

Description

This invention relates to apparatus for heating material, preferably for liquefying glass batch or the like as disclosed in US-A-4,381,934 (Kunkle et al.), by means of a rotating vessel. A rotating vessel having a vertical axis is disclosed as the preferred embodiment in that patent. Similarly oriented rotary melters are also shown, for example, in US-A-2,007,755 (Ferguson), 2,834,157 (Bowes), and 3,917,479 (Sayce et al.). Such arrangements may be satisfactory for operation on a relatively small scale, but when such a process is carried out on a commercial production scale dynamic instabilities may arise in the rotating apparatus that have the potential to put severe stress on the restraining structure. One source of these instabilities may be non-uniform distribution of material in the vessel. Another may be thermal warpage of the vessel. As long as the mass center of the rotating vessel and its contents is on the vertical axis of rotation, the system is stable. But if the mass center deviates from the axis of rotation, the system attempts to bring the two into conformity, which can force the vessel out of its intended alignment and set up oscillations and vibrations. Prior art approaches typically involve attempts to restrain the rotating vessel from any movement out of its intended alignment, but with a commercial scale vessel the forces entailed by such an attempt can be so great that the vessel or other structural elements are distorted or deflected, setting up other modes of vibration or oscillation. Also, feeding batch materials to a precise location with the vessel can be difficult if its motion is unstable. It would be desirable if the apparatus economies that result from the liquefaction process of the Kunkle et al. patent could be preserved by providing practical means for supporting and rotating a relatively massive vessel with stability.

GB-A-2,140,902 describes a rotary melter having rigid means for maintaining a fixed axis of rotation. Support means support the vessel at an elevation above the center of gravity of the vessel loaded with material. The pre-characterising part of claim 1 is based on this document.

This structure has been found to be an arrangement incapable of sufficiently stabilizing the rotation of the vessel of the size needed for commercial production.

It is the object of the invention to improve the structure of known rotary melters in that oscillations and vibrations during operation are avoided.

This object is attained by an apparatus for heating material comprising a generally cylindrical or a downwardly converging frustoconical shape or stepped shape vessel adapted to contain a quantity of material to be heated, oriented with a substantially vertical axis and having a central outlet in the bottom for discharging heated material from the vessel, means to heat the material within the vessel, support means spaced from the vessel and mounted for rotation sub-

stantially coaxially with the axis of the vessel and providing support for the vessel at an elevation above the center of the gravity of the vessel loaded with the material, characterized by link means joining the vessel to the support means and being attached to the vessel at an elevation below the elevation of the rotating support means and permitting radial expansion of the vessel relative to the support means.

In the present invention a support and drive arrangement is provided whereby a massive vessel rotated about a vertical axis is made dynamically self-stabilizing. The invention involves two novel aspects which in combination with features defined in dependent claims comprises the preferred embodiment.

One aspect is the separation of the vessel from its support means. The container portion of the vessel, or drum, is spaced from an encircling support table with radial freedom of movement therebetween, thus isolating the support structure from thermal expansion and warpage effects that may be experienced by the drum. Although motion is permitted therebetween, coaxiality of the vessel and the support structure is preserved. The support table is mounted for rotation about a substantially vertical axis coincident with the cylindrical axis of the vessel.

In another aspect, support for the drum is provided at an elevation above the mass center of the drum and its contents, and the drum is mounted with freedom for its vertical axis to oscillate. The result is a pendulum-like effect that permits self-centering and avoids absolute restraint. If the mass center deviates from the intended axis for rotation, gravity pulls the mass center toward the intended axis. On the other hand, a center of gravity above the plane of support would create an unstable, inverted pendulum situation. Attempts to totally restrain the system against movement of the mass center would produce unduly high stresses in a large scale apparatus.

A bias against gross lateral displacement of the vessel is provided by a conical orientation of the support surfaces, that is, the surface of the support table that contacts supporting rollers slopes downwardly toward the center of the vessel. Thus total reliance on lateral restraint means to keep the vessel in position is avoided. The load bearing surfaces of the support rollers are also preferably conical, with the apex of each cone falling at the axis of rotation of the vessel, so that the tangential velocities of the rollers match that of the support surface along the lines of contact therebetween, thereby reducing wear, noise, and vibration.

The support is provided above the mass center by a support structure separate from the drum and attached to the drum at a lower elevation. Elongated link means extend from the support structure to the points of attachment to the drum. Because of an inward tapering of lining material within the drum, the lower portions of the drum are more insulated from the interior heat than the

upper portions. Therefore, the link means are attached to lower portion of the drum because of the stable geometry there. Upper portions of the drum can be subject to thermal expansion and contraction and can sometimes become deformed, so that attachment of the support system there would have the potential of introducing unsymmetrical conditions, and thus instability, into the rotating system. Because of the attachment to the lower, relatively cool portion of the drum, and the preference to support the drum from above its center of gravity, the link means preferably extend downwardly from the support structure to their points of attachment to the drum. The link means also provide flexibility in the radial direction, thereby achieving the advantage of structurally isolating the support means from the drum. This arrangement advantageously permits thermal expansion or warpage of the drum, but maintains the drum fixed relative to the support means. The link means preferably comprise a plurality of rods, but could comprise plates, cables, straps, or the like.

Another important aspect of preferred embodiments is the provision of horizontal restraining means acting on the support table. The horizontal restraining means may comprise wheels separate from the vertical support wheels on which the table is supported. Although the present system does not attempt to provide absolute horizontal restraint, a major stabilizing effect is provided to the system by exerting resilient horizontal centering forces on the support table to control excursions and to damp oscillations (i.e., swinging motions). Providing separate propulsion for rotation of the support table through the horizontal restraining means advantageously enables the load-bearing vertical support means to be lubricated, and allows for various configurations and materials for the vessel support system.

The following features are preferred.

The support means comprises a ring-like structure encircling the vessel and rotatably supported on support wheels. The link means is attached to the support means at an elevation above the center of gravity of the vessel loaded with the material. The elevation of the support means preferably is within the upper half of the vessel and the link means is attached to a lower portion of the vessel. The link means comprises a plurality of elongated elements extending downwardly from the support means to the vessel. The elements may comprise a plurality of rods, wherein each rod is oblique to the radial planes of the vessel. The support wheels are tapered inwardly toward the axis of the vessel and the surface of the support means contacted by the support wheels comprises a conical segment sloped downwardly toward the axis of the vessel. The support wheels are rotatably carried by bearings that are affixed to stationary structural members. The support ring is horizontally restrained by wheels bearing horizontally against a peripheral surface of the ring. The support surface of the support means is sloped toward or below the

center of gravity of the vessel loaded with material. The ends of the rods are pivotably received in sockets in upper and lower support blocks. The vessel is provided with lining material within the vessel, tapering from a region near the upper edge of the sides to the outlet, whereby the lining thickness is greater on the lower portion of the sides than the top portion.

These and other advantages of the invention will be apparent from the drawing and the detailed description of the preferred embodiment which follows.

The Drawing

The figure is a vertical cross-section of a preferred embodiment of rotary heating apparatus incorporating the improvements of the present invention.

Detailed Description of the Preferred Embodiment

This description of a particular preferred embodiment relates to a process for liquefying glass batch but it should be understood that the invention is applicable to other processes as well. Details of the specific process may be found in US-A-4,381,934 of Kunkle et al. and need not be repeated here.

Referring to the specific embodiment shown in the figure, the basic structure of the melting vessel is a drum 10 which may be fabricated of steel and which has a generally cylindrical side configuration, a generally open top, and a bottom portion that is closed except for a drain outlet. The drum 10 is mounted for rotation about a vertical axis in a manner to be described in detail hereinbelow. A substantially enclosed cavity is formed within the melting vessel by means of a lid structure generally designated as 11 which is provided with stationary support. The lid 11 may be constructed with a variety of materials and configurations as would be known to those of skill in the furnace construction art. The preferred arrangement depicted in the figure is an upwardly domed, sprung arch construction fabricated from a plurality of refractory blocks 12. In the typical arch construction shown, the arch blocks rest on a peripheral support structure 13. The area between the stationary lid and rotating vessel may be closed in various ways. In the arrangement shown in the drawing, plate blocks 14 extend slightly below upper rim of the drum 10 and are supported by stationary support plate 15. Seal blocks 16 may be provided to close the gap between the arch blocks 12 and the plate blocks 14. It should be understood that monolithic and flat suspended designs and other materials, either cooled or uncooled, could be employed for the lid.

Batch materials, preferably in a pulverulent state, may be fed into the cavity of the heating vessel by means of a water cooled chute 20. A layer 21 of the batch material is retained on the interior walls of the drum 10 to act as an insulating lining. As the drum is rotating, the feed chute 20 directs batch material onto upper portions of

the lining 21. Heating for liquefying the batch material may be provided by one or more burners 22 extending through the lid 11. Preferably a plurality of burners 22 are arranged around the perimeter of the lid so as to direct their flames toward a wide area of the lining 21. The burners are preferably water cooled to protect them from the harsh environment within the vessel. Exhaust gases escape from the vessel through an opening 23 in lid 11 or through the bottom outlet 25. As batch material on the surface of lining 21 liquefies it flows down the sloped lining to a central outlet opening 25 at the bottom of the vessel. The outlet 25 may be fitted with a refractory ceramic bushing 26. A stream of liquefied material 27 falls freely from the vessel into a stationary receptacle 28 and may thereafter be subjected to additional treatment to complete the melting process.

The drawing shows several optional features that are included in the preferred embodiment. At the interface between the upper rim of the rotating drum 10 and the stationary lid 11 an atmosphere seal may be provided comprised of a stationary, circular, water-containing trough and a circular flange member 31 extending downwardly into the trough from the rotating drum. A similar stationary water trough 32 and flange 33 extending downwardly from the rotating drum may be provided at the lower end of the drum.

Another optional feature associated with the preferred embodiment is an arrangement to cool the upper rim portion of the drum 10 in the event that irregular retention of the lining 21 on the upper interior portion of the drum causes undue exposure of the upper rim portion of the drum to the heat. To this end, a stream of water may be sprayed against the exterior of the upper portion of the drum. The water spray may be supplied with water by way of conduits 40, and the spray may be confined to the space closely adjacent to the drum by means of a spray shield 41. Spent water may be collected in a circular trough 42 and drained by way of conduits 43 that extend down along the slides of and rotate with the drum 10. Discharge of water from the conduits 43 may conveniently be provided into the water trough 32 of the bottom atmosphere seal.

The base on which the drum 10 is rotatably supported and driven is a support table 50 which, as shown in the drawing, may be configured as a hollow ring of generally rectangular cross-section. The support ring 50 encircles the drum and is spaced therefrom. The link means for connecting the support ring 50 to the drum 10 in this embodiment comprise a plurality of support rods 51. The number and size of the rods 51 are inversely related and depend upon the weight of a particular drum when fully loaded and the transient forces expected to be borne. Three rods could theoretically support the drum, but the use of more (preferably eight or more) rods permits a bicycle spoke type of arrangement to be employed whereby rotating and swinging of the drum 10 relative to the ring 50 is counteracted. In such an arrangement the rods do not lie in radial

planes of the drum, but rather extend along vertical planes that do not intersect the vertical axis of the drum, with the planes of adjacent rods passing on opposite sides of the vertical axis of the drum. With larger vessels the number of rods may be increased accordingly in order to distribute the load, and it is contemplated that the number of rods may be on the order of twenty-four in the embodiment of the type shown in the drawing. Rods are the preferred form of link means because they provide little obstruction to the sides of the drum, thereby permitting access for construction and maintenance, providing free circulation of air, and avoiding accumulation of any spilled materials. Because of the isolation between the support mechanism and the vessel provided by elongated link means such as the rods 51, the support mechanism can act as a self-centering system regardless of the configuration of the vessel and its contents.

The rods 51 are preferably held in place at each end by spherical ended nuts 52 which are in turn received in spherical sockets in upper and lower support blocks 53 and 54 respectively. This arrangement causes the rods 51 to carry tensile loads only. The upper support blocks 53 are mounted on the support ring 50 at an elevation above the center of gravity "C" of the loaded vessel in accordance with the preference to support the vessel from an elevation above its center of gravity. The lower support blocks 54 are affixed to a peripheral ring 55 or the like, which is attached to the drum 10 at an elevation lower than the elevation of the upper support blocks 53. Because the lining material 21 tapers to a greater thickness at the bottom of a cylindrical drum as shown in the drawing, the center of gravity will usually be within the lower half of the height of the drum. Accordingly, the elevation of support may alternatively be expressed as being at the upper half of the height of the drum. Elongating the rods 51, within practical limits of the surrounding structure, can be advantageous for better isolation of the drum from the support system because longer, and thus more vertical, rods avoid transmitting drum distortion along the length of a rod.

Attachment of the link means such as rods 51 to the drum preferably is located at a region of the drum that is relatively cool and therefore less susceptible to thermal warpage. The thickening of the lining 21 toward the bottom of the cylindrical drum renders lower portions of the drum more desirable for the attachment locations. Although attachment at the upper half of the drum may sometimes be acceptable, it is preferred to make the attachment at the lower half. In the most preferred arrangement, the attachment is at or below the elevation of the center of gravity "C" of the vessel loaded with a normal amount of material including the lining, which would usually be in a reliably stable portion of the vessel.

The vessel 10, instead of the generally cylindrical shape shown may be provided with other shapes such as a downwardly converging frusto-

conical shape or a stepped shape as shown in US—A—4,496,387 (Heithoff et al.). In such cases, the center of gravity may not lie within the lower half of the vessel, but the preferred elevation of support would be above the center of gravity, and the elevation of attachment to the vessel would be at the lower half.

The underside of the support ring 50 is provided with a tapered track 60 that makes rolling contact with a plurality of tapered wheels 61. The wheels 61 are rotatably carried by bearings 62 that are affixed to suitable stationary structural members such as beams 63. The wheels 61 carry the vertical load of the drum and its contents, and the number of wheels should be chosen accordingly to distribute the load, eight wheels being considered suitable in a typical commercial scale installation as shown in the drawing. The contact surface of the track 60 tapers downwardly toward the drum 10, thus being configured as a segment of a cone. The wheels 61 may be tapered at the same slope as the track, and together with the tapered track 60 bias the rotating vessel toward the center. The angle is chosen to avoid velocity differences along the line of contact, thus reducing wear and noise.

Lateral restraint is applied to the rotating drum 10 and support ring 50 by means of a plurality of wheels 70 bearing against the periphery of the support ring 50. The lateral restraint wheels 70 may be rotatably carried on rigid support means 71, which may be adjustable in the radial direction with respect to the drum 10. At least three lateral restraint wheels 70 are provided, and the wheels 70 are preferably resilient, most preferably pneumatic tires. At least one of the wheels 70 is driven by means of a motor (not shown) so as to rotate the support table 50 and thus the drum 10. Rather than serving as absolute restraint for the rotating elements, the wheels 70 serve to damp oscillation or other deviation of the drum axis from its intended locus. The wheels 70 thus serve as a primary centering force to the rotating system.

Claims

1. Apparatus for heating material comprising a generally cylindrical or a downwardly converging frustoconical shape or stepped shape vessel (10) adapted to contain a quantity of material to be heated, oriented with a substantially vertical axis and having a central outlet (25) in the bottom for discharging heated material from the vessel, means (22) to heat the material within the vessel (10), support means (50, 53, 60) spaced from the vessel and mounted for rotation substantially coaxially with the axis of the vessel (10) and providing support for the vessel (10) at an elevation above the center of the gravity of the vessel (10) loaded with the material, characterized by link means (51) joining the vessel (10) to the support means (50, 53) and being attached to the vessel (10) at an elevation below the elevation of the rotating support means (50, 53) and permitting radial expansion of the vessel (10) relative to the support means (50, 53).

2. The apparatus of claim 1 wherein the support means comprise a ring-like structure (50) encircling the vessel (10) and rotatably supported on support wheels (61).

3. The apparatus of claim 1 wherein the link means (51) are attached to the support means (50) at an elevation above the center of gravity of the vessel (10) loaded with the material.

4. The apparatus of claims 1 or 3 wherein the elevation of the support means (50, 53) is within the upper half of the vessel (10).

5. The apparatus of claim 1 wherein the link means (52) are attached to a lower portion of the vessel (10).

6. The apparatus of claim 1 wherein the link means (51) comprise a plurality of elongated elements extending downwardly from the support means (50, 53) to the vessel (10).

7. The apparatus of claim 6 wherein the link means (51) comprise a plurality of rods.

8. The apparatus of claim 7 wherein each rod is oblique to radial planes of the vessel (10).

9. The apparatus of claim 2 wherein the support wheels (61) are tapered inwardly toward the axis of the vessel (10), and the surface of the support means (50) contacted by the support wheels (61) comprises a conical segment (60) sloped downwardly toward the axis of the vessel (10).

10. The apparatus of claim 2 wherein the support ring (50) is horizontally restrained by wheels (70) bearing horizontally against a peripheral surface of the ring (50).

11. The apparatus of claim 1 wherein the support surface of the support means (50) is sloped toward or below the center of gravity of the vessel (10) loaded with material.

12. The apparatus of claim 7 wherein the ends of the rods (51) are pivotably received in sockets in upper and lower support blocks (53, 54).

13. The apparatus of claim 2 wherein the wheels (61) are rotatably carried by bearings (62) that are affixed to stationary structural members (63).

14. The apparatus of claim 1 wherein the vessel (10) is provided with lining material (21) within the vessel (10) tapering from a region near the upper edge of the sides to the outlet (25) whereby the lining thickness is greater on the lower portion of the sides than the top portion.

Patentansprüche

1. Vorrichtung zum Erwärmen von Material mit einem im allgemeinen zylindrischen oder nach unten sich konisch verjüngenden oder abgestuften Behälter (10), der eine Menge des zu erwärmenden Materials enthalten kann, der um eine im wesentlichen senkrechte Achse ausgerichtet ist und im Boden einen zentralen Auslaß (25) aufweist zum Abziehen des erwärmten Materials aus dem Behälter, mit Einrichtungen (22) zum Erwärmen des Materials im Behälter (10), mit Trageinrichtungen (50, 53, 60) in Abstand vom Behälter, die drehbar um eine im wesentlichen coaxial zur Achse des Behälters (10) verlaufende Achse befestigt sind und den Behälter (10) oberhalb des

conical shape or a stepped shape as shown in US-A-4,496,387 (Heithoff et al.). In such cases, the center of gravity may not lie within the lower half of the vessel, but the preferred elevation of support would be above the center of gravity, and the elevation of attachment to the vessel would be at the lower half.

The underside of the support ring 50 is provided with a tapered track 60 that makes rolling contact with a plurality of tapered wheels 61. The wheels 61 are rotatably carried by bearings 62 that are affixed to suitable stationary structural members such as beams 63. The wheels 61 carry the vertical load of the drum and its contents, and the number of wheels should be chosen accordingly to distribute the load, eight wheels being considered suitable in a typical commercial scale installation as shown in the drawing. The contact surface of the track 60 tapers downwardly toward the drum 10, thus being configured as a segment of a cone. The wheels 61 may be tapered at the same slope as the track, and together with the tapered track 60 bias the rotating vessel toward the center. The angle is chosen to avoid velocity differences along the line of contact, thus reducing wear and noise.

Lateral restraint is applied to the rotating drum 10 and support ring 50 by means of a plurality of wheels 70 bearing against the periphery of the support ring 50. The lateral restraint wheels 70 may be rotatably carried on rigid support means 71, which may be adjustable in the radial direction with respect to the drum 10. At least three lateral restraint wheels 70 are provided, and the wheels 70 are preferably resilient, most preferably pneumatic tires. At least one of the wheels 70 is driven by means of a motor (not shown) so as to rotate the support table 50 and thus the drum 10. Rather than serving as absolute restraint for the rotating elements, the wheels 70 serve to damp oscillation or other deviation of the drum axis from its intended locus. The wheels 70 thus serve as a primary centering force to the rotating system.

Claims

1. Apparatus for heating material comprising a generally cylindrical or a downwardly converging frustoconical shape or stepped shape vessel (10) adapted to contain a quantity of material to be heated, oriented with a substantially vertical axis and having a central outlet (25) in the bottom for discharging heated material from the vessel, means (22) to heat the material within the vessel (10), support means (50, 53, 60) spaced from the vessel and mounted for rotation substantially coaxially with the axis of the vessel (10) and providing support for the vessel (10) at an elevation above the center of the gravity of the vessel (10) loaded with the material, characterized by link means (51) joining the vessel (10) to the support means (50, 53) and being attached to the vessel (10) at an elevation below the elevation of the rotating support means (50, 53) and permitting radial expansion of the vessel (10) relative to the support means (50, 53).

2. The apparatus of claim 1 wherein the support means comprise a ring-like structure (50) encircling the vessel (10) and rotatably supported on support wheels (61).

3. The apparatus of claim 1 wherein the link means (51) are attached to the support means (50) at an elevation above the center of gravity of the vessel (10) loaded with the material.

4. The apparatus of claims 1 or 3 wherein the elevation of the support means (50, 53) is within the upper half of the vessel (10).

5. The apparatus of claim 1 wherein the link means (52) are attached to a lower portion of the vessel (10).

6. The apparatus of claim 1 wherein the link means (51) comprise a plurality of elongated elements extending downwardly from the support means (50, 53) to the vessel (10).

7. The apparatus of claim 6 wherein the link means (51) comprise a plurality of rods.

8. The apparatus of claim 7 wherein each rod is oblique to radial planes of the vessel (10).

9. The apparatus of claim 2 wherein the support wheels (61) are tapered inwardly toward the axis of the vessel (10), and the surface of the support means (50) contacted by the support wheels (61) comprises a conical segment (60) sloped downwardly toward the axis of the vessel (10).

10. The apparatus of claim 2 wherein the support ring (50) is horizontally restrained by wheels (70) bearing horizontally against a peripheral surface of the ring (50).

11. The apparatus of claim 1 wherein the support surface of the support means (50) is sloped toward or below the center of gravity of the vessel (10) loaded with material.

12. The apparatus of claim 7 wherein the ends of the rods (51) are pivotably received in sockets in upper and lower support blocks (53, 54).

13. The apparatus of claim 2 wherein the wheels (61) are rotatably carried by bearings (62) that are affixed to stationary structural members (63).

14. The apparatus of claim 1 wherein the vessel (10) is provided with lining material (21) within the vessel (10) tapering from a region near the upper edge of the sides to the outlet (25) whereby the lining thickness is greater on the lower portion of the sides than the top portion.

Patentansprüche

1. Vorrichtung zum Erwärmen von Material mit einem im allgemeinen zylindrischen oder nach unten sich konisch verjüngenden oder abgestuften Behälter (10), der eine Menge des zu erwärmenden Materials enthalten kann, der um eine im wesentlichen senkrechte Achse ausgerichtet ist und im Boden einen zentralen Auslaß (25) aufweist zum Abziehen des erwärmten Materials aus dem Behälter, mit Einrichtungen (22) zum Erwärmen des Materials im Behälter (10), mit Trageeinrichtungen (50, 53, 60) in Abstand vom Behälter, die drehbar um eine im wesentlichen coaxial zur Achse des Behälters (10) verlaufende Achse befestigt sind und den Behälter (10) oberhalb des



Schwerpunktes des mit Material beladenen Behälters (10) tragen, dadurch gekennzeichnet, daß Verbindungseinrichtungen (51) zum Verbinden des Behälters (10) mit den Trageinrichtungen (50, 53), die am Behälter (10) unterhalb der Höhe für die drehbaren Trageinrichtungen (50, 53) befestigt sind, so daß eine radiale Auslenkung des Behälters (10) relativ zu den Trageinrichtungen (50, 53) möglich ist.

2. Vorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die Trageinrichtungen einen den Behälter (10) umgebenden rinförmigen Aufbau (50) enthalten, der drehbar von Tragrollen (61) getragen wird.

3. Vorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die Verbindungseinrichtungen (51) mit der Trageinrichtung (50) an einer Stelle oberhalb des Schwerpunktes des mit Material beladenen Behälters (10) verbunden sind.

4. Vorrichtung nach Ansprüchen 1 oder 3, dadurch gekennzeichnet, daß die Trageinrichtungen (50, 53) auf einer Höhe innerhalb der oberen Hälfte des Behälters (10) angeordnet sind.

5. Vorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die Verbindungseinrichtungen (52) am unteren Teil des Behälters (10) befestigt sind.

6. Vorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die Verbindungseinrichtungen (51) eine Vielzahl von langgestreckten Elementen enthalten, die sich von den Trageinrichtungen (50, 53) nach unten zum Behälter (10) erstrecken.

7. Vorrichtung nach Anspruch 6, dadurch gekennzeichnet, daß die Verbindungseinrichtungen (51) eine Vielzahl von Stäben aufweisen.

8. Vorrichtung nach Anspruch 7, dadurch gekennzeichnet, daß jeder Stab schräg zu Radialflächen des Behälters (10) angeordnet ist.

9. Vorrichtung nach Anspruch 2, dadurch gekennzeichnet, daß die Tragrollen (61) konisch nach innen zur Achse des Behälters (10) ausgebildet sind und die mit den Tragrollen (61) in Berührung stehende Oberfläche der Trageinrichtung (50) ein konisches Segment (60) aufweist, das nach unten zur Achse des Behälters (10) geneigt ist.

10. Vorrichtung nach Anspruch 2, dadurch gekennzeichnet, daß der Tragring (50) von Rollen (70) horizontal gehalten wird, die horizontal gegen eine Umfangsfläche des Ringes (50) drücken.

11. Vorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die Tragfläche der Trageinrichtung (50) zum oder unter den Schwerpunkt des mit Material beladenen Behälters (10) geneigt ist.

12. Vorrichtung nach Anspruch 7, dadurch gekennzeichnet, daß die Enden der Stäbe (51) schwenkbar in Buchsen in oberen und unteren Lagerblöcken (53, 54) angeordnet sind.

13. Vorrichtung nach Anspruch 2, dadurch gekennzeichnet, daß die Rollen (61) drehbar von Lagern (62) getragen werden, die an festen Bauteilen (63) befestigt sind.

14. Vorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß der Behälter (10) mit Auskleidungsmaterial (21) im Inneren des Behälters (10) versehen ist, das von einem Bereich in der Nähe der oberen Seitenkanten konisch zum Auslaß (25) verläuft, so daß die Auskleidungsdicke im unteren Teil der Seiten größer ist als im oberen Teil.

Revendications

1. Appareil pour chauffer une matière, comprenant un récipient de forme cylindrique dans son ensemble ou de forme échelonnée ou de forme tronconique, convergeant vers le bas (10), adapté à contenir une proportion de matière à chauffer, orienté selon un axe sensiblement vertical et possédant une sortie centrale (25) prévue au fond du récipient pour décharger la matière chauffée de celui-ci, un dispositif (22) destiné à chauffer la matière présente dans le récipient (10), un dispositif de support (50, 53, 60), disposé dans le récipient et monté pour tourner de façon sensiblement co-axiale avec l'axe du récipient (10) et constituant un support pour le récipient (10) à une certaine hauteur au-dessus du centre de gravité du récipient (10) chargé de matière, caractérisé en ce que sont prévus des dispositifs (51) assujettissant le récipient (10) au dispositif de support (50, 53) et fixés au récipient (10) à une certaine hauteur en-dessous de la hauteur du dispositif de support tournant (50, 53) et permettant l'expansion radiale du récipient (10) par rapport au dispositif de support (50, 53).

2. Appareil suivant la revendication 1, caractérisé en ce que le dispositif de support comprend une structure annulaire ou en forme d'anneau (50) encerclant le récipient (10) et supporté à rotation sur des roues de support (61).

3. Appareil suivant la revendication 1, caractérisé en ce que les dispositifs de liaison (51) sont fixés au dispositif de support (50) à une certaine hauteur au-dessus du centre de gravité du récipient (10) chargé de la matière.

4. Appareil suivant les revendications 1 ou 3, caractérisé en ce que la hauteur du dispositif de support (50, 53) se situe dans la moitié supérieure du récipient (10).

5. Appareil suivant la revendication 1, caractérisé en ce que les dispositifs de liaison (52) sont fixés à une partie inférieure du récipient (10).

6. Appareil suivant la revendication 1, caractérisé en ce que les dispositifs de liaison (51) comprennent une multiplicité d'éléments allongés s'étendant vers le bas depuis le dispositif de support (50, 53) jusqu'au récipient (10).

7. Appareil suivant la revendication 6, caractérisé en ce que les dispositifs de support (51) comprennent une multiplicité de tiges ou barres.

8. Appareil suivant la revendication 7, caractérisé en ce que chaque tige ou barre est oblique par rapport à des plans radiaux du récipient (10).

9. Appareil suivant la revendication 2, caractérisé en ce que les roues de support (61) s'effilent vers l'intérieur en direction de l'axe du récipient



(10) et la surface du dispositif de support (50) qui entre en contact avec les roues de support (61) est constituée par un segment conique (60) en pente vers le bas en direction de l'axe du récipient (10).

10. Appareil suivant la revendication 2, caractérisé en ce que l'anneau de support (50) est retenu horizontalement par des roues (70) portant horizontalement contre une surface périphérique de l'anneau (50).

11. Appareil suivant la revendication 1, caractérisé en ce que la surface de support du dispositif de support (50) est en pente vers et en-dessous du centre de gravité du récipient (10) chargé de matière.

12. Appareil suivant la revendication 7, caractérisé en ce que les extrémités des tiges ou barres

(51) sont reçues à pivotement dans des douilles prévues dans des blocs de support supérieurs et inférieurs (53, 54).

13. Appareil suivant la revendication 2, caractérisé en ce que les roues (61) sont portées à rotation par des palliers (62) qui sont fixés à des éléments de structure immobiles (63).

14. Appareil suivant la revendication 1, caractérisé en ce que le récipient (10) est pourvu d'une matière de garniture (21) présente dans le récipient (10) s'effilant depuis une région proche du bord supérieur des côtés jusqu'à la sortie (25), si bien que l'épaisseur de la garniture est supérieure à la partie inférieure des côtés qu'à leur partie supérieure.

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