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Remarks:
Amended claims in accordance with Rule 137(2) EPC.

(54) APPARATUS TO AGITATE AND OXYGENATE WATER IN PARTICULAR FOR ITTIC BREEDING TANKS

(57) An apparatus (1) for agitating and oxygenating water, comprising a hull (2) that is overturned and is in use partially sinkable in water and in which said hull (2) defines an inner volume (V) and has an upper surface (2a) and a lower face (2b) open towards the water.

The hull (2) comprises at least one cross member (7) extending along a direction that is substantially parallel to the surface of the water (100) and transverse to a direction of main extension direction (E) of the hull (2), in which said cross member (7) is arranged in the inner volume (V) of the hull (2) and is vertically distanced from the upper surface (2a) by a preset distance so as to define a passage (P) for recirculating water drops rising from the surface of the water (100) to the hull (2) and passing between said cross member (7) and the rear surface so as to increase oxygenation of the water.

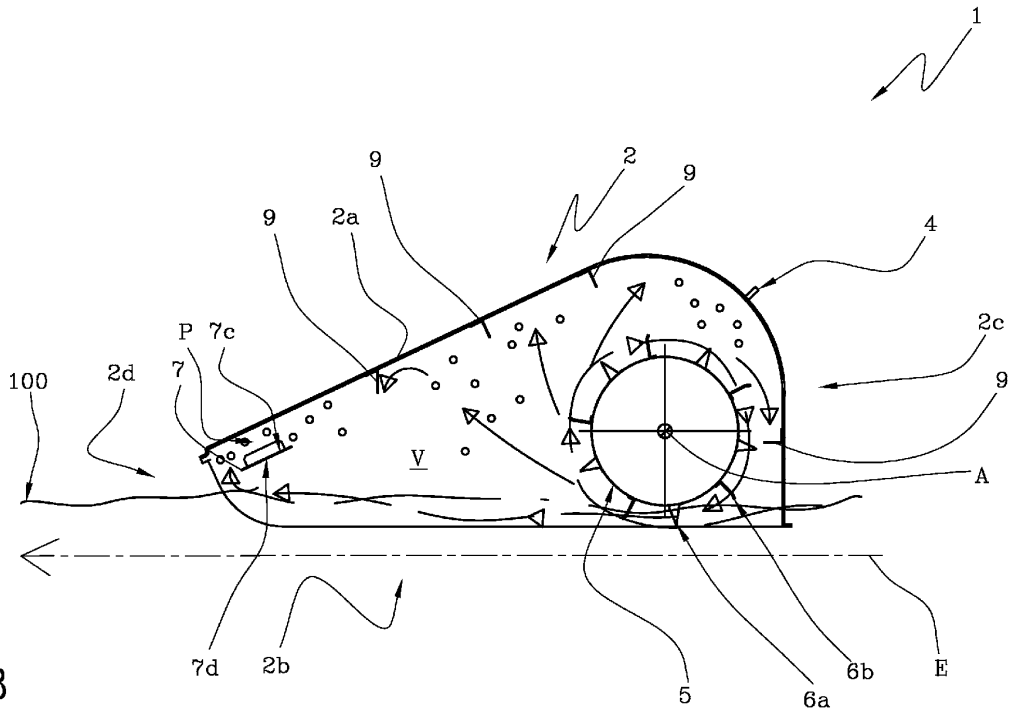

Fig.3

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Description

Technical Field

[0001] The object of the present invention is an apparatus for agitating and oxygenating water, often defined as an mixer-oxygenator. In particular, the apparatus is used in the fish breeding tanks in order to increase oxygenation of the water. Nevertheless, the present invention could also be used for other uses that are not expressly disclosed here.

Prior art

[0002] Currently, in many fish breeding plants using mixers-oxygenators is known in order to create for the fauna contained in the artificial tanks living conditions that are as similar as possible to the natural habitat of the fish, bearing in mind that such tanks are often overcrowded.

[0003] Accordingly, in order to ensure healthy growth of the fauna, it is often necessary to increase the oxygen in the water.

[0004] In order to perform this operation, there are may known types of mixers-oxygenators, including those consisting of an overturned partially sinkable hull and of an immersed pump, which is configured to throw upwards a volume of water through a crusher, causing jets that are filled with oxygen. Nevertheless, this known technique has the disadvantage that in no situation is the water moved below the surface but the water is transported only when below the system there is a channel or ditch with moving water. Alternatively, below the hull there is an internal rotating drum which has different radially protruding wings or the like so as to atomise the water as much as possible to thus create a greater surface of attack for the oxygen. During use, the hull is floated on the water whilst the drum, by rotating, lifts the water, dividing the water into drops. Simultaneously, oxygen that comes from an outer source is delivered to the lifted water, the oxygen bonds with these water particles, increasing the oxygen concentration thereof.

[0005] One embodiment of this known technique is for example disclosed in prior document DE10104329.

[0006] However, this known technique has some drawbacks.

[0007] In particular, with the current devices, delivered oxygen is often wasted as a large part tends to "escape" outside the hull and does not bond with the water.

[0008] Accordingly, reduced oxygenation of the water occurs, as well as a loss of oxygen that has a not insignificant cost.

Aims of the invention

[0009] In this situation, the object of the present invention is to realise an apparatus for agitating and oxygenating water that obviates the aforesaid drawbacks.

[0010] In particular, the object of the present invention is to make an apparatus for agitating and oxygenating water that enables the oxygenation of the water to be increased and oxygen waste to be reduced.

[0011] The objects indicated are substantially attained by an apparatus for agitating and oxygenating water according to what is disclosed in the appended claims.

Brief description of the figures

[0012] Further features and advantages of the present invention will come clearer from the detailed description of some preferred but not exclusive embodiments of an apparatus for agitating and oxygenating water illustrated in the appended drawings, in which:

- figure 1 shows an axonometric raised side view of the apparatus for agitating and oxygenating water according to the present invention;
- figure 2 shows an axonometric view from below of the apparatus of figure 1;
- figure 3 shows an axonometric side view in partial transparency of the apparatus of figure 1;
- figure 4 shows an axonometric external side view of the apparatus of figure 1;
- figure 5 shows an external front view of the apparatus of figure 1;
- figure 6 shows a view from below of the apparatus of figure 1;
- figure 7 shows a side view in partial transparency of an alternative embodiment of the apparatus of figure 1;
- figure 8 shows an external side view in partial transparency of an alternative embodiment of the apparatus of figure 7.

Detailed description of one or more preferred embodiments of the invention

[0013] With reference to the figures mentioned, reference number 1 generally denotes an apparatus for agitating and oxygenating water, according to the present invention.

[0014] In particular, the apparatus 1 comprises a hull 2 or casing that is overturned and in use is partially sinkable in water inside which an inner volume V is defined wherein the water is oxygenated.

[0015] This hull 2 has a closed upper surface 2a and a lower face 2b that is open to the water. In other words, the hull 2 is open to the bottom and in use is put into the water with the lower face 2b facing downwards.

[0016] The hull 2 extends along the main extension direction E that is substantially parallel to the surface of the water 100.

[0017] Further, the apparatus 1 comprises at least one floating body 3 incorporated into or connected to said hull 2 so as to maintain said hull 2 in floating state on the water. In the embodiments illustrated in the appended

figures, the apparatus 1 comprises two outer floating bodies 3 that are arranged respectively on opposite sides of the hull 2 according to the main extension direction E of the hull 2.

[0018] Preferably, these floating bodies 3 extend along the entire length of the hull 2 according to the main extension direction E. These lateral floating bodies 3 can be constrained to the hull 2 adjustably in order to vary the draught with respect to the surface of the water 100 and to maintain the hull 2 in an overturned position.

[0019] The hull 2 has a rear part 2c having a top that is higher out of the water then a front part 2d that is lower with respect to the water. Said rear part 2c defines a portion of inner volume V that is greater than the portion of inner volume V arranged at the front part 2d.

[0020] The figures show two possible embodiments of hull 2 in which the first (figures 1-6) shows an upper surface 2a shaped as a chute from the rear part 2c to the front part 2d. Whilst a second embodiment (figures 7, 8) shows the upper surface 2a shaped as a step from the rear part 2c to the front part 2d.

[0021] It should be noted that this latter embodiment is used for apparatuses with reduced external dimensions.

[0022] Further, the apparatus 1 has at least one oxygen delivery port 4 arranged in fluid communication with said inner volume V to convey there oxygen that is suppliable from an external source;

[0023] Preferably, the oxygen is delivered by a conduit and in a controlled manner for better management of oxygenation according to need.

[0024] The delivery port 4 is preferably arranged at the rear part 2c of the hull 2 and at an inner volume V zone comprised between the drum (disclosed below) and the upper surface 2a.

[0025] As already mentioned, the apparatus 1 comprises at least one rotating drum 5 that is arranged inside said inner volume V and is rotatable around an axis of rotation A that is substantially parallel to the surface of the water 100. The drum 5 is arranged in the rear part 2c of the hull 2. Further, the drum 5 during use is at least partially immersed in water in order to lift the water to generate jets to the upper surface 2a so as to obtain the aforesaid effect of a mixer..

[0026] In other words, the rotating drum 5 , in use, is arranged at least partially near said open face 2b so as to come into contact with the water and create a plurality of jets of water directed at the upper surface 2a of the hull 2.

[0027] The drum 5 extends transversely from the main extension direction of the hull 2 and is constrained to the side walls of the hull 2.

[0028] Further, the drum 5 is motor driven and rotates during use of the apparatus 1. The direction of rotation is indicated in the appended figures and is directed from the front part 2d to the rear part 2c of the hull 2, passing through the upper surface 2a.

[0029] Preferably, the motor (not illustrated in the appended figures) that moves the drum 5 is mounted outside the hull 2 and acts on a shaft on which the drum 5 is keyed.

[0030] The drum 5 comprises a plurality of elements protruding radially with respect to the axis of rotation A of the drum 5 and is intended to interact with the surface of the water 100.

[0031] The drum 5 has an external cylindrical surface that is preferably drilled in order to increase the breaking up of the water particles. This external cylindrical surface is preferably drilled through from the exterior to an inner chamber of the drum 5.

[0032] Further, the protruding elements of said drum 5 are preferably of two types: blade elements 6a and wing elements 6b. The blade elements 6a have an extension along a longitudinal direction that is substantially parallel to the axis of rotation A that is greater than the wing elements 6b.

[0033] In other words, the blade elements 6a have an elongated longitudinal extension and are preferably arranged around the drum 5 according to a helical or sinusoidal sequence preferably at a constant pitch from one another.

[0034] Advantageously, the blade elements 6a have the function of breaking up the water and creating a strong passage flow inside the hull 2. Further, these blade elements 6a enable a large part of the water to be pushed in depth, thus enabling the permeability of oxygen to be increased significantly therein for the use and consumption of the inhabitants of the tank.

[0035] Further, the wing elements 6b have a reduced longitudinal extension but are radially more protruding than the blade elements 6a and are preferably arranged around the drum 5 according to a helical or sinusoidal sequence preferably at a constant pitch from one another and interposed between two rows of consecutive blade elements 6a along the circumference of the drum 5.

[0036] Nevertheless, it should be noted that, alternatively, there can be any distribution of the blade elements 6a and/or wing elements.

[0037] Advantageously, the blade elements 6a and/or wing elements and the particular distribution and/or dimension thereof contributes to creating transverse flows of the lifted water that are intended to break progressively against the successive rotating blade elements and/or wing elements.

[0038] In particular, the wing elements 6b have the function of breaking up the water, throwing it in a radial and helical direction so as to promote the oxygen loading.

[0039] Preferably, the blade elements 6a have through holes and preferably have a triangular section profile so as to define two tilted faces.

[0040] The wing elements 6b each have an elongated body that ends with a curved end to favour the collection of water.

[0041] Preferably, the blade elements 6a are made of the same material as the drum 5, i.e. of metal (preferably steel). The wing elements 6b are made of plastic.

[0042] According to the present invention, the hull 2 comprises at least one cross member 7 extending along a direction substantially parallel to the surface of the water 100 and arranged in the inner volume V in a position opposite the rotating drum 5 according to the main extension direction E of the hull 2 parallel to the surface of the water 100. This cross member 7 extends along a direction that is perpendicular to the main extension direction E of the hull 2.

[0043] The cross member 7 is distanced from the upper surface 2a of the hull 2 by a preset distance so as to define a passage P for recirculating drops of water rising from the surface of the water 100 to the hull 2 and passing between said cross member 7 and the rear surface so as to increase oxygenation of the water.

[0044] In fact, in this manner (as shown by the arrows in the appended figures) the water rises frontally above the cross member 7 in order to remix with the oxygen present in the inner volume V.

[0045] Preferably, the cross member 7 is arranged at a front mouth 8 of the hull 2 comprised in the front portion of the hull 2.

[0046] It should be noted that the cross member 7 is arranged in a position that is distanced vertically from the open face 2b of the hull 2 (considering that the open face 2b is defined by an imaginary surface on which the side walls of the hull 2 rest) so as to be arranged, in use, above the surface of the water 100.

[0047] Preferably, the cross member 7 extends between two opposite ends 7a, 7b fixed to the side walls 2e, 2f of the hull 2 (preferably from the exterior) for example by screws.

[0048] Further, the cross member 7 has two opposite sides: an upper side 7c facing the upper surface 2a of the hull 2 and a lower side 7d facing the lower face 2b.

[0049] Preferably, the cross member 7 is flat. It is further tilted with respect to the surface of the water 100 to the front part 2d of the hull 2. In detail, the upper side of the cross member 7 is substantially parallel to the upper surface of the hull 2 arranged at the cross member 7.

[0050] This cross member 7 has a depth measured according to the main extension direction E of the hull 2 comprised between 10 cm and 30 cm, preferably 20 cm.

[0051] Further, the apparatus 1 comprises one or more wings 9 fixed to the upper surface 2a of the hull 2 between the drum 5 and the cross member 7 according to the main extension direction E.

[0052] Each wing 9 protrudes from the upper surface 2a of the hull 2 to the inner volume V so as to break further the water jets generated by the drum 5 that collide against the upper surface 2a. Preferably, each wing 9 protrudes orthogonally with respect to the upper surface 2a and, preferably, for a height comprised between 2 cm and 10 cm, preferably 5 cm.

[0053] In particular, each wing 9 extends parallel to the cross member 7 in a distanced position from the latter.

[0054] Preferably, the apparatus 1 comprises a plurality of said wings 9 distanced from one another along the upper surface 2a. Each of said wings 9 extends orthogonally with respect to the main extension direction over the entire width of the hull 2.

[0055] Further, such wings 9 are preferably drilled so as to further increase breaking up of the water particles.

[0056] As can be seen in figure 3, the wing 9 nearest the cross member 7 is tilted towards the cross member 7 so as to promote the fall of the water downwards.

[0057] Further, one of said wings 9 is arranged at the drum 5 and above the drum in order to break up the water particles immediately as soon as they are lifted from the drum 5.

[0058] During use of the apparatus 1, these wings 9 work with the cross member 7 as the flow of water lifted by the drum 5 tends to drop back immediately downwards, re-entering the surface of the water owing to the wings 9, whilst the cross member 7 creates recirculation for the water particles that rise up and are oxygenated by the oxygen remained in the inner volume V. In the alternative embodiment illustrated in figures 7 and 8, it is also possible to see that the cross member 7 is part of an extended dividing wall 70 mounted in the inner volume V of the hull 2 and extending to a zone near the drum 5.

[0059] In other words, the front part 2d of the dividing wall 70 encompasses the cross member 7. In these case, the passage P arranged between the cross member 7 and the upper surface 2a is part of a channel that extends near the drum 5.

[0060] In addition, the cross member 7 is arranged at the front mouth 8, but extends to the rear towards the drum 5 for a length that is greater than the main embodiment shown in figures 1-6.

[0061] Preferably, the dividing wall 70 is of broken shape and has a front portion 70a arranged near the front mouth 8, a rear portion 70b arranged near the drum 5 and a central portion 70c arranged between the two front and rear portions.

[0062] These front 70a, central 70c and rear 70b portions are tilted towards the water in a direction that goes from the drum 5 to the front mouth 8. Preferably, the front portion 70a and the rear portion 70b are tilted further down than the central portion.

[0063] In particular, the rear portion 70b of the dividing wall 70 is configured to intercept a large part of the flow of water lifted by the drum 5, so as to convey the flow of water below the dividing wall 70 and push the flow of water that is lifted and enriched with oxygen inside the water below.

[0064] The front portion 70a of the dividing wall 70 defines the cross member 7.

[0065] Further, this front portion of the dividing wall 70 is at least partly immersed in water so as to create frontally a reflux of water that rises upwards and thus towards the upper surface 2a inside the channel and which is again enriched with oxygen found in the inner volume V.

[0066] Further, as is possible to see from figures 2 and 6, the apparatus 1 comprises two preferably flat protruding elements 10, connected at the lower face 2b and pro-

truding from the side walls 2e, 2f to the centre of the hull 2. These protruding elements 10 are arranged parallel to the lower face 2b and determine advantageously greater stability of the hull 2.

[0067] The present invention reaches the set objects.

[0068] In particular, the presence of the cross member 7 or of the dividing wall 70 that in the front part 2d encompasses the cross member 7 enables the enrichment of the water with oxygen to be optimised because the water rises at the front part 2d of the hull 2 and is remixed with the oxygen present in the inner volume V.

[0069] This results in the oxygen in the water being enriched and to reducing the waste of oxygen in the air.

[0070] Also worthy of note is that the present invention is relatively easy to realise and also that the cost connected to the actuation of the invention is not very high.

Claims

1. An apparatus (1) for agitating and oxygenating the water, comprising:

- a hull (2) that is overturned and in use is partially sinkable in water wherein said hull (2) defines an inner volume (V) and has an upper surface (2a) and a lower face (2b) open towards the water;
- at least one floating body (3) incorporated into or connected to said overturned hull (2) so as to maintain said hull (2) floating on the water;
- at least one oxygen delivery port (4) arranged in fluid communication with said inner volume (V) to convey there oxygen that is suppliable by an external source;
- at least one rotating drum (5) arranged inside said inner volume (V) and rotatable around an axis of rotation A thereof and comprising a plurality of protruding elements; said rotating drum (5) being, in use, arranged at least partially near said open face (2b) so as to come into contact with the water and create a plurality of jets of water directed to the upper surface (2a) of the hull (2);

characterised in that said hull (2) comprises at least one cross member (7) extending along a direction that is substantially parallel to the surface of the water (100) and is transverse to a main extension direction (E) of the hull (2), wherein said cross member (7) is arranged in the inner volume (V) in a position opposite the rotating drum (5) according to the main direction of extension (E) of the hull (2); said cross member (7) being vertically distanced from the upper surface (2a) of the hull (2) by a preset distance so as to define a passage (P) for recirculating drops of water rising from the surface of the water (100) to the hull (2) and passing between said cross member (7) and the rear surface so as to increase oxygenation of the water.

2. The apparatus (1) according to claim 1 **characterised in that** the cross member (7) is arranged at a front mouth (8) of the hull (2).

3. The apparatus (1) according to any one of the preceding claims **characterised in that** the cross member (7) is arranged in a distanced position from the open face (2b) of the hull (2) according to a vertical direction so as to be arranged, in use, above the surface of the water (100).

4. The apparatus (1) according to any one of the preceding claims, **characterised in that** the cross member (7) extends between two fixed opposite ends (A) of the side walls (2e), (2f) of the hull (2).

5. The apparatus (1) according to any one of the preceding claims, **characterised in that** the cross member (7) has an upper side (7c) substantially parallel to the upper surface of the hull (2) arranged at the cross member (7).

6. The apparatus (1) according to any one of the preceding claims **characterised in that** it comprises one or more wings (9) fixed to the upper surface (2a) of the hull (2) between the drum (5) and the cross member (7); said wing (9) protruding from the upper surface (2a) of the hull (2) to the inner volume (V) so as to break further the water jets generated by the drum (5) that collide against the upper surface (2a).

7. The apparatus (1) according to claim 6 **characterised in that** said wing (9) extends parallel to the cross member (7) in a distanced position from the latter.

8. The apparatus (1) according to one of the claims from 6 to 7 **characterised in that** it comprises a plurality of said wings (9) distanced from one another along the upper surface (2a).

9. The apparatus (1) according to any one of the preceding claims **characterised in that** said cross member (7) has a depth measured according to the main extension direction (E) of the hull (2) comprised between 10 cm and 30 cm.

10. The apparatus (1) according to any one of the preceding claims **characterised in that** said upper surface (2a) of the hull (2) is shaped (A) as a chute from the drum (5) to the front mouth (8).

11. The apparatus (1) according to any one of the preceding claims **characterised in that** said cross member (7) is part of an elongated dividing wall (70)

fitted in the inner volume (V) of the hull (2) and extending as far as a zone near the drum (5).

12. The apparatus (1) according to claim 11 **characterised in that** said dividing wall (70) is of broken shape and has a front portion (70a) arranged near the front mouth (8), a rear portion (70b) arranged near the drum (5) and a central portion (70c) arranged between the two front (70a) and rear (70b) portions.

13. The apparatus (1) according to claim (12) **characterised in that** said front (70a), central (70c) and rear (70b) portions are tilted towards the water according to a direction that goes from the drum (5) to the front mouth (8).

14. The apparatus (1) according to any one of the preceding claims **characterised in that** said protruding elements of said drum (5) comprise blade elements (6a) and wing elements (6b); said blade elements (6a) having an extension along a longitudinal direction that is substantially parallel to the axis of rotation (A) that is greater than the wing elements (6b).

15. The apparatus (1) according to claim 14 **characterised in that** the blade elements (6a) have a drilled surface to increase the breaking up of the water particles.

Amended claims in accordance with Rule 137(2) EPC.

1. An apparatus (1) for agitating and oxygenating the water, comprising:

- a hull (2) that is overturned and partially sinkable in water wherein said hull (2) defines an inner volume (V) and has an upper surface (2a) and a lower face (2b) opened to the water;
- at least one floating body (3) incorporated into or connected to said overturned hull (2) so as to maintain said hull (2) floating on the water;
- at least one oxygen delivery port (4) arranged in fluid communication with said inner volume (V) to convey there oxygen that is suppliable by an external source;
- at least one rotating drum (5) arranged inside said inner volume (V) and rotatable around an axis of rotation A thereof and comprising a plurality of protruding elements; said rotating drum (5) being arranged at least partially at said open face (2b) so as to come into contact with the water and create a plurality of jets of water directed to the upper surface (2a) of the hull (2);

said hull (2) comprises at least one cross member (7) extending along a direction that is substantially parallel to the lower face (2b) in such a way to be substantially parallel to surface of the water (100) and is transverse to a main extension direction (E) of the hull (2), wherein said cross member (7) is arranged in the inner volume (V) in a position opposite the rotating drum (5) according to the main direction of extension (E) of the hull (2);
characterised in that said cross member (7) is vertically distanced from the upper surface (2a) of the hull (2) by a preset distance so as to define a passage (P) for recirculating drops of water rising from the surface of the water (100) to the hull (2) and passing between said cross member (7) and the upper surface (2a) so as to increase oxygenation of the water.

2. The apparatus (1) according to claim 1 **characterised in that** the cross member (7) is arranged at a front mouth (8) of the hull (2).

3. The apparatus (1) according to any one of the preceding claims **characterised in that** the cross member (7) is arranged in a distanced position from the open face (2b) of the hull (2) according to a vertical direction so as to be arranged above the surface of the water (100).

4. The apparatus (1) according to any one of the preceding claims, **characterised in that** the cross member (7) extends between two fixed opposite ends (A) of side walls (2e), (2f) of the hull (2).

5. The apparatus (1) according to any one of the preceding claims, **characterised in that** the cross member (7) has an upper side (7c) substantially parallel to the upper surface of the hull (2) arranged at the cross member (7).

6. The apparatus (1) according to any one of the preceding claims **characterised in that** it comprises one or more wings (9) fixed to the upper surface (2a) of the hull (2) between the drum (5) and the cross member (7); said wing (9) protruding from the upper surface (2a) of the hull (2) to the inner volume (V) so as to break further the water jets generated by the drum (5) that collide against the upper surface (2a).

7. The apparatus (1) according to claim 6 **characterised in that** said wing (9) extends parallel to the cross member (7) in a distanced position from the latter.

8. The apparatus (1) according to one of the claims from 6 to 7 **characterised in that** it comprises a plurality of said wings (9) distanced from one another along the upper surface (2a).

9. The apparatus (1) according to any one of the preceding claims **characterised in that** said cross

member (7) has a depth measured according to the main extension direction (E) of the hull (2) comprised between 10 cm and 30 cm.

10. The apparatus (1) according to any one of the preceding claims when dependent from claim 2, **characterised in that** said upper surface (2a) of the hull (2) is shaped (A) as a chute from the drum (5) to the front mouth (8).

11. The apparatus (1) according to any one of the preceding claims **characterised in that** said cross member (7) is part of an elongated dividing wall (70) fitted in the inner volume (V) of the hull (2) and extending as far as a zone at the drum (5).

12. The apparatus (1) according to claim 11 when dependent from claim 2, **characterised in that** said dividing wall (70) is of broken shape and has a front portion (70a) arranged at the front mouth (8), a rear portion (70b) arranged at the drum (5) and a central portion (70c) arranged between the two front (70a) and rear (70b) portions.

13. The apparatus (1) according to claim 12 **characterised in that** said front (70a), central (70c) and rear (70b) portions are tilted towards the lower face (2b) according to a direction that goes from the drum (5) to the front mouth (8).

14. The apparatus (1) according to any one of the preceding claims **characterised in that** said protruding elements of said drum (5) comprise blade elements (6a) and wing elements (6b); said blade elements (6a) having an extension along a longitudinal direction that is substantially parallel to the axis of rotation (A) that is greater than the wing elements (6b).

15. The apparatus (1) according to claim 14 **characterised in that** the blade elements (6a) have a drilled surface to increase the breaking up of the water particles.

Fig. 1

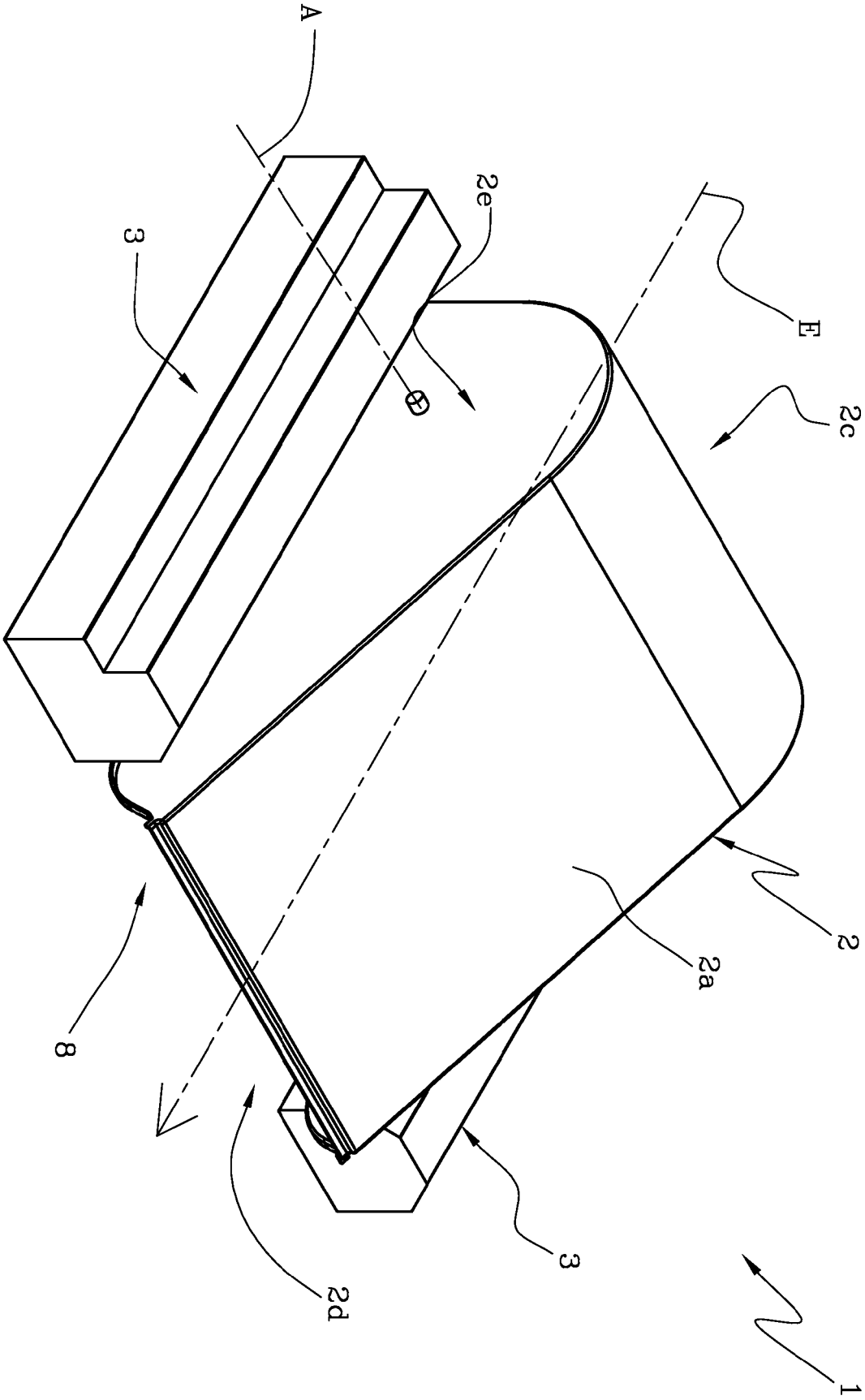


Fig.2

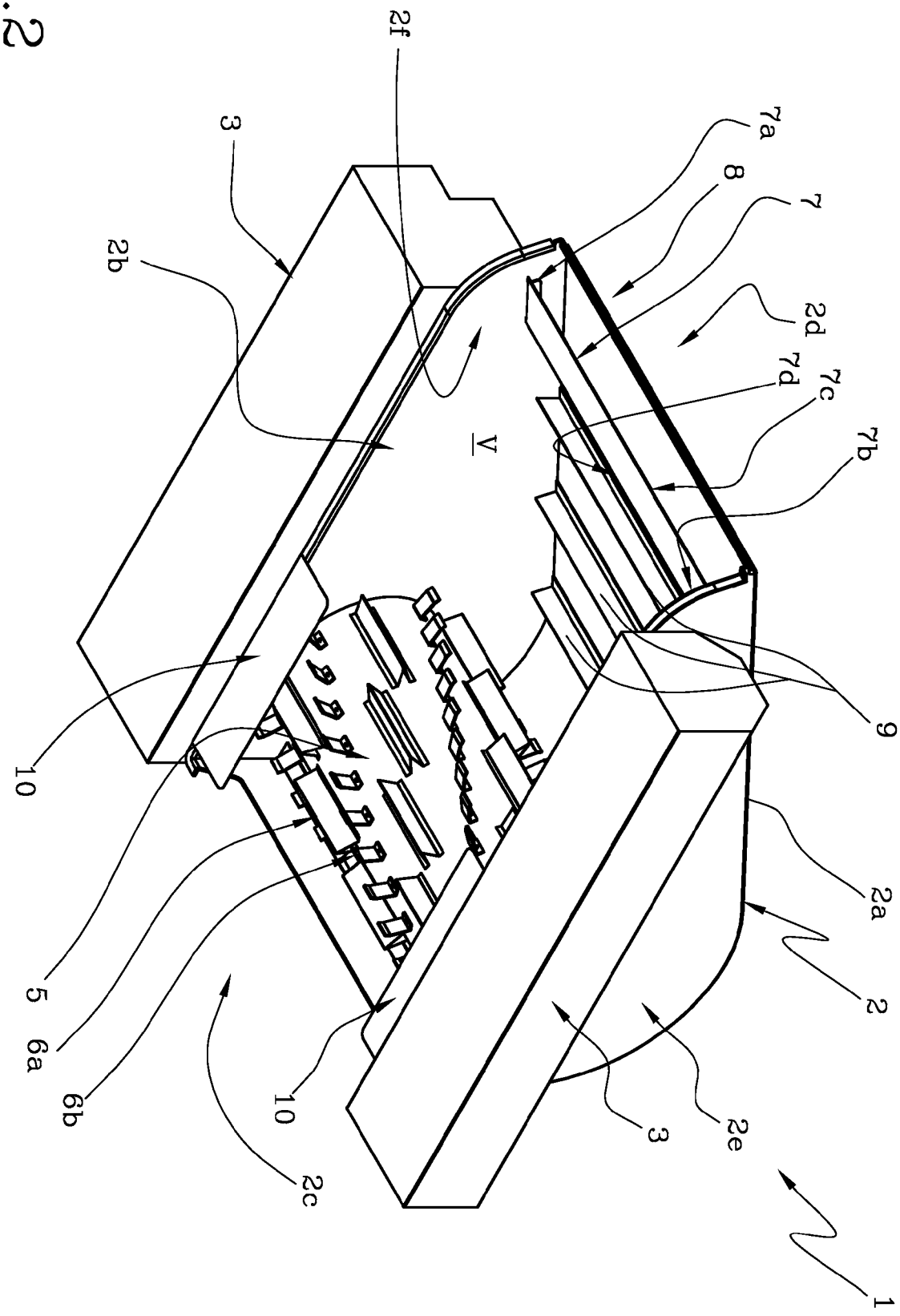


Fig.3

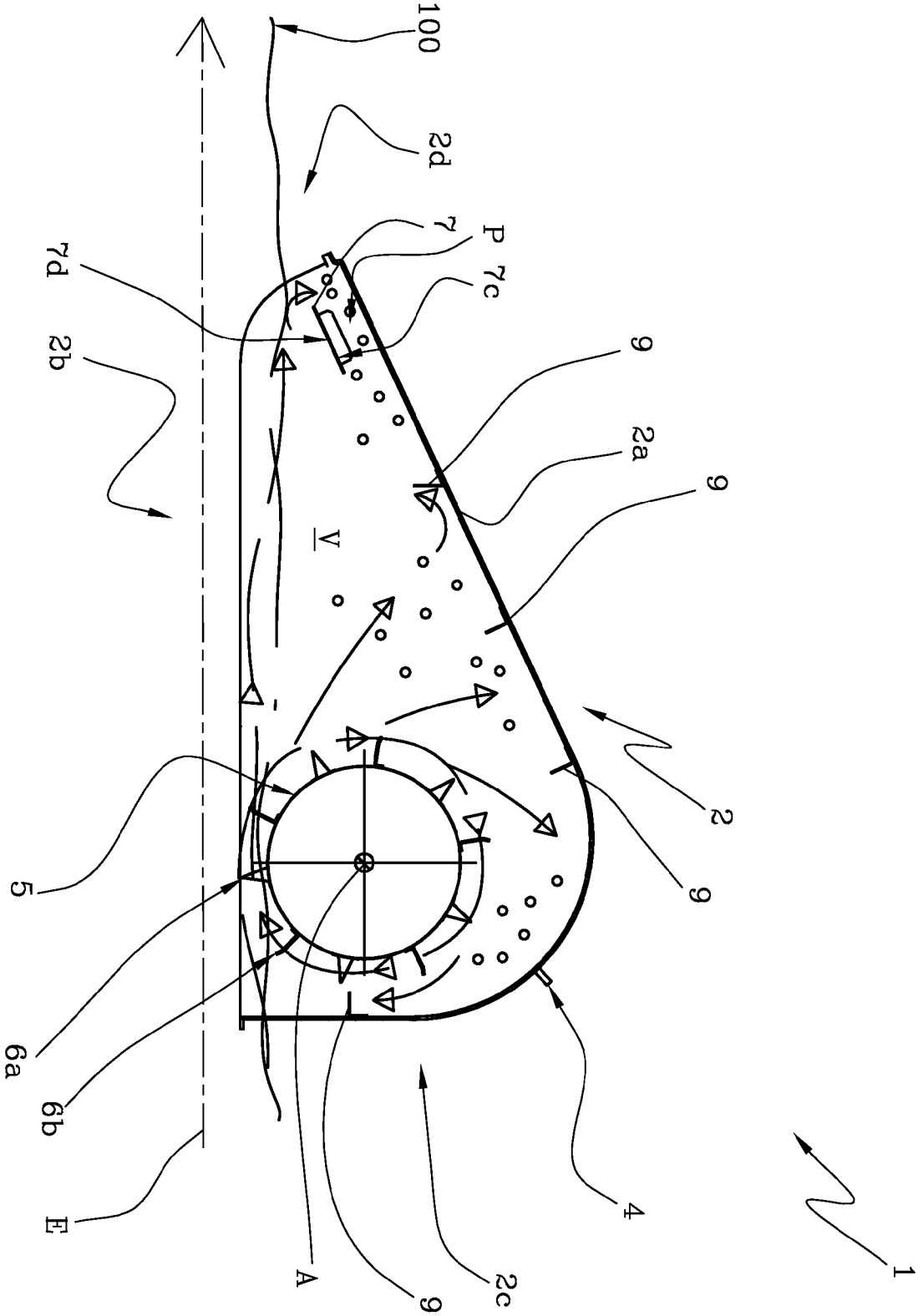


Fig.4

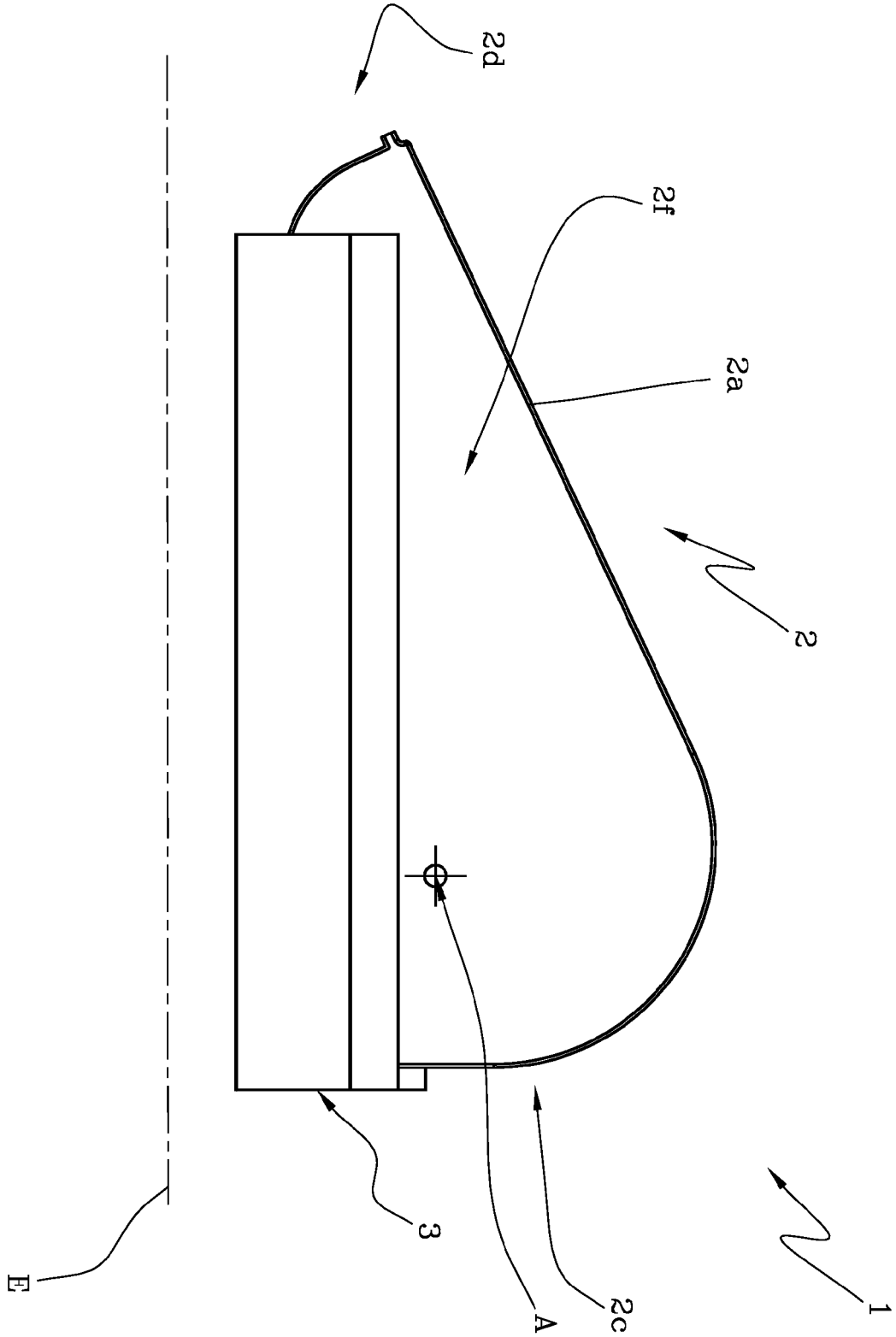


Fig.5

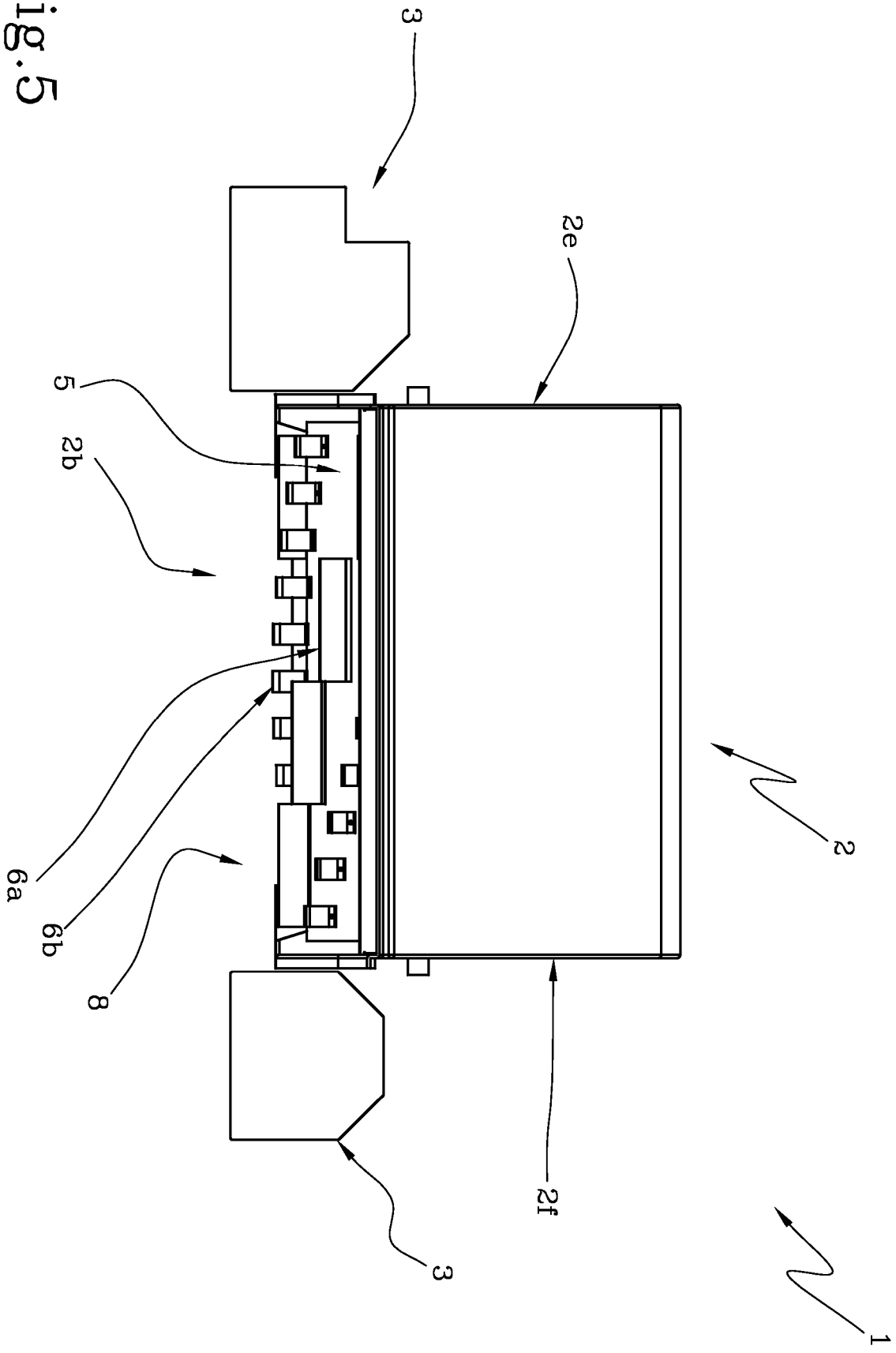


Fig.6

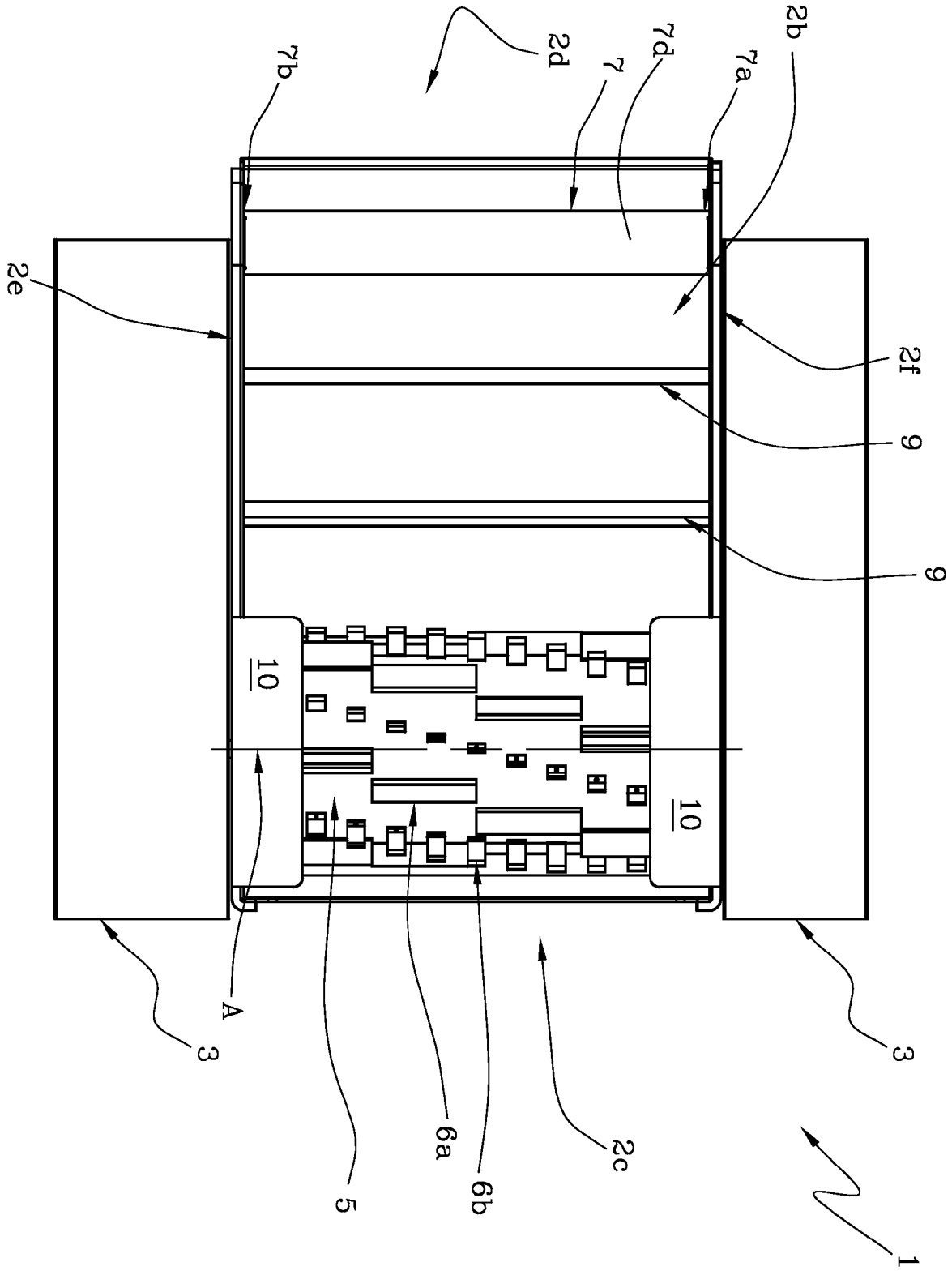


Fig. 7

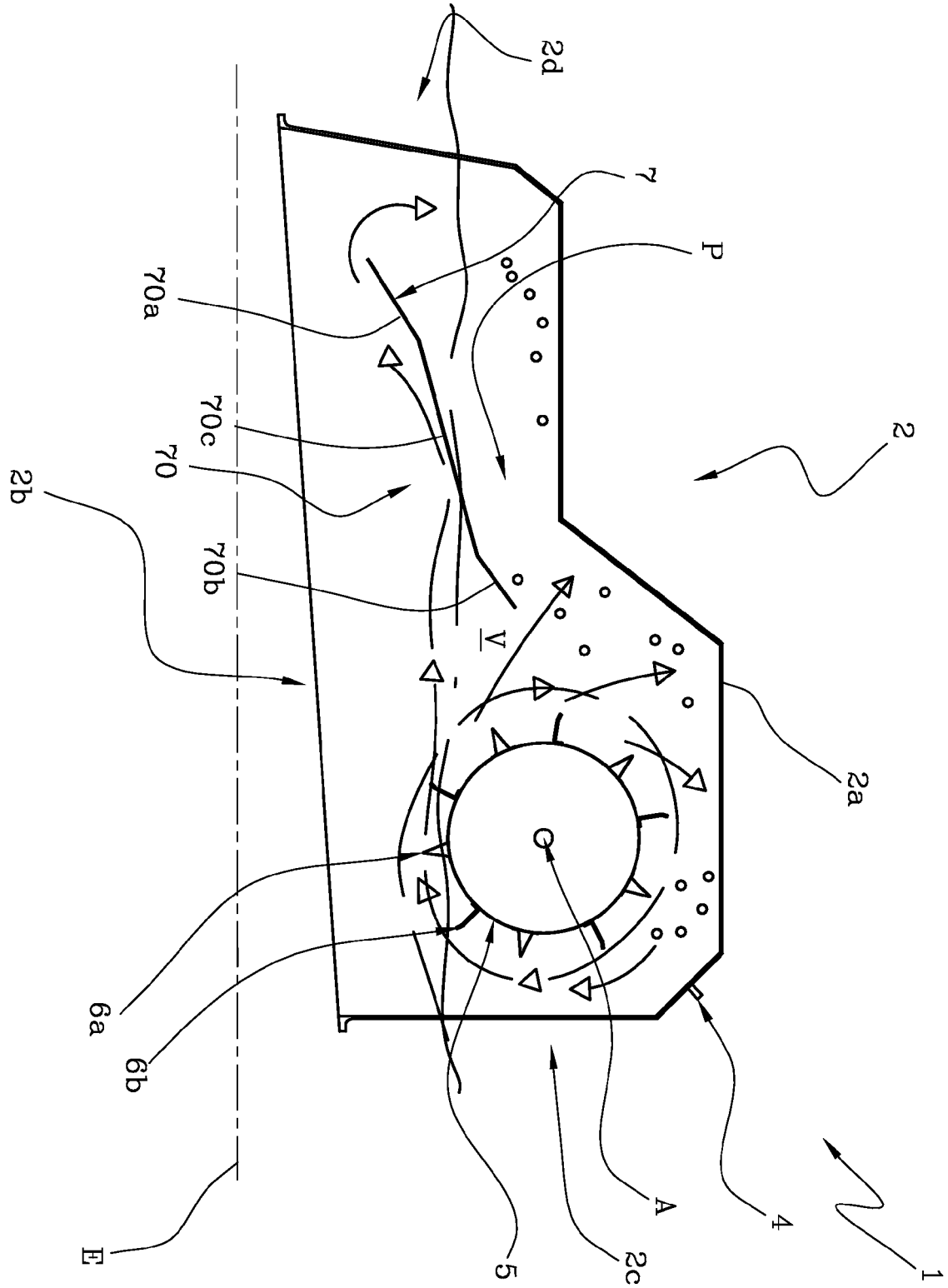
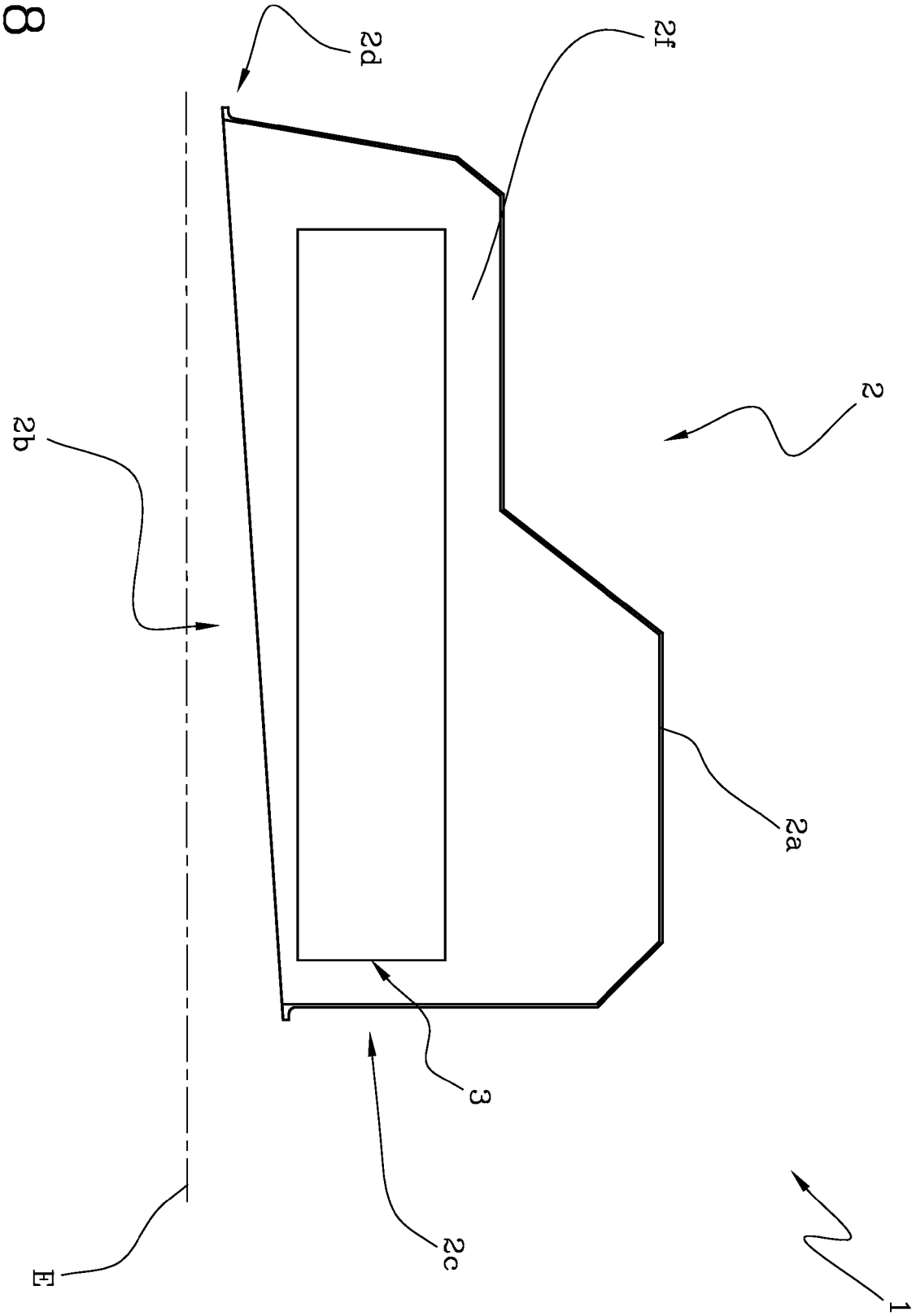


Fig.8



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EUROPEAN SEARCH REPORT

Application Number
EP 18 17 4884

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 5 948 326 A (PATE HENRY O [US]) 7 September 1999 (1999-09-07) * column 8, line 11 - column 9, line 3 * * figures *	1-15	INV. B01F3/04 B01F13/00
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TECHNICAL FIELDS SEARCHED (IPC)

B01F
C02F
A01K

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	27 November 2018	Real Cabrera, Rafael

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