaped entraining elements (3) is connected to the one side wall (4) and the other end is connected to the other side wall (2). Said entraining elements (3) are positioned at a certain distance from one another and are, as can be seen in Fig. 3, placed on this rotor in the shape of a fan in the direction (of rotation) (R) of the rotor.

[0029] The plate-shaped entraining elements (3) can be designed to be flat, deflected or profiled. They are preferably made of stainless steel. The entraining elements (3) may have both a smooth and a perforated surface. Their surface may also be provided with protuberances by means of, for example, sandblasting.

[0030] The device (1) according to the invention may be provided with a large number of plate-shaped entraining elements (3) as a result of which, on the one hand, a large amount of mixture to be dried can be entrained and, on the other hand, a much greater drying surface is created in the second part of the orbital path, compared to the known thickeners, as is clear from the following example.

[0031] Generally, each rotor comprises 40 plate-shaped entraining elements (3) which as it were move along a closed orbital path, as they form part of the movable body (2), with each entraining element (3) being situated in the mixture during a first part of its orbital path and being situated outside the mixture during a second part of its orbital path. The arrangement of the rotor and the dimensions (in particular the width) of the various entraining elements (3) are such that there are always 8 entraining elements (3) which are immersed in the water-containing mixture. Thus, there are 32 entraining elements (3) which are situated in the second part of their orbital path.

[0032] In a preferred embodiment, one entraining element (3) has the following dimensions: length: 3 m; width: 0.75 m; thickness: 1.5 mm. Thus, one side of an entraining element has a surface area of 2.25 m².

[0033] As 32 elements (3) are situated in the second part of their orbital path, the total drying surface of the device is formed by these 32 plates. The total drying surface thus is: 2.25 m² x 32 x 2 (each entraining element has two sides which can be moistened) = 144 m².

[0034] The above dimensions only serve as an illustration. Obviously, the dimensions of the entraining elements can be greater or smaller or the number of entraining elements (3) of the device can be higher (e.g. 60 or 80) or lower (e.g. 25 or 35).

Claims

1. Device (1) for drying a water-containing mixture comprising a storage container (7) for the water-containing mixture and at least one body (2) which comprises a number of plate-shaped entraining elements (3) extending along approximately the entire length of the device (1) and which are designed in such a manner that they entrain part of the mixture, wherein said body is a rotor which is rotatable about a central axis (8) so that said plate-shaped entraining elements (3) can be moved along a closed orbital path and are situated in the mixture provided in the storage container during a first part of the orbital path and are situated outside the mixture during a second part of the orbital path, **characterized in that** said plate-shaped entraining elements (3) are fixedly arranged in a fan-shaped way and in a curved manner, in the direction of rotation (R) of the body (2), on this body (2). 5 10 15 20
2. Device according to Claim 1, **characterized in that** the device comprises ventilation means for generating an air flow (L) directed at the device in order to dry the entrained mixture during the second part of its orbital path. 25
3. Device (1) according to Claim 1 or 2, **characterized in that** the plate-shaped entraining elements (3) extend substantially along the central rotation axis. 30
4. Device (1) according to one of the preceding claims, **characterized in that** said body (2) comprises two side walls (4), with each plate-shaped entraining element (3) being connected to both side walls. 35
5. Device (1) according to one of Claims 2 to 4, **characterized in that** said body (2) is provided in a housing (5), said housing (5) comprising an inlet and outlet for the air flow (L) generated by the ventilation means. 40
6. Device (1) according to one of the preceding claims, **characterized in that** said device (1) comprises drive means (6) for the body (2). 45

Patentansprüche

1. Vorrichtung (1) zum Trocknen eines wasserhaltigen Gemischs, umfassend einen Speicherbehälter (7) für das wasserhaltige Gemisch und mindestens einen Körper (2), der eine Zahl von plattenförmigen Mitnahmeelementen (3) umfasst, die sich entlang ungefähr der gesamten Länge der Vorrichtung (1) erstrecken und die auf derartige Weise ausgeführt sind, dass sie einen Teil des Gemischs mitnehmen, wobei es sich bei dem Körper um einen Rotor han-

delt, der um eine mittlere Achse (8) drehbar ist, so dass die plattenförmigen Mitnahmeelemente (3) entlang einer geschlossenen Umlaufbahn bewegt werden können und sich während eines ersten Teils der Umlaufbahn in dem Gemisch befinden das in dem Speicherbehälter bereitgestellt ist und sich während eines zweiten Teils der Umlaufbahn außerhalb des Gemischs befinden, **dadurch gekennzeichnet, dass** die plattenförmigen Mitnahmeelemente (3) auf fächerförmige Weise und auf gekrümmte Weise in der Drehrichtung (R) des Körpers (2) an diesem Körper (2) fest angeordnet sind.

2. Vorrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** die Vorrichtung Lüftungsmittel zum Erzeugen eines auf die Vorrichtung gerichteten Luftstroms (L) umfasst, um das mitgenommene Gemisch während des zweiten Teils ihrer Umlaufbahn zu trocknen. 15 20
3. Vorrichtung (1) nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** sich die plattenförmigen Mitnahmeelemente (3) im Wesentlichen entlang der mittleren Drehachse erstrecken. 25
4. Vorrichtung (1) nach einem der vorangehenden Ansprüche, **dadurch gekennzeichnet, dass** der Körper (2) zwei Seitenwände (4) umfasst, wobei die plattenförmigen Mitnahmeelemente (3) jeweils mit beiden Seitenwänden verbunden sind. 30
5. Vorrichtung (1) nach einem der Ansprüche 2 bis 4, **dadurch gekennzeichnet, dass** der Körper (2) in einem Gehäuse (5) bereitgestellt ist, wobei das Gehäuse (5) einen Einlass und einen Auslass für den von den Lüftungsmitteln erzeugen Luftstrom (L) umfasst. 35
6. Vorrichtung (1) nach einem der vorangehenden Ansprüche, **dadurch gekennzeichnet, dass** die Vorrichtung (1) Antriebsmittel (6) für den Körper (2) umfasst. 40

Revendications

1. Dispositif (1) pour sécher un mélange contenant de l'eau comprenant un conteneur de stockage (7) pour le mélange contenant de l'eau et au moins un corps (2) qui comprend un certain nombre d'éléments d'entraînement en forme de plaque (3) s'étendant approximativement le long de la totalité de la longueur du dispositif (1) et qui sont conçus de telle sorte qu'ils entraînent une partie du mélange, dans lequel ledit corps est un rotor qui est rotatif autour d'un axe central (8) de sorte que lesdits éléments d'entraînement en forme de plaque (3) peuvent être déplacés le long d'un trajet orbital fermé et sont placés dans le mé-

lange disposé dans le conteneur de stockage pendant une première partie du trajet orbital et sont placés à l'extérieur du mélange pendant une seconde partie du trajet orbital, **caractérisé en ce que** lesdits éléments d'entraînement en forme de plaque (3) sont agencés de manière fixe à la façon d'un éventail et d'une façon courbée, dans la direction de rotation (R) du corps (2), sur ce corps (2). 5

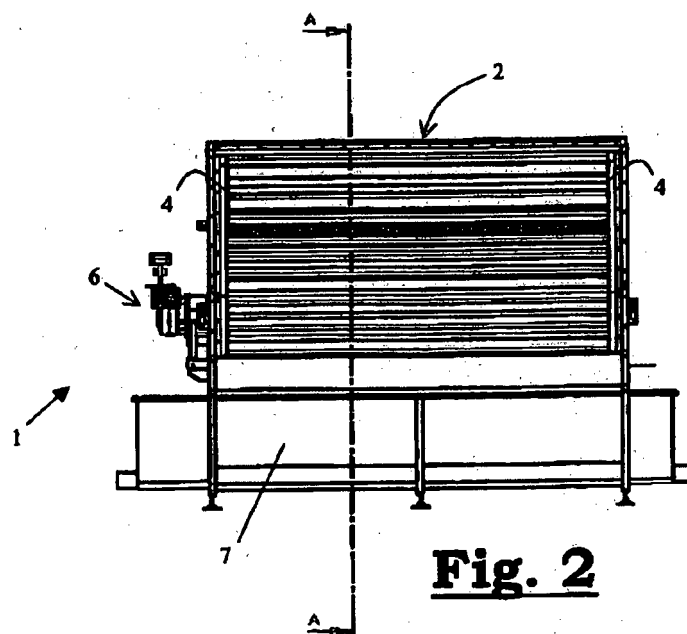
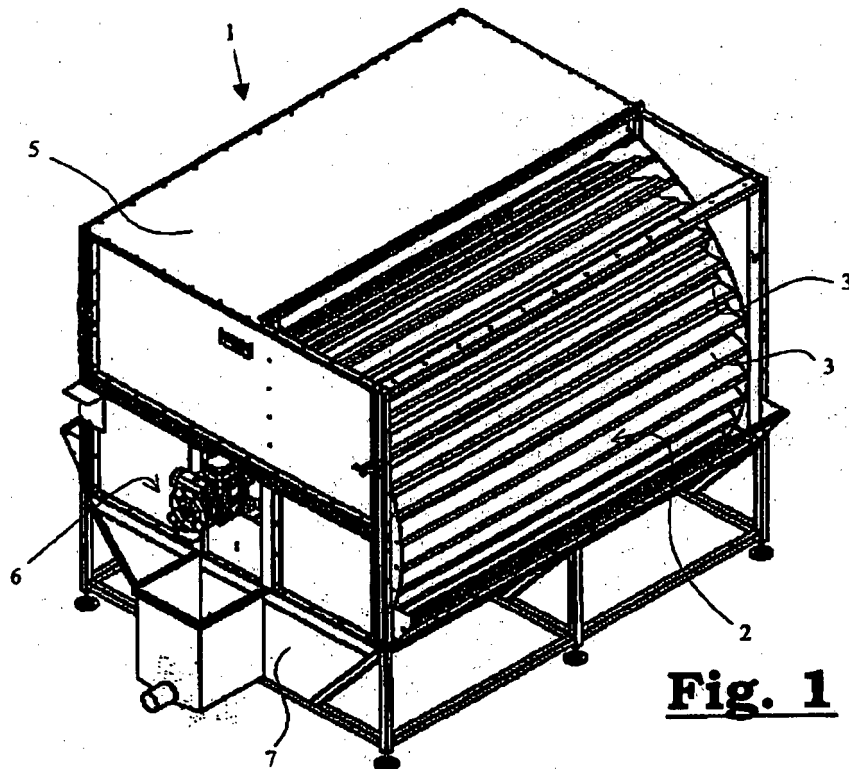
2. Dispositif selon la revendication 1, **caractérisé en ce que** le dispositif comprend un moyen de ventilation pour produire un flux d'air (L) dirigé au niveau du dispositif afin de sécher le mélange entraîné pendant la seconde partie de son trajet orbital. 10
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3. Dispositif (1) selon la revendication 1 ou 2, **caractérisé en ce que** les éléments d'entraînement en forme de plaque (3) s'étendent sensiblement le long de l'axe de rotation central. 20
4. Dispositif (1) selon l'une des revendications précédentes, **caractérisé en ce que** ledit corps (2) comprend deux parois latérales (4), chaque élément d'entraînement en forme de plaque (3) étant relié aux deux parois latérales. 25
5. Dispositif (1) selon l'une des revendications 2 à 4, **caractérisé en ce que** ledit corps (2) est disposé dans un logement (5), ledit logement (5) comprenant une entrée et une sortie pour le flux d'air (L) produit par le moyen de ventilation. 30
6. Dispositif (1) selon l'une des revendications précédentes, **caractérisé en ce que** ledit dispositif (1) comprend un moyen moteur (6) pour le corps (2). 35

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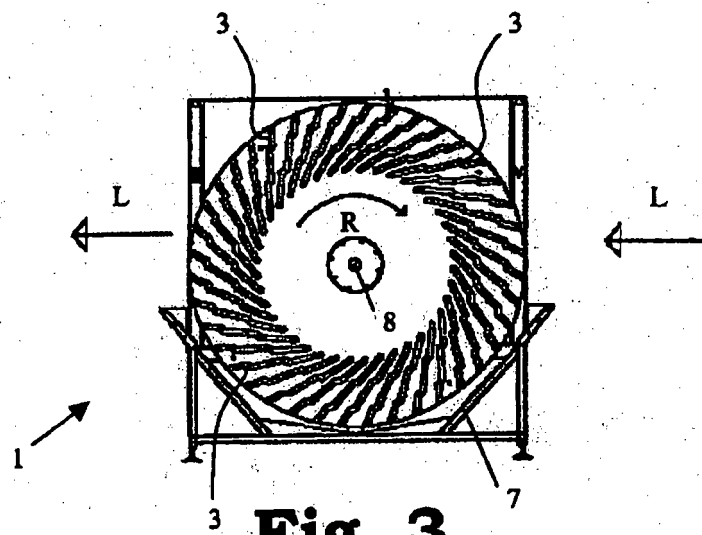


Fig. 3

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