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(73) Patenthaver: **Applied Chemicals Handels-GmbH, Wolfgang-Pauli-Gasse 3, 1149 Wien, Østrig**

(72) Opfinder: **KOZANDA, Christian, Hinterleiten 57, A-2873 Feistritz/Wechsel, Østrig**
STRECKER, Dietmar, Ferdinand Porsche Gasse 17, A-2603 Felixdorf, Østrig
KERN, Ewald, Niklas Steubergasse 32, A-2361 Laxenburg, Østrig
ZABL, Manfred, Linzerstrasse 227 RH4, A-1140 Wien, Østrig

(74) Fuldmægtig i Danmark: **Budde Schou A/S, Hausergade 3, 1128 København K, Danmark**

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The present invention relates to a screw extruder comprising a screw shaft rotationally mounted in oppositely located frames and having a substantially conically widening diameter between an inlet port for crude liquid and a discharge port for dehydrated material, and on which screw shaft at least one screw blade extending at a substantially constant pitch is disposed, wherein a filter screen cylindrically surrounding the screw shaft and including a plurality of filter openings is further arranged within the frames, wherein a cleaning device with a plurality of cleaning nozzles for the filter screen and a funnel-shaped filtrate trough disposed below the filter screen are additionally arranged on the outer side of the filter screen.

Sludges from industrial waste water treatment plants, communal clarification plants and all kinds of procedural processes have to be dehydrated prior to being disposed of or finally utilized, in order to be subsequently recyclable. Recycling, for instance, involves combustion, composting or release to agriculture. In the past, rising transport costs for sludge disposal have made it necessary to dehydrate the occurring sludges to high final solids contents in order to be reusable for subsequent utilizations. To this end, polymer coagulants and/or flocculants have been added to all kinds of sludges in order to provide a sludge comprising flocks and thus rendered easier to dehydrate.

For continuous dehydration, the sludge plus flocculants is charged onto a screw extruder from a charging side and continuously dehydrated to the desired degree of drying or dehydration of the sludge by conveying the sludge through the extruder and increasing the dehydration pressure. Since, in such a screw extruder, the solids concentration of the

sludge is low on the side of the inlet port into the extruder and increases continuously towards the discharge side, a large amount of water has to be immediately discharged in the region of the inlet port, which filtrate water is usually only little loaded as compared to the water present in screw extruder regions farther remote from the inlet port, and by which only extremely small amounts of solid particles have been entrained. Despite this known fact that most of the amount of filtrate water occurs in the region of the inlet port, the filtrate water in the screw extruders according to the prior art is collected in one and the same, or one, filtrate trough in order to be subsequently returned into the process and, in particular, into the crude sludge.

Thus, screw extruders are, for instance, known, in which the screw shaft is mounted so as to be inclined relative to the horizontal and in which, in particular, the inlet side is arranged to be lower than the discharge side of the screw shaft so as to enforce additional stimulation of the filtrate water drain in the direction towards the inlet side by the inclined arrangement of the screw shaft.

From EP-B 1 148 990, for instance, a screw extruder is, furthermore, known, in which a device for preventing an obstruction of the filter zone on the inlet side of the extruder is configured such that the filter tube or the filter screen is driven for rotation, in particular on the inlet side, in order to prevent an obstruction of the filter screen, on the one hand, and to ensure the safe removal of the excess amount of filtrate water in this region, on the other hand.

From US 6,615,710 B1 a screw extruder according to the preamble of the main claim has become known, in which a

plurality of filtrate troughs are provided below a screw shaft conically extending over the entire length of the screw extruder and in which an inlet port for crude liquid is, moreover, provided. The first filtrate trough in that case is provided in the region of the inlet port for crude liquid and has a smaller longitudinal extension than the second filtrate trough.

From RU 2 021 143 C1, a fruit press comprising a screw extruder has become known, which screw extruder is cylindrically designed in the region of a charging opening, in which region a further drain for directly running-off fruit juice is provided.

From DE 10 2005 057 591 A1, a cleaning device for removing solids from a liquid, in particular for a cooling lubricant cycle, has become known, in which a cylindrical filter body comprises a screw shaft conically widening in its central region and a screw shaft cylindrically extending in an inlet and overrun region.

Furthermore, various screw extruders have been provided, in which the mesh size of the filter screen is variably adaptable in order to be adapted to the degree of dehydration of the filtering material and be able to safely discharge the occurring amount of filtrate in the inlet region of the filter press, wherein it has been common to all of the known screw extruders that, although importance is attached to ensuring a dehydration of the filter sludge as complete and efficient as possible, the occurring filtrate is in any case immediately returned into the process or discarded irrespectively of its composition, without trying to improve the overall energy balance of the screw extruder or to supply the filtrate to a direct further use.

The document DE 29 23 646 A1 describes a screw press according to the preamble of claim 1

The present invention aims to provide a screw extruder of the initially defined kind, by which it is feasible to not only safely and reliably dehydrate sludge or crude liquid to be dehydrated, but, at the same time, also separate the occurring filtrate so as to enable the filtrate to be directly returned into the process, on the one hand, and those amounts of filtrate which can be used for other purposes to be directly drained from the process and further used without additional purification or treatment, on the other hand.

This object is solved with a screw press showing the features of claim 1.

In that the screw shaft is configured to be cylindrical in the region of the inlet port for crude liquid, it is possible to allow a large portion of the ultra-large amount of liquid occurring in this region to directly run off the filter, or the screw extruder, without applying in this region to the charged crude liquid a pressure increase by a change in the diameter of the screw shaft or a changing pitch of the screw blades. Due to the conical configuration of the screw shaft in the central region of the screw extruder, the pressure exerted on the crude liquid to be filtered or dehydrated, or the sludge to be dehydrated, is continuously increased so as to continuously raise the degree of dehydration. In that the end region of the screw shaft is again cylindrically configured, the pressure in the region of the screw extruder where the major portion of the liquid has already been filtered off and a nearly completely dehydrated filter cake

has been obtained will not be further increased by a change in the diameter of the screw shaft or a changing pitch of the screw blades, but only the discharging of the substantially solid filter cake will be ensured.

Such a configuration of the screw shaft safeguards that the filtrate water occurring in the first cylindrical region flows off through the openings of the filter screen into the filtrate trough, which is formed with a separate, first chamber in this region of the screw extruder, nearly free of entrained solid particles due to the substantially pressureless guidance of the crude liquid in this region of the screw extruder. The filtrate water occurring in this region can thus be immediately separated from the system, i.e. from the sludge to be dehydrated, yet also from the remaining, still contained filtrate water, and immediately supplied to further use without additional purification, filtration or other treatment.

Due to the fact that the drain of the first chamber is connected to the cleaning device for the filter screen in the region of the inlet port via a return line for filtrate to recirculate the filtrate, such a configuration will successfully provide a substantially closed liquid circulation in the interior of the screw extruder so as to enable not only a drastic reduction of the supply of fresh water, but also a significant improvement in the overall energy balance of the screw extruder, since the amount of filtrate loaded with suspended matter and particles that is returned into the process can be considerably reduced. Moreover, the overall amount of water to be cleaned, or amounts to be returned to the crude liquid, will be significantly reduced so as to significantly improve the energy balance of the whole screw extruder.

In that, as in correspondence with a further development of the present invention, the subdivision or chambered design of the filtrate trough is configured such that the chamber, in the region of the inlet port, has a longitudinal extension of 10% to 35%, in particular 15% to 25%, of the length of the screw shaft, it will be ensured that nearly pure filtrate water, which is substantially free of suspended matter and entrained solid particles, will be collected in the region of the chamber below the inlet port of the screw extruder and no additional aftertreatment of this filtrate will be required prior to its reutilization, thus resulting not only in an equipment simplification of the device, but, in particular, also in a significant improvement of its overall energy balance because of the reduced amount of filtrate water to be treated.

In that, as in correspondence with a further development of the present invention, the device is further developed such that a pumping device as well as a control device and a direct drain are provided in the return line, an in particular rapid and reliable supply of the unloaded filtrate water to the cleaning device, or nozzles of the cleaning device, at an appropriately adjusted supply pressure will be ensured. If required, excess filtrate water can in this case be directly withdrawn via the drain so as to drastically reduce the overall amount of filtrate water to be supplied.

In order so safely avoid a back-up of liquid at the occurrence of excessive amounts of filtrate water in the region of the firsts chamber of the filtrate trough, and safeguard continuous operation, the invention is preferably further developed such that an overflow from the first chamber in the region of the inlet port to the at least one

further chamber in the region of the outlet port is additionally provided. When providing such an overflow, not only a liquid back-up in the first chamber will be safely prevented, but it will further be ensured that in the event of an excessive dehydration in the first part of the screw extruder sufficient liquid, in particular sufficient filtrate, will also be available to be returned into the crude liquid in order to be able to charge crude liquid with the correct and desired consistency and, in particular, a substantially constant solids content on the inlet side, thus not only safeguarding a continuous mode of operation of the whole screw extruder, but also providing an overall low-maintenance device.

In order to ensure such a continuous operation of the device, the invention is preferably further developed such that the drain of the at least one further chamber in the region of the outlet port is connected, via a return device, to an intake, in particular a supply pump for charging crude liquid. In that the drain of the at least one further chamber in the region of the outlet port is connected, via a return device, to an intake, in particular a supply pump for charging crude liquid, not only the filtrate, which is heavily loaded with suspended matter or particles, will be directly returned into the process in order to be dehydrated again, and hence be freed of entrained sludge particles, but also a liquid solid-particle ratio as constant as possible will be adjusted in the crude liquid so as to ensure a constant, continuous operation of the entire plant without having to respond to changing process parameters which are, for instance, due to a change in the speed of the extruder or the like, so that, as a whole, a continuous operation that will remain constant over time, and hence energy-efficient to manage, will be ensured.

Due to the fact that also the return device in the drain of the at least one further chamber is provided with a pump, a control device, and a return line into the intake for crude liquid, and with a direct drain, it is possible, as a function of the process parameters, to adapt the plant to the respective requirements directly and without changing any of the operating parameters and to adjust a liquid solid-particle ratio as constant as possible in the crude liquid to be charged, in particular by providing the control device, e.g. a control valve, so as to enable the whole screw extruder to be operated continuously over a long period of time, thus further improving the overall efficiency and, in particular, the energy balance of the plant.

In particular, in order to safely and reliably drain the high amount of liquid occurring in the inlet region of the screw extruder without simultaneously entraining major amounts of solid particles along with the filtrate, the screw extruder according to a preferred further development of the invention is configured such that the filter screen is formed with elongated holes having semicircular end portions in the region of the first chamber and with round holes in the region of the at least one further chamber. By providing two different types of perforations in the filter screen, the excessive liquid amount occurring in the inlet region is taken into account, on the one hand, yet by providing elongated holes having semicircular end portions, a filter screen is provided, on the other hand, which, on the one hand, is secured against excessive wear by the special hole shape and, on the other hand, ensures that no excessive amounts of solid particles, or especially large solid particles, will be entrained by the filtrate.

In that, as in correspondence with a preferred further development of the invention, the longitudinal extension of the elongated holes corresponds to 1.5 to 3 times the diameter of the round holes, it is possible to safely and reliable remove the excessive amounts of liquid from the region of the inlet port without, however, enabling the passage of major amounts of solid particles. As compared to, for instance, the provision of round holes having larger diameters, the configuration of elongated holes will prevent particles from being directly entrained, since the usually substantially spherical particle or sludge flocks will be safely held back on the edges of the elongated holes rather than be discharged through holes having enlarged diameters.

In order to, in particular, ensure complete cleaning of the filter screen and, in particular, safely prevent any obstruction of the passage holes of the filter screen, the invention is further developed to the effect that the cleaning device for the filter screen is configured as at least one movably mounted nozzle assembly comprising spraying nozzles, and that cleaning liquid at least partially containing filtrate from the first chamber of the filtrate trough can be supplied to the spraying nozzles of the nozzle assembly at a variable liquid pressure. Since the cleaning device is configured as at least one movably mounted nozzle assembly comprising spraying nozzles and cleaning liquid at least partially containing, or consisting of, filtrate from the first chamber can be supplied to the spraying nozzles of the nozzle assembly at a variable liquid pressure, it is possible to control the cleaning of the filter screen as a function of the degree of contamination of the latter, in particular by continuously raising the liquid pressure exerted on the spraying nozzles, for

instance in the region of the screw shaft in which the latter is conically widened, in order to prevent obstruction, or safely reopen and/or clean already obstructed filter nozzles. In that the nozzle assembly is, moreover, movably mounted, it is possible by suitable control to selectively supply cleaning liquid also to those regions in which, for instance, an obstruction has already occurred in order to make them passable again.

In that, as in correspondence with a preferred further development of the invention, the device is further developed such that the nozzle assembly of the cleaning device substantially encompasses the entire periphery of the filter screen and is drivable to a reciprocating movement substantially covering the entire longitudinal extension of the filter screen, it is possible, in particular in that region of the filter screen in which an excessive obstruction of the screen holes is to be feared, to increase both the speed of the cleaning device during its reciprocating movement and the residence time of the nozzle assembly in this region, so that, for instance, the region of the filter screen in which no obstruction of the filter screen is to be feared will be less frequently swept by the nozzle assembly than those regions in which obstruction has to be feared. In that substantially the whole filter screen is encompassed by the nozzle assembly, the simultaneous cleaning of all areas of the screening drum or filter screen possibly affected by obstructions will be ensured so as to enable the maintenance of a continuous operation of the screw extruder without requiring shutdowns or separate cleaning passes for the screening drum due to obstructions of the passage openings of the screening drum.

In order to ensure the in particular rapid and reliable dehydration of the crude liquid in the inlet region of the screening drum and, in particular, the discharging of the substantially unloaded filtrate water in this region, the screw extruder according to a preferred further development of the invention is further developed such that the screw shaft at least in the cylindrically configured region near the inlet port, preferably approximately in the region of the longitudinal extension of the first chamber, in the region of the inlet port comprises two screw blades having opposite starting points and identical pitches.

In the following, the invention will be explained in more detail by way of exemplary embodiments illustrated in the drawing. Therein:

Fig. 1 depicts a longitudinal section through a screw extruder according to the invention comprising a filter trough having two chambers according to the prior art, and

Fig. 2 depicts a longitudinal section through a modified embodiment of the screw extruder according to Fig. 1, and Fig. 3 depicts a longitudinal section through the screw extruder according to Fig. 1 having a modified filtrate reflux.

Fig. 1 illustrates a longitudinal section through a screw extruder generally denoted by 1, in whose center a screw shaft 4 rotationally mounted in a frame 2 and 3 is provided. The screw shaft 4 is configured in such a manner as to have a constant cylindrical diameter 6 on the inlet side 5 of the screw extruder 1, which widens into a cone 7 in a central portion of the screw extruder 1, and is again cylindrically configured in an end portion 8 oriented towards an ejection

side. A screw blade 9 extending over the entire length of the screw shaft 4 at a constant pitch is arranged on the screw shaft 4, wherein a second screw blade 10 is arranged, in particular, in the inlet region 5 of the screw extruder 1, which also has the same pitch, yet a starting point opposite the first screw blade 9 so as to ensure both the reliable advance of the charged crude liquid and the dehydration of the same in the inlet region 5.

The screw extruder 1 further comprises a filter screen or filter drum 11 cylindrically surrounding the screw shaft 4, which filter screen or filter drum 11 comprises a plurality of filter openings 12, through which the filtrate is discharged towards outside and, in particular, into the filtrate trough 13. In the illustration according to Fig. 2, the filtrate trough 13 is configured to comprise two chambers 14 and 15, wherein the filtrate chamber 15 located in the direction towards the inlet side 5 of the screw extruder 1 comprises a direct drain 16, through which substantially unloaded filtrate is immediately discharged from the system and fed into a schematically illustrated supply line 17 of a cleaning device 18 for the filter screen 11 via a return device not illustrated in detail in Fig 1. The filtrate trough 15 is configured such that its longitudinal extension is substantially identical with that of the region of the screw shaft 4 in which the latter comprises two screw blades 9, 10, on the one hand, and is configured to be substantially cylindrical 6, on the other hand. In this region of the screw shaft 4, the highly fluid material to be dehydrated is charged at 19 and, due to the high liquid freight of the crude liquid, substantially pure filtrate will run off through the filter screen in the first 10% to 30% of the longitudinal extension of the screw extruder without having to apply a pressure or an excessive

amount of crude liquid. The filtrate running off in this region is nearly free of suspended matter, and hence apt to be supplied to a further use.

In order to be able to safely handle the total, large amount of liquid occurring in this region, a weir 20 is provided between the chamber 14 and the chamber 15 of the filtrate trough 13, which weir 20 serves as an overflow such that, at the occurrence of an excessive amount of liquid, excess liquid will be immediately introduced into the second, usually larger, chamber 14 of the filtrate trough 13. The second chamber 14 of the filtrate trough 13 similarly comprises a drain 21, via which drain 21 filtrate loaded with suspended matter is discharged. Said filtrate can, for instance, be directly readmixed to the crude liquid and recharged into the screw extruder 1 via the inlet 19. Such a partial return of more strongly loaded filtrate offers the advantage that, on the one hand, the crude liquid can be adjusted to a defined consistency by said liquid and, on the other hand, the overall amount of loaded filtrate to be purified or cleaned can be significantly reduced.

In Fig. 1, the cleaning device 18 for the filter screen 11 is shown only schematically, wherein the cleaning device 18 is configured to comprise a nozzle assembly 18 substantially encompassing the screening drum 1, by which nozzle assembly 18 the filter nozzles are cleaned by displacing or moving the cleaning device 8 in the longitudinal direction of the screw extruder 1 along arrow 22. The nozzles are arranged on the cleaning device 18 so as to substantially completely surround the periphery of the filter screen 11.

Merely for the sake of completeness, it is noted that the drive for the screw shaft 4 in the illustration according

to Fig. 1 comprises a gear 23 and a motor 24, and that a further motor 25 is provided to drive the opening and closing means and the adjustment of a discharge port 26 for a filter cake.

In the illustration according to Fig. 2, the reference numerals of Fig. 1 have essentially been retained, wherein only those parts of the device which differ from Fig. 1 will be described anew.

In the illustration according to Fig. 2, the filtrate trough 13 is substantially configured to differ from that of Fig. 1. The filtrate trough 13 according to Fig. 2 comprises two trough portions or chambers 27 and 28, wherein, again analogously to the illustration of Fig. 1, the two troughs 27 and 28 are separated by a weir 20, which weir is designed as an overflow for excess filtrate from the filtrate trough 27 into the filtrate trough 28.
The drain 29 of the filtrate trough 27 is provided with a directional valve 30, via said directional valve 30 the filtrate can either be discharged from the system or supplied to the cleaning device 18 via a return line 31, in which a pump 32 is provided, in order to again serve as cleaning liquid for the filter screen 11.

The pump 32 is of particular importance to enable the supply pressure to the nozzles of the device 18 to be appropriately controlled so as to be able to apply a more or less high cleaning pressure to the filter screen 11 as a function of the degree of contamination of the filter screen 11. In doing so, the liquid pressure exerted on the nozzles of the cleaning device 18 can, of course, also be changed as a function of the position of the cleaning device 18 via the filter screen, and hence as a function of the level of

contamination or obstruction of the same (sense of arrow 22) such that, for instance, a higher cleaning pressure can be applied to the discharge end of the screw extruder 1 than at the inlet end 5 of the same.

According to the configuration of Fig. 2, the second filtrate trough 28 too is provided with a direct drain 33, in which a valve 34 is again provided for the loaded filtrate to be either returned to the inlet 19 for crude liquid or discharged from the system and supplied to a separate cleaning device.

In the return line 35 for the filtrate to the inlet 19 for crude liquid, a pump 36 is again provided, yet, as in contrast to the pump 32, merely to maintain a constant supply pressure or supply amount of filtrate loaded with suspended matter or waste material to the inlet 19 for crude liquid. Fig. 3, in which the whole screw extruder and also the drain device are substantially configured as in Fig. 2, differs from Fig. 2 in that the filtrate collected in the second filtrate trough 28, which is more heavily loaded with waste material, is introduced into a storage tank 37 via drain 33. In the storage tank is further arranged a pump 38 to supply drain liquid from the storage tank 37 to a charging line for the screw extruder (not illustrated) in the sense of arrow 40. It is also possible to position additional devices in said supply line, such as a flow meter, dosing means for further, optionally required, substances, and, if desired, further sensing elements.

It goes without saying that combinations of the variants according to Fig. 2 and Fig. 3, which, for instance, comprise a storage tank and a directional valve, are conceivable without departing from the scope of the present invention.

Furthermore, additional charging devices, for instance, for additives for the waste water to be cleaned, such as flocculants or the like, may be provided.

Overall, it has thus become possible by a device according to the present invention to largely recycle the waste liquids discharged during a filter process such that the overall amount of occurring waste liquid is significantly reduced and, due to the recirculation of the filtrate, the overall energy balance and, in particular, also the balance of the fresh water to be used are significantly improved relative to conventional plants.

PATENTKRAV

1. Snekkepresse (1), omfattende en i overfor hinanden liggende rammer drejeligt lejret snekkeaksel (4), som imellem en indløbsåbning (19) for råvæske og en udtagsåbning for afvandet materiale har en diameter, som i det væsentlige udvider sig konisk, og på hvilken snekkeaksel (4) der er placeret et skrueblad (9, 10), som strækker sig med i det væsentlige ensartet stigning, idet der yderligere i rammerne (2, 3) er anbragt en filtersigte, som cylindrisk omgiver snekkeakslen (4) og som har adskillige filteråbninger, idet der yderligere på ydersiden af filtersigten (11) er anbragt en renseindretning (18) for filtersigten, som omfatter adskillige rensedyser, og et under filtersigten (11) anbragt tragtformet filtratkar (13), idet snekkeakslen (4) i området ved indløbsåbningen (19) for råvæske er udformet cylindrisk (6), i et midterområde af snekkepressen (1) er udformet sig konisk (7) udvidende i retning mod udtagsåbningen og i området ved udtagsåbningen er udformet cylindrisk (8), og hvor det under filtersigten (1) anbragte filtratkar (13) er udformet med i det mindste to kamre (14, 15, 27, 28) henholdsvis to indbyrdes adskilte områder, hvilke to kamre (14, 15, 27, 28) hver især er forsynede med et udløb (29, 33) for filtrat, **kendetegnet ved**, **at** det første kammer (15, 27) i området ved indløbsåbningen (19) har en langsgående udstrækning, som i det mindste svarer til længden af det cylindrisk udformede område (6) af snekkeakslen (4) i området ved indløbsåbningen (19) for råvæske, og at udløbet (16) fra det første kammer (15, 27) i området ved indløbsåbningen, via en tilbageløbsledning (31) for filtrat, er forbundet med renseindretningen for filtersigten (11), for recirkulation af filtratet.

2. Snekkepresse ifølge krav 1, **kendetegnet ved, at** kammeret (15, 27) i området ved indløbsåbningen (19) har en langsgående udstrækning på fra 10 til 35%, især 15 til 25% af længden af snekkeakslen (1).

3. Snekkepresse ifølge krav 1 eller 2, **kendetegnet ved, at** der i tilbageløbsledningen (31) er tilvejebragt en pumpeindretning (32) samt en styre- henholdsvis reguleringsindretning (30) og et direkte udløb (16).

4. Snekkepresse ifølge krav 1, 2 eller 3, **kendetegnet ved, at** der supplerende er tilvejebragt et overløb (20) fra det første kammer (15, 27) i området ved indløbsåbningen (19) til i det mindste ét yderligere kammeer (14, 28) i området ved udtagsåbningen.

5. Snekkepresse ifølge ethvert af kravene 1 til 4, **kendetegnet ved, at** udløbet (33), fra det i det mindste ene yderligere kammer (14, 28) i området ved udløbsåbningen, via en tilbageføringsindretning (38), er forbundet med tilgangen, især en tilførselspumpe (36) for en indføring af råvæske.

6. Snekkepresse ifølge krav 5, **kendetegnet ved, at** tilbageføringsindretningen er forsynet med en pumpe (36), en styre-henholdsvis reguleringsindretning (34) samt en tilbageføringsledning (35) i indløbet (19) for råvæske og et direkte udløb.

7. Snekkepresse ifølge ethvert af kravene 1 til 6, **kendetegnet ved, at** filtersigten (4) i området ved det første kammer (15) er udformet med aflange huller med halvcirkelformede endeområder og i området ved det i det mindste ene yderligere kammer (14) er udformet med runde huller.

8. Snekkepresse ifølge krav 7, **kendetegnet ved, at** den langsgående udstrækning af de aflange huller svarer til omtrent 1,5 til 3 gange diameteren af de runde huller.

9. Snekkepresse ifølge ethvert af kravene 1 til 8, **kendetegnet ved, at** renseindretningen (18) for filtersigten (4) er udformet som et bevægeligt lejret dysearrangement (18), som omfatter i det mindste én sprøjtedyse, og at sprøjtedyserne i dysearrangementet (18) med varierende væsketryk kan forsynes med en rensevæske, som i det mindste delvis indeholder filtrat fra det første kammer i filtratkaret.

10. Snekkepresse ifølge krav 9, **kendetegnet ved, at** dysearrangementet i renseindretningen i det væsentlige omslutter hele omkredsen af filtersigten (11) og kan drives til en frem- og tilbagegående bevægelse, som i det væsentlige overstryger hele den langsgående udstrækning af filtersigten (11).

11. Snekkepresse ifølge ethvert af kravene 1 til 10, **kendetegnet ved, at** snekkeakslen (4), i det mindste i det cylindrisk udformede område (6) ved indløbsåbningen (19), fortrinsvis omtrent i området for den langsgående udstrækning af det første kammer (15) i området ved indløbsåbningen, har to skrueblade (9, 10) med samme stigning og modstående liggende udgangspunkt.

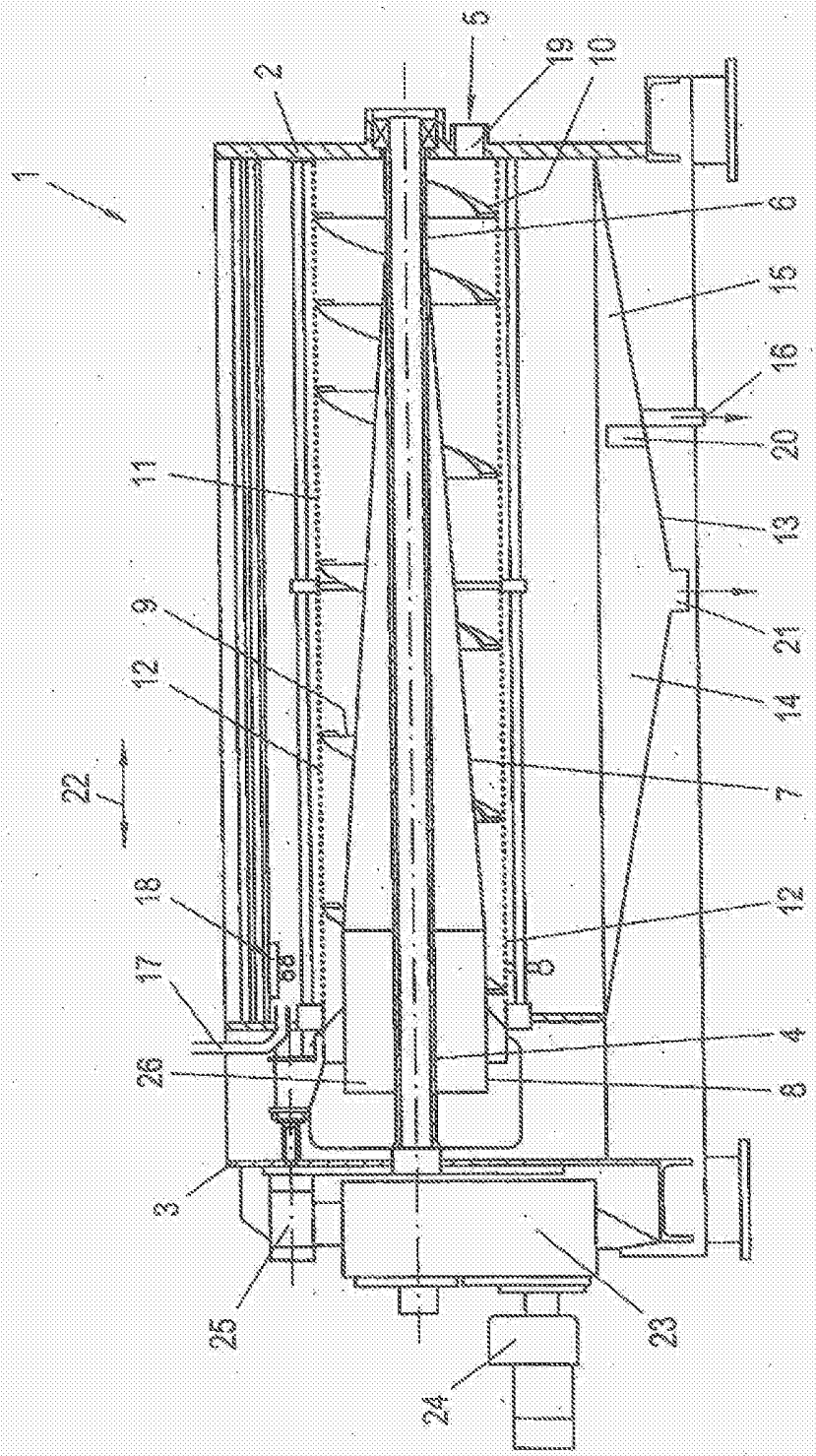

Fig. 1

KENDT TEKNIK

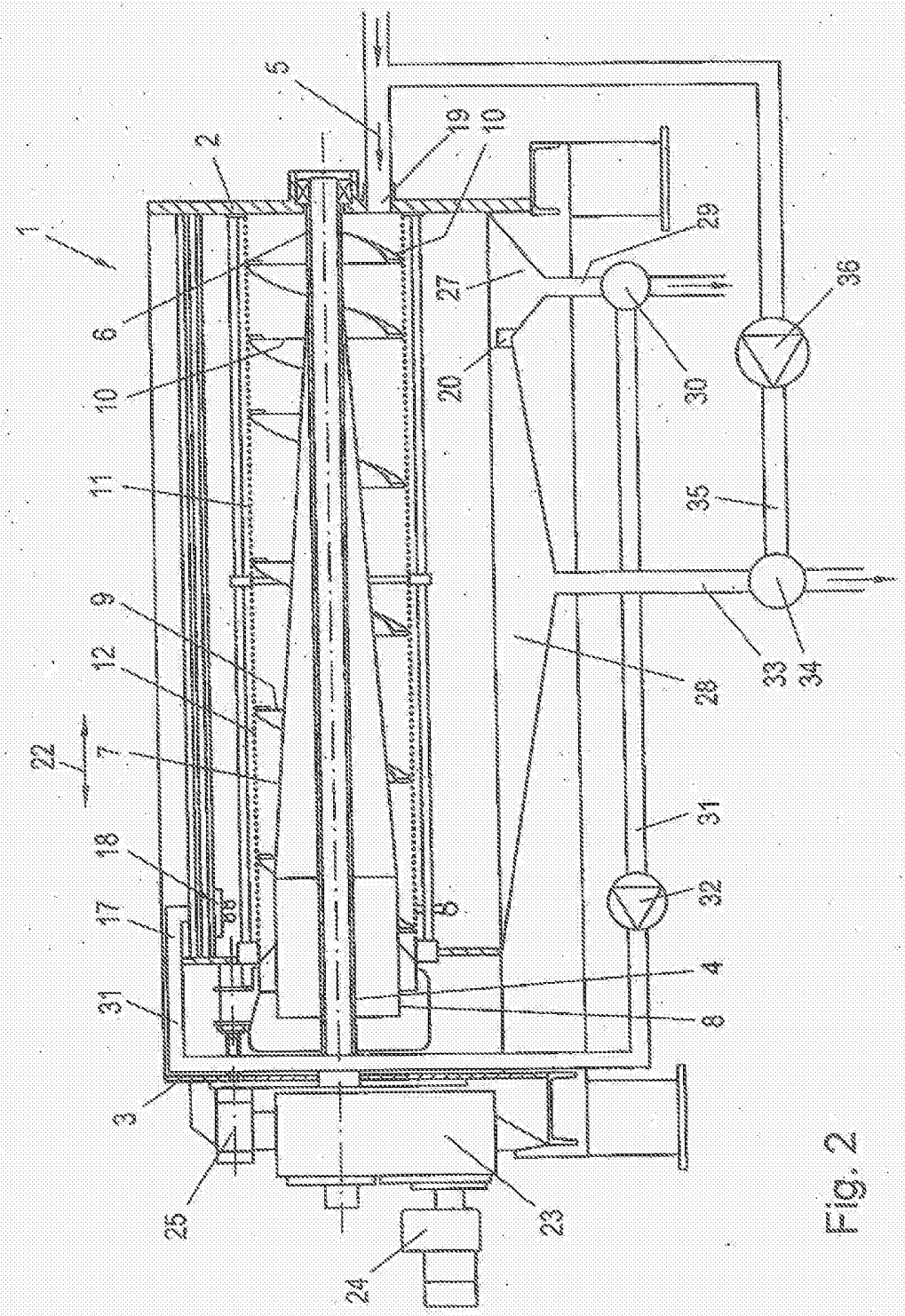
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Fig. 2

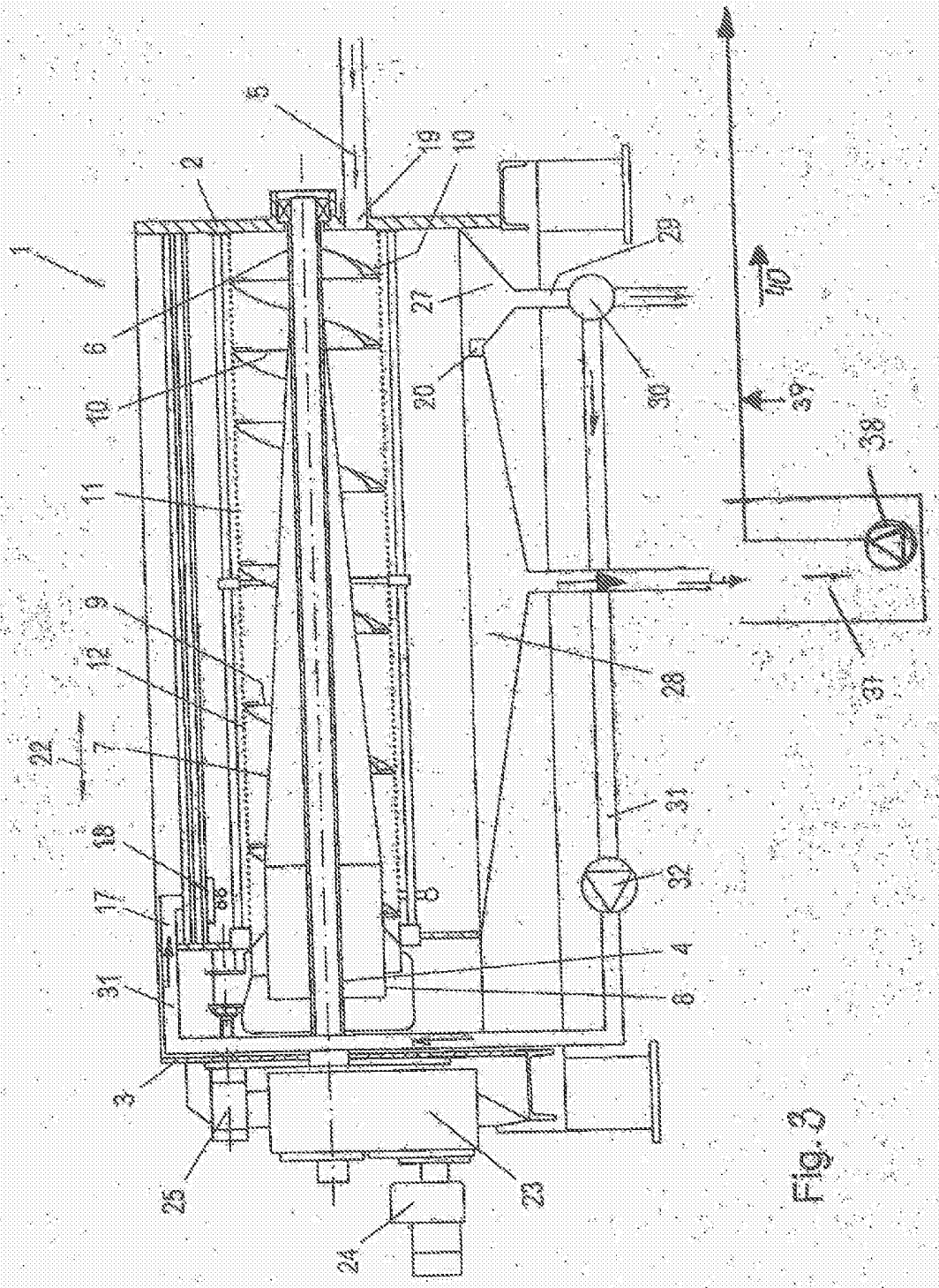
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Fig. 3