(19) DANMARK

(10) **DK/EP 2958678 T3**

(12) Oversættelse af europæisk patentskrift

Patent- og Varemærkestyrelsen

(51) Int.Cl.: ***B 04 B 1/08 (2006.01)*** ***B 04 B 7/14 (2006.01)***

(45) Oversættelsen bekendtgjort den: **2017-07-24**

(80) Dato for Den Europæiske Patentmyndigheds bekendtgørelse om meddelelse af patentet: **2017-04-26**

(86) Europæisk ansøgning nr.: **14704591.8**

(86) Europæisk indleveringsdag: **2014-02-14**

(87) Den europæiske ansøgnings publiceringsdag: **2015-12-30**

(86) International ansøgning nr.: **EP2014052954**

(87) Internationalt publikationsnr.: **WO2014128063**

(30) Prioritet: **2013-02-20 DE 102013101654**

(84) Designerede stater: **AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR**

(73) Patenthaver: **GEA Mechanical Equipment GmbH, Werner-Habig-Strasse 1, 59302 Oelde, Tyskland**

(72) Opfinder: **Quiter, Kathrin, An der Pferdebahn 43, 48317 Drensteinfurt, Tyskland**
KÖNIG, Julian, Heinrich-Lücking-Str. 21, 33098 Paderborn, Tyskland
BATHELT, Thomas, Von-Brachum-Str. 18, 59302 Oelde, Tyskland

(74) Fuldmægtig i Danmark: **Patrade A/S, Fredens Torv 3A, 8000 Århus C, Danmark**

(54) Benævnelse: **SEPARATIONSTALLERKENSAMLING**

(56) Fremdragne publikationer:
DE-A1-102011 050 046
DE-C- 610 987
US-A- 3 133 880

Separator disk package

The invention relates to a separator disk package according to the preamble of claim 1.

US 3,133,880 A discloses a separator disk package in a separator. In this case, two separator disks each form a flow channel with a meandering shape along a sectional plane, on which the rotational axis of the separator is arranged.

A centrifuge having a separator disk package is disclosed, for instance, in DE 10 2008 051 867 A1. Separator disks are commonly produced from metal. Usually, lugs in the form of webs or points are here configured on the separator disk, which lugs on the one hand ensure the spacing of the disks in the axial direction, and on the other hand define flow paths. For the technological background, DE 610 987 PS, DE 195 37 268 C1, US 3 133 880 A, US 3,335,946 and DE 17 69 636, which respectively disclose separator disks having a wide variety of lug arrangements, should also be cited. One aim of the development is to design the separator disks of a disk package of a separator or of some other centrifuge such that, when a product is clarified of solids, an optimal clarification effect is obtained.

The achievement of this aim is the object of the invention.

The invention achieves this object by virtue of the subject of claim 1. It further provides a separator drum having a separator disk package as claimed in claim 14.

As a result of the separator disks, having a labyrinth-like channel course comprising an at least dual or multiple diversion of the product at web-like lugs

through respectively more than 120°, preferably through more than 150°, particularly preferably through substantially 180° respectively, a guided flow is achieved, which flow enables better utilization of the clarifying area of the separator disks.

In design terms, it is particularly simple if the flow channel or flow channels is/are bounded by elevations in the form of formed-in or formed-on or attached lugs, as web-like lugs of the separator disks.

Furthermore, it is advantageous if preferably each separator disk is divided by first lugs in the peripheral direction into a plurality of peripherally distributed angular segments, so that, during operation of the centrifuge with rotating drum, no or only little liquid can flow from disk segment to disk segment in the peripheral direction.

The web-like lugs of the separator disks are distributed according to the invention in such a way on the separator disk, in particular within the angular segments, that a product to be processed is conducted initially radially from outside to in, then radially from inside to out (first diversion through virtually or substantially 180°), and then back radially from outside to in (second diversion through substantially or virtually 180°). In this way, a particularly good utilization of the clarifying area is achieved, since a product remains in the disk gap for a relatively long time before it is led off as a clarified phase to the center. In this way, a very advantageous flow behavior in a flow channel which can also be denoted as Z-shaped or S-shaped is achieved.

It is here, in turn, particularly advantageous if the flow channel or flow channels is/are designed such that in any event a part of a product, which product enters in the outer radial third in at least one rising

channel of the separator disk package into gaps between the separator disks, initially flows radially inward, is then diverted radially outward, and then is diverted back radially inward, where it, at the radial inner rim of the separator disk package, is discharged from the latter. As a result of the entry radially on the extreme outside and the exit radially on the extreme inside, the path of that part of the product which flow along the whole of this path becomes, particularly advantageously, very long.

In DE 610 987 PS or in US 3,133,880, for example, specifically a diversion back outward of a product component which initially flow radially inward does not takes place.

According to one variant and also according to a further invention which shall be considered independently, between two radially or substantially radially extending lugs, in particular between the second lug of a disk segment and the first lug of the, in the peripheral direction, next disk segment in the peripheral direction, there is provided a further (preferably fourth) lug, which has a lesser radial height, in any event than the lugs also serving as spacers, so that, between the vertical top side of this further lug and the bottom side of the axially next upper disk, a cross-sectional reduction or a gap is formed in the flow channel, through which product (in particular solid particles) can flow outward out of the disk package.

Below, the invention is described in greater detail, on the basis of several illustrative embodiments, with reference to the drawing, wherein:

fig. 1 shows a perspective view of a schematically represented separator disk;

fig. 2 shows a basic diagram of a nozzle-type separator which is suitable for a use of the separator disks from fig. 1;

fig. 3 shows a top view of a segment of a second separator disk;

fig. 4 shows a top view of a segment of a third separator disk;

fig. 5a shows a perspective view fourth separator disk;

fig. 5b shows a view of a rim portion of the fourth separator disk from 5a in the direction of the arrow F, in enlarged representation in relation to fig. 5a.

Fig. 2 shows a centrifuge configured as a separator, here as a nozzle-type separator, comprising a drum 1 which is rotatable about a rotational axis D and into which is respectively inserted a separator disk package 2 made up of separator disks 3, 3' arranged or stacked one above the other. The working of such separators comprising an inlet 4, a solids chamber 5, and outlets 6, 7 for the emptying of solids and or the evacuation of liquid phase(s) has long been common knowledge and therefore requires no further comment. The rotational axis D is here oriented vertically and the drum 2 is preferably of double-conical configuration. It enables a continuous processing, in particular clarification, of a product to be processed. In addition thereto, a separation of the product into two liquid phases of different density can also be realized. For the emptying of solids, nozzles (outlet 6), or openings, closable by piston valves, in the drum are preferably used (not represented).

Figure 1 shows a schematic representation of a separator disk 3 of the separator disk package 2, which preferably consists of a metal plate.

The respectively adjacent separator disks 3 and 3' are arranged at an axially distance apart, so that a gap, a so-called disk gap, is respectively formed between them.

The separator disk 3 has a conical basic shape 9 (see fig. 1), so that a succession of a plurality of separator disks 3, 3' also forms a substantially conical separator disk package 2.

The separator disk 3 here has a radial outer rim 10 and a radial inner rim 11. At the separator disks 3, solids are separated from a liquid to be clarified.

On the conical basic shape 9 of the separator disk 3, elevations are formed by lugs 12, 13, 14, which can preferably be formed by a stamping process, but also by a mounting of appropriate webs onto the disks. In figs. 1, 3, 4 and 5a, although the lugs are shown simplistically in dashed representation, this serves for easier recognizability for identification of the lugs, which can be produced by stamping, welding or the like and protrude axially from the disk.

These lugs 12, 13, 14 serve as spacers and influence the flow. On the bottom side of the separator disks, preferably no lugs are provided. There the separator disks 3 are smooth or have a microstructuring which, in comparison to the lugs 12 to 14 which preferably protrude axially by a few tenths of a millimeter, is axially very small.

The lugs 12 to 14 preferably form a lug pattern, as is evident in fig. 1.

Initially, the top side of the separator disks 3, preferably each separator disk 3, is divided by first lugs 12 in the peripheral direction into a plurality of peripherally distributed angular segments 15a, b, c, ….

The first lugs 12 run radially. They extend preferably over at least 90-100% of the radial length of the separator disks, preferably from the outer rim 10 up to the inner rim 11, or up to directly before these rims. In the peripheral direction, preferably no liquid can flow from disk angular segment 15a to disk angular segment 15b, etc.

In interaction with the further lugs 13, 14, a labyrinth-like flow channel 16 is formed, which provides for an at least single, preferably, however, dual or even triple or multiple diversion of through-flowing product through at least respectively 120°, preferably in each case substantially 180°.

This shall be explained in greater detail below.

In addition to the first lugs 12, distanced or offset in the peripheral direction as well as in the rotational direction D of the centrifuge drum, there is respectively formed for each angular segment 15 a, b, c … a second lug 13, which likewise extends radially, to be precise preferably directly from the outer rim 10 radially inward, preferably inward from the outer rim 10 over 50% to 80% of the radial extent of the separator disk 3.

Furthermore, for each angular segment 15 a, b, c …, a third lug 14 is preferably present. According to the embodiment of figs. 2 and 3, this third lug, in top view of the separator disk 3, has an L-shape comprising two legs 14a and 14b oriented at an angle, in particular a right angle, to each other. The third lug 14 passes preferably directly into the first lug 12 or attaches directly thereto.

Preferably, one of the legs 14a extends likewise radially. This leg 14a lies, distanced in the

rotational direction from the second lug 13, between the second lug 13 and the first lug 12 of the, in the rotational direction, next or adjacent disk segment 15b. The leg 14a extends preferably over more than 50% of the radial extent of the separator disk 3, wherein it is arranged approximately midway between the outer rim 10 and the inner rim 11. In particular, it has a radial distance to the outer rim 10 which amounts to at least 5%, preferably at least 10% of the radial extent of the separator disk 3.

The radially inner end of this leg 14a is connected to the first lug 12 by a leg 14b extending preferably in the peripheral direction or perpendicular, or substantially perpendicular, to the leg 14a and the first lug 12. This lug 14b preferably lies, in the peripheral direction, directly next to the inner rim 11.

In this way, in each disk segment a labyrinth-like flow channel 16 is preferably formed in the disk segment 15a, b, c …, which flow channel extends between the lugs and diverts a liquid twice through virtually or substantially 180° (or virtually 180°).

Product which in an inflow zone 16a between the lugs 12, 13 flows radially from outside into the disk gap initially flows in the radially inward direction, is then diverted around the inner end of the second lug 13, then flows in a second zone 16b of the channel 16 in the radially outward direction, and is finally diverted around the outer end of the third lug 14 back radially inward into a zone 16c. At the radially outer end of the zone 16b, solids are preferably discharged from the separator disk package in the radially outward direction, so that here an outward flow exists.

Essentially, the clarified product next flows between the third lug 14 and the first lug 12 of the, in the

rotational direction, next disk segment 15b in the third zone 16c of the channel 16 radially inward via the inner rim 11 and is led off there. This arrangement is preferably repeated in the peripheral direction.

As a result of the labyrinth-like channel course comprising at least one, or preferably at least dual diversion of the product in the directions P1, P2, P3 through more than 120°, in particular more than 150°, preferably substantially 180°, a guided flow is achieved, which flow enables better utilization of the clarifying area.

Figs. 3 and 4 further show that the separator disks 3 according to one variant of the previously discussed invention and also an invention which shall be considered independently, distributed in the peripheral direction, can alternately have regions 17, 18 of different outer diameter.

Represented is a top view of one of the angular segments 15. In the regions 17 of somewhat smaller or larger outer diameter (preferably the outer diameter is here 1 to 10 mm larger or smaller than in the regions 18) should preferably lie the entry into the first zone 16a of the flow channel 16. In the regions 18 of smaller or larger diameter, on the other hand, should lie the radial exit for the solid particles. In this way, the path of the product in the disk gap is once again lengthened and the clarification effect optimized.

The separator disk 3 can optionally have openings or recesses, which in interaction, in the mounted state, form with further separator disks 3′ a rising channel (not represented). Preferably, the configuration is free of a rising channel, however, since in this way use can particularly advantageously be made of the fact that product or centrifuge material flowing from

outside radially into the disk package 2 is respectively multiply diverted on its path radially inward between the separator disks. If rising channels are provided, these are preferably located in the outer radial third of the separator disk package, in order that, in this way too, a relatively long path is covered radially inward from the fluid centrifugal material to be processed. In the region between the lugs, the surface of the conical separator disks is preferably not stepped or wavy, as is shown by US 3,133,880, but rather - apart from possibly present microscopic structures on the disk surface, smooth.

Fig. 4 shows, like fig. 3, a top view of a single disk segment adjoined in the peripheral direction preferably by further, same-shaped disk segments.

According to fig. 4, the first and the second lug 12, 13 are radially configured and oriented in the style of fig. 1.

According to fig. 4, the third lug 14' is not, however, of L-shaped configuration, but rather is configured as a third lug 14' oriented at an acute angle - preferably at an angle between 30° and 60° - to the first lug 12, which third lug runs obliquely outward from the inner rim 11, so that its radially outer free end protrudes radially outward (and in the peripheral direction) over the radial inner end of the second lug 13. In this way too, a dual diversion through 180° is achieved. The oblique arrangement of the lug 14' enables the solids to slide off radially outward at this third lug 14'. It is clear that it is very easily possible to put the invention into practice through the use of lug patterns of different type.

According to fig. 5, it is provided as an option to provide a fourth lug 19 in the peripheral direction between the second lug 13 of one disk segment and the

first lug 12 of the next disk segment - preferably directly before the or on the outer rim 10. This fourth lug 19 has however - see fig. 5b - a lesser radial height than the other lugs 12, 13, 14a, b which act as spacers of the disks in the disk package. In this way, between the top side of this fourth lug 19 and the bottom side of the axially next upper disk (indicated in fig. 5 by a dashed line T), a cross-sectional reduction or gap 20 (which generally extends just one or a very few tenths of a millimeter) is formed in the flow channel, by which the flow relationships are so positively influenced that the solids can readily leave the disk package in the outward direction, while the principal flow of the product in the inward direction is positively promoted.

Reference symbols

drum	1
separator disk package	2
separator disks	3, 3’
inlet	4
solids chamber	5
outlets	6, 7
basic shape	9
outer disk rim	10
inner disk rim	11
lugs	12, 13, 14, 14’
legs	14a, b
angular segments	15a, b, c, …
flow channel	16
zones	16a, b, c
regions	17, 18
lug	19
gap	20
arrows	F, S
product stream directions	P1, P2, P3

SEPARATIONSTALLERKENSAMLING

Patentkrav

1. Separationstallerkensamling til en drejelig tromle (1) i en centrifuge, især i en separator eller i en spiralformet transportørcentrifuge med fast skål til processering af et flydende produkt i kontinuerlig drift, hvilken separationstallerkensamling omfatter aksialt opstablede koniske separationstallerkner (3, 3'), hvor der mellem tilgrænsende separationstallerkner er dannet tallerkenspalter, hvor der på én eller flere af eller alle de aksialt tilgrænsende separationstallerkner (3) er konfigureret én eller flere labyrintlignende strømningskanaler (16), i hvilke strømningsretningen for et gennemstrømmende produkt, som skal klares for faststoffer, i drift ændrer sig ved to eller flere lejligheder med mindst 120°, hvor strømningskanalen eller strømningskanalerne (16) er begrænset af forhøjninger i form af deri dannede eller derpå dannede eller påsatte lapper (12, 13, 14) på separationstallerknerne og af to tilgrænsende separationstallerkner (3, 3'), og hvor lapperne (12, 13, 14) på separationstallerknerne (3) er i en trinlignende konfiguration, hvilken separationstallerkensamling er **kendetegnet ved, at** de trinlignende lapper (12, 13, 14) på separationstallerknerne (3) er fordelt på en sådan måde på separationstallerknerne, at et produkt, som skal processeres, helt eller delvis initialt føres radialt udefra og indefter, derefter radialt indefra og udefter og derefter igen radialt udefra og indefter.

2. Separationstallerkensamling ifølge krav 1, der er **kendetegnet ved, at** strømningskanalen eller strømningskanalerne (16) er udformet således, at de to gange omdirigerer det produkt, som skal

processeres, med i det væsentlige 180°.

3. Separationstallerkensamling ifølge ét af de foregående krav 1 eller 2, der er **kendetegnet ved, at** separationstallerknerne (3) har en radial yderkant (10) og en radial inderkant (11), og **ved, at** separationstallerknernes (3) overflade ved hjælp af første lapper (12) i omfangsretningen er opdelt i en flerhed af perifert fordelte vinkelsegmenter (15a, b, c, ...), således at der ved drift af centrifugen med roterende tromle fortrinsvis ikke strømmer væske fra vinkelsegment til vinkelsegment i omfangsretningen.

4. Separationstallerkensamling ifølge ét af de foregående krav, der er **kendetegnet ved, at** de trinlignende lapper (12, 13, 14) på separationstallerknerne (3) er fordelt på en sådan måde på separationstallerknerne i vinkelsegmenterne (15), at et produkt, som skal processeres, helt eller delvis initialt føres radialt udefra og indefter, derefter radialt indefra og udefter og derefter igen radialt udefra og indefter.

5. Separationstallerkensamling ifølge krav 1, der er **kendetegnet ved, at** strømningskanalen eller strømningskanalerne (16) er udformet således, at under alle omstændigheder en del af et produkt, hvilket produkt indføres på den ydre periferi i separationstallerkensamlingen (2) på yderkanten i tallerkenspalter mellem separationstallerknerne (3), initialt strømmer radialt indad, derefter omdirigeres radialt udad og derefter igen omdirigeres radialt indad, hvor det ved separationstallerkensamlingens (2) radiale inderkant udledes fra sidstnævnte.

6. Separationstallerkensamling ifølge ét af de foregående krav, der er **kendetegnet ved, at** strømningskanalen eller

strømningskanalerne (16) er udformet således, at under alle omstændigheder en del af et produkt, hvilket produkt indføres i den ydre radiale tredjedel i mindst én stigekanal i separationstallerkensamlingen i tallerkenspalter mellem separationstallerknerne (3), initialt strømmer radialt indad, derefter omdirigeres radialt udad og derefter igen omdirigeres radialt indad, hvor det ved separationstallerkensamlingens (2) radiale inderkant udledes fra sidstnævnte.

7. Separationstallerkensamling ifølge ét af de foregående krav, der er **kendetegnet ved, at** der ud over de første lapper (12) med en afstand i omfangsretningen af centrifugens tromle er dannet en anden lap (13), som strækker sig radialt, hvor den anden lap (13) fortrinsvis strækker sig over 50 % til 80 % af separationstallerknens (3) radiale bredde.

8. Separationstallerkensamling ifølge ét af de foregående krav, der er **kendetegnet ved, at** der er tilvejebragt en tredje lap (14), hvilken tredje lap har en L-form, som omfatter to vinkelben (14a og 14b), der er orienteret i en vinkel, især en ret vinkel, i forhold til hinanden.

9. Separationstallerkensamling ifølge ét af de foregående krav, der er **kendetegnet ved, at** den tredje lap (14') er påsat på den første lap (12) og orienteret i en spids vinkel i forhold til sidstnævnte, således at den radialt ydre frie ende stikker radialt udad over den indre ende af den anden lap (13), og/eller at den tredje lap (14) støder op til den første lap (12) eller går direkte over i den første lap (12).

10. Separationstallerkensamling ifølge ét af de foregående krav, der er **kendetegnet ved, at** ét af vinkelbenene (14a) i den

tredje lap (14) strækker sig radialt, således at dette vinkelben (14a) med afstand i rotationsretningen fra den anden lap (13) ligger mellem den anden lap (13) og den første lap (12) på det i rotationsretningen næste eller tilgrænsende tallerkensegment (15b), og/eller at vinkelbenet (14a) strækker sig over mere end 50 % af separationstallerknens (3) radiale bredde, hvor det har en afstand til yderkanten (10), som udgør mindst 5 %, fortrinsvis mindst 10 % af separationstallerknens (3) radiale bredde eller omfang, og/eller at det yderligere vinkelben (14b) er dannet eller anbragt mellem det radiale vinkelbens (14a) radialt indre ende og den første lap.

11. Separationstallerkensamling ifølge ét af de foregående krav, der er **kendetegnet ved, at** den er konfigureret uden en stigekanal.

12. Separationstallerkensamling ifølge ét af de foregående krav eller ifølge overbegrebet til krav 1, hvilken separationstallerkensamling er **kendetegnet ved, at** separationstallerknerne (3) fordelt i omfangsretningen skiftevis har områder (17, 18) med forskellig ydre diameter.

13. Separationstallerkensamling ifølge ét af de foregående krav, der er **kendetegnet ved, at** der mellem to radialt eller i det væsentlige radialt udstrækkende lapper, især mellem den anden lap (13) på et tallerkensegment og den første lap (12) på det i omfangsretningen næste tallerkensegment i omfangsretningen, er tilvejebragt en yderligere (fjerde) lap (19), som har en mindre radial højde, under alle omstændigheder mindre end lapperne (12, 13), der også fungerer som afstandsstykker, således at der mellem oversiden af denne yderligere lap (19) og undersiden af den aksialt næste øvre tallerken dannes en tværsnitsreduktion eller en spalte (20) i strømningskanalen, gennem hvilken produkt (især

faststoffer) kan strømme udefter ud ad tallerkensamlingen.

14. Separatortromle med en separationstallerkensamling ifølge ét af de foregående krav.

Fig. 1

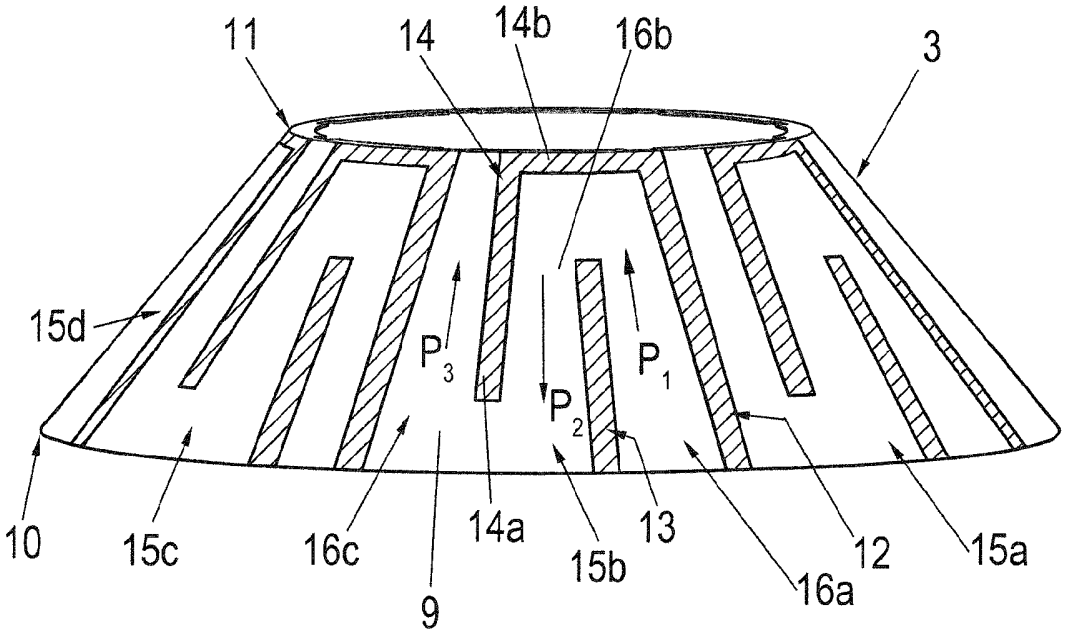
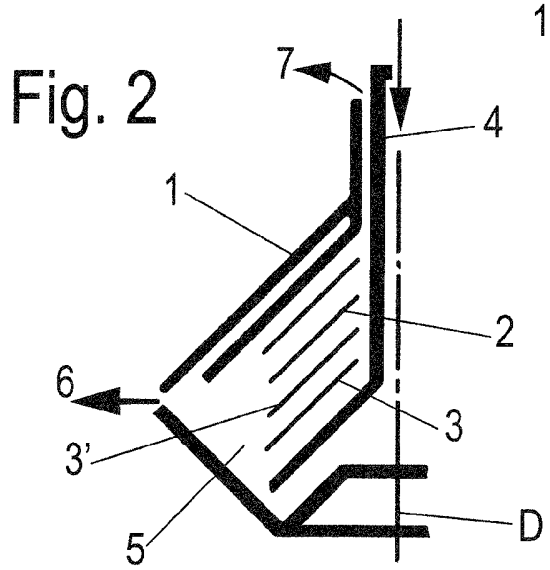


Fig. 2



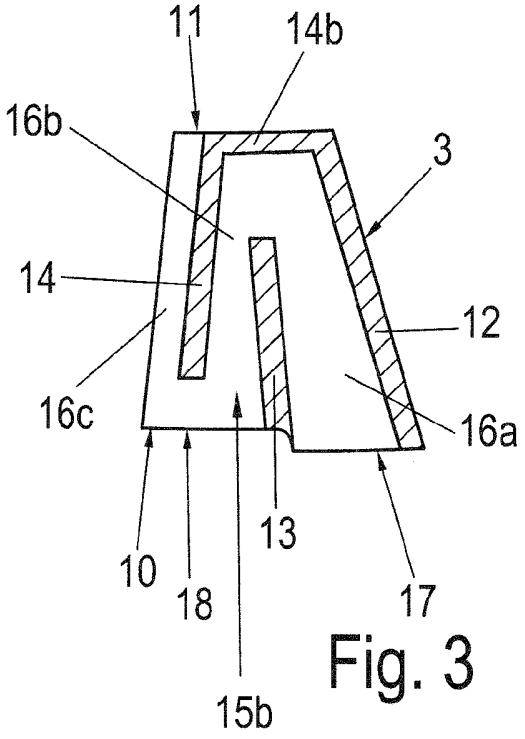


Fig. 3

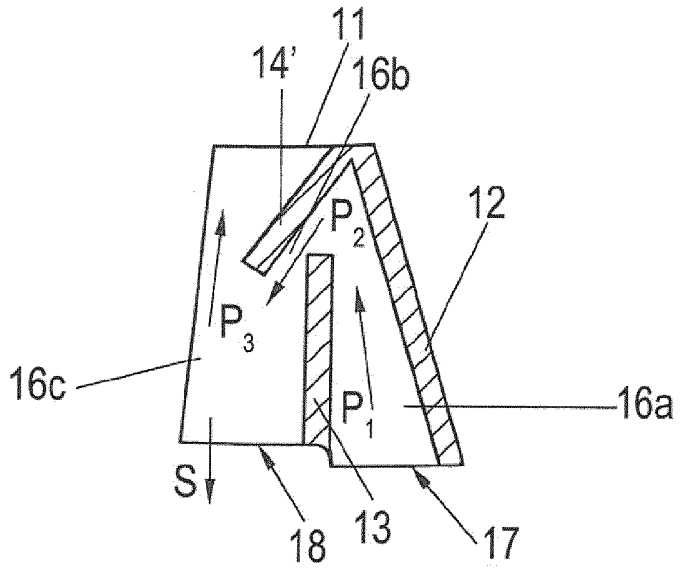


Fig. 4

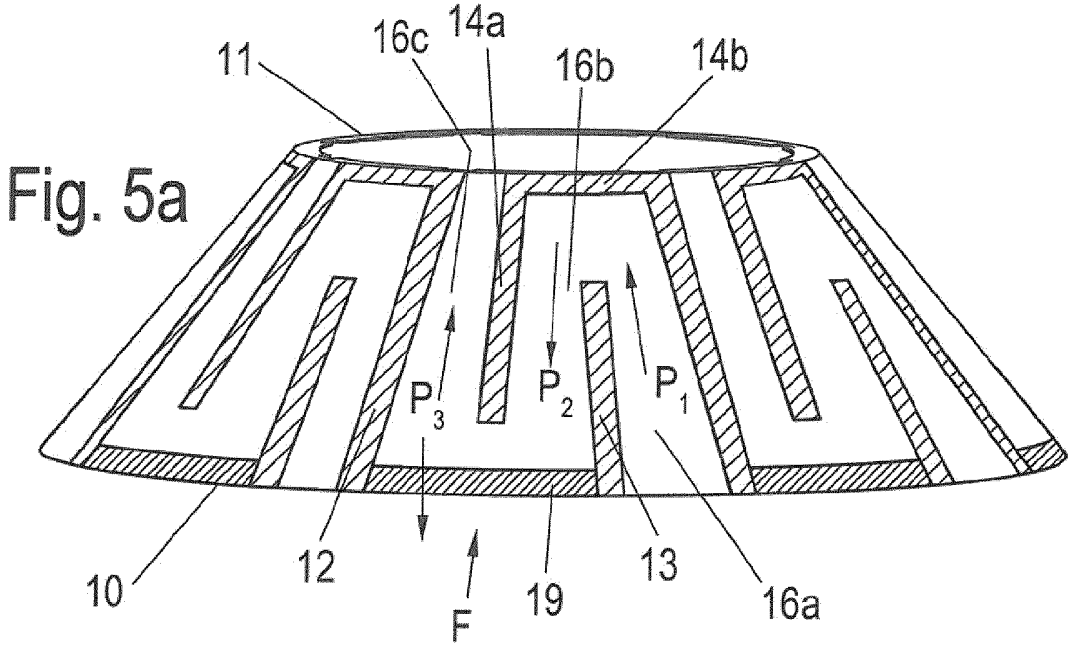


Fig. 5a

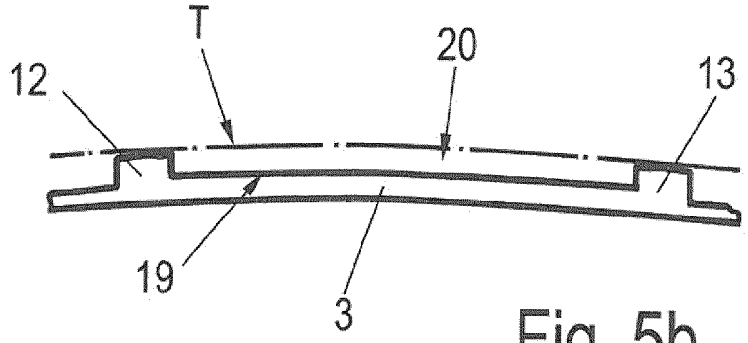


Fig. 5b