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SCREW FILTER PRESS

DESCRIPTION

TECHNICAL FIELD

[0001] The invention relates to a worm filter press arranged vertically in space and in which, with the aid of a worm shaft mounted and driven on one side at the upper shaft end, which worm shaft has at least one, but preferably two or more helical threads or "coils" for brevity, a suspension of very finely distributed solid substances in a liquid (so-called suspension) is collected from a supply pipe located at the bottom and conveyed upwards along the coils, wherein the solids make it upwards along the coils as a solid cake to the discharge opening, whilst the liquid flows out via a filter pipe, which coaxially surrounds the worm shaft at least in a lower subregion, into a filtrate chamber, and from there is sucked off.

PRIOR ART

[0002] A worm filter press of this type with the features of the preamble of Claim 1 is known from DE 10 2005 002 997 A1.

[0003] In this known worm filter press, in which the worm shaft is driven at the top by means of a motor and in which the worm shaft is mounted on one side at the top below the motor, the cylindrical filter pipe reaches up to the height of the discharge opening and the worm shaft has a clearance of 0.1 to 0.3 mm from the cylindrical filter pipe over the entire length.

[0004] Furthermore, the worm shaft with filter pipe reaches virtually to the base of the inflow or the inflow pipe, which is arranged at the lower end of the worm shaft. The disadvantage of this known worm filter press lies in the fact that one the one hand, after a relatively short time, the openings of the filter pipe are occluded, because the coil webs or edges wear, solids, such as e.g. sand, settle at the base of the inflow and therefore block the entire inflow, and on the other hand, that the filter cake easily settles in the top part of the coils or the filter cake agglutinates.

[0005] A further disadvantage consists in the fact that due to the sucking in of the suspension in the lower part of the inflow pipe, relatively large parts, such as e.g. stones, are swirled up and make it into the coils, which leads to damage of the coils and the filter pipe.

[0006] A further comparable worm filter press can be drawn from AT 411 892 B, which provides specially constructed coil-edge attachments, which should prevent clogging or occlusion of the drainage openings provided in the filter pipe.

DESCRIPTION OF THE INVENTION

[0007] It is the object of the present invention to overcome the disadvantages of the known worm filter press and to create a worm filter press with little technical outlay, in which a controllable, high dry-substance content and also a high throughput of solids are possible. Furthermore, a pre-separation of coarse solids should be possible during suspension supply, in order to ensure trouble-free operation.

[0008] The solution of the object on which the invention is based is specified in Claim 1. The features which advantageously develop the inventive idea are the subject of the subclaims and also to be drawn from the description, particularly with reference to the exemplary embodiments mentioned.

[0009] According to the solution, a worm filter press as can be drawn from DE 10 2005 002 997 A1 – having a worm shaft having at least one helical thread and two worm shaft ends, the shaft axis of which is orientated parallel to the gravity vector, which is mounted on one side via the upper worm shaft end thereof and connected to a rotary drive, and which is coaxially surrounded at least in the lower subregion thereof in a so-called filter region by a cylindrical filter pipe, which is provided with openings and which is radially adjoined by a filtrate chamber, in which underpressure can be applied – is developed in such a manner that a sliding tube, which corresponds to a so-called cylindrical sliding region, with the same internal diameter as the filter pipe coaxially adjoins the filter pipe and radially surrounds the worm shaft in a fluid-tight manner in the direction of the upper worm shaft end, and that the at least one helical thread of the worm shaft opens radially to the worm shaft in an edge helically surrounding the worm shaft, which edge adjoins the filter tube indirectly or directly at the inner wall in the region of the filter tube.

[0010] By arranging a cylindrical sliding tube or sliding region with the same internal diameter as the filter region, it is ensured that the solid cake is conveyed to the discharge opening without constriction. Both the length of the sliding region, which preferably corresponds to half the length of the filter region, and a play which is preferably present between the outer edges of the coils and the internal diameter of the sliding region on the one hand cause the solid cake to maintain a certain consistency, so that it forms a block against the penetration of air from outside, and on the other hand prevent the solid cake in the sliding region from agglutinating in the coils.

[0011] A preferred arrangement of abrasion-resistant, elastic elements at the outer edges of the coils, which are introduced into the filter pipe under slight prestress, cause the scraping-off of the solids to take place in an optimal manner. Furthermore, the elastic elements form the outer edges with a sliding transition to the coil itself, the solid does not accumulate at an edge and the discharge of the solids is not hindered.

[0012] The construction of the actual scraping lip with a width of 1-3 mm and a height of 2-5 mm has proven particularly advantageous. Because the elastic lip is produced from polyurethane (so-called cellular Vulkollan), the elasticity of the material at these dimensions has a particularly beneficial effect on the scraping action and the service lives of the lips are correspondingly long.

[0013] Manufacturing the elastic elements as prefabricated individual parts, which are adhesively bonded into grooves at the outer edge of the coils or which are connected via adhesive bonding to the outer edge of the groove, is, on the one hand, chosen as a simple method in terms of manufacturing, which allows the production of inexpensive elastic elements. On the other hand, by adhesively bonding into grooves, the drainage required for the solid cake is ensured, because the flow of the solid along the coils is not hindered.

[0014] Due to a radial play of 0.1 to 0.3 mm in the sliding region, it is ensured that the solid does not agglutinate on the coils or in the sliding region at an appropriately set rotational speed and the underpressure applied to the filtrate chamber.

[0015] By changing the rotational speed of the worm shaft and/or changing the underpressure in the filtrate chamber, the consistency of the solid plug in the sliding region can be changed, in order to achieve an optimal solid cake.

[0016] During the start-up phase, in which no solids have been deposited into the grooves yet, the applied underpressure is already effective for filtration, because, due to the liquid level in the collecting basin, the same liquid level is achieved in the sliding region across the bank of pipes. Reference is made at this point to the description of a filter arrangement, which is explained in more detail in Figure 3.

[0017] The described worm filter press has the advantage, that during commissioning, the initially empty coil grooves can rapidly fill with a solid plug, because in the filled state external air can no longer reach the suction chamber, even if the liquid level in the collecting basin is low. Thus, the operating underpressure is set immediately and the differential pressure between atmosphere and underpressure in the suction chamber acts on the solid plug as a drainage pressure.

[0018] So that the solid plug can better overcome the thus-created force to exit upwards, guide grooves are provided inside the inner wall of the sliding tube, which in addition to drainage, form an additional resistance in the circumferential direction of the coil and therefore benefit solid transport upwards, counter to the pressing direction, through the coil web, which is inclined at an angle of preferably 45°. Angles between 20° to 60° are fundamentally suitable for the coil gradient. Gradient angles for the helical thread of between 30° and 50° are particularly preferred, however.

[0019] Thus, the solid throughput can be increased for the same coil grooves. If the suspension has a low solid content, the reduced solid transport requirement can be adapted to demand by reducing the rotational speed.

[0020] Due to the arrangement of a supply line or a bank of pipes and the worm-shaft connectors projecting into the same and also due to a back-and-forth suspension flow in the pipe space of the supply as a consequence of the level-controlled collecting basin, the suspension is kept homogeneous and there is the possibility that larger solid particles in the supply line or the bank of pipes are kept back, so that great operational reliability results. This pipe space can be inspected well and, if necessary, cleaned by means of the stopcocks attached at the respective ends.

[0021] A gradient angle of the worm shaft in a range of 30° - 50° has a positive effect on the separation and conveying of suspensions of this type.

[0022] Having an odd number of coils has a positive effect on mounting the worm shaft in the filter pipe, because the elastic elements, which are introduced into the filter pipe with a slight prestress, are not directly opposite one another.

[0023] Because the collar of the worm shaft is constructed as part of the claw coupling and the matching part of the claw coupling is fastened on the motor as a hub, a reliable, simple coupling is created, which above all takes account of the tight space.

BRIEF DESCRIPTION OF THE INVENTION

[0024] The invention is described by way of example in the following without limitation of the general inventive idea on the basis of exemplary embodiments with reference to the drawings. In the figures:

Fig. 1	shows a longitudinal section through a vertically standing worm filter press according to the invention,
Fig. 2a	shows an edge construction of the coils in the filter region in cross section (Section A-A in Fig. 1),
Fig. 2b	shows an alternative edge construction of the coils in the filter region (Section A-A in Fig. 1),
Fig. 2c	shows a further edge construction of the coils in the filter region as long as the entire worm shaft consists of polyurethane (so-called cellular Vulkollan) (Section A-A in Fig. 1),
Fig. 2d	shows the edge construction of the coils and the guide grooves in the sliding region (Section B-B in Fig. 1),
Fig. 3	shows a plant with four worm filter presses, which are mounted one behind the other, connected to a bank of pipes, and
Figs. 4a-c	show sectional images through the worm coil in different axial positions longitudinally to the worm coil.

WAYS OF REALISING THE INVENTION, INDUSTRIAL USABILITY

[0025] A worm shaft 10, which is standing vertically, i.e. parallel to the acting gravitational force, and can be driven, is arranged coaxially in a vertically standing housing 1, with a central axis 2.

[0026] The housing, which is arranged to be standing, has multiple parts, wherein the individual parts are connected to one another via flanges. The lower part 24 of the housing has a larger outer diameter than the upper part 28 of the housing flanged thereon. The filter pipe 3 is arranged coaxially to the worm shaft 10 in the lower housing part 24. The filtrate chamber 5 is located between filter pipe 3 and housing inner wall 6.

[0027] The lower housing part 24, in which the filter pipe 3 is held between the upper and lower housing flanges 8, 9 and the filtrate can drain through the filter pipe, is also termed filter region F in the following. The upper flange 8 is constructed as a fixed bearing for holding the filter pipe, whilst the housing flange 9 merely prevents a radial displacement of the filter pipe 3.

[0028] The filter pipe 3 has, depending on requirements, openings in the order of magnitude of 0.05 to 1 mm, so that the liquid of the suspension can drain through the openings of the filter pipe 3 into the filtrate chamber 5 between housing inner wall 6 and filter-pipe outer wall 7.

[0029] The filter pipe 3 can consist of a perforated sheet, wherein the through holes are constructed such that they open towards the housing inner wall 6; the filter pipe 3 can however also be a cylindrical disc filter, the openings of which likewise open towards the housing inner wall 6, that is to say open in a conical or funnel-shaped manner towards the housing inner wall. This perforated construction has the advantage that the holes themselves virtually do not clog.

[0030] The filtrate chamber 5, which is formed between housing inner wall 6 and filter-pipe outer wall 7, is delimited at the top by the flange 8, which is connected to the housing 1 and is constructed as described.

[0031] At the bottom, the filtrate chamber 5 is delimited by the housing flange 9, in which the filter pipe 3 is mounted in such a manner that it cannot be radially displaced. A filtrate outlet connection 11 is attached laterally above the housing flange 9, through which connection the liquid of the suspension drains or is pumped out of the filtrate chamber 5.

[0032] In the sense of this description, a suspension is understood to mean a suspension of very finely distributed solid substances in a liquid, as is present e.g. in the case of so-called manure or so-called liquid manure.

[0033] The filtrate outlet connection 11 can be closed by a cock 12, e.g. a ball cock.

[0034] A sliding tube 4 is placed by means of its lower pipe flange 13 on the flange 8, which delimits the filtrate chamber 5 at the top towards the top drive motor/rotary motor 15, and connected to the flange 8 e.g by means of screws.

[0035] The longitudinal axis of the installed sliding tube 4 and the longitudinal axis of the worm shaft 10 are congruent with the central axis 2. Likewise, the internal diameter of the filter pipe 3 and the internal diameter of the sliding tube 4 are the same, i.e. the filter region F and the sliding region G have the same internal diameter.

[0036] The upper part of the housing 28 is delimited at the top by a plate 18. The discharge opening 20 for the solid particles of the suspension is located below the plate 18. The coils 14 of the worm shaft 10 end at a distance from the plate 18. The worm shaft 10 itself, which has a collar 30 at the end, is guided by means of a hub 19, which carries the coupling 17 at the bottom end, as far as the drive shaft of the drive motor 15, e.g. an electric motor, and rotationally connected to the same.

[0037] The worm shaft 10 preferably has two or a plurality of coils 14. An odd number of coils is particularly beneficial. A number of five has proven particularly beneficial in experiments. The number of coils of course depends on the diameter of the worm shaft. In the experiment, the diameter was 75 mm.

[0038] Thus, in the exemplary embodiment, the worm shaft 10 has five coils 14 for a diameter of 75 mm, with a gradient angle of preferably 45°. The gradient angle α should preferably lie in a range of 30° to 50°.

[0039] The worm shaft 10 is driven by means of a drive motor 15. The drive motor 15 is connected to the worm shaft in the circumferential direction by means of a coupling 17, e.g. a claw coupling (not illustrated in detail).

[0040] The fastening of the drive motor 15 takes place on the likewise top bearing plate 16 by means of threaded bolts. The bearing plate is placed onto the vertically standing housing 1, above the bearing of the worm shaft.

[0041] The bearing of the worm shaft, which accommodates both the axial and radial forces, is integrated into the plate 18 of the upper housing part.

[0042] The bearing plate 16, on the upper side of which the motor 15 is fastened, has a spacing from the plate 18, which is used for the connection or coupling of the worm shaft with the motor.

[0043] The discharge opening 20 is arranged at the upper end of the upper housing part. A chute 21 is connected to the discharge opening, on which the solids conveyed to the discharge opening slide into a collecting container (not illustrated).

[0044] The suspension is supplied by means of a housing connector 22 flanged onto the housing flange 9 of the lower housing.

[0045] The housing connector is shaped in such a manner that the worm shaft 10 reaches through the part connected directly to the lower housing approximately as far as the centre of the tubular supply line 23 or the bank of pipes 40 (cf. Fig. 3). The supply line 23 is constructed in the region of the supply as a one-piece part together with the housing connector, onto which part the supply-line parts are welded or flanged (not shown).

[0046] If a worm filter press is then used, then one side of the housing connector is used for connection to the supply line and the opposite side of is used for coupling the routing to a level-maintaining collecting basin 25, which ensures compliance with the maximum and minimum level in the housing of the worm filter press by means of level controllers. The inflow line for the collecting basin is connected to the housing connector on the same axis in the horizontal and has a stopcock 29 or a drainage opening for the supply line; for the most part, the inflow of a flushing line 31 is provided on the opposite side, see Fig. 3.

[0047] If a plurality of worm filter presses are connected one behind the other, the horizontal sides of the housing connectors are connected by means of welding to form a bank of pipes 40 and the worm filter presses are flanged onto the vertically-standing connections. (See Fig. 3 in particular). Of course, a level control, which must be appropriately dimensioned, is also arranged here, as in the case of an individual worm filter press. Flushing line 31 and a stopcock 29 are likewise provided. The supply of the suspension takes place via the connector 35.

[0048] An induced flow, which ensures that the suspension is always evenly mixed, is created in the supply line or the bank of pipes as a consequence of the level control. Relatively large foreign bodies, which are specifically heavier, remain in the lower part of the supply line or the bank of pipes, however.

[0049] Because the worm shaft only reaches approximately to the centre of the supply line or the bank of pipes, coarse solid material can be deposited at the bottom of the supply line and does not make it into the region of the worm shaft. The deposits can be removed from time to time by means of the flushing line 31 via the stopcock 29.

[0050] The worm shaft 10 is, depending on requirements, driven using an electric, pneumatic or hydraulic, speed-regulated motor. In the working range, the number of revolutions lies in the order of magnitude of 30 to 100 rpm.

[0051] A range-splitter gearbox or a range-change gearbox can be arranged on the drive side to achieve the rotational speed, a geared motor can also be used. A claw coupling or, if required, an adjustable overload coupling is used as coupling.

[0052] The filter pipe 3 is made from metal and the holes are machined out towards the housing inside 6, e.g. by means of laser methods in the desired shape, generally with a relatively large hole cross section.

[0053] A cylindrical disc filter can also be used instead of a filter pipe. So that the worm shaft, which is only mounted on one side at the top in the bearing plate, is not damaged when run up to the filter pipe, the worm shaft or the coil thereof is produced from plastic.

[0054] The vertically standing worm filter press can roughly be divided into two regions vertically, which essentially have to fulfil two different tasks.

[0055] The lower housing with the cylindrical filter pipe can be termed filer region F, the upper housing region up to the height of the discharge opening can be termed the sliding region G. The filter region F is approximately twice as tall as the sliding region G.

[0056] The rotating worm shaft 10 conveys the suspension out of the supply line 23 or the bank of pipes 40 and the suspension migrates upwards along the coils. Here, the liquid is separated from the solids, i.e. the liquid flows through the openings of the filter pipe 3 into the filtrate chamber. Here, solid is also thrown against the inner wall of the filter pipe by means of the rotation of the worm shaft.

[0057] The edges of the coils must be constructed in such a manner in this region that they keep the inner wall of the filter pipe clear. This takes place in that the edges scrape off the solids, so that the solids are conveyed further to the discharge opening and the solids form a solid cake with a provided consistency by means of the removal of liquid.

[0058] With increasing desiccation, the solid cake tends to settle on the coil. In the sliding region, in which a solid cake has already formed, the sliding capability of the solid cake is paramount and a further strong desiccation may even cause the solid cake to agglutinate.

[0059] Therefore, in the sliding region, the worm shaft alone has the task of conveying and so that it can fulfil this task, a play 5 of 0.1 to 0.3 mm is provided between the inner wall of the sliding tube and the outer edge of the coils, so that the coils of the worm shaft do not bear against the interior of the sliding tube in the sliding region (cf. Fig. 2d).

[0060] By contrast, in the filter region, the coils edges should remove the solids from the inner side of the filter pipe 3, so that the discharge of the liquid is not hindered.

[0061] Figs. 2a-c show three different options for constructing the elastic elements 38 on the coil edges. Fig. 2a shows the insertion of a strip 32 into a groove 33. The strip consists of an abrasion-resistant and elastic material, such as e.g. polyurethane (so-called cellular Vulkollan).

[0062] Fig. 2b shows a different option for edge construction. Here also, the edges of the coils have been turned and a profile is applied to the edge surface, adhesively bonded either into a groove or to the planar surface, wherein the profile has an attachment 34 pointing towards the filter pipe, which is e.g. approximately 2 mm wide and 3 mm high. Like the strip, the profile consists of the elastic, abrasion-resistant polyurethane (so-called cellular Vulkollan).

[0063] Fig. 2c shows an attachment 34 to the coils as in Fig. 2b. In the worm shaft illustrated in Fig. 2c, the entire worm shaft is manufactured from polyurethane (so-called Vulkollan) or at least the part of the worm shaft in the filter region is manufactured from polyurethane; of course, even in the case of the manufacture of the entire worm shaft from polyurethane (so-called Vulkollan), a play of 0.1-0.3 mm is to be provided in the sliding region between coil edge and inner surface of the sliding tube.

[0064] The edge construction of the coils in the filter region in the described alternatives always has the same dimensions; thus the width of the edges is between 1-3 mm; the height is between 2-5 mm.

[0065] The material mentioned is a cellular Vulkollan, a polyurethane foamed with water, which has very high dynamic properties. Cellular Vulkollan allows approx. 80 % compression for slight lateral expansion and minimal residual deformation (see type list, 1992 edition from Paul Pleiger, Maschinenfabrik GmbH + Co. KG, Im Hammertal 51, 58456 Witten, Germany).

[0066] Due to these physical properties, the worm shaft 10 is introduced into the filter pipe 3 in the filter region under slight prestress. It has therefore proven particularly advantageous to use an odd number of coils e.g. 3, 5, 7 for the installation.

[0067] As already described, the solid is conveyed upwards through the coils 14 to the discharge opening 20. A solid cake forms in the process, which becomes ever more solid the more it migrates upwards.

[0068] In order to accelerate the formation of the solid cake, the underpressure, which is created by pumping out the filtrate, is controlled via the connector 26 by means of a valve 36. In the case of a constant underpressure of approx. 0.5 bar, set at the valve 36, which is acting on the suspension, liquid is not only drawn more heavily from the suspension, rather liquid is also drawn from the solid cake in the sliding region.

[0069] A constant underpressure is first achieved after the start-up phase when a solid cake has formed in the sliding tube 4, so that air influx from the region of the discharge opening 20 is reduced, indeed is virtually suppressed.

[0070] The solid cake itself often has a tendency to agglutination as a consequence of liquid withdrawal. This can cause blockage of the individual coils.

[0071] In order to prevent agglutination on the one hand and too strong a bonding of the solid cake on the coil, particularly the coil base, guide grooves 27 are provided in the sliding tube, cf. Fig. 2d.

[0072] In the exemplary embodiment, eight guide grooves 27 are provided in the longitudinal direction. These guide grooves counteract the blockage of the coils and increase solid discharge. Instead of vertical guide grooves, the latter can also be constructed in a spiral or helical manner.

[0073] Fig. 3 shows a filter arrangement with four worm filter presses mounted one behind the other.

[0074] The suspension is supplied to the four worm filter presses via a supply line 23, of a so-called bank of pipes 40. If the four worm filter presses cannot discharge the quantity supplied by a pump, then the excess is pumped into the collecting basin 25. This is equipped with a level control, so that a top level and a lowest level are defined.

[0075] Thanks to this level control, the suspension is constantly moving in the bank of pipes, either it is flowing to the collecting basin or it is flowing from the collecting basin back to the supply line; this means that the suspension is constantly being thoroughly mixed.

[0076] The top level reaches up to the lower half of the sliding tube 4, the lowest level is in the lower region of the filter pipe. Because the worm shaft 10 only receives suspension from the upper half of the supply line 23, it is ensured that no relatively large solids, which could cause damage, make it into the coils.

[0077] Should solids collect in the supply line or the bank of pipes over time, they can be removed via the stopcock 29, which is connected to the inflow.

[0078] The suspension is conveyed upwards along the coils, wherein, depending on the solid content, the rotational speed of the worm shaft is increased or reduced and/or the underpressure is increased. The rotational speed and the underpressure are constantly being changed in such a manner that the desired consistency is achieved in the solid cake.

[0079] Solid and liquid are separated to the intended extent on the way upwards. When the solid has reached the discharge opening 20, it is discharged. The liquid is pumped away via the filtrate outlet connection 11.

[0080] The coils of the worm shaft 10 preferably have a gradient of between 30° and 50°. A gradient of 45° has proven particularly good.

[0081] If, in the case of a worm filter press as illustrated in Fig. 1, a suspension with a solid content of approx. 3 % is supplied via the housing connector 22, the suspension is conveyed upwards along the helical threads. The liquid of the suspension is filtered through the filter pipe 3 and reaches the filtrate chamber 5. From there, the filtrate flows or is pumped away.

[0082] When the supply of the suspension begins, the worm shaft 10 is set rotating by the drive motor 15 at approx. 50 to 60 rpm. Wherein it is self evident that the coil rotation and the direction of rotation of the motor run in the same direction as long as there is no reversing gear unit connected therebetween.

[0083] The grooves between the coils are constructed in such a manner that, again and again, the coils of the worm shaft press the solids against the filter pipe and subsequently the pipe inner wall of the pipe 4, and attempt to convey the solid for discharge. Therefore, it is important that the design of the groove spaces between the coils is adapted to the accumulation of solids in this respect and that the dwell time of the solid in the coils of the worm shaft can be adapted to the requirements, which is why, inter alia, a rotational speed in a low range of approx. 50 rpm was chosen, or the underpressure is increased. The type of suspension must be taken into account, even when choosing the worm shaft itself.

[0084] In a test plant, the worm shaft had five coils at an overall diameter of the worm shaft of 75 mm. The filter pipe had a hole size of 0.1 mm. The height of the filter region F, from the housing flange 9 to flange 8 was 200 mm. The height of the sliding region G was approx. 100 mm. The worm shaft was rotated at approx. 50 rpm. The discharged solid pellets had a moisture content of approx. 75 %. The underpressure in the filtrate chamber was approx. -0.4 bar.

[0085] The diameter of the cylindrical sliding tube 4 arranged on the same axis and the filter pipe 3 was 75 mm. The guide-groove depth was approx. 1 mm, it had a width of 3 mm and 8 guide grooves were arranged on the circumference.

[0086] Worm filter presses of this type are used for separating solids and liquid in suspensions. Suspensions of this type, often also termed a solid suspension, are generally found for example, in fermenter sludge preparation from biogas plants, in manure preparation, in sewage sludge disposal, in vegetable oil pressing plants, in fruit juice production, in resource recycling in the case of process liquids, in the cleaning of waster water and others.

[0087] In order to optimise desiccation, it may be necessary that the degree of desiccation of the solid pellets is measured continuously or at certain intervals and e.g. the rotational speed of the worm shaft or the underpressure in the filtrate chamber is controlled. The underpressure can be changed by means of a change of rotational speed of the suction pump or by means of an air inlet valve. This can take place manually or via automatic controls.

[0088] A further measure for improving the degree of desiccation can be seen on the basis of an exemplary embodiment illustrated in the Figures 4a, b and c. The Figures 4a to c in each case show radial sectional images through the worm shaft 10 in respectively different axial positions relatively to the worm shaft 10. Figure 4a shows a section through the worm shaft 10 in the sliding region, in which the worm shaft 10 is surrounded by the sliding tube 4. The sliding tube 4 with the worm shaft 10 includes one conveying chamber 41 in each case along the helical threads helically surrounding the worm shaft 10. In a corresponding manner, the filter pipe 3 with the worm shaft 10 also includes one conveying chamber 41 in each case in the filter region, cf. Figures 4b and 4c. It is noted at this point that the radial section shown in Figure 4b lies in the upper region along the filter region and Fig. 4c shows the worm-shaft end, which is surrounded by the filter pipe 3 in the axial viewing direction. It is important that the cross section of the respective conveying chamber 41 decreases from the lower worm-shaft end in the direction of the upper worm-shaft end, as a result of which the compaction effect increases for the material to be conveyed upwards by means of the worm shaft. A worm shaft designed in this manner is principally suited for drying or desiccating suspensions, which contain lightly compressible solid portions.

REFERENCE LIST

[0089]

1	Housing
2	Central axis
3	Filter pipe
4	Sliding tube
5	Filtrate chamber
6	Housing inner wall
7	Filter-tube outer wall
8	Flange
9	Housing flange
10	Worm shaft
11	Filtrate outlet connection
12	Cock
13	Pipe flange
14	Coil/helical thread
15	Drive motor/rotary drive

16 Bearing plate
17 Coupling
18 Plate
19 Hub
20 Discharge opening
21 Chute
22 Housing connector
23 Supply line
24 Lower part of the housing
25 Collecting basin
26 Connector
27 Guide grooves
28 Upper part of the housing
29 Stopcock
30 Collar
31 Flushing line
32 Strip
33 Groove
34 Attachment
35 Connector
36 Valve
37 N.N
38 Elastic element
39 N.N
40 Bank of pipes
41 Conveying chamber
F Filter region
G Sliding region
S Play
α Gradient angle

CSIGÁS SZŰRŐPRÉS

Szabadalmi igénypontok

1. Csigás szűrőprés, legalább egy csigamenettel (14) és két csigatengelyvéggel rendelkező csigatengellyel (10), amelynek hossztengelye a gravitációs erő vektorához képest párhuzamosan van tájolva, amely csigatengely a felső csigatengelyvégen keresztül egy oldalon van ágyazva és egy forgató hajtással (15) van összekötve, és amely legalább az alsó résztartományában, egy úgynevezett szűrési tartományban (F) koaxiálisan egy

nyílásokkal ellátott, hengeres szűrőcső (3) által van körülvéve, amelynek szomszédságában radiálisan kívül egy szűrlettér (5) van elrendezve, amelyben vákuum áll fenn,

azzal jellemezve, hogy a szűrőcsőhöz (3) koaxiálisan egy a szűrőcsővel (3) azonos belső átmérőjű, a csigatengelyt (10) a felső csigatengelyvég irányában radiálisan közegtömör módon körülvevő csúszócső (4) van csatlakoztatva, és a legalább egy csigamenet (14) a szűrőcső (3) és a csúszócső (4) tartományában terjed ki,

emellett a felső csigatengelyvég tartományában a csúszócső (4) egy oldalsó kidobónyílással (20) rendelkezik, és

a csigatengely (10) legalább egy csigamenete (14) a csigatengelyhez (10) képest radiálisan egy a csigatengelyt (10) spirálisan körbefutó élbe fut ki, amely a szűrőcső (3) tartományában közvetve vagy közvetlenül a belső falon a szűrőcsővel (3) határos.

2. Az 1. igénypont szerinti szűrőprés, *azzal jellemezve*, hogy a csigamenet (14) éle mentén a szűrési tartományban (F) egy lehúzóajak jellegű rugalmas elem (38) van elrendezve, amely előfeszítve határos a szűrőcső (3) belső felületével.

3. A 2. igénypont szerinti szűrőprés, *azzal jellemezve*, hogy a rugalmas elem (38) egy rugalmas, kopásálló anyagból van készítve, és

ennek a lehúzóajakként kiképzett rugalmas elemnek (38) 1-3 mm-es szélessége és a csigamenet (14) éléhez képest 2-5 mm-re kiemelkedő magassága van.

4. A 2. vagy 3. igénypont szerinti szűrőprés, *azzal jellemezve*, hogy a rugalmas elem (38) poliuretánból van készítve.

5. A 2-4. igénypontok bármelyike szerinti szűrőprés, *azzal jellemezve*, hogy a rugalmas elem (38) előre gyártott alkatrészként egy az él mentén futó horonyba (33) van beragasztva.

6. Az 1-5. igénypontok bármelyike szerinti szűrőprés, *azzal jellemezve*, hogy a csigatengely (10) legalább egy csigamenete (14) és a csúszócső (4) között egy radiális játék (S) van előirányozva.

7. A 6. igénypont szerinti szűrőprés, *azzal jellemezve*, hogy a radiális játék (S) a csigatengely csigamenete (14) és a csúszócső (4) között 0,1-0,3 mm-t tesz ki.

8. Az 1-7. igénypontok bármelyike szerinti szűrőprés, *azzal jellemezve*, hogy mind a forgató hajtás (15) fordulatszáma, mind pedig a szűrlettérben (5) létesíthető vákuum szabályozható.

9. Az 1-8. igénypontok bármelyike szerinti szűrőprés, *azzal jellemezve*, hogy a csúszócső (4) belső falában axiálisan futó vagy spirál alakú szállítóhornyok (27) vannak elrendezve.

10. Az 1-9. igénypontok bármelyike szerinti szűrőprés, *azzal jellemezve*, hogy a csigatengely (10) páratlan számú csigamenettel (14) rendelkezik.

11. Az 1-10. igénypontok bármelyike szerinti szűrőprés, *azzal jellemezve*, hogy a legalább egy csigamenet (14) emelkedési szöge (α) a 30° és 50° közötti tartományba esik, ahol α a csigatengely hossztengelye és a csigamenet (14) által bezárt szög.

12. Az 1-11. igénypontok bármelyike szerinti szűrőprés, *azzal jellemezve*, hogy a csúszócső (4) csőhosszúsága fele akkora, mint a szűrőcső (3) csőhosszúsága.

13. Az 1-12. igénypontok bármelyike szerinti szűrőprés, *azzal jellemezve*, hogy az alsó csigatengelyvég szabadon egy betápláló vezetékbe (23) nyúlik be és a szűrőcső (3) közegtömör módon van a betápláló vezetékre (23) felszerelve.

14. Az 1-13. igénypontok bármelyike szerinti szűrőprés, *azzal jellemezve*, hogy a csigatengely legalább egy csigamenete a szűrőcsővel és s csúszócsővel együtt egy a csigatengelyt spirálisan körülvevő szállítóteret zár közre, és ez a szállítótér a szűrőcső tartományában nagyobb szállítótér-keresztmetszettel rendelkezik, mint a csúszócső tartományában.

15. A 14. igénypont szerinti szűrőprés, *azzal jellemezve*, hogy a szállítótér-keresztmetszet az alsó csigatengelyvégtől növekvő távolságra folyamatosan összeszűkül.

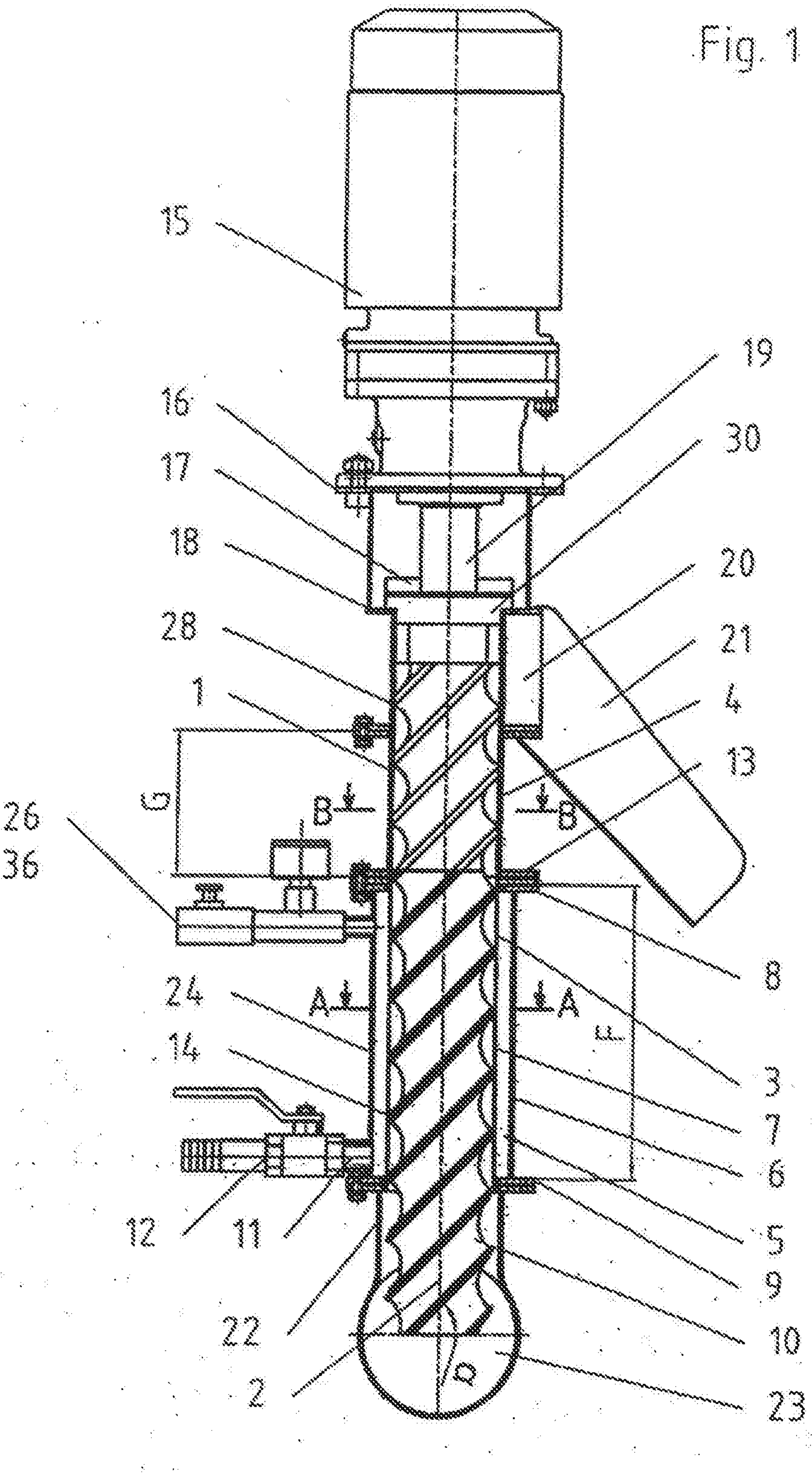
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Fig. 1

Fig 2a
Section A - A

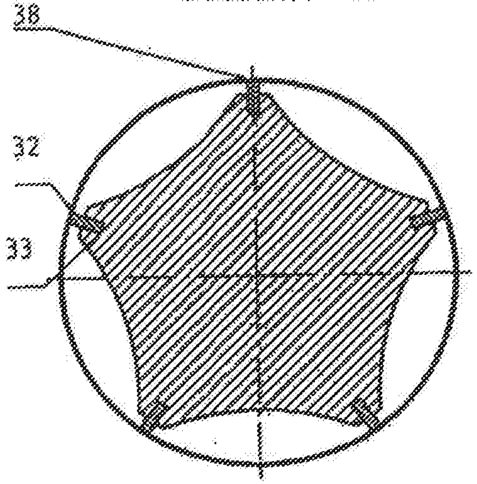


Fig. 2b
Section A - A

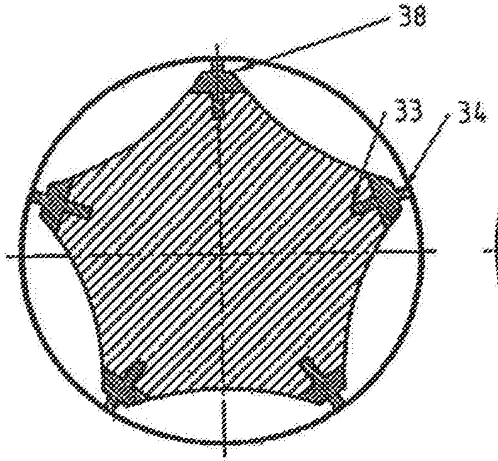


Fig. 2c
Section A - A

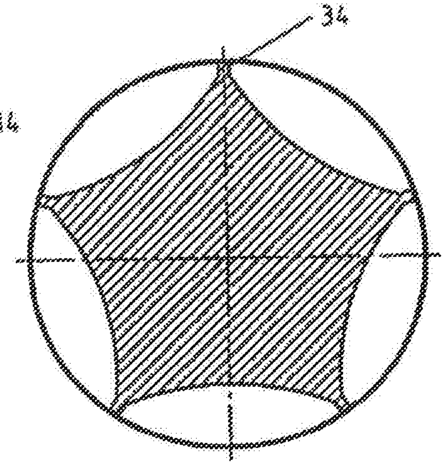
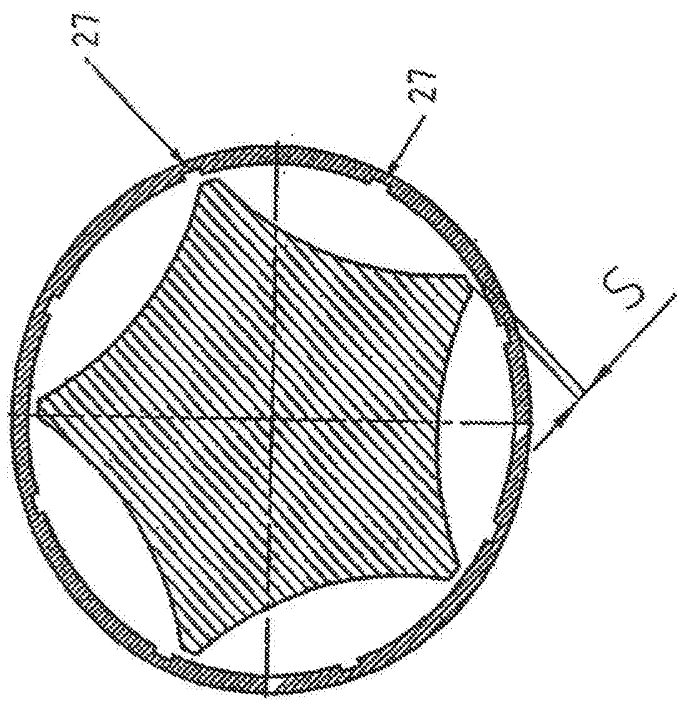


Fig. 2d

Section B – B



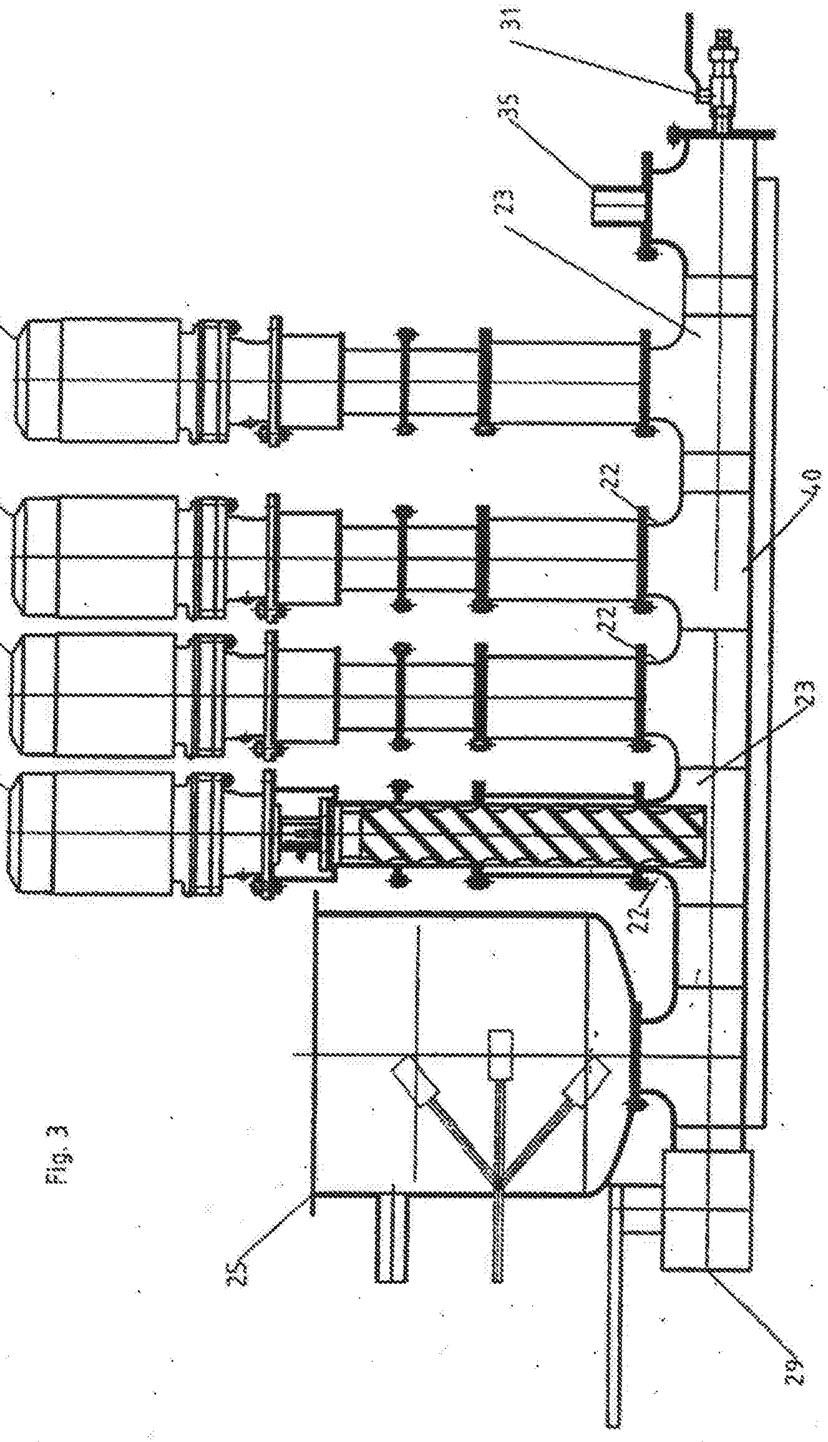


Fig. 3

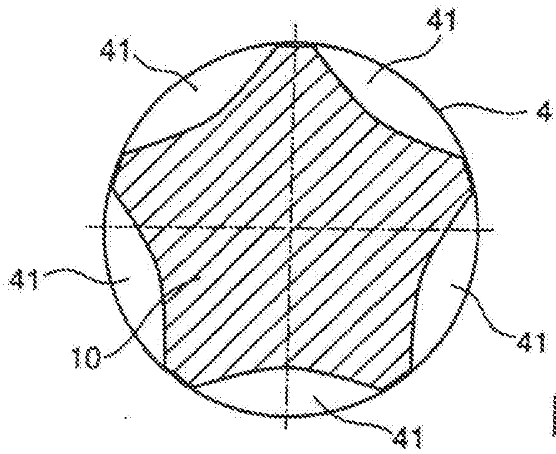


Fig. 4a

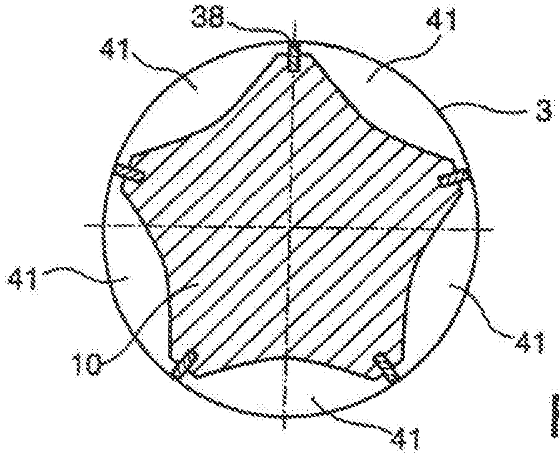


Fig. 4b

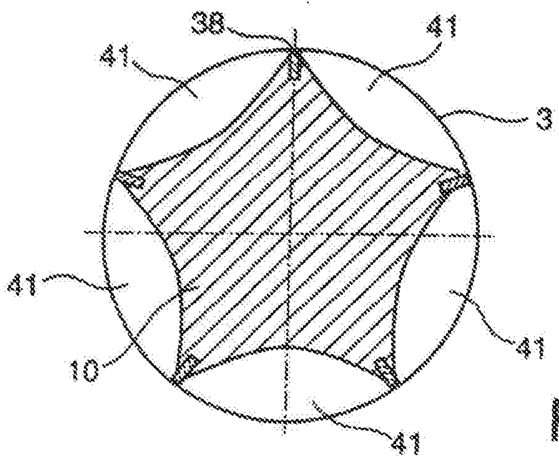


Fig. 4c