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(54) **A DISC ARRANGEMENT FOR A CENTRIFUGAL SEPARATOR**

(57) The disclosure relates to a disc arrangement (1) for a centrifugal separator, the disc arrangement (1) comprises: a truncated cone shaped top disc (4) comprising a top circumference (6), a base circumference, an outer conical surface (10) and an inner conical surface; a neck device (14) attached to the top circumference (6) of the top disc (4); and at least three wing elements (18) connected to the neck device (14). The wing elements (18) are configured to rest on and extend along the outer conical surface (10) of the top disc (4).

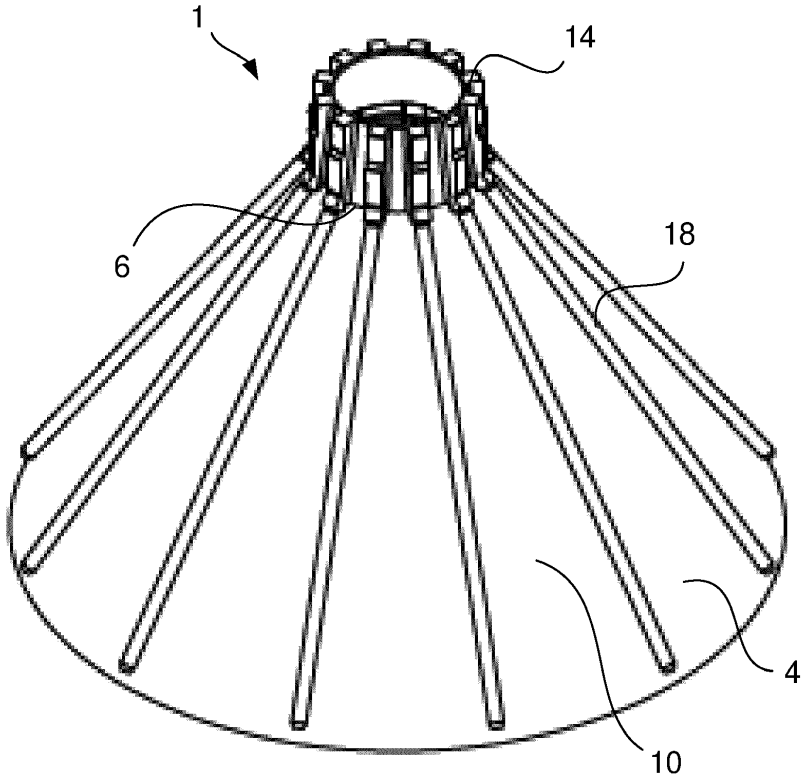

Fig. 1

EP 4 549 026 A1

Description

Technical field

[0001] The present disclosure relates to a disc arrangement for a centrifugal separator and a centrifugal separator as defined in the introductory parts of the independent claims.

Background art

[0002] Centrifugal separators are generally used for separation of liquids and/or solids from a liquid mixture or a gas mixture. During operation, fluid mixture that is about to be separated is introduced into a rotating bowl and due to the centrifugal forces, heavy particles or denser liquid, such as water, accumulates at the periphery of the rotating bowl whereas less dense liquid accumulates closer to the centre axis of rotation. This allows for collection of the separated fractions, e.g. by means of different outlets arranged at the periphery and close to the rotational axis, respectively. Conical separation discs are stacked in the rotating bowl at a mutual distance to form interspaces between themselves. Spacing members on an inner conical surface of the separation discs form the interspaces between separation discs. The separation discs are shaped as a truncated cone and can be made of thin sheet metal. In some separator applications the separation discs can be made of plastics. The separation discs are provided with spacing members in order to create interspaces between the adjacent discs when they are arranged in a stack in the separator. The disc arranged at the top of the stack, the top disc, is fixated in place and abuts the separator bowl. Wing elements can be arranged on an outer conical surface of the top disc, which is arranged at the top of the stack. The wing elements create a distance between the outer conical surface of the top disc and the inner surface of the separator bowl. Depending on the type of separator and if fluids or particles in fluids are to be separated, fluid passes between the wing elements and further to an outlet of the separator bowl. The rotational motion of the discs and thus the wing elements creates fluid pressure of the fluid or gas between the wing elements, which pressure results of a flow of fluid or gas to the outlet. In other separator applications, the wing elements have the function of creating a distance between the outer conical surface of the top disc and the inner surface of the separator bowl for hygienically reasons. The wing elements are welded to the outer conical surface of the top disc. The top disc may be arranged with a larger thickness than the separation discs. The top disc may be provided with spacing members on an inner conical surface in order to create an interspace between the top disc and the adjacent separator disc when the top disc is arranged in the top of the stack of separator discs in the separator.

Summary

[0003] A problem with the solutions of the prior art is that the known top discs may buckle when the wing elements are welded to the outer conical surface. Since the top disc is rotating with high rotational speed, it is important that the top disc is well balanced. Therefore, the top disc often must be machined after welding of the wings in order to achieve the top disc balanced. The machining of the top disc is time consuming and costly. In some cases the separator bowl must be machined due to the imbalance in the top disc. A solution in the prior art to this solution is to increase the sheet thickness of the top disc. This will increase the production cost of the top disc. Further, the increased thickness of the top disc will reduce the number of discs in the stack of discs, which results in a decreased performance of the centrifugal separator.

[0004] Another problem with the solutions of the prior art is that the height of the wing elements is fixed due to the welding joints. In some cases it would be preferred if the height of the wings could be changed or could be adjusted in order to change the distance between the outer conical surface of the top disc and the inner surface of the separator bowl and thus change or regulate the flow of fluid or gas between the wing elements.

[0005] A further problem with the solutions of the prior art is that the number of wing elements welded to the top disc cannot simply be reduced due to the welding joints. Reducing or alter the number of wing elements may change or regulate the flow of fluid between the wing elements.

[0006] There is thus a need for an improved disc arrangement, which comprises a top disc and wing elements.

[0007] It is an objective of the present disclosure to mitigate, alleviate or eliminate one or more of the above-identified deficiencies and disadvantages in the prior art.

[0008] A further objective is to achieve a disc arrangement, which provide for an improved balance of the top disc after arranging the wing elements to the top disc.

[0009] A further objective is to achieve a disc arrangement, which comprises a top disc with small sheet thickness.

[0010] A further objective is to achieve a disc arrangement, in which the distance between the outer conical surface of the top disc and the inner surface of the separator bowl can be changed.

[0011] A further objective is to achieve a disc arrangement, in which the number of wing elements easily can be changed.

[0012] This is achieved by the disc arrangement and the centrifugal separator according to the appended claims.

[0013] According to a first aspect there is provided a disc arrangement for a centrifugal separator, the disc arrangement comprises: a truncated cone shaped top disc comprising a top circumference, a base circumfer-

ence, an outer conical surface and an inner conical surface; a neck device attached to the top circumference of the top disc; and at least three wing elements connected to the neck device. The wing elements are configured to rest on and extend along the outer conical surface of the top disc.

[0014] The disc arrangement may be arranged in a stack of separation discs in the centrifugal separator. The centrifugal separator may be configured for separating a mixture of fluids of different densities from each other. The centrifugal separator may be configured for separating particles and a liquid phase from a liquid mixture, such as a clarifier.

[0015] The top disc may be made from a work piece of metal, such as a flat, circular disc of metal. Alternatively, the top disc may be made of plastic. The completed top disc may have a frustoconical shape, which corresponds to a truncated cone. The truncated cone shaped top disc may comprise an opening with a top circumference at the top of the truncated cone. The opening at the top of the top disc may be circular. The base of the truncated cone shaped top disc may be a circular opening with a base circumference. The outer conical surface may be smooth. The inner conical surface may be smooth or provided with spacing members. The opening at the top of the separation disc and the circular opening at the base of the top disc are configured to be concentric with a common center axis.

[0016] The neck device may be attached to the top disc by a connection device or a suitable fastener element. The at least three wing elements may be releasably connected to the neck device. The wing elements may be disconnectable from the neck device and replaced by another type of wing elements. The other type of wing elements may have a different shape. The other type of wing elements may have a larger or smaller extension in the direction of a normal to the outer conical surface. The neck device may be provided with bores into which the wing elements extend. The neck device may be provided with protrusions or tabs on which the wing elements are connected. The neck device may be provided with a central opening, which is configured to concentric with the opening at the top of the top disc. The neck device may be provided with channels, which are axially arranged in the neck device. The channels in the neck device are configures to convey the separated fluid flowing on the outer conical surface between the wing elements and into the channels in the neck device and further to an outlet of the separator.

[0017] The wing elements may be configured to rest on and extend along the outer conical surface of the top disc. The wing elements may thus be separable from the outer surface of the top disc, i.e. not be welded to, or by other means securely fastened to, the outer surface of the top disc. The wing elements may have linear contact with the outer conical surface of the top disc. The number of wing elements may be selected in view of the type of fluid to be separated and the pressure exerted from the separator bowl when the disc arrangement is arranged in a stack in the separator bowl.

[0018] This disc arrangement may need little or no machining for balancing the disc arrangement. Since the wings are configured to rest on the outer conical surface of the top disc and no welding operation is used, the sheet thickness of the top disc can be reduced. As a result, the number of separation discs in the stack can be increased, which increases the performance of the centrifugal separator. Further, since the wing elements are replaceable, the flow of fluid on the outer conical surface of the top disc can be controlled and adapted to the fluids to be separated. Also, the number of wing elements can easily be changed for regulating the flow of fluid between the wing elements.

[0019] Each wing element may be a rod with a longitudinal extension and be provided with a first end and a second end, wherein the first end of the wing elements is connected to the neck device. The rods may be homogenous or provided with a central bore. The cross-section of the rods may be adapted to the fluid to be separated. The surface of the rods may be smooth or be provided with indentations or grooves.

[0020] The wing elements may have a cylinder shape. The cylinder shape of the wing elements may result in a reduced contact surface between the wing element and the outer conical surface of the top disc. This will reduce contamination at the contact area between the wing elements and the top disc.

[0021] The wing elements may have a circular cross-section. The circular cross-section reduces the contact surface between the wing element and the outer conical surface of the top disc. The circular cross-section simplifies the arrangement of the wing elements on the outer conical surface of the top disc and the connection to the neck device.

[0022] The wing elements may extend from the neck device to a position adjacent to the base circumference of the top disc. The wing elements may end at the base circumference of the top disc. The wing elements may end at a position on the outer conical surface of the top disc a distance from the base circumference.

[0023] The wing elements and the neck device may comprise threads for the connection of the wing elements with threaded fittings to the neck device. The threaded connection simplifies the replacement of the wing elements and may also be used to add or reduce the number of wing elements of the disc arrangement.

[0024] The wing elements may be connected to the neck device by shrink fittings. The shrink fitting may reduce contamination into the fitting and thus increase the hygienic aspects of the arrangement. The shrink fitting may also be arranged for a replacement of the wing element. Increasing the temperature of the neck devise will release the wing elements from the neck device.

[0025] The wing elements may be configured to be arranged with equal mutual distances to each other on

the outer conical surface of the top disc. The equal mutual distance between the wing elements will keep the disc arrangement well balanced. Further, the flow of the separated fluid may be equalized when the distance between the wing element is equal.

[0026] The second end of each wing element may be provided with a tapered point. The tapered point will decrease any disturbance in the fluid flow of the separated fluid that flows between the wing elements on the outer conical surface of the top disc.

[0027] The top disc is configured to be arranged at the top in a stack of separation discs in the centrifugal separator. The top disc of the disc arrangement may have a similar shape as the separation discs in the stack. However, the top disc may have a lager sheet or wall thickness than the separation discs in the stack. In some centrifugal separator applications the pressure from the separator bowl on the wing elements and on the top disc of the disc arrangement is very high. In order to withstand this pressure the top disc may be provided with an increased sheet or wall thickness.

[0028] The top disc may comprise spacing members on the inner conical surface. The spacing members may be integrated in the material of the top disc. Alternatively, the spacing members may be a separate member, which is arranged on the inner conical surface of the top disc.

[0029] According to a second aspect there is provided a centrifugal separator comprising the disc arrangement disclosed herein. The centrifugal separator may be configured for separating a mixture of fluids of different densities from each other. The centrifugal separator may be configured for separating particles and a liquid phase from a liquid mixture, such as a clarifier. The centrifugal separator may comprise a rotatable centrifuge bowl in which the separation takes place; a stack of separation discs arranged in said centrifuge bowl; and wherein said disc arrangement may be arranged as a top disc of said disc stack and in contact with an inner surface of said centrifuge bowl. During operation, fluid mixture that is about to be separated is introduced into the rotatable centrifuge bowl and due to the centrifugal forces, heavy particles or denser liquid, accumulates at the periphery of the rotating bowl whereas less dense liquid accumulates closer to a centre axis of rotation. The top disc is configured to be arranged at the top in a stack of separation discs in the centrifugal separator. The wings of the disc arrangement may have contact with an inner surface of said centrifuge bowl.

[0030] The stack of separation discs may be compressed with a compression force when mounted in said the centrifuge bowl, and wherein said disc arrangement may be arranged such that said wing elements form an element for transmitting the compression force to the compressed stack of separation discs. The top disc of the disc arrangement may be similar to the other separation discs in the stack. However, the top disc may have a lager sheet or wall thickness than the separation discs in the stack. In some centrifugal separator applications the pressure from the separator bowl on the wing elements and on the top disc of the disc arrangement is very high. In order to withstand this pressure the top disc is provided with an increased sheet or wall thickness.

[0031] Additional objectives, advantages and novel features of the invention will be apparent to one skilled in the art from the following details, and through exercising the invention. While the invention is described below, it should be apparent that the invention may not be limited to the specifically described details. One skilled in the art, having access to the teachings herein, will recognize additional applications, modifications and incorporations in other areas, which are within the scope of the invention.

Brief descriptions of the drawings

[0032] For fuller understanding of the present disclosure and further objects and advantages of it, the detailed description set out below should be read together with the accompanying drawings, in which the same reference notations denote similar items in the various figures, and in which:

Fig. 1 schematically illustrates a disc arrangement in a view of perspective according to an example;

Fig. 2 schematically illustrates a top disc in a view of perspective according to an example;

Fig. 3 schematically illustrates a cross-section view of a disc arrangement according to an example;

Fig. 4 schematically illustrates a detail view of the disc arrangement disclosed in fig. 3;

Fig. 5 schematically illustrates an exploded view of a disc arrangement according to an example;

Fig. 6 schematically illustrates a disc arrangement in a view from above according to an example, and

Fig. 7 schematically illustrates a centrifugal separator according to an example.

Detailed description

[0033] The detailed description with reference to the examples depicted are to be viewed as examples comprising a combination of certain features, which features have been described in detail above. It is thus to be understood that additional examples may be achieved by combining other features into examples not depicted herein. The figures are to be viewed as examples and not mutually exclusive combinations. It should also be noted that all figures shown and described are schematically represented, wherein generic parts of machinery or similar is not depicted for the sake of simplicity.

[0034] Fig. 1 schematically illustrates a disc arrange-

ment 1 in a view of perspective according to an example. The disc arrangement 1 comprises a truncated cone shaped top disc 4. A neck device 14 is attached to a top circumference 6 of the top disc 4. Wing elements 18 are connected to the neck device 14. The wing elements 18 are configured to rest on and extend along an outer conical surface 10 of the top disc 4. The wing elements 18 are configured to be arranged with equal mutual distances to each other on the outer conical surface 10 of the top disc 4. The disc arrangement 1 is configured to be a component of a centrifugal separator 2, which is described in connection to fig. 7.

[0035] Fig. 2 schematically illustrates the top disc 4 in a view of perspective according to an example. The top disc 4 is shaped as a truncated cone with a top circumference 6, a base circumference 8, an outer conical surface 10 and an inner conical surface 12. The top disc 4 comprises a number of spacing members 34 on the inner conical surface 12. When arranging a top disc 4 over a separation disc 5 in a stack of separation discs 5 (see fig. 7) the spacing members 34 will achieve a space between the inner conical surface 12 of one of the top disc 4 and the outer conical surface 10 of the separation disc 5.

[0036] Fig. 3 schematically illustrates a cross-section view of a disc arrangement 1 according to an example. Each wing element 18 is a rod with a longitudinal extension and is provided with a first end 20 and a second end 22. The first end 20 of the wing elements are connected to the neck device 14. The wing elements 18 have a cylinder shape and have a circular cross section. The wing elements 18 extend from the neck device 14 to a position adjacent to the base circumference 8 of the top disc 4. The second end 22 of each wing element 18 is provided with a tapered or rounded point 30.

[0037] Fig. 4 schematically illustrates a detail view of the disc arrangement 1 disclosed in fig. 3. The wing elements 18 and the neck device 14 comprises threads 24 for the connection of the wing elements 18 with threaded fittings 26 to the neck device 14. Alternatively, the wing elements 18 are connected to the neck device 14 by shrink fittings 28. The spacing members 34 arranged on the inner conical surface 12 of the top disc 4 are disclosed in fig. 4. A first sealing element 38 is arranged between the neck device 14 and the top disc 4. The first sealing element 38 may be an O-ring. A second sealing element 40 is arranged at the connection between each wing element 18 and the neck device 14. The second sealing element 40 may be an O-ring.

[0038] Fig. 5 schematically illustrates an exploded view of a disc arrangement 1 according to an example. The wing elements 18 are connected to the neck device 14. The wing elements 18 and the neck device 14 can be connected as a unit to the separation disc 4 after the wing elements 18 have been attached to the neck device 14. The first sealing element 38 is disclosed in fig. 5, which is configured to be arranged between the neck device 14 and the top disc 4.

[0039] Fig. 6 schematically illustrates a disc arrangement 1 in a view from above according to an example. Twelve wing elements 18 are arranged with equal mutual distances to each other on the outer conical surface 10 of the top disc 4. However, the disc arrangement 1 can comprise more or less than twelve wing elements 18. Preferably, at least three wing elements 18 are arranged with equal mutual distances to each other on the outer conical surface 10 of the top disc 4.

[0040] Fig. 7 schematically illustrates a centrifugal separator 2 according to an example. The separator 2 comprises a centrifuge bowl 42 that forms within itself a separation chamber 44 in which centrifugal separation of fluids or particles in fluids takes place during operation. The separation chamber 44 is provided with a stack 32 of truncated cone shaped separation discs 5 to facilitate effective separation. The disc arrangement 1 is a top disc 4, which is configured to be arranged at the top in a stack 32 of separation discs 5 in the centrifugal separator 2.

[0041] The foregoing description of the embodiments has been furnished for illustrative and descriptive purposes. It is not intended to be exhaustive, or to limit the embodiments to the variations described. Many modifications and variations will obviously be apparent to one skilled in the art. The embodiments have been chosen and described in order to best explicate principles and practical applications, and to thereby enable one skilled in the art to understand the invention in terms of its various embodiments and with the various modifications that are applicable to its intended use. The components and features specified above may, within the framework of the disclosure, be combined between different embodiments specified.

Claims

1. A disc arrangement (1) for a centrifugal separator (2), the disc arrangement (1) comprises: a truncated cone shaped top disc (4) comprising a top circumference (6), a base circumference (8), an outer conical surface (10) and an inner conical surface (12); a neck device (14) attached to the top circumference (6) of the top disc (4); and at least three wing elements (18) are connected to the neck device (14), **characterized in that** the wing elements (18) are configured to rest on and extend along the outer conical surface (10) of the top disc (4).

2. The disc arrangement (1) according to claim 1, wherein each wing element (18) is a rod with a longitudinal extension and is provided with a first end (20) and a second end (22), wherein the first end (20) of the wing elements is connected to the neck device (14).

3. The disc arrangement (1) according to any one of claims 1 and 2, wherein the wing elements (18) have a cylinder shape.

4. The disc arrangement (1) according to any one of the preceding claims, wherein the wing elements (18) have a circular-cross section.

5. The disc arrangement (1) according to any one of the preceding claims, wherein the wing elements (18) extend from the neck device (14) to a position adjacent to the base circumference (8) of the separation disc (4).

6. The disc arrangement (1) according to any one of the preceding claims, wherein the wing elements (18) and the neck device (14) comprises threads (24) for the connection of the wing elements (18) with threaded fittings (26) to the neck device (14).

7. The disc arrangement (1) according to any one of the claims 1 - 5, wherein the wing elements (18) are connected to the neck device (14) by shrink fittings (28).

8. The disc arrangement (1) according to any one of the preceding claims, wherein the wing elements (18) are configured to be arranged with equal mutual distances to each other on the outer conical surface (10) of the top disc (4).

9. The disc arrangement (1) according to any one of the preceding claims, wherein the second end (22) of each wing element (18) is provided with a tapered point (30).

10. The disc arrangement (1) according to any one of the preceding claims, wherein the top disc (4) is configured to be arranged at the top in a stack (32) of separation discs (5) in the centrifugal separator (2).

11. The disc arrangement (1) according to any one of the preceding claims, wherein the top disc (4) comprises spacing members (34) on the inner conical surface (12).

12. A centrifugal separator (2), comprising a disc arrangement (1) according to any one of the preceding claims.

13. A centrifugal separator (2) according to claim 12, wherein the centrifugal separator (2) comprises

a rotatable centrifuge bowl (42) in which the separation takes place;
a stack (32) of separation discs (5) arranged in said centrifuge bowl (42);
and wherein said disc arrangement (1) is arranged as a top disc (4) of said disc stack (32) and in contact with an inner surface of said centrifuge bowl (42).

14. A centrifugal separator (2) according to claim 13, wherein the stack (32) of separation discs (5) is compressed with a compression force when mounted in said the centrifuge bowl (42),
and wherein said disc arrangement (1) is arranged such that said wing elements (18) form an element for transmitting the compression force to the compressed stack (32) of separation discs (5).

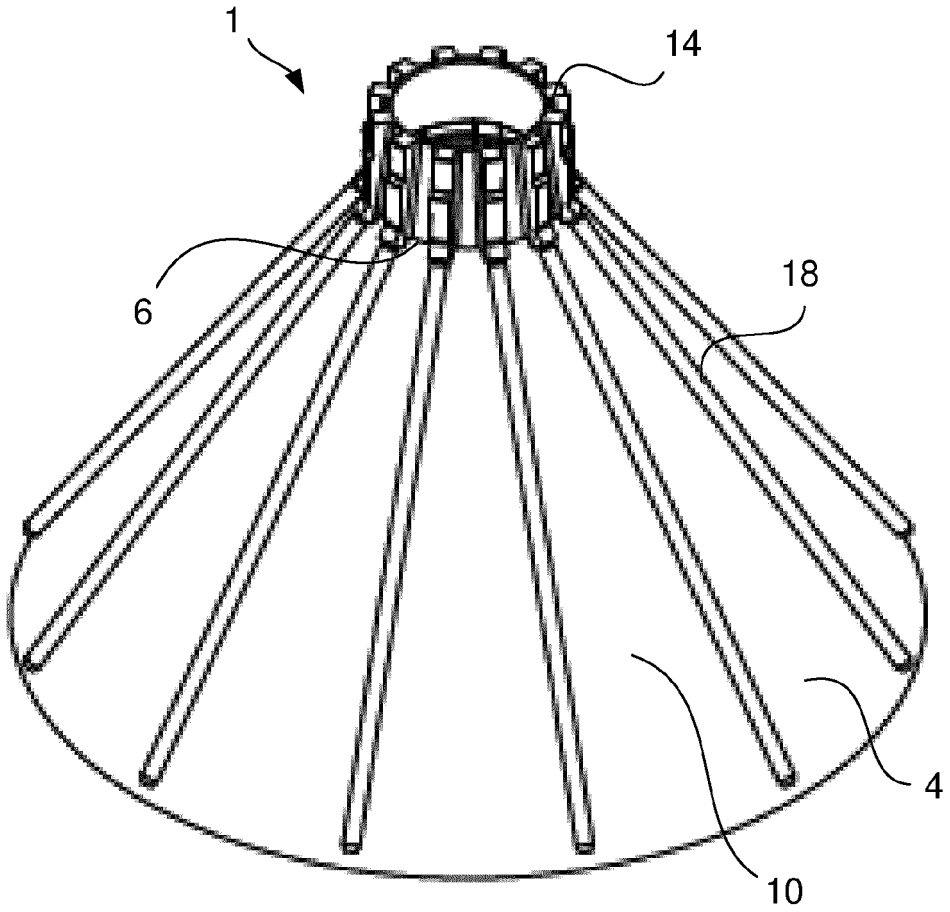

Fig. 1

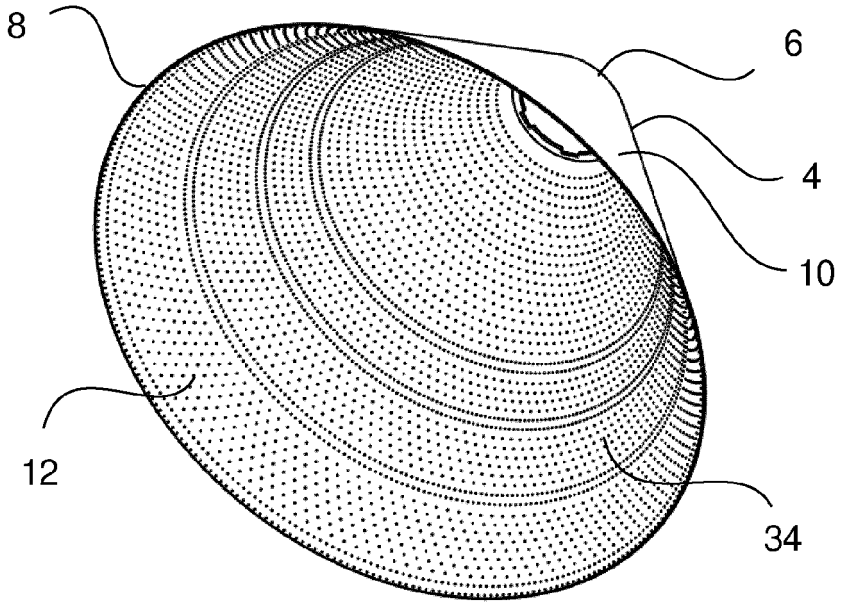

Fig. 2

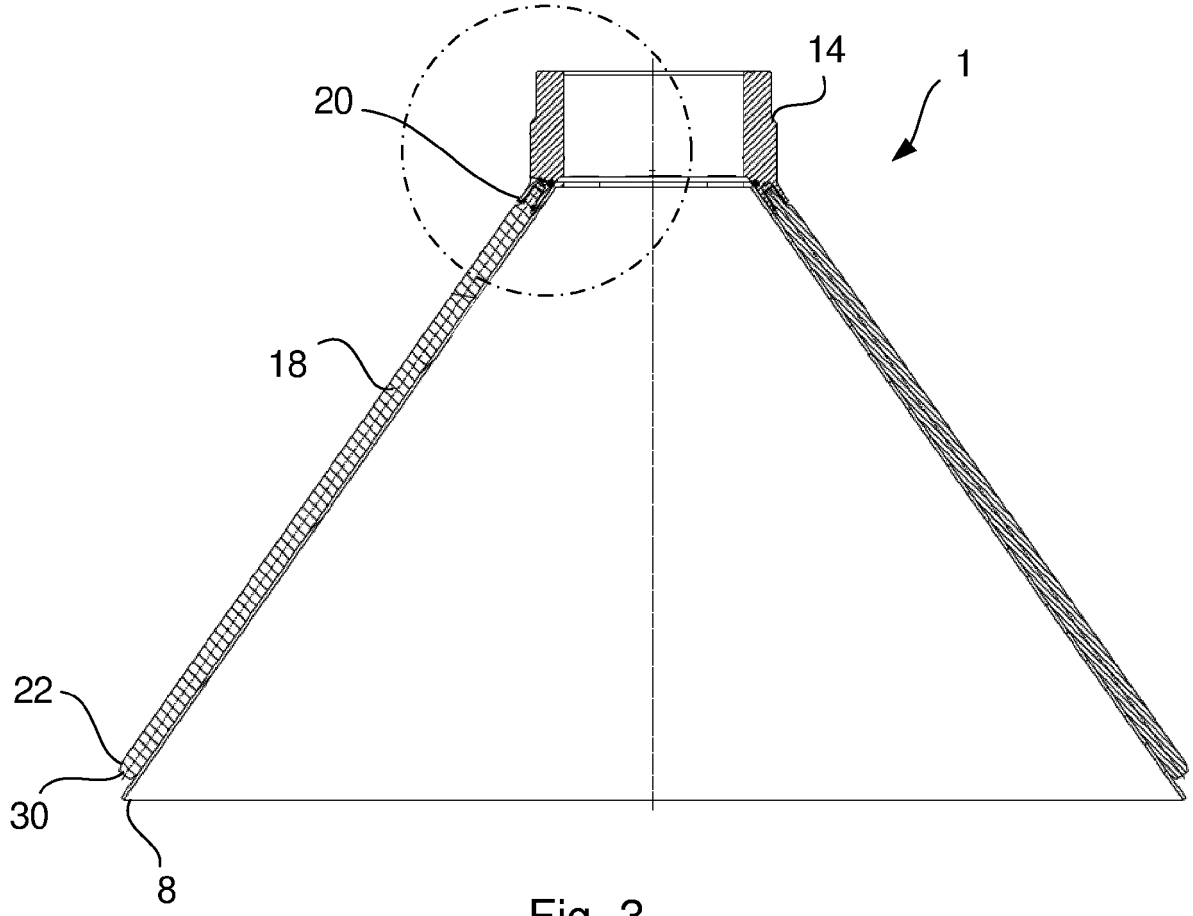

Fig. 3

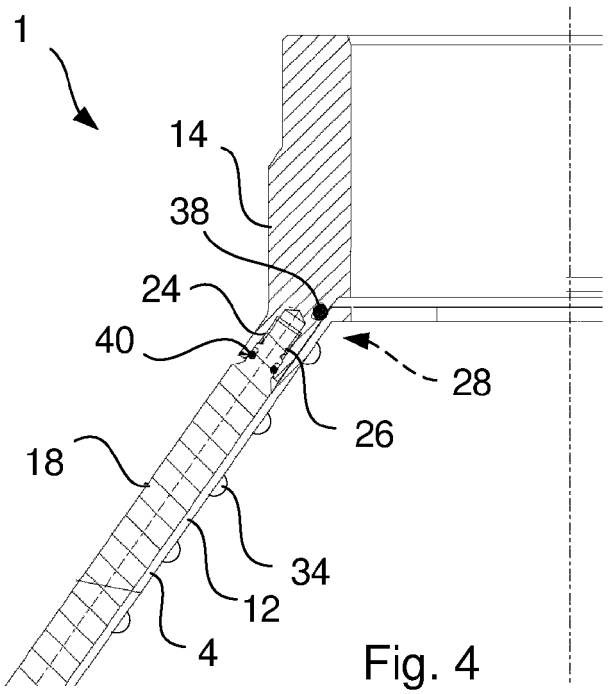

Fig. 4

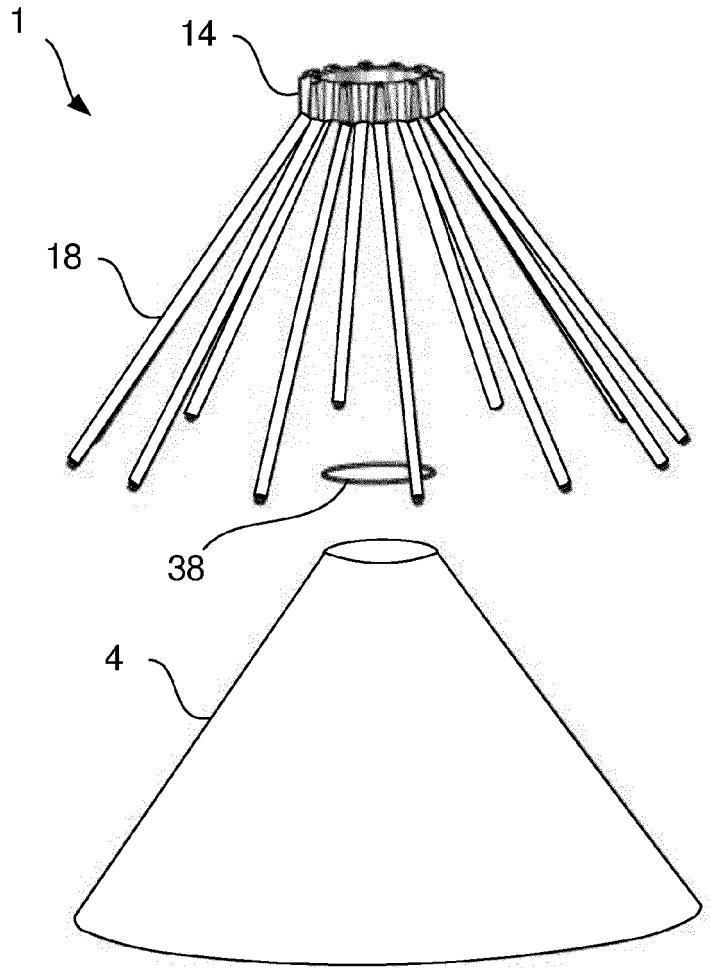

Fig. 5

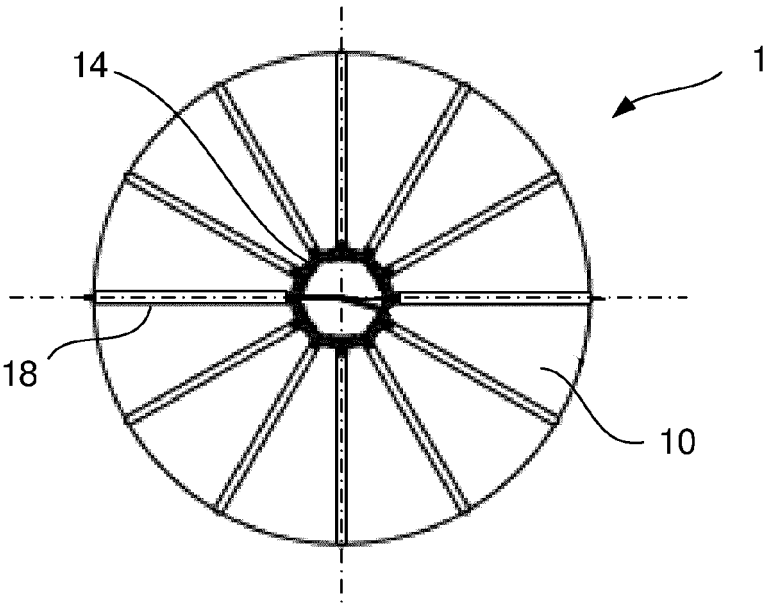

Fig. 6

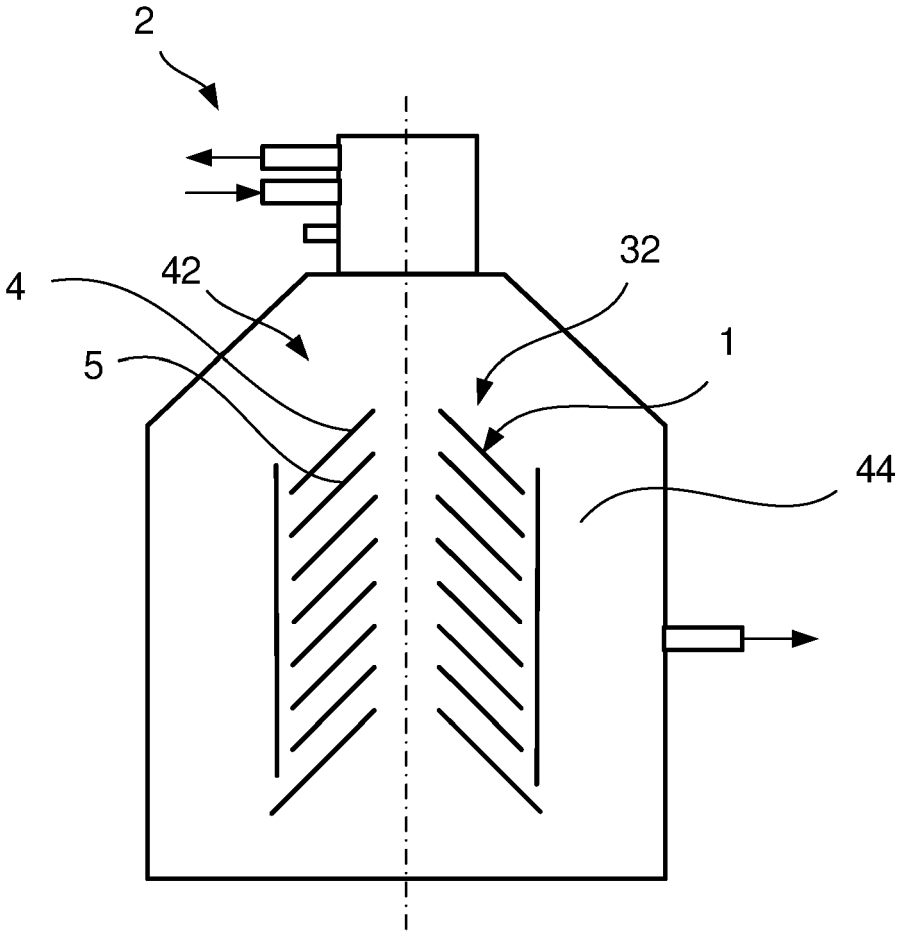

Fig. 7

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EUROPEAN SEARCH REPORT

Application Number
EP 23 20 7359

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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A	US 2021/107014 A1 (HILDING KLAS [SE] ET AL) 15 April 2021 (2021-04-15) * the whole document *	1-14	

TECHNICAL FIELDS SEARCHED (IPC)

B04B

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	14 March 2024	Laurim, Jana

CATEGORY OF CITED DOCUMENTS

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