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⑤④ **Mixing apparatus having a mixing screw and a conical mixing vessel.**

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## Description

The invention relates to a mixing apparatus having at least one mixing vessel with a conical side wall and vertical axis and having in this mixing vessel a mixing screw which may be driven from above only, which mixing screw is simultaneously rotatable around its axis and around the mixing vessel axis which extends under an angle therewith, the mixing screw shaft being journalled adjacent to its lower end in a rotatable bearing, provided in a housing portion of the mixing apparatus below the vessel bottom, the screw shaft extending through an opening in the vessel bottom and is sealed at the position of this opening by means of a sealing element shaped as a spherical part.

Such mixing apparatus are known, e.g. from the NL-C-162.850. According to that publication the mixing screw shaft is journalled below the vessel bottom by means of the rotary bearing and a universal joint in order to avoid contamination of the bearings by the material to be mixed. A spherical segment with stuffing box at the position of the vessel bottom and a sealing element relative to the screw shaft serve for permitting the passage of the screw shaft through the bottom without loss of contents of the vessel.

Although this apparatus operates satisfyingly a disadvantage is that, if the seals have to be renewed after a predetermined operation period, the universal joint and the rotary bearing have to be demounted in order to obtain access to said seals. This takes much work by a specialized engineer and a rather long non working period of the mixing apparatus.

The invention aims at removing this disadvantage. This is achieved according to the invention in that the lower end of the mixing screw shaft carries a hinge pin with which a vertical connection piece to a vertical inner bearing sleeve of the rotary bearing is articulated, said hinge pin being situated at the position of the opening in the vessel bottom, the lower housing portion of the mixing apparatus comprising an annular horizontal plate which is secured spaced from the vessel bottom through a plurality of vertical columns to said bottom, a second plate, being in engagement with the lower side of said plate, being removably connected therewith, an outer bearing sleeve of the rotary bearing being secured to said second plate.

By releasing the second plate together with the rotary bearing through some simple actions the packing around the sealing element may be easily reached, as well at the lower side of, and also from the lateral side between, the column fixtures.

In that the screw shaft is connected by means of the connecting piece through a vertical rotary bearing the universal joint may be omitted. Due to the fixation through the columns and the absence of the moving universal joint it will now also be visible at an earlier stage when the bottom seal leaks than with the known structure in which material could accumulate within the spherical segment, namely when it is pasty, and then yet could penetrate into the rotary bearing.

For quick release of the lower or second plate from the lower housing portion, preferably the connecting piece is secured to the inner bearing sleeve through a central threaded bolt, which is inserted from below through said sleeve.

In order to prevent that this bolt is overrotated when establishing the connection and thereby is damaged, it is preferable when the head of the central bolt is of such width in radial direction that through it fasteners for clamping the bearing sleeve to the connecting piece may be screwed.

A so-called quick service connection of both housing plates is obtained if the second plate of the lower mixer housing part is connected at a point of its circumference through a hinge connection to a superimposed point of the circumference of the first plate, eye bolts being further, circumferentially spaced, secured to one of the plates for releasably clamping the second to the first plate.

Preferably the sphere centre of the sphere part shaped sealing element is situated in the axis of the hinge pin and is this element substantially rotationally symmetrical with reference to that centre and releasably connected to the screw. In the known structure the screw is fixedly connected with the shaft which rotates relative to the sealing element. Therefore also a seal has to be present between said sphere segment and the shaft. According to the invention the screw rotates relative to the shaft and the sphere may be secured to the screw, since the sphere centre is in the hinge pin and the sphere radius may consequently be small. The spherical surface may then also contain a larger part of the theoretical sphere, on which it is based, than the known sphere segments and yet has sufficient sealing surface. Due to the smaller diameter rotation together with the screw (e.g. 70 rpm) is permitted. The large diameter of the known segment (caused in that the centre must be situated in the axis of the universal joint) would produce excessive heat generation and quick wear of the packing. Moreover, the small diameter results in less space occupied by the sealing element so that it is more compact.

It would also be possible to use a cylindrical sleeve as the sealing element, which is in engagement with a sleeve which extends obliquely according to the inclination angle of the screw shaft and which is secured to a ring which is rotatably provided in the vessel bottom. A disadvantage thereof is that the inclination angle and the axis of the cylindrical sleeve has to be provided very accurately since otherwise undesired tensions and friction will arise.

The sealing means cooperating with the sphere part shaped sealing element may be a stuffing box or a fluid (air) seal.

For demounting the sealing element preferably the vessel bottom has a ring part which is releasably secured in the bottom around the sealing element.

The invention will be further explained below with reference to the drawing which shows as an example an embodiment of the mixer according to the invention.

Fig. 1 shows a longitudinal section through the lower bearing structure of the mixing apparatus.

Fig. 2 is a view from below of the mixing apparatus of fig. 1. The mixing apparatus according to fig. 1 comprises a conical mixing vessel, of which the lower portion of the upright conical wall 1 is visible in fig. 1.

The mixing vessel has a bottom 2. A mixing screw 3 extends into the mixing vessel, said screw being drivable in a known manner (not further shown) at the upper end around its axis with a number of revolutions of e.g. 70 rpm and also, through a swinging arm (not shown), in the position parallel to the conical wall 1 in a rotary movement along said wall and around the mixing vessel axis which includes an angle with the screw. The screw 3 is rotatable around a non-rotating screw shaft 6 through axial slide-thrust bearings 4 and a radial roller bearing 5.

The screw shaft 6 has a clevis-shaped portion, which engages around a vertical connecting piece 7, a hinge pin 8 being provided in transverse direction through said parts.

The connecting piece 7 is secured, in a manner further to be described, to an inner bearing sleeve 9 of a vertical rotary bearing which in the embodiment shown is constituted by two conical roller bearings 10 which are radially enclosed by an outer bearing sleeve 11 and axially by a closure ring 13, secured by bolts 12.

An annular horizontal housing plate 15 is secured to the vessel bottom through columns 14 which are equally spaced around the circumference, e.g. pipe lengths, which are welded to the vessel bottom 2. A second housing plate 16 is releasably secured against the under side of the first housing plate 15 and said second plate is welded by radial connecting strips 17 to the outer bearing sleeve 11 of the rotary bearing.

In the embodiment shown the second plate 16 is connected to the first plate 15 by means of a hinge 18 having a horizontal hinge pin 19. Spaced around its circumference pins 20 for eye bolts 21 are provided on the lower plate 16, said bolts being pivotable around the pins 20 and the bolt shank of each of which may be placed vertically, as seen in figure 1, through radial recesses extending from the outer circumference of the plates 15, 16, whereafter the shanks may be clamped against the upper side of the plate 15 through a nut 22 and a washer 23, whereby both plates 15, 16 may be fixedly mutually clamped.

The connecting piece 7 is secured to the inner bearing sleeve 9 through a central bolt 24, which extends from below through the closure ring 13 and the sleeve 9 and is screwed into a threaded opening at the lower end of the connecting piece 7. In the embodiment shown a widened head 25 is connected to the bolt head through a transverse pin 26, extending radially through the widened head and the bolt head. Stud bolts 27, four in the embodiment shown, are screwed into corresponding threaded apertures of the widened head 25. When the bolt 24 has been screwed into the connecting piece 7, the connection may be tensioned by screwing home the

studs 27 which are in engagement with the lower side of the closure ring 16 and thereby tension the bolt 24 through the head 25. Thereby it is prevented that when screwing the bolts 24 in or out, the screw thread thereof or of the corresponding opening is damaged.

The roller bearings 10 are sealed through a cup ring seal 28 at the lower side of the outer bearing sleeve 11.

The rotary bearing is closed at its lower end by a cover 29, which is secured to the sleeve 11 through bolts 30.

A sphere part shaped sealing element 32 is secured to the lower end of the screw through bolts 31, around the lower end of the screw shaft 6, at the position of the hinge pin 8. Said sphere part shaped element contains a large portion of a sphere and is provided in a corresponding opening in a ring 33, which is secured in the vessel bottom 2 through bolts 34.

As the sealing means a packing 35 with packing gland 36 and press bolts 37 may serve, such as shown in the left portion of figure 1. The sealing means may also be constituted by a fluid or aerodynamic seal, constituted by two vertically spaced discs 38, which are mutually and relative to the sphere part element 35 biased by a spring 39 engaged around a bolt 40 secured in the upper element 38, a plurality of which are provided spaced around the circumference. Through one or more apertures 41 air having a predetermined pressure may be supplied between the elements 38.

In order to demount the structure, e.g. for the replacement of the packing 35 or of the sphere part element 32, the following steps are taken.

The bottom cover 29 is removed by removing the bolts 30, whereby the bolts 27 may be released so that the tension in the connection between the bolt 24 and the connection piece 7 is removed. Thereafter the bolt 24 may be unscrewed by hand and may be taken out. Subsequently the nuts 22 of the eye bolts 21 are released so far that the bolts 21 may be pivoted around the pivot pins 20. Prior to pivoting the last bolt, the second or lower plate 16 of the housing is retained in position through the handle 17, and thereafter the lower plate may be pivoted around the hinge pin 19 together with the rotary bearing 9-11 secured therein. Then the plate 16 may be released and is vertically suspended. If necessary, replacement of the roller bearings 10 or of the seals for the rotary bearing is now easy.

Furthermore the packing gland 36 is now accessible from the under side through the central opening in the annular first or upper plate 15 of the housing, so that the bolts 37 thereof may be taken out, said bolts being also accessible from the side between the columns 14. After removal of the packing gland 36 the packing 35 may be replaced. In the embodiment shown in the right part of figure 1, provided with the fluid seal, the springs 39 may be removed from the bolts 40, whereafter the lower ring 38 may be removed and the O-ring, provided thereon and not indicated by a reference number, may be replaced. Also through an inspection door (not shown) provided in such a mixing apparatus in the wall 1 ad-

adjacent to the bottom 2, the sphere part element 32 may be released from the screw shaft 6 and removed through releasing the bolts 34, whereafter the ring 33 may be taken out.

Remounting may be established by taking the above mentioned steps in reverse order.

### Claims

1. A mixing apparatus having at least one conical mixing vessel with conical side wall and vertical axis and having in this mixing vessel a mixing screw, which is drivable from the upper side only, i.e. the side of the largest part of the conical mixing vessel and is simultaneously rotatable around its axis and around the mixing vessel axis including an angle therewith, the mixing screw shaft being journaled adjacent to its lower end in a rotary bearing provided in a housing portion of the mixing apparatus below the vessel bottom, the screw shaft extending through an opening in the vessel bottom and being sealed at the position of this opening by a sealing means having the shape of a sphere part, characterized in that the lower end of the mixing screw shaft (6) carries a hinge pin (8) to which a vertical connecting piece (7) with a vertical inner bearing sleeve (9) of the rotary bearing is hingedly connected, said hinge pin (8) being situated at the level of the opening in the vessel bottom (2), the lower mixer housing part comprising an annular horizontal plate (15), which is secured spaced from the vessel bottom (2) to said bottom through a plurality of vertical columns (14), a second plate (16) engaged with the under side of the plate (15) being releasably secured thereto, an outer bearing sleeve (11) of the rotary bearing being secured to said second plate.

2. Mixing apparatus according to claim 1, characterized in that the connecting piece (7) is secured to the inner bearing sleeve (9) through a central threaded bolt (24) extending from below through said sleeve.

3. Mixing apparatus according to claim 2, characterized in that the head (25) of the central bolt (24) is widened in radial direction such that clamping screws (27) for clamping the bearing sleeve (9) to the connecting piece (7) may be screwed through it.

4. Mixing apparatus according to one of the preceding claims, characterized in that the second plate (16) of the lower mixer housing part is connected at a point of its circumference through a hinge connection (18, 19) with a superimposed point of the circumference of the first plate (15), while further eye bolts (21) are secured to one of the plates, spaced around its circumference, for releasably clamping the second plate (16) to the first plate (15).

5. Mixing apparatus according to claim 1, characterized in that the sphere centre of the sphere part shaped sealing element (32) is situated in the axis of the hinge pin (8), this element being substantially rotatory symmetrical relative to said centre and being releasably secured to the screw (3).

6. Mixing apparatus according to claim 5, characterized in that a stuffing box (35, 36) is provided around the sealing element (32) in the vessel bottom

(2), having a packing gland (36) situated below the bottom.

7. Mixing apparatus according to claim 5, characterized in that a fluid seal (38, 39), having biasing means (39, 40) situated below the bottom, is provided around the sealing element (32) in the vessel bottom (2).

8. Mixing apparatus according to one of the claims 5-7, characterized in that the vessel bottom (2) has a ring part (33) releasably secured therein around the sealing element (32).

### Revendications

1. Appareil de mélange comprenant au moins un seul conteneur de mélange conique à paroi latérale conique et à axe vertical et prévu dans ledit conteneur de mélange d'une jélice de mélange étant activable seulement du côté supérieur, c'est-à-dire du côté de la partie la plus large du conteneur de mélange conique, et est rotative autour de son axe et autour de l'axe du conteneur de mélange, ledits axes mutuellement délimitant un angle, l'arbre de l'hélice de mélange étant supporté auprès de l'extrémité inférieure dans un palier rotatif, prévu dans une partie du corps de l'appareil de mélange, au dessous du fond du conteneur, l'arbre de l'hélice s'étendant à travers une ouverture dans le fond du conteneur et étant prévu à la position de ladite ouverture d'un élément détaché en forme de partie d'une sphère, caractérisé en ce que l'extrémité intérieure de l'arbre (6) de l'hélice de mélange supporte une cheville d'articulation (8) étant reliée pivotable à une partie (7) verticale de connexion ayant une fourrure (9) intérieure verticale de support du palier rotatif, ladite cheville (8) d'articulation étant située au niveau de l'ouverture dans le fond (2) du conteneur, la partie intérieure du corps de mélange comprenant une tôle (15) annulaire horizontale reliée à une distance du fond (2) du conteneur audit fond au moyen d'un nombre de colonnes (14) verticales, une deuxième tôle (16) contactant la surface inférieure de la tôle (15), étant reliée de façon détachable à ladite tôle, une fourrure (11) extérieure du palier rotatif étant reliée à ladite deuxième tôle.

2. Appareil de mélange selon la revendication 1, caractérisé en ce que la partie (7) de connexion est reliée à la fourrure (9) intérieure du palier au moyen d'un boulon à vis (24) central, s'étendant de dessous à travers ladite fourrure.

3. Appareil de mélange selon la revendication 2, caractérisé en ce que la tête (25) du boulon (24) central est élargie en direction radiale de sorte que des vis (27) de serrage pour serrer la fourrure (9) du palier contre la partie (7) de connexion pourront être vissées à travers ladite tête.

4. Appareil de mélange selon une des revendications précédentes caractérisé en ce que la deuxième tôle (16) de la partie intérieure de corps de mélange est reliée à une position de sa périphérie au moyen d'une connexion (18, 19) articulée à une position située en dessus de la périphérie de la première tôle (15), tandis que d'autres boulons à œil (21) sont reliés à l'une des tôles, répartis autour de sa péri-

phérie, pour serrage détachable de la deuxième tôle (16) contre la première tôle (15).

5. Appareil de mélange selon la revendication 1, caractérisé en ce que le centre sphérique de l'élément (32) d'étanchéité en forme de partie de sphère est situé dans l'axe de la cheville (8) d'articulation, ledit élément étant substantiellement symétrique en direction rotative par rapport audit centre et étant relié de façon détachable à l'hélice (3).

6. Appareil de Mélange selon la revendication 5, caractérisé en ce qu'une boîte à garniture (35, 36) est prévue autour de l'élément (22) d'étanchéité dans le fond (2) du conteneur, ladite boîte comprenant un presse-étoupe (36) situé au dessous du fond.

7. Appareil de mélange selon la revendication 5, caractérisé en ce qu'un joint (38, 39) fluide, ayant des éléments (39, 40) à précontrainte, situés au dessous du fond, est prévu autour de l'élément (32) d'étanchéité dans le fond (2) du conteneur.

8. Appareil de mélange selon une des revendications 5-7, caractérisé en ce que le fond (2) du conteneur comprend une partie (33) annulaire attachée dans ledit fond autour de l'élément (32) d'étanchéité.

#### Patentansprüche

1. Mischer mit wenigstens einem kegeligen Mischbehälter mit keglicher Seitenwand und senkrechter Achse und innerhalb dieses Mischbehälters versehen mit einer Mischschnecke welche nur von der Oberseite, das heisst von der Seite des weitesten Teils des kegeligen Mischbehälters, antreibbar ist und gleichzeitig um ihre Achse und um die Mischbehälterachse rotierbar ist, von welchen die Schneckenachse einen Winkel mit der Mischbehälterachse einschliesst, die Mischschneckenachse in der Nähe ihres unteren Endes in einem Drehlager gelagert ist, welches in einem Gehäuseteil des Mixers unterhalb des Behälterbodens angeordnet ist, während die Schneckenachse sich durch eine Öffnung im Behälterboden erstreckt und an der Stelle dieser Öffnung mittels eines Dichtungsteils in Form eines Kugelteils abgedichtet ist, dadurch gekennzeichnet, dass das untere Ende der Mischschneckenachse (6) einen Gelenkbolzen (8) trägt, mit welchem ein senkrechter Verbindungsteil (7) mit einer senkrechten inneren Lagerbüchse (9) des Drehlagers gelenkig verbunden ist, welcher Gelenkbolzen (8) in der Höhe der Öffnung im Behälterboden (2) liegt, während der untere Mischergehäuseteil eine ringförmigewaagerechte Platte (15) aufweist, welche in einem Abstand vom Behälterboden (2) an diesem Boden mittels einer Anzahl senkrechter Säulen (14) befestigt ist und eine zweite Platte (16), welche die Unterseite der Platte (15) berührt, lösbar an erstgenannter befestigt ist, und eine äussere Lagerbüchse (11) des Drehlagers an der zweiten Platte befestigt ist.

2. Mischer nach Anspruch 1, dadurch gekennzeichnet, dass der Verbindungsteil (7) an der inneren Lagerbüchse (9) mittels eines zentralen Schraubbolzens (24) befestigt ist, welcher sich von unten durch die Büchse hindurch erstreckt.

3. Mischer nach Anspruch 2, dadurch gekennzeichnet, dass der Kopf (25) des zentralen Bolzens (24) in radialer Richtung derart erweitert ist, dass Klemmschrauben (27) zur Festklemmung der Lagerbüchse (9) am Verbindungsteil (7) durch diesen Kopf hindurch schraubbar sind.

4. Mischer nach einem der vorangehenden Ansprüche, dadurch gekennzeichnet, dass die zweite Platte (16) des unteren Mischergehäuseteils in einem Punkt ihres Umfangs mittels einer Gelenkverbindung (18, 19) verbunden ist mit einem darüber liegenden Punkt des Umfangs der ersten Platte (15), während weitere Augenbolzen (21) an einer der Platten befestigt sind, gleichmässig um ihren Umfang verteilt, zur lösbaren Festklemmung der zweiten Platte (16) an der ersten Platte (15).

5. Mischer nach Anspruch 1, dadurch gekennzeichnet, dass der Kugelmittelpunkt des kugelförmigen Dichtungselements (32) in der Achse des Gelenkbolzens (8) liegt, welches Element in der Hauptsache umdrehungssymmetrisch gegenüber diesem Mittelpunkt und lösbar mit der Schnecke (3) verbunden ist.

6. Mischer nach Anspruch 5, dadurch gekennzeichnet, dass eine Stopfbüchse (35, 36) um das Dichtungselement (32) im Behälterboden (2) herum vorgesehen ist, welche Stopfbüchse einen Packungsdrücker (36) aufweist, welcher unterhalb des Bodens liegt.

7. Mischer nach Anspruch 5, dadurch gekennzeichnet, dass eine Mediumsdichtung (38, 39), mit unterhalb des Bodens liegenden Vorspannorganen (39, 40), um das Dichtungselement (32) herum im Behälterboden (2) vorgesehen ist.

8. Mischer nach einem der Ansprüche 5-7, dadurch gekennzeichnet, dass der Behälterboden (2) einen Ringteil (33) aufweist, welcher lösbar darin um das Dichtungselement (32) herum befestigt ist.



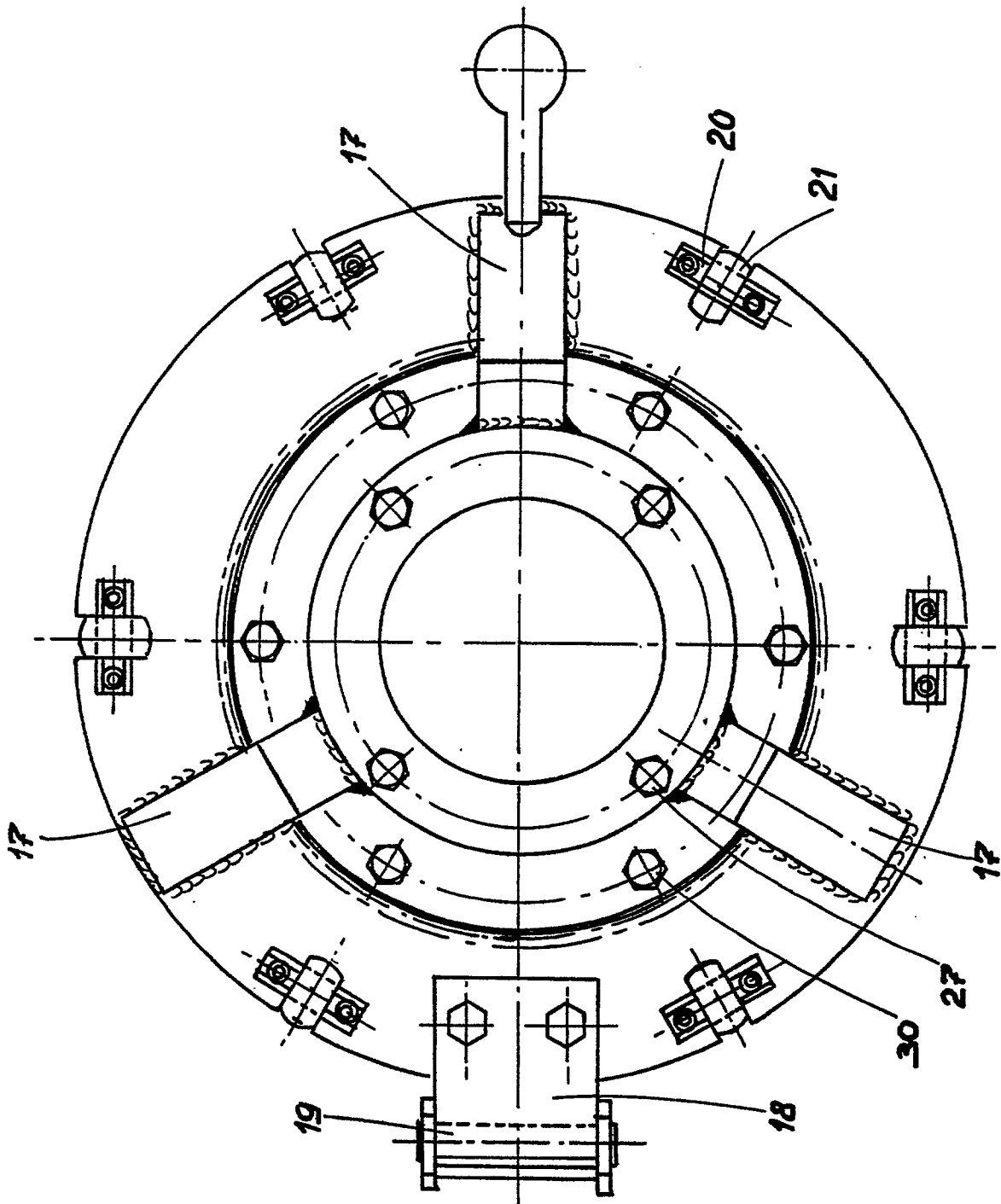


FIG. 2