

Separator with direct drive

The invention relates to a separator with the features of the preamble of claim 1.

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Separators of this type which are also suitable for an industrial application, especially also in continuous operation, are known from the prior art per se.

10 The power transmission from the electric motor to the rotor is often carried out via a drive belt or by means of a helical gearing.

Under the known systems there are, furthermore, also
15 constructions in which the drum, the drive spindle and the electric drive motor are rigidly connected to form a modular unit which is then as a whole elastically supported on a machine frame. The generic GB 368 247, FR 1.287.551, DE 1 057 979 and DE 43 14 440 C1 disclose
20 examples of such a prior art. It is disadvantageous that such arrangements are of relatively large construction, especially also in the radial direction (GB 368 247).

25 In this context, reference is also to be made to EP 1 617 952 which again has embraced the constructional basic principle of GB 368 247, wherein in comparison to GB 368 247 the supporting of the weight of the centrifugal drum is carried out on the neck bearing
30 (upper bearing) and not on the foot bearing (lower bearing). Overall, the constructional design of this separator drive also is still relatively costly, however. Moreover, the type of lubrication and cooling of the electric motor are also still in need of
35 improvement.

Finally, reference is also to be made to DE 513 192 in relation to the prior art. This document discloses a

centrifugal spindle in which the drive motor is admittedly arranged in an axial extension of the rotational axis of the centrifugal drum coaxially to this but in which the drive spindle passes through a
5 pipe section, wherein the drive spindle and the pipe section in the case of DE 513 192 are connected in the region of a foot bearing, whereas the pipe section and the drive spindle in a relatively more expensive type of construction have separate neck bearings and only
10 the drive spindle is supported in a radially elastic manner on a machine frame. This type of construction is therefore very costly. The drive housing itself is designed in two parts, wherein an upper part bears on a lower part by means of a flange. There is lubrication
15 with oil but no cooling with a coolant in addition to the lubricant. The stator is fastened directly on the outer circumference of the drive housing.

Overall, the structural design of the known
20 constructions is relatively costly and not adaptable to different application purposes with sufficient flexibility. The cooling of known drive devices, moreover, appears to be worthy of improvement.

25 In this respect, the modern constructions of DE 10 2006 011 895, DE 10 2006 020 467 A1 constitute a development. Deviating from their construction principle, however, there continues to be a demand for compact separator drives which are easily adaptable to
30 different application purposes and have a perfected and efficient cooling system.

Embodiments of the invention seek to provide a separator which is distinguished by a compact type of
35 construction and especially also by a low maintenance requirement and preferably also an efficient cooling system.

According to an aspect of the present invention, there is provided a separator, which features the following: a centrifugal drum with vertical rotational axis, a drive spindle for the centrifugal drum, which by a neck bearing and a foot bearing is rotatably mounted in a drive housing which encloses or forms a drive chamber, an electric motor, which has a stator and a motor rotor, wherein the motor rotor is arranged in the drive chamber of the drive housing directly on the drive spindle in the axial region between the foot bearing and the neck bearing, wherein the stator is also directly supported in the drive housing and wherein an air gap exists between the stator and the motor rotor, wherein the stator and the motor rotor are arranged between the neck bearing and the foot bearing in an open manner in the drive chamber which is otherwise completely or in the main closed toward the outside, wherein provision is made for a lubricating system for the lubrication of especially the neck bearing and the foot bearing, which is wholly or partially integrated directly into the drive chamber, wherein provision is made for a coolant system comprising a coolant circuit for a free flowable coolant, which is wholly or partially integrated directly into the drive housing, the coolant system, at least in certain sections, is adjacent to a lubricant channel for the passage of liquid and, in the drive chamber, flowing lubricant and in that it is also adjacent, at least in certain sections, to the stator, and in that the stator has a sleeve body on its outer circumference, the sleeve body having a flange section for locating and resting, on a corresponding collar section of the inner circumference of the drive housing.

35 The simple installation and maintenance of the separator drive and also the advantageous cooling system both for the cooling of the motor and of the

liquid lubricant which flows back vertically from the top downwards in the drive chamber are to be referred to as being particularly advantageous. Creating lubricant mist is not necessary with this but
5 lubricating of the bearings of the drive spindle with flowing, liquid lubricant can be used directly so that no lubricant can enter the electric motor itself, which would be unavoidable when using an oil mist system. The rotor is mounted directly on the drive spindle
10 which is radially movable in this region and on the end of which is mounted the drum.

In this case, the cooling system - being a cooling circuit for a cooling fluid, especially water - is
15 preferably and advantageously integrated wholly or partially directly into the drive housing, whereas the electric motor - especially the stator - itself does not have a separate liquid cooling system built into it. In such a way, the electric motor - especially the
20 stator as a preassembled modular unit without a liquid cooling device - can be designed in a particularly cost-effective manner. In addition to cooling with the coolant, there is preferably lubrication with a lubricant. Different liquids are preferably used as the
25 lubricant and the coolant.

Advantageous embodiments are to be gathered from the dependent claims.

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The invention is described in more detail below based on exemplary embodiments with reference to the drawing. In the drawing:

5 Fig. 1 shows a sectional view of a schematically represented first separator according to the invention; and

Fig. 2 shows a sectional view of schematically
10 represented second separator according to the invention.

Fig. 1 shows a separator 1 with a centrifugal drum 2 with a vertical rotational axis D, the separator being
15 enclosed by a hood arrangement 3 which is supported on a machine frame-like drive housing 4. The drive housing 4 can be supported on a foundation, preferably in a sprung design, via foot elements - not shown here.

20 The centrifugal drum 2 is shown only schematically here. It is preferably designed for a continuous operation for the continuous clarification and/or separation of a free-flowable product in one or two liquid phases and, if necessary, in one solid phase -
25 especially in the industrial process. To this end, its interior space is preferably provided with a separating plate stack. The hood arrangement 3 is also shown only schematically. It can especially have a solid material collector and also one or more lead-throughs for
30 product feed and discharge pipes - not shown here. These features have been known to the person skilled in the art for a long time and do not require a more detailed description here.

35 The preferably single or double cone centrifugal drum 2 is mounted on the vertical upper end, in this case, of a drive spindle 5. This drive spindle 5 is rotatably

mounted by a bearing arrangement which in this case has a neck bearing 6 and a foot bearing 7.

The neck bearing 6 is radially supported, in this case
5 via at least one elastic element, in a bearing housing
9 which in its turn is fastened on the drive housing 4.
Here, the bearing housing 9 has a flange section 10 for
this purpose which bears on a first - vertically upper
- collar 11 on the inner circumference of the drive
10 housing 4 and is fastened there, in this case by
circumferentially distributed first screws 12. The
bearing housing 9 and the neck bearing preferably and
advantageously form a preassembled and exchangeable
modular unit. The elastic element consists in this
15 case - also preferably and in a simple type of
construction - of two metal sleeves 8', 8''' which are
interconnected by means of a ring consisting of
elastomer material 8''. The outer ring or the outer
sleeve 8' is machined on the outside in this case so
20 that it is guided in the housing in an accurately
fitting manner. The elastic element is preferably
fixed here, for example pressed in and therefore
secured axially and to counteract co-rotation. The
inner ring or the inner sleeve 8''' is machined on the
25 inside so that the rolling bearing is preferably
movably guided by its outer ring.

Further known alternative constructional forms for this
elastic neck bearing support are possible, for example
30 spring pistons with helical springs, leaf springs,
pneumatic springs, etc.

The neck bearing 6 is preferably designed as a rolling
bearing which in this case rests on a ring 13 which in
35 its turn is seated on the spindle 5 and towards the
bottom rests there on a diameter step 14 of the spindle
5. The neck bearing is vertically axially guided and
radially supported in the elastic element.

The foot bearing 7 is designed as an axial fixed bearing and is preferably arranged in a rotation-resistant manner on the drive spindle 5. The foot bearing is also arranged in the drive housing 4 via inner ring 18 and outer ring 19 in an articulated, cardanically inclinable but, with regard to the ring 18, non-rotatable manner (articulated element 15) and/or itself is designed like a pivot bearing so that the drive spindle 5 together with the drum can follow the precessional movements of the centrifugal drum 2 during operation.

The resistance to rotation of the foot bearing 7 is achieved here by way of example by means of a pin 42 which is inserted in each case into an opening of the inner ring 18 and of the drive housing.

In this case, the weight of the centrifugal drum together with all the drive parts which are connected to the spindle are supported in the drive housing 4 for the most part via the lower foot bearing 7. Accordingly, use is preferably made here of a rolling bearing which in a suitable manner can absorb the emerging axial forces. Deep groove ball bearings or angular contact ball bearings, for example, are suitable for this. If required, these bearings can also be arranged in pairs if the forces which are to be absorbed require this.

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The described pivot bearing undertakes the cardanic inclinability and support in this case.

The entire unit consisting of pivot bearing and rolling bearing, in the event of small forces, especially axial forces, which are to be absorbed can be replaced by a self-aligning bearing or pivot roller bearing.

Towards the top, the foot bearing 7, by its inner circumference, in this case butts against a further diameter step 16 of the drive spindle 5 and towards the bottom, by its outer circumference, butts against a
5 step 17 of an inner ring 18, having a spherical segment-like outer circumference, which inner ring in its turn engages in an articulated manner in a correspondingly complementarily formed outer ring 19 which rests on a step 41 of the drive housing 4.

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This arrangement is of compact construction and in a simple and reliable manner enables the supporting of the weight of the centrifugal drum 2 on the drive housing 4 via the foot bearing.

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An electric motor 20 with a rotor 21 and a stator 22 is arranged as a drive device in the axial region between the bearings. This lies entirely between the neck bearing 6 and the foot bearing 7.

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In this case, the rotor 21 is arranged and fastened directly on the drive spindle. As a result, the rotor 21 and the rotatable drive spindle 5 move together in a fixed coupled manner, especially also during
25 precessional movements of the drive spindle 5 during operation. The drive spindle 5 in this case can have a suitable contouring - e.g. stepping - on its circumference for the fixing or arranging of the rotor 21.

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The stator 22 is fixedly connected to the drive housing 4 in this case. In this way, the radial gap width between the stator 22 and the rotor 21 alters during operation as a result of the movements of the drive
35 spindle 5.

The drive spindle 5 admittedly also executes its precessional movement, as a result of centrifugal laws,

between the neck bearing 6 and the foot bearing 7 (as a fixed bearing), but this can be definably limited (stop) in this region so that with the aid of a corresponding air gap between the stator 22 and the motor rotor 21 it can be ensured that the rotor 21 and the stator 22 do not come into contact during operation despite radial relative movement. Such relative movements can occur, and possibly have their greatest deflections, for example as a result of unbalanced masses, especially in the range of the resonance frequency of the system when the drum is running up, or for example as a result of movements of the complete machine due to wave influence when being used on board ships.

The support which is formed in the foot bearing 7, designed as a pivot bearing, (which essentially undertakes the axial supporting of the centrifugal drum 2), and in the elastically supported neck bearing 6 advantageously enables a supercritical operation of the motor rotor 21 and the centrifugal drum 2 with regard to the resonance frequency. The mass characteristics of the motor rotor 21 are so small in this case that they do not have a negative effect upon the dynamic behavior of the drive system.

The separator drum together with the spindle and the neck bearing support form in a first approximation a single-mass oscillator which is excited as a result of the rotating drum and especially as a result of the co-rotating unbalanced mass. The elastic neck bearing support significantly lowers its natural frequency in relation to approximately rigid constructions. That rotational speed at which the forces created by the rotating drum and co-rotating unbalanced mass set the machine in resonance oscillations is referred to as the critic rotational speed (or frequency). (The excitation frequency ((drum rotational speed)) is the

same as the natural frequency of the system in this case). Above this frequency (rotational speed), the system stabilizes since unbalanced mass and rotor center of gravity lie on opposite sides of the actual rotational axis here. Separators are usually operated with their operational rotational speed significantly above the critical rotational speed (resonance frequency) so that a larger unbalanced mass is also endured by the machine without damaging effects.

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Unlike in the case of the prior art, the entire stator 22 together with the winding region 23 with the end windings and the stator plate packets 23' and sleeve body 24, and also the entire rotor 21, are preferably and compactly arranged axially between the neck bearing neck bearing 6 and the foot bearing 7.

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For the fastening of the stator 22 on the machine housing 4, it is advantageously provided here to enclose the winding region 23 together with the stator plate packet(s) of the stator 22 by a sleeve body 24 which - preferably at its vertically upper end - has a flange section 25 which butts against, or rests on in this case, a corresponding collar section 26 on the inner circumference of the drive housing 4. For the fastening of the flange section 25 and the collar section 26 provision is made for suitable fastening means, in this case one or more (circumferentially distributed) screws 27.

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In the design of the stator, it is primarily particularly advantageous that the stator, simply prefabricated as a preassembled unit, can be fastened in the drive housing by means of the radially outer sleeve body 24.

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Moreover, on account of the selected type of construction motors (stators 22 and rotors 21) of

different length and therefore of different motor capacities can be fastened in a simple manner on the flange section 25, which a comparison of Figures 1 and 2 especially also illustrates.

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The constructions of Figs. 1 and 2 are largely structurally the same and in the main differ only by the axial overall length of the electric motors 20 and 20'. As is evident, the axial overall length of the electric motor 20, 20' can vary within a considerable range, which advantageously enables the same drive housings 4 to be used for electric motors 20, 20' of different length and capacity.

15 A comparison of Figs. 1 and 2 makes it clear that in the case of stators 22 of different lengths the sleeve body 24 which is used as the interface of the stator 22 to the drive housing 4 has the same vertical overall length, however. Even a sleeve body 24 which is structurally the same is preferably used despite a different vertical length.

The electric motor can be an asynchronous motor or a synchronous motor.

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The drive chamber 28 in the upward direction (up to an annular gap 29 for the drive spindle 5 above the neck bearing 6) and in the downward direction, and also to the side, is preferably and advantageously as far as possible a closed design.

If higher quality sealing is required between drive chamber and drum chamber, a labyrinth seal or a corrugated ring seal of known type of construction (not shown here) can be used in addition to the annular gap.

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The stator 22 and the rotor or motor rotor 21 are arranged between the neck bearing 6 and the foot bearing 7 in an open manner in the drive chamber 28.

- 5 In the constructions of Figs. 1 and 2, the embodiment of the functional areas of "lubrication" and "cooling of the components of the drive region and of the lubricant" also offer particular advantages.
- 10 First of all, the lubrication system may be considered in more detail.

The drive spindle 5 is of hollow design or has an inner central lubricant pipe or hole 30 which extends axially
15 from a region beneath the foot bearing 7, through the region of the rotor 21 of the electric motor 20, into the region of the neck bearing 6 where the lubricant pipe 30, via a radial lubricant feed hole 31, preferably opens into the drive chamber 28,
20 specifically in such a way that lubrication of the neck bearing 6 can be carried out with the lubricant issuing from this hole 31.

The lubricant feed hole 31 therefore preferably opens
25 into the drive chamber above the neck bearing 6. Alternatively, it could also open into the drive chamber 28 just below the neck bearing 6 if as a result of this sufficient lubrication of the neck bearing 6 is ensured.

30 Integrated into the lower (preferably open) spindle end is in this case a lubricating pump (especially a suction pipe pump or a centrifugal pump; in this case realized with a fin arrangement 32 on the inner
35 circumference of the axial lower end of the lubricant hole 31). The fin arrangement together with the dimensioning of the inlet diameter allows a particularly accurate oil volume control (-adjustment)

and, if necessary, can be matched to the lubricant or to the operating conditions, such as the installation location (ambient temperature), and can be of exchangeable design.

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Since the lower end of the drive spindle 5 together with the lubricant pump immerse into a lubricant sump 33, lubrication of the neck bearing 6 is carried out in a simple and reliable manner by means of the drive spindle 5 and its pipe 30 and the lubricant feed hole 31.

Lubricant (especially oil) which passes through the neck bearing 6 and lubricates this runs or trickles downward in the drive chamber 28.

It is therefore advantageous that the ring 13 is arranged on the drive spindle 5 beneath the neck bearing 6 between this and the electric motor 20, which ring has a radial collar 38 so that during operation it forms a slinger ring which throws the lubricant in the drive chamber 28 radially outward during rotations of the drive spindle 5, which prevents the lubricant from being able to trickle directly into the electric motor 20. As a result of this, the effect of oil taking the path back into the sump through the gap between the stator 22 and the rotor 21 is prevented. The oil runs downward on the inner wall of the drive housing 4 and through the holes back into the oil or lubricant sump 33. The motor is shown schematically here in a different manner on the left and right of the rotational axis in order to make the understanding easier.

Outside the stator 22, one or more especially vertically extending holes or the like are preferably designed as a lubricant channel 34 in the radially inwardly projecting collar section 26 of the machine housing 4, through which channel the lubricant is

directed in the main radially outward past the stator 22 and the motor rotor 11 on its path downward into the lubricant sump 33.

5 The foot bearing 7 can be located completely beneath the lubricant level in the lubricant sump 33 or can be arranged completely in the lubricant bath.
The end winding temperature as a rule is very high. In this case, these end windings are at a distance which
10 is far to the right of the bearings which is an advantage compared with the prior art. Since the foot bearing 7 lies in the oil sump in this case, it can also be kept cool particularly well. Since the neck bearing 6 is lubricated with flowing lubricating
15 substance, it is, moreover, also cooled better than in the case of an oil mist lubrication system, as is known from the prior art.

In this case, the lubricant can flow back again through
20 further channels/holes 35 into a region of the drive chamber 28 lying beneath the foot bearing 7 in order to be able to enter the pipe 30. As an option, a drain screw 39 enables draining/changing of the lubricant.

25 The lubricant level preferably lies just below the electric motor 20 without having to come into contact with this.

The heat capacity which results from the losses of the
30 electric motor can be radiated on one side over the surface of the drive housing or a correspondingly designed surface enlargement (e.g. cooling fins on the outer surface of the drive housing 4 over the entire axial length between the neck bearing and the foot
35 bearing 7 in a correspondingly large design). Alternatively or additionally, it is conceivable to direct a coolant through channels and, if necessary,

through chambers in the drive housing in order to cool the lubricant.

This coolant preferably and especially advantageously
5 cools both the lubricant and the electric motor (especially the stator 20) in the process.

This is realized in a simple manner here, as follows.

10 Provision is made in the drive housing of Figs. 1 and 2 for a coolant feed pipe 35 and a coolant discharge pipe 36 for a cooling liquid or a cooling gas, which open into at least one chamber, preferably an annular chamber 37, which is formed in the drive housing 4 or
15 formed in a constructionally particularly simple and practical manner between the drive housing 4 and sections of the sleeve body 24. Additional components such a coolant pump and possibly a filter for completion of the coolant circuit are not shown here
20 since they are known per se.

In such a way, the lubricant flowing through the lubricant channel 34 is cooled. Furthermore, the stator 20 is also cooled in a particularly effective
25 manner. For the sake of clarification, reference may be made here to Fig. 2.

In Fig. 2, it is evident that the cooling of the electric motor 20 is carried out in the main by means
30 of the chamber, especially the annular chamber of the cooling circuit which is integrated into the drive housing 4.

The actual electric motor, admittedly in this case by
35 the sleeve body 24, also delimits the cooling chamber, in this case the annular chamber 37. However, the motor itself does not have to have a separate cooling system. This simplifies its installation and also the

exchange which, moreover, becomes particularly cost-effective as a result of this measure. The stator 22 of the electric motor 20 itself can be provided and exchanged in a particularly simple manner as a
5 prefabricated module. It would also be conceivable to delimit the annular chamber on the inside with an additional sleeve, which, however, is less preferable.

Since the cooling circuit in one region, especially in
10 the region of the chamber, especially the annular chamber 37, is adjacent both to the stator 22 - in this case the sleeve body 24 - and closely to the at least one of the holes of the lubricant channel which directs the lubricant as a liquid, flowing lubricating
15 substance past the electric motor downward back into the lubricant sump, double cooling is achieved in a simple manner. In this case, one or more seals 40 can be advantageously arranged on the inner circumference of the sleeve body in order to seal the gap between the
20 sleeve body 24 and the collar section 26 (or the cooling chamber). The sleeve body 24 therefore forms one of the walls of the annular chamber 37 in a constructionally particularly simple manner.

25 Sight glasses 43 in the outer wall allow a visual check especially of the lubricating system, especially since in this case one of the sight glasses lies vertically level with the maximum lubricant level so that the lubricant level can be monitored, wherein a second
30 (upper in this case) sight glass 43 enables the view into lubricant channel 34 and therefore into the oil return.

Since the drive apart from the neck bearing 6 and the
35 foot bearing 7 operates with low wear, a large part of the customary maintenance cost is omitted, which lowers the operating costs.

List of designations

	Separator	1
5	Centrifugal drum	2
	Hood arrangement	3
	Drive housing	4
	Drive spindle	5
	Neck bearing	6
10	Foot bearing	7
	Sleeves	8', 8'''
	Elastomer	8''
	Bearing housing	9
	Flange section	10
15	Collar	11
	Screws	12
	Ring	13
	Diameter step	14
	Articulated element	15
20	Diameter step	16
	Step	17
	Inner ring	18
	Outer ring	19
	Electric motor	20
25	Rotor	21
	Stator	22
	Winding region	23
	Stator plate packet	23'
	Sleeve body	24
30	Flange section	25
	Collar section	26
	Screws	27
	Drive chamber	28
	Annular gap	29
35	Lubricant pipe	30
	Lubricant feed hole	31
	Fins	32
	Lubricant sump	33

	Lubricant channel	34
	Channels	35, 36
	Annular chamber	37
	Radial collar	38
5	Drain screw	39
	Seals	40
	Step	41
	Pin	42
	Sight glasses	43
10	Rotational axis	D

Claims

1. A separator, which features the following:
 - a. a centrifugal drum with vertical rotational axis,
 - 5 b. a drive spindle for the centrifugal drum, which by a neck bearing and a foot bearing is rotatably mounted in a drive housing which encloses or forms a drive chamber,
 - 10 c. an electric motor, which has a stator and a motor rotor,
 - d. wherein the motor rotor is arranged in the drive chamber of the drive housing directly on the drive spindle in the axial region between the foot bearing and the neck bearing,
 - 15 e. wherein the stator is also directly supported in the drive housing and wherein an air gap exists between the stator and the motor rotor,
 - f. wherein the stator and the motor rotor are arranged between the neck bearing and the foot bearing in an open manner in the drive chamber which is otherwise completely or in the main closed toward the outside,
 - 20 g. wherein provision is made for a lubricating system for the lubrication of especially the neck bearing and the foot bearing, which is wholly or partially integrated directly into the drive chamber,
 - 25 h. wherein provision is made for a coolant system comprising a coolant circuit for a free flowable coolant, which is wholly or partially integrated directly into the drive housing,
 - 30 i. the coolant system, at least in certain sections, is adjacent to a lubricant channel for the passage of liquid and, in the drive chamber, flowing lubricant and in that it is also adjacent, at least in certain sections, to the stator, and
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- j. in that the stator has a sleeve body on its outer circumference, the sleeve body having a flange section for locating and resting, on a corresponding collar section of the inner circumference of the drive housing.
- 5
2. The separator as claimed in claim 1, wherein the coolant system has a chamber, especially an annular chamber.
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3. The separator as claimed in claim 2, wherein coolant channels are formed in at least one wall of the drive housing and open into the chamber.
- 15
4. The separator as claimed in claim 3, wherein the chamber, especially the annular chamber, is directly adjacent to the lubricant channel and directly to the stator.
- 20
5. The separator as claimed in any one of the preceding claims, wherein the stator together with the sleeve body form a preassembled, exchangeable modular unit.
- 25
6. The separator as claimed in claim 2, wherein the sleeve body in the

installed state in the drive housing forms a boundary wall of the chamber, especially of the annular chamber of the coolant circuit.

- 5 7. The separator as claimed in any one of the preceding claims, wherein the neck bearing is arranged in a bearing housing which has a flange section, wherein the bearing housing and the neck bearing form a preassembled and exchangeable modular unit.
- 10
8. The separator as claimed in any one of the preceding claims, wherein the neck bearing is supported in the drive housing via at least one elastic element and in that the foot bearing is designed like a pivot
- 15 bearing or is arranged in the drive housing in an articulated manner so that the drive spindle can follow precessional movements of the centrifugal drum during operation.
- 20 9. The separator as claimed in any one of the preceding claims, wherein a rotating system together with the centrifugal drum and the drive spindle are supported in the drive housing essentially axially via the foot bearing.
- 25
10. The separator as claimed in any one of the preceding claims, wherein the drive spindle is of hollow design and has an axial inner lubricant pipe which extends from a region beneath the foot bearing,
- 30 axially through the

region of the motor rotor, into the region of the neck bearing where the lubricant pipe opens into the drive chamber.

- 5 11. The separator as claimed in any one of the preceding claims, wherein a lubricant feed hole opens into the drive chamber above or below the neck bearing.
- 10 12. The separator as claimed in any one of the preceding claims, wherein a lubricant pump is arranged or formed at the lower end of the drive spindle.
- 15 13. The separator as claimed in claim 12, wherein the lubricant pump is designed as a centrifugal pump or in that the lubricant pump is designed as a suction pipe pump.
- 20 14. The separator as claimed in any one of the preceding claims, wherein a slinger ring is arranged or formed on the drive spindle in the axial region between the neck bearing and the electric motor.
- 25 15. The separator as claimed in any one of the preceding claims, wherein a lubricant sump is formed in the lower region of the drive chamber, into which flows back the lubricant flowing back from the lubricant channel.
- 30 16. The separator as claimed in any one of the preceding claims, wherein the lubricating system is integrated altogether into the drive chamber as a circulating system.
- 35 17. The separator as claimed in any one of the preceding claims, wherein one or more

5 especially vertically extending holes are formed as the lubricant channel in the drive housing outside the stator, through which holes lubricant is directed past the stator and the motor rotor essentially radially on the outside.

10 18. The separator as claimed in claim 15, wherein the foot bearing during operation is located completely beneath a lubricant level or is arranged completely in the lubricant sump.

15 19. The separator as claimed in claim 18, wherein the lubricant level lies beneath the electric motor during operation.

20 20. The separator as claimed in any one of the preceding claims, wherein provision is made for one or more sight glasses for the visual checking especially of the lubricating system, especially of one or both parameters which are "lubricant level" and "lubricant in the lubricant channel".