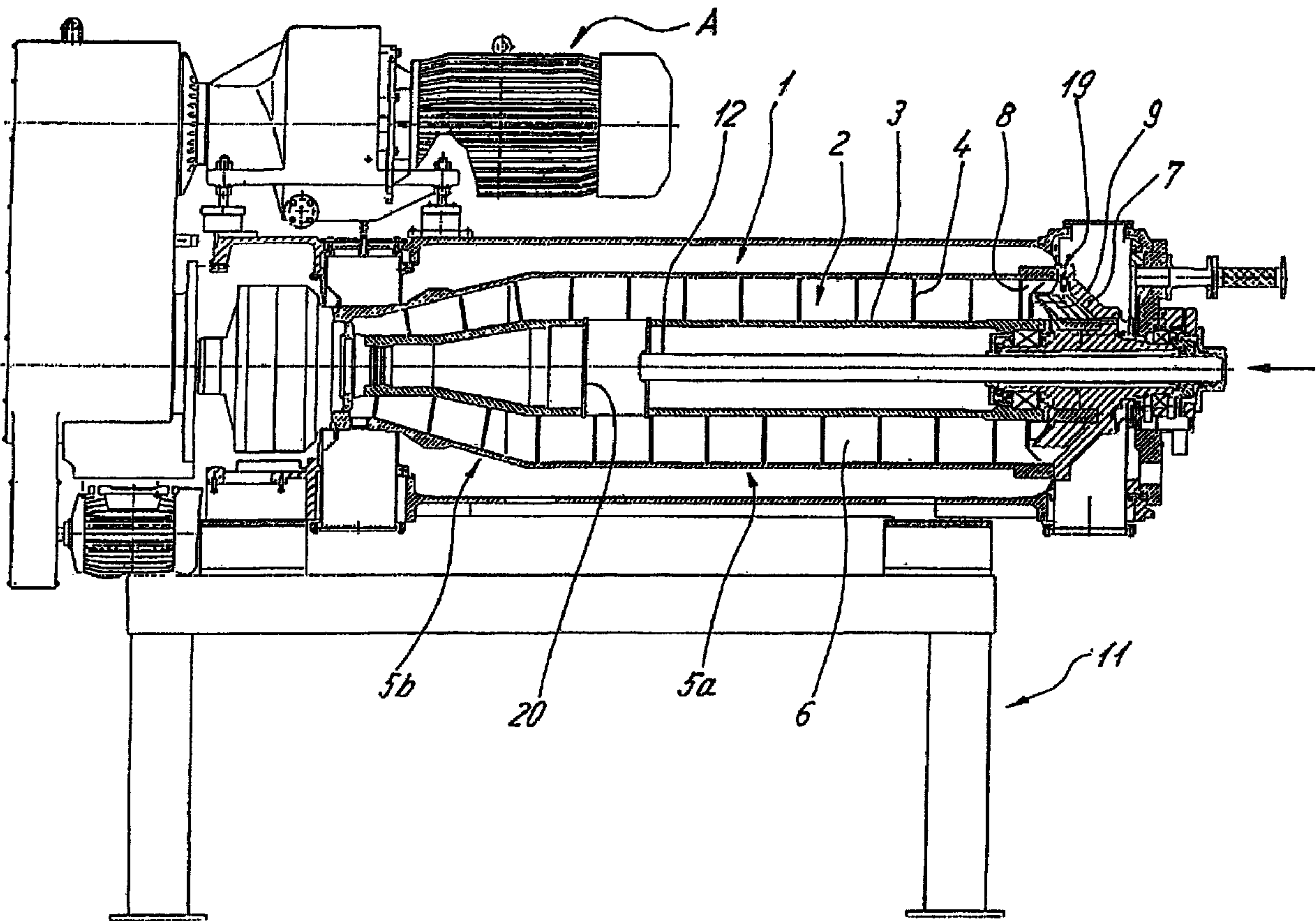




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 (72) Inventeurs/Inventors:
 HERMELER, JUERGEN, DE;
 BRUENING, PAUL, DE;
 HORSTKOETTER, LUDGER, DE
 (73) Propriétaire/Owner:
 WESTFALIA SEPARATOR AG, DE
 (74) Agent: FETHERSTONHAUGH & CO.

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 (54) Title: SOLID-BOWL SCREW CENTRIFUGE



(57) Abrégé/Abstract:

The invention relates to a solid-bowl screw centrifuge, comprising the following: - a centrifugal drum with a drum casing (1) and a screw (2) comprising a screw body (3), which is surrounded by a screw blade (4) that forms several screw spirals, a conveyer path

(57) **Abrégé(suite)/Abstract(continued):**

for transporting a material to be centrifuged being formed between the screw spirals; an inlet (12) into the centrifugal drum for the material to be centrifuged; at least one solid matter discharge and at least one liquid outlet (16). The invention is characterised in that a stack (9) of discs (11) is located in the centrifugal drum, the drum chamber (6) is sealed axially by a drum casing (1), the stack of discs (11) is located in a cylindrical section of the drum chamber with a substantially constant diameter and that the stack of discs (11) is mounted directly upstream of the liquid outlet (16), lying adjacent to and/or on the drum cover (7).

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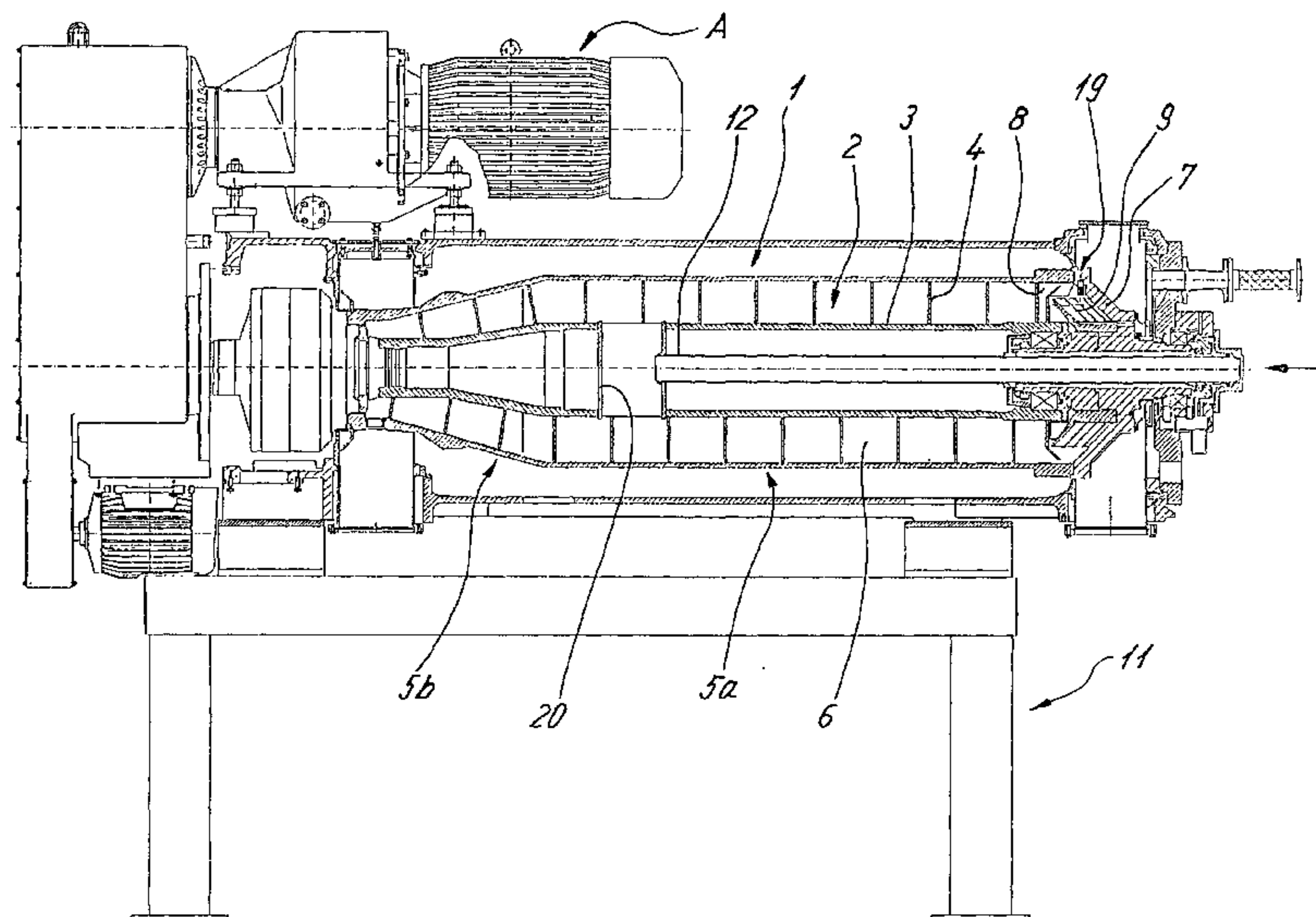
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- (51) Internationale Patentklassifikation⁷: **B04B 1/20** (71) Anmelder (für alle Bestimmungsstaaten mit Ausnahme von US): **WESTFALIA SEPARATOR INDUSTRY GMBH** [DE/DE]; Werner-Habig-Strasse 1, 59302 Oelde (DE).
- (21) Internationales Aktenzeichen: PCT/EP01/12196 (72) Erfinder; und (75) Erfinder/Anmelder (nur für US): **HERMEIER, Jürgen** [DE/DE]; Auf der Hovestatt 12, 45721 Haltern (DE). **BRÜNING, Paul** [DE/DE]; Fürstenbergstrasse 22, 59302 Oelde (DE). **HORSTKÖTTER, Ludger** [DE/DE]; Im Stuste 4a, 59320 Ennigerloh (DE).
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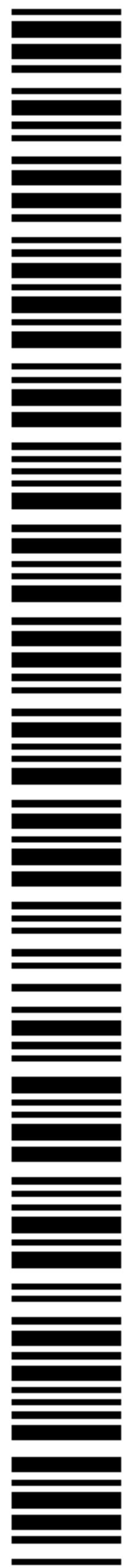
(54) Bezeichnung: VOLLMANTEL-SCHNECKENZENTRIFUGE MIT TELLEREINSATZ



(57) **Abstract:** The invention relates to a solid-bowl screw centrifuge, comprising the following: - a centrifugal drum with a drum casing (1) and a screw (2) comprising a screw body (3), which is surrounded by a screw blade (4) that forms several screw spirals, a conveyer path for transporting a material to be centrifuged being formed between the screw spirals; an inlet (12) into the centrifugal drum for the material to be centrifuged; at least one solid matter discharge and at least one liquid outlet (16). The invention is characterised in that a stack (9) of discs (11) is located in the centrifugal drum, the drum chamber (6) is sealed axially by a drum casing (1), the stack of discs (11) is located in a cylindrical section of the drum chamber with a substantially constant diameter and that the stack of discs (11) is mounted directly upstream of the liquid outlet (16), lying adjacent to and/or on the drum cover (7).

(57) **Zusammenfassung:** Eine Vollmantel-Schneckenzenrifuge weist folgendes auf: - eine Schleudertrommel mit einem Trommel-mantel (1) und einer Schnecke (2) mit einem Schneckenkörper (3), welcher von einem Schneckenblatt (4) umgeben ist, das mehrere Schneckengänge ausbildet, wobei zwischen des Schneckengängen

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Zur Erklärung der Zweibuchstaben-Codes und der anderen Abkürzungen wird auf die Erklärungen ("Guidance Notes on Codes and Abbreviations") am Anfang jeder regulären Ausgabe der PCT-Gazette verwiesen.

Veröffentlicht:

— mit internationalem Recherchenbericht

eine Förderbahn zum Transport eines zu verarbeitenden Schleudergutes ausgebildet ist, - einen Zulauf (12) für das Schleudergut in die Schleudertrommel, - mindestens einen Feststoffaustrag und mindestens einen Flüssigkeitsablauf (16), - wobei in der Schleudertrommel ein Tellerpaket (9) aus Tellern (11) angeordnet ist, - Trommelraum (6) axial von einem Trommelmantel (1) verschlossen ist, - wobei das Tellerpaket (11) in einem zylindrischen Abschnitt der Trommelraumes mit im wesentlichen konstanten Durchmesser angeordnet ist und - wobei das Tellerpaket (11) direkt dem Flüssigkeitsablauf (16) vorgeschaltet ist, wobei es am Trommeldeckel (7) anliegt und/oder an diesem angeordnet ist.

SOLID-BOWL SCREW CENTRIFUGE

The invention relates to a solid-bowl screw centrifuge.

It is known from the prior art to provide disk arrangements also in the case of solid-bowl screw centrifuges. Thus, U.S. Patent Document US 5 310 399 shows disks which are arranged on the screw body, specifically between several spirals of the screw. A similar construction is known from German Patent Document DE 26 17 692. Also in this multi-stage decanter arrangement, the disks are in each case arranged on the screw.

In addition, there are constructions in which a type of disk drum is connected behind the actual decanter drum (see, for example, IT 496 031 or SU 385 629).

Additional known combinations of solid-bowl screw centrifuges with disk inserts are known from International Patent Document WO 98/45045, French Patent Document 1 449 064, French Patent Document 2 532 189 and British Patent Document 998 669.

The British Patent Document GB 998 669 forms the state of the art of the initially mentioned type. Here, a type of complete separator is connected on the output side of the decanter as a constructional unit. As a result, the after clarification of the product preclarified in the decanter basically takes place as in the case of a completely separate series connection of the decanter and the separator.

In the separator with the stack of disks, the concentrate is discharged on a larger diameter of the nozzles and the clarified phase is discharged in the center. Outside the stack of disks, a solid matter space is constructed which is bounded on both sides by conical walls. The outside diameter of this separator, for example, in the SU 385 629, or in the GB 998 669

of the initially mentioned type, is situated on a larger radius than the outside diameter of the decanter.

The initially mentioned additional decanter constructions with integrated disk stacks are distinguished in that the disk stacks are each mounted on the screw bodies and thus rotate at a differential rotational speed with respect to the drum casing. This necessarily results in disturbing gaps; furthermore, no optimal utilization of the space can be accomplished.

From International Patent Document WO 99/52641 (as well as parallel U.S. Patent Document US-A-6030332), it is known to mount the disk stack directly upstream of the liquid outlet, so that it is arranged on the drum cover. However, in this case, it is problematic that the disk stack essentially fills out the cylindrical area of the centrifuge, so that, differently than in British Patent Document GB-A-998669, a separator is not connected to the output side of a complete decanter, which first develops its effect. A similar construction as that of U.S. Patent Document US-A 6 030 322 is illustrated in German Patent Document DE 1 482 721.

The invention seeks to further develop the centrifuge of the above-mentioned type such that, while the construction is cost-effective, a discharge of the concentrate from the area of the disks toward the drum casing takes place in a simple manner, in which case the problems resulting from the fastening of the disk stacks on the screw body should also be avoided.

Accordingly, the present invention provides a solid-bowl screw centrifuge, having the following: a centrifuging drum having a drum bowl and a screw with a screw body, which is surrounded by a screw blade which forms a plurality of screw turns, a conveying path for

transporting a centrifuging material to be processed being formed between the screw turns; an inlet for the centrifuging material to enter the centrifuging drum; at least one solids outlet and at least one liquid outlet; a set of plates comprising plates being arranged in the centrifuging drum; the drum space being axially closed off by a drum cover which is substantially conical in form; the set of plates being connected directly upstream of the liquid outlet and bearing against or being arranged on the drum cover; characterized in that: the set of plates is arranged in a cylindrical portion of the drum space with a substantially constant diameter; and a disk; which has a disk-like inner portion and a conical outer portion, opposite to the drum cover, is provided between the first screw turn, as seen from the drum cover, and the drum cover itself, as a termination of the screw.

The present invention also provides a solid-bowl screw centrifuge, comprising: a centrifugal drum having a drum casing and a screw, the screw having a screw body surrounded by a screw blade forming at least one screw spiral with a conveying path constructed between the at least one screw spiral for transporting material to be centrifuged; an inlet into the centrifugal drum; at least one solid matter discharge; at least one liquid outlet; a drum chamber axially closed by a drum cover having essentially a conical shape; a disk stack having at least one conical disk, the disk stack being mounted to the drum cover directly upstream of the liquid outlet and at least a portion of the disk stack being arranged in a cylindrical section of the drum chamber that has an essentially constant diameter; and a screw disk arranged on the screw body between the drum cover and a first screw spiral of the at least one screw spiral, the screw disk having an interior section and a conical exterior section.

The conical section of the disk as well as the conical drum cover constructed opposite the conical section of the disk thereby form a solid matter or concentrate collecting space which is conically tapered twice and which permits a particularly advantageous draining of the concentrate toward the drum casing, without requiring the joining of a separately constructed separator connected to the output side of the decanter in the manner of the state of the art of the initially mentioned type. For this purpose, the disk stack is arranged in a cylindrical section of the drum chamber with an essentially constant diameter and the disk stack is mounted directly upstream of the liquid outlet, while resting on the drum cover and/or being arranged on the latter.

Since the stack of disks rests directly on the drum cover or is fastened thereto, it no longer rotates at a differential rotational speed with respect to the drum casing but rotates together with it. In contrast to disk inserts on the screw, in the case of this disk insert connected with the liquid-side drum casing, no disturbing short-circuit connections occur between the clear-phase collecting pipe of the disk insert and the solid matter space outside the disk insert. The concentrate space of the disk insert is situated on the outside on the disk stack, in which the diameter of the drum casing can be constructed to be continuous and requires no widening. In this manner, mixtures which are difficult to clarify, for example, mixtures with fine suspended matter, can be separated.

The maximal radial dimension of the disk is preferably smaller than the radial dimension of the screw blade. In particular, the discharge is achieved by means of a removal device on the first screw blade which penetrates the disk.

The drum cover preferably has an essentially conical construction, which permits a particularly simple fastening of the preferably preassembled disk stack on the drum cover, particularly since the disks of the stack of disks also have a preferably conical construction.

It should also be stressed that, according to another preferred embodiment of the invention, the clear-phase collecting pipe is situated at a lower diameter than the exterior wall of the screw body.

In the following, embodiments will be described in detail by means of the drawing.

Figure 1 is a sectional view of a solid-bowl screw centrifuge according to the invention; and

Figure 2 is a sectional view of a partial area of the solid-bowl screw centrifuge according to the invention.

Figure 1 shows a solid-bowl screw centrifuge which, in addition to the components which do not have to be explained here in detail, such as the drive A and the machine frame M, has a centrifugal drum with a drum casing 1 and a screw 2, the screw 2 comprising a screw body 3 as well as a screw blade 4 surrounding the screw body 3 several times. Between the screw spirals 4, a conveyer path is constructed for conveying/transporting a material to be centrifuged.

The screw body 3 has a cylindrical section 5a, which is slightly stepped in the rearward area, and an adjoining conically tapering section 5b. The cylindrical section 5a is axially closed off by a drum cover 7 which has a conical construction at least in the area of the drum chamber 6 between the screw body 3 and the drum casing 1.

The operation of this solid-bowl screw centrifuge is as follows.

The material S to be centrifuged is guided through the centrally arranged as well as co-rotating inlet pipe 12 by way of a distributor 20 into the drum chamber 6 with the screw 2 and the drum casing 1 surrounding the screw 2. As a result of the force of gravity, the solid matter particles deposit in a very short time on the interior wall of the rotating drum casing 1. The distributor 20 and the co-rotating inlet pipe 12 form an advantageously hygienic, largely tight system.

The screw 2 rotates at a slightly lower or higher speed than the drum 1 and conveys the centrifuged solid matter toward the conical section out of the drum to the solid matter outlet.

In contrast, the liquid flows toward the cylindrical section 5a at the rearward end of the drum 1 and is discharged there.

In this case, the following construction is mounted upstream of the liquid discharge in Figure 1.

Between the first screw spiral x, viewed from the direction of the drum cover 7, and the drum cover 7, a type of disk 8 is arranged on the screw body as the end the screw, which screw body has a disk-type interior section 8a and preferably a stabilizing, conical exterior section 8b, the maximal radial dimension of the disk 8 being smaller than the radial dimension of the screw blade 4. At the inside diameter of the disk 8, at least one opening - here, a ring gap - is provided for a passing-through of the liquid. The conical disks 11 are preferably constructed to essentially correspond to the conical shape of the drum cover 7.

Between the disk 8 and the drum cover 7, a stack 9 of disks is arranged, in turn, which is constructed as a unit which can be preassembled and is fastened directly to the interior side of the drum cover 7. The stack of disks has a holding device 10 “shaped in the manner of a distributor”, which holding device 10 comprises an interior cylindrical section 10a and an axially adjoining conical section 10b. Between the conical section 10b and the drum cover 7, the actual conical disks 11 are arranged which are preferably spaced by means of spacers which are adapted to the respective application purpose (molded-on strips, punctiform spacers, etc.).

In the exterior area of the disks 1, ascending ducts 13 are constructed which also penetrate the conical section 10b. As an alternative, the stack 9 of disks may be constructed such that the feeding of the material to be clarified takes place radially from the outside (not shown here).

The draining-off of the clear phase takes place by a collecting pipe 14 at the interior diameter of the disks 1 in the wall of the cylindrical section 10b.

The collecting pipe 14 is preferably situated at least partially on a smaller diameter than the exterior wall of the screw body 3, which results in a more energy-saving operating mode than an arrangement of the collecting pipe on a larger diameter, which, however, is theoretically also conceivable. The collecting pipe 14 is axially continued in a bore 15 of the drum cover which leads into a radially outward extending outlet 16 for the clear phase.

The concentrate space is situated here on the outside at the stack 9 of disks, the diameter of the drum casing 1 having a continuous construction and comprising no widening. The concentrate discharge takes place by means of the screw 2. For discharging the solid

matter from the concentration space, the screw has a removal projection 17 which penetrates the disk 8. The diameter of the drum casing 1 has an essentially constant construction in this area.

For adjusting the level diameter in the drum, known systems, such as the applicant's Varipond System, can be used (regulating disk 22 which can be slid axially in front of the drain - German Patent Document DE 43 20 265). Other adjusting possibilities of the level are conceivable, such as a trailing blade disk connected behind the disk stack.

On the holding device 10 and/or on the drum cover 7, ribs 23 are advantageously constructed on the side facing away from the disks 9, which ribs 23 promote the introduction of the material to be centrifuged into the disk stack.

The operation of this arrangement is as follows. The material to be centrifuged passing through the ring gap 21 flows along the ribs 23 into the ascending ducts 13 of the disk stack 9, where the clear phase is drained to the collecting pipe and the solid matter is discharged to the outside. The solid matter is taken along by the removal projection 17 and is conveyed by the screw to the conical section 5b.

The system or the disk stack can be cleaned by means of a flush-back device. As required, the cleaning effect can be promoted by an evacuation by way of a nozzle in the outlet 16 or a centrifugal force valve 19.

The spacing of the disks 11 of the stack 9 is preferably larger than 0.5 mm and small than 3 mm, measured perpendicularly to the surface of the disks. The angle of slope of the conical disks with respect to the drum axis is preferably between 35° and 55°, particularly at 40° to 50°.

Particularly preferably, the diameter of the disks 11 at the outer edge amounts to approximately 50 to 75%, particularly $2/3$ of the diameter of the free screw area or of the drum chamber.

Reference Numbers:

Drum casing	1
screw	2
screw body	3
screw blade	4
cylindrical section	5a
conical section	5b
drum chamber	6
drum cover	7
disk	8
interior section	8a
conical section	8b
disk stack	9
holding device	10
cylindrical section	10a
conical section	10b
conical disk	11
inlet pipe	12
ascending ducts	13
collecting pipe	14
bore	15

outlet	16
removal projection	17
centrifugal valve	19
distributor	20
ring gap	21
regulating disk	22
ribs	23
drive	A
machine frame	M

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A solid-bowl screw centrifuge, having the following:
 - a centrifuging drum having a drum bowl (1) and a screw (2) with a screw body (3), which is surrounded by a screw blade (4) which forms a plurality of screw turns, a conveying path for transporting a centrifuging material to be processed being formed between the screw turns;
 - an inlet (12) for the centrifuging material to enter the centrifuging drum;
 - at least one solids outlet and at least one liquid outlet (16);
 - a set of plates (9) comprising plates (11) being arranged in the centrifuging drum;
 - the drum space (6) being axially closed off by a drum cover (7) which is substantially conical in form;
 - the set of plates (9) being connected directly upstream of the liquid outlet (16) and bearing against or being arranged on the drum cover (7);
 - characterized in that:
 - the set of plates (9) is arranged in a cylindrical portion of the drum space with a substantially constant diameter; and
 - a disk (8); which has a disk-like inner portion (8a) and a conical outer portion (8b), opposite to the drum cover, is provided between the first screw turn (x), as seen from the drum cover (7), and the drum cover (7) itself, as a termination of the screw.

2. The solid-bowl screw centrifuge according to Claim 1, characterized in that that conical plates (11) are designed so as to substantially correspond to the conicity of the drum cover (7).

3. The solid-bowl screw centrifuge according to Claim 1 or 2, characterized in that the set of plates has a collection line (14) for a clarified liquid phase, which line is located at least partially or completely on a smaller diameter in the centrifuging drum than an outer wall of the screw body (3).

4. The solid-bowl screw centrifuge according to any one of Claims 1 to 3, characterized in that the maximum radial extent of the disk (8) is smaller than a radial extent of the screw blade (4).

5. The solid-bowl screw centrifuge according to any one of Claims 1 to 5, characterized in that at least one opening (21) for liquid to pass through is formed at an inner diameter of the disk (8).

6. The solid-bowl screw centrifuge according to any one of Claims 1 to 5, characterized in that the set of plates (9) is formed between the disk (8) and the drum cover (7).

7. The solid-bowl screw centrifuge according to any one of Claims 1 to 6, characterized in that the set of plates (9) has a holder (10) which comprises an inner cylindrical portion (10a) and a conical portion (10b) which adjoins the inner cylindrical

portion in the axial direction, the conical plates (11) being arranged between the conical portion (10b) and the drum cover (7).

8. The solid-bowl screw centrifuge according to any one of Claims 1 to 7, characterized in that the set of plates (9) is designed in such a manner that the centrifuging material that is to be clarified is supplied radially from outside the centrifuge.

9. The solid-bowl screw centrifuge according to Claim 7, characterized in that riser passages (13) are formed in an outer region of the plates (11) and pass through the conical portion (10b) of the holder (10).

10. The solid-bowl screw centrifuge according to Claim 7, characterized in that at least one collection line is formed in the cylindrical portion of the holder (10).

11. The solid-bowl screw centrifuge according to Claim 10, characterized in that the at least one collection line (14) opens into an outlet (16) via a bore (15) in the drum cover (7).

12. The solid-bowl screw centrifuge according to any one of Claims 1 to 11, characterized in that the screw (2) has a clearing attachment (17) for discharging solids from the concentrate space.

13. The solid-bowl screw centrifuge according to any one of Claims 1 to 12, characterized in that the inlet (12) is designed in such a manner as to rotate with the screw (2).

14. The solid-bowl screw centrifuge according to any one of Claims 7 to 11, characterize in that ribs (23) for introducing the centrifuging material into the set of plates (9) are fitted to one of the holder (10) on the side remote from the plates (11) and to the drum cover (7).

15. The solid-bowl screw centrifuge according to any one of Claims 1 to 14, characterized in that a distance between the plates (11) of the set of plates (9) is between 0.5 and 3 mm, measured perpendicular to the surface of the plates.

16. The solid-bowl screw centrifuge according to any one of Claims 1 to 15, characterized in that the angle of inclination of the conical plates (11) with respect to the drum axis is between 35° and 55°.

17. The solid-bowl screw centrifuge according to any one of Claims 1 to 16, characterized in that the maximum radial extent of the plates (11) amounts to between 50 and 75% of one of a free screw region and of the drum space (6).

18. The solid-bowl screw centrifuge according to any one of Claims 1 to 16, characterized in that the maximum radial extent of the plates (11) is approximately 2/3 of one of a free screw region and of the drum space (6).

19. The solid-bowl screw centrifuge according to any one of Claims **1** to **18**, characterized in that at least one of a back-flushing device, a centrifugal-force valve (19), and a nozzle (19) is provided for cleaning purposes.

20. The solid-bowl screw centrifuge according to any one of Claims **1** to **19**, characterized in that a regulating disk (22) is axially slidable in front of the outlet in order to regulate a liquid level.

21. The solid-bowl screw centrifuge according to Claim **5**, characterized in that the at least one opening (21) is an annular gap.

22. The solid-bowl screw centrifuge according to any one of Claims **1** to **21**, characterized in that the angle of inclination of the conical plates (11) with respect to the drum axis is between 40° and 50°.

23. A solid-bowl screw centrifuge, comprising:

- a centrifugal drum having a drum casing and a screw, the screw having a screw body surrounded by a screw blade forming at least one screw spiral with a conveying path constructed between the at least one screw spiral for transporting material to be centrifuged;
- an inlet into the centrifugal drum;
- at least one solid matter discharge;
- at least one liquid outlet;

a drum chamber axially closed by a drum cover having essentially a conical shape;

a disk stack having at least one conical disk, the disk stack being mounted to the drum cover directly upstream of the liquid outlet and at least a portion of the disk stack being arranged in a cylindrical section of the drum chamber that has an essentially constant diameter; and

a screw disk arranged on the screw body between the drum cover and a first screw spiral of the at least one screw spiral, the screw disk having an interior section and a conical exterior section.

24. The solid-bowl screw centrifuge according to Claim **23**, wherein the conical disks are constructed to essentially correspond to the conical shape of the drum cover.

25. The solid-bowl screw centrifuge according to Claim **23** or **24**, wherein the disk stack has a collecting pipe for a clarified liquid phase, and the disk stack is at least partially situated closer radially to a rotational axis of the centrifugal drum than an exterior wall of the screw body.

26. The solid-bowl screw centrifuge according to Claim **23**, **24** or **25**, wherein a maximal radial dimension of the screw disk is smaller than a radial dimension of the screw blade.

27. The solid-bowl screw centrifuge according to any one of Claims **23** to **26**, wherein at least one opening is constructed on an inside diameter of the screw disk for the passing-through of a liquid.

28. The solid-bowl screw centrifuge according to any one of Claims **23** to **27**, wherein the disk stack is constructed between the screw disk and the drum cover.

29. The solid-bowl screw centrifuge according to any one of Claims **23** to **28**, wherein the disk stack has a holding device which includes an interior cylindrical section and an axially adjoining conical section, the at least one conical disk being arranged between the axially adjoining conical section and the drum cover.

30. The solid-bowl screw centrifuge according to Claim **29**, wherein ascending ducts are constructed in an exterior area of the at least one conical disk, which ascending ducts penetrate the conical section of the holding device.

31. The solid-bowl screw centrifuge according to Claim **29**, wherein at least one collecting pipe is constructed in the cylindrical section of the holding device.

32. The solid-bowl screw centrifuge according to Claim **31**, wherein the at least one collecting pipe leads into an outlet through a bore of the drum cover.

33. The solid-bowl screw centrifuge according to Claims **29** to **32**, wherein ribs for introducing the material to be centrifuged into the disk stack are joined to one of the

holding device on a side facing away from the at least one conical disk and to the drum cover.

34. The solid-bowl screw centrifuge according to any one of Claims **23** to **33**, wherein the disk stack is arranged such that the feeding of the material to be centrifuged takes place radially from outside the centrifuge.

35. The solid-bowl screw centrifuge according to any one of Claims **23** to **34**, wherein the screw has a removal projection for discharging solid matter from a concentrate space.

36. The solid-bowl screw centrifuge according to any one of Claims **23** to **35**, wherein the inlet is configured such that it rotates along with the screw.

37. The solid-bowl screw centrifuge according to any one of Claims **23** to **36**, wherein the at least one conical disk includes at least two conical disks and a spacing between each of the at least two conical disks is between 0.5 and 3 mm, as measured perpendicularly to a surface of the at least one conical disk.

38. The solid-bowl screw centrifuge according to any one of Claims **23** to **37**, wherein an angle of slope of the at least one conical disk, with respect to a rotational axis of the drum, is about 35° and 55°.

39. The solid-bowl screw centrifuge according to any one of Claims **23** to **38**, wherein a maximal radial dimension of the at least one conical disk is approximately between 50 and 75% of one of a radial space between the screw body and the drum casing and a radial space of the drum chamber.

40. The solid-bowl screw centrifuge according to any one of Claims **23** to **38**, wherein a maximal radial dimension of the at least one conical disk is approximately 2/3 of one of a radial space between the screw body and the drum casing and a radial space of the drum chamber.

41. The solid-bowl screw centrifuge according to any one of Claims **23** to **40**, further including one or more of a flush-back device, a centrifugal valve and a nozzle for cleaning at least a portion of the centrifuge.

42. The solid-bowl screw centrifuge according to any one of Claims **23** to **41**, further including a regulating disk slidable axially in front of the liquid outlet for regulating a liquid level.

43. The solid-bowl screw centrifuge according to any one of Claims **23** to **42**, wherein an angle of slope of the at least one conical disk, with respect to a rotational axis of the drum, is between 40° and 50°.

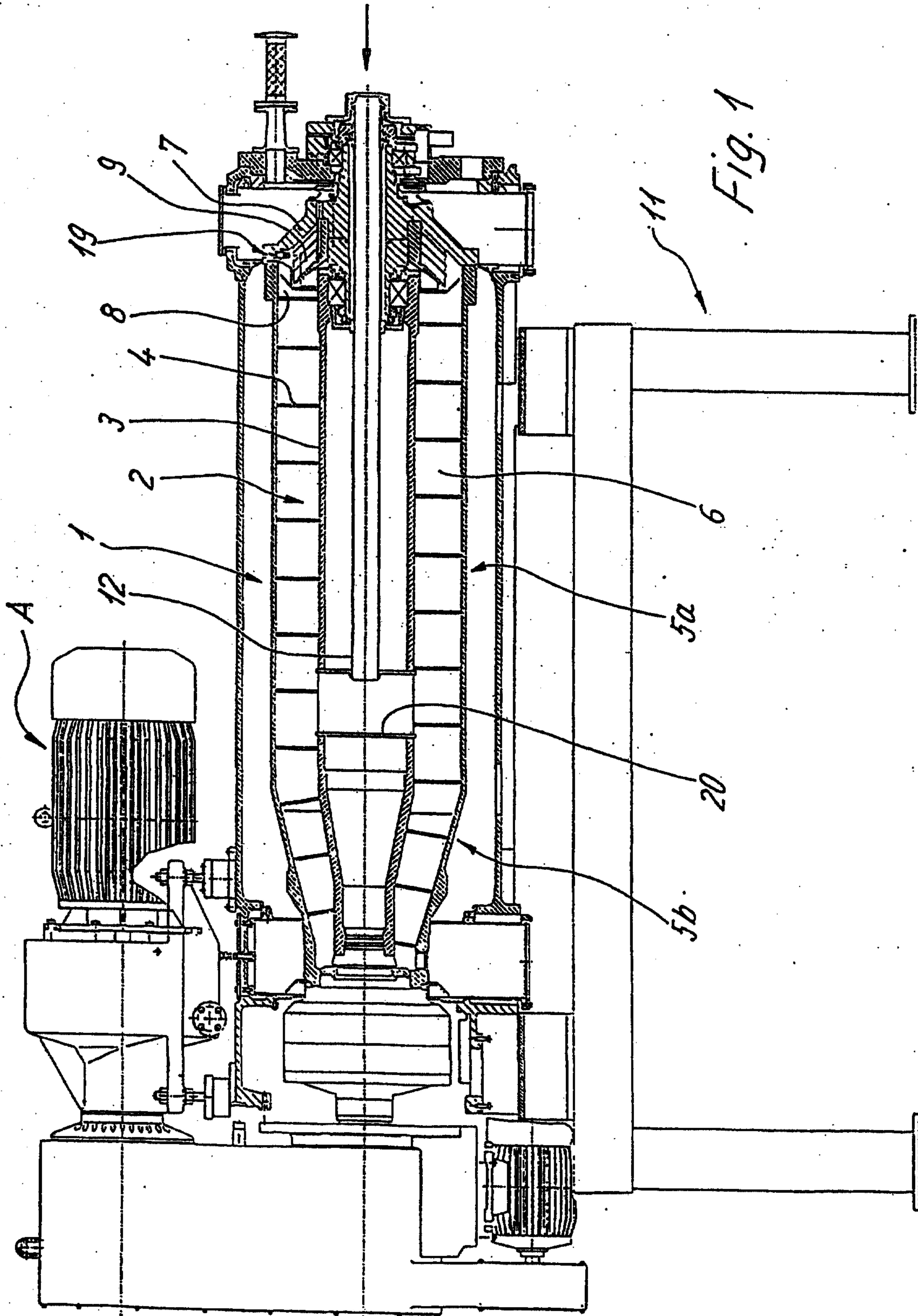


Fig. 1

