(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
22 April 2021 (22.04.2021)

WIPO | PCT

(10) International Publication Number
WO 2021/075962 A1

(51) International Patent Classification:
E02B 1/00 (2006.01) *E02B 15/00* (2006.01)

(21) International Application Number:
PCT/NL2020/050633

(22) International Filing Date:
14 October 2020 (14.10.2020)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
2024013 14 October 2019 (14.10.2019) NL

(71) Applicant: **THE GREAT BUBBLE BARRIER B.V.** [NL/NL]; Johan van Hasseltweg 39, 1021 KN Amsterdam (NL).

(72) Inventors: **ZOET, Francis Rosita Agnes**; Johan van Hasseltweg 39, 1021 KN Amsterdam (NL). **EHRHORN, Max Philip Thomas**; Johan van Hasseltweg 39, 1021 KN Amsterdam (NL). **EVELEENS, Anne Marieke**; Johan van Hasseltweg 39, 1021 KN Amsterdam (NL). **STUDER, Saskia**; Johan van Hasseltweg 39, 1021 KN Amsterdam (NL).

(74) Agent: **WITMANS, H.A.**; V.O., P.O. Box 87930, 2508 DH Den Haag (NL).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, IT, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK,

(54) Title: WATERCOURSE PROVIDED WITH A BUBBLE SCREEN, AND BUBBLE SCREEN THEREFORE

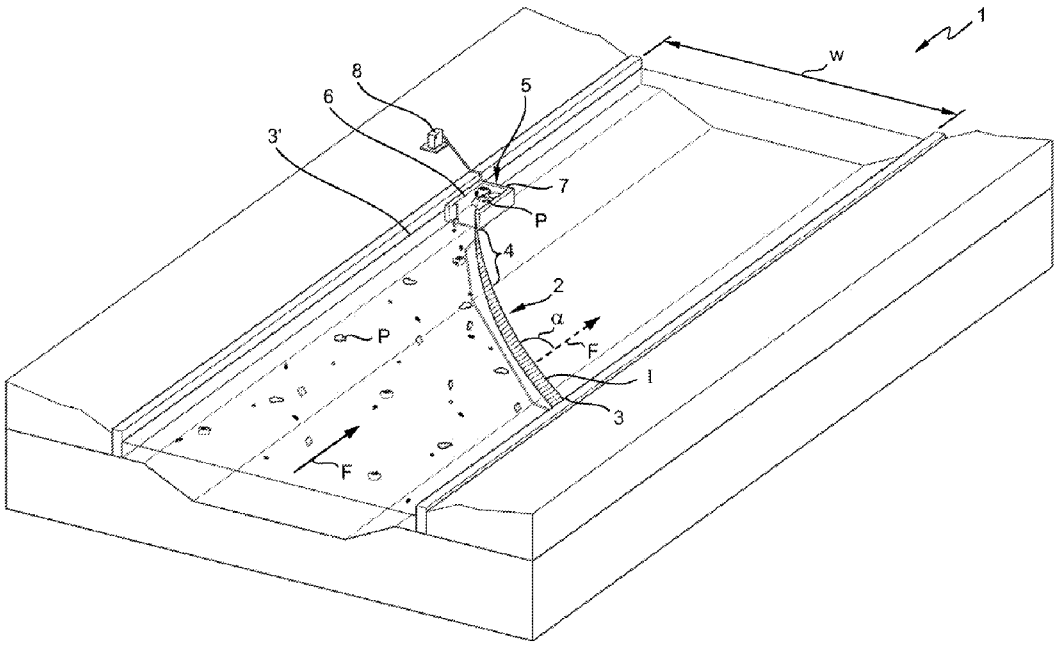

FIG. 1

(57) Abstract: Watercourse with water flowing in a flow direction, wherein the watercourse comprises a bubble screen provided at an angle relative to the water flow direction, wherein the bubble screen substantially extends from a water guide element to another water guide element, wherein a downstream part of the bubble screen is provided with a collection area, and wherein a bubble intensity of the downstream part of the bubble screen is less than the bubble intensity elsewhere in the bubble screen.

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EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

Title: Watercourse provided with a bubble screen, and bubble screen therefore

The invention generally relates to a bubble screen for aerating a liquid, in particular water.

Bubble screens for distributing and/or dispersing fluids into a liquid are generally known. Often, the fluid is air and the liquid is a body of water, in particular a watercourse, such as a pond, lake, river, canal, stream, part of a sea and/or ocean like a bay, fjord or arm of the sea. Such bubble screens are applied for various purposes. For instance, bubble screens are typically applied to aerate water for aquaculture, bacterial and/or waste treatment, ice-melting, or the like.

It has previously been proposed to use such bubble screens to recover plastic waste, i.e. plastics, from watercourses. Although an upward thrust provided by known bubble screens may beneficially bring plastics to the water surface, it has proven difficult in practice to effectively intercept plastics before they reach e.g. seas and/or oceans, in particular in such a way that allows efficient recovery of the plastics for further treatment.

The invention aims to alleviate one or more of the aforementioned drawbacks, while maintaining the above-mentioned advantage. In particular, the invention aims to provide an improved bubble screen watercourse configuration that is more efficient and allows an improved recovery yield of plastic waste from a watercourse.

To that end, the invention provides for a watercourse with water flowing in a flow direction, wherein the watercourse comprises a bubble screen provided at an angle relative to the water flow direction, wherein the bubble screen substantially extends from a water guide element to another water guide element, wherein a downstream part of the bubble screen is provided with a collection area, and wherein a bubble intensity of the

downstream part of the bubble screen is less than the bubble intensity elsewhere in the bubble screen.

In general, plastics move in the water flow direction and/or are taken along with the water flow direction, in particular downstream e.g. to a further watercourse, sea or ocean. In certain cases, at least part of the water and thus the plastics may move in a substantially opposite flow direction, for instance due to tidal influences or relatively strong winds. In such cases a further collection area may be provided at an opposite part of the bubble screen relative to the part that is provided with the collection area. This way, a collection area may be provided on both sides of the bubble screen and may hence allow improved recovery of plastics.

By providing the bubble screen at an angle relative to the water flow direction, plastic intercepted by the bubble screen may conveniently be guided downstream and towards the collection area. When a bubble intensity of the downstream part of the bubble screen is less than the bubble intensity elsewhere in the bubble screen, plastic may be guided less forcefully towards the collector. In addition, formation of eddies in the water in the vicinity of the collection area may be counteracted. An eddy is a circular current of water. By providing a lower bubble intensity at the downstream part of the bubble screen, formation of a so-called swirling motion of eddies in the water may at least partially be mitigated. Thereby, accumulation and/or build-up of plastics in the vicinity, in particular upstream, of the collection area may be counteracted. In particular, this may promote the run through of plastic towards the collection area.

Within the context of this patent specification, the term 'water guide element' is to be construed as an element that at least partially bounds water. For instance, a water guide element may thus refer to ground bounding water, such as an embankment, riverside or shore, but may also refer to artificial or so-called manmade constructs that bound water, such as a causeway, quay, wharf, levee, dyke, and in particular may additionally

refer to a further bubble screen. These expressions in this context are understood to be comprised within the definition of the term 'water guide element'.

When the downstream end of the bubble screen curves, in particular convexly, towards the collector, plastic may be gradually urged towards the collection area thereby achieving a freer flow of plastic towards the collection area. This way, the recovery yield of plastics from watercourses may be further improved.

The collection area may for instance be a waterside, such as a riverbank, shore or beach. Advantageously, the collection area may comprise a collector, in particular a catchment system to further improve the recovery yield of plastics. In addition, by providing the collection area with a collector, in particular a catchment system, plastics may conveniently be recovered in a more controlled manner.

When the bubble screen is provided with at least one partial overlap, presence and/or formation of a gap in the bubble screen may be counteracted. Thereby, loss of plastics slipping through the bubble screen may be mitigated. In particular, when the at least one partial overlap forms a cascade in the bubble screen, guidance of the plastic along the bubble screen and towards the collection area and/or collector may beneficially be promoted.

By providing the bubble screen with a pressure supply that is configured to supply compressed gas to the bubble screen, a relatively simple and cost-effective construction may be provided. Advantageously, the pressure supply may be coupled to an upstream end of the bubble screen, allowing a pressure drop along the bubble screen, in particular due to frictional forces, at the downstream part to be greater than elsewhere in the bubble screen. This way, the bubble intensity of the downstream part of the bubble screen may conveniently be less than elsewhere in the bubble screen.

The invention further provides for a bubble screen device for aerating liquid, in particular for use in a watercourse including features as described above, comprising a first portion provided with a conduit arrangement presenting a plurality of apertures along at least part of the conduit arrangement, wherein substantially each aperture of the plurality of apertures is configured to allow passage of a gas, a second portion extending along at least a part of the first portion and provided with a ballast module that is arranged to submerge the bubble screen device in a liquid, in particular water, and an aeration module arranged to regulate an aeration capability of a part of the conduit arrangement presenting apertures to be less than the aeration capability elsewhere in the conduit arrangement presenting apertures.

When the bubble screen device comprises a first portion provided with a conduit arrangement presenting a plurality of apertures along at least part of the conduit arrangement, wherein substantially each aperture of the plurality of apertures is configured to allow passage of a gas, the bubble screen device may be used to aerate a watercourse. In particular, substantially each aperture of the plurality of apertures may be configured to allow passage of a gas whilst counteracting ingress of water therethrough and into the conduit arrangement. The conduit arrangement may e.g. be substantially formed of a plastic material, such as polyvinylchloride (PVC), low-density polyethylene (LDPE), high-density polyethylene (HDPE), or the like.

When the bubble screen device comprises a second portion provided with a ballast module that is arranged to submerge the bubble screen in a liquid, the bubble screen device may conveniently be placed in a watercourse. The ballast module may e.g. comprise a ballast reservoir, a substantially solid member, and/or an anchoring arrangement comprising at least one anchor. The ballast module may be formed of a material similar to and/or compatible with that of the conduit arrangement. Additionally or

alternatively, the ballast module may comprise one or more weights such as metal weights included therein and/or connected thereto.

By providing an aeration module that is arranged to regulate an aeration capability of a part of the conduit arrangement presenting apertures to be less than the aeration capability elsewhere in the conduit arrangement presenting apertures, a bubble intensity induced by part of the bubble screen device during use may be less than the bubble intensity induced elsewhere by the bubble screen device. In particular, the bubble screen device may thus be provided in a watercourse with a water flow direction such that the part of the conduit arrangement presenting apertures having less aeration capability corresponds to a downstream part of the bubble screen device. This way, during use, plastics may conveniently be guided less forcefully towards a collection area, such as a waterside, collector and/or catchment system. Additionally or alternatively, during use, formation of eddies in the water at least in the vicinity of a collection area may be counteracted.

The aeration module may comprise a constriction provided on the conduit arrangement that is arranged to constrict fluid flow through part of the conduit arrangement. This way, a pressure in part of the conduit arrangement may be reduced which in turn diminishes the aeration capability of that part. Hence, during use, a bubble intensity of a corresponding part of a bubble screen induced by the bubble screen device may conveniently be less than elsewhere in the bubble screen. In particular, the constriction may be provided as a valve to allow control over the amount of constriction within the conduit arrangement. Additionally or alternatively, the constriction may e.g. be porous membrane/material, a flange or a de Laval nozzle (i.e. convergent –divergent nozzle).

The constriction may be provided on an inner periphery of a mantle surface of the conduit arrangement, such as a flange extending radially inwardly from the mantle surface along at least part of the circumference of

the inner periphery. Additionally or alternatively, the constriction may be provided on an outer periphery of a mantle surface of the conduit arrangement, e.g. as a collar or clamp device. This may work particularly well when the conduit arrangement is substantially made of a flexible plastic material.

When the aeration module comprises a divergent conduit section forming and/or in fluid connection with said part of the conduit arrangement, a pressure in that part of the conduit arrangement may effectively be lowered with respect to the pressure elsewhere in the conduit arrangement. This way, the aeration capability of that part is less than elsewhere in the conduit arrangement presenting apertures and during use the corresponding part of the bubble screen may have less bubble intensity than elsewhere in the bubble screen.

The aeration module may comprise at least one textured surface on and/or extending at least partially along an inner periphery of a mantle surface of said part of the conduit arrangement, the at least one textured surface being rough compared to an adjacent portion of the inner periphery of the mantle surface of the conduit arrangement.

Within the context of this patent specification, the term 'textured surface' is to be construed as a surface portion that is rough compared to an adjacent surface portion of the inner periphery of the mantle surface of the conduit arrangement. Such adjacent surface portion may in particular have a surface finish that is smooth compared to the textured surface. Such adjacent surface portion may in the context of this application then in particular be considered a non-textured surface. Such a smooth surface may, as a matter of reference, be as smooth as a regular (inner) mantle surface of a typical conduit arrangement. The textured surface may thus be rough compared to a surface having the normal surface finish of the mantle surface of conventional conduit arrangement for aeration of watercourses.

Advantageously, the aeration module may comprise a temperature device that is configured to regulate at least a temperature inside the conduit arrangement. For instance, the temperature device may comprise at least one insulation element and/or at least one heating element. This way, by heating or insulating elsewhere in the conduit arrangement, the pressure there may be higher relative to said part of the conduit arrangement. Hence, during use the bubble intensity of a corresponding part of the bubble screen may be increased relative to said part of the conduit arrangement. Additionally or alternatively, in said part of the conduit arrangement e.g. at least one cooling element may be provided as a temperature device.

When the aeration module comprises at least one further conduit segment as part of the conduit arrangement presenting a further plurality of apertures along at least part of its length, wherein substantially each aperture of the further plurality of apertures is configured to allow passage of a gas, and wherein part of the at least one further conduit segment extends along part of the conduit arrangement presenting apertures, such that a part of the further plurality of apertures overlaps with a part of the plurality of apertures, a relatively simple construction may be achieved whilst counteracting a possibility of a gap forming in the bubble screen during use at a transition between the part of the conduit arrangement and the further conduit segment. This way, during use, it may be mitigated that plastics slip through the bubble screen and continue downstream e.g. towards a further watercourse, sea and/or ocean.

When at least the part of the conduit arrangement presenting apertures and at least the part of the at least one further conduit segment presenting apertures are disposed adjacent to each other, it may be counteracted that during use part of the bubble screen at and/or near the overlap is blocked.

When the conduit arrangement comprises a loop and a portion of the conduit arrangement is looped back onto itself, a meandering flow path

through the conduit arrangement may be provided. This way, a pressure drop may conveniently be realized in said part of the conduit arrangement during use. Additionally or alternatively, the portion of the conduit arrangement that is looped back onto itself may provide additional aeration elsewhere in the bubble screen as desired. For instance, during use a bubble intensity of a part of the bubble screen in a relatively deep part of the watercourse may be increased.

The invention further relates to a method for recovering plastic waste from a watercourse, the method comprising:

- providing a bubble screen that extends between a water guide element and another water guide element of the waterway such that it is at an angle relative a water flow direction of the waterway,
- intercepting plastic waste on the bubble screen and guiding it along the bubble screen towards a collection area at a downstream part of the bubble screen near the guide element, and
- providing a bubble intensity of the downstream part of the bubble screen that is less than the bubble intensity elsewhere in the bubble screen to mitigate the formation of eddies near the collection area so as to prevent accumulation and/or build-up of plastics in the collection area's vicinity.

The invention will further be elucidated on the basis of exemplary embodiments which are represented in the drawings. The drawings are only schematic representations of embodiments of the invention, which are given by manner of non-limiting exemplary embodiments.

In the drawings:

Fig. 1 shows a schematic perspective view of a watercourse provided with a bubble screen in accordance with the invention;

Fig. 2 shows a schematic top view of another watercourse provided with a bubble screen in accordance with another aspect of the invention;

Fig. 3 shows a schematic top view of a watercourse with a bridge provided with a bubble screen and a further bubble screen that meet each other at a pillar of the bridge in accordance with an aspect of the invention;

Fig. 4 shows a schematic perspective view of part of a bubble screen device comprising a conduit arrangement and a ballast module in accordance with an aspect of the invention;

Fig. 5 shows a schematic perspective view of part of a bubble screen device provided with a divergent conduit section as an aeration module in accordance with a further aspect of the invention; and

Fig. 6 shows a schematic perspective view of part of a bubble screen device comprising a further conduit segment as part of the conduit arrangement in accordance with a still further aspect of the invention.

In the drawings, the same or corresponding parts are designated with the same reference numerals.

Fig. 1 shows a watercourse 1. The watercourse 1 comprises water flowing in a flow direction F and has a width w extending substantially transverse to the water flow direction F. The watercourse 1 comprises a bubble screen 2 provide at an angle α relative to the water flow direction F. The angle α shown here is approximately 45°, however any angle in the range between circa 1°-90° may be chosen, such as between circa 5°-75° or between circa 10°-60°. Here, the bubble screen 2 extends from an embankment as water guide element 3 to another embankment as another water guide element 3'. A downstream part 4 of the bubble screen 2 is provided with a collection area 5 that comprises a catchment system 6 as a collector. Additionally or alternatively, the collection area 5 may be provided as a waterside, such as a riverbank, shore or beach, where plastics e.g. wash ashore. A bubble intensity I of the downstream part 4 of the bubble screen 2 is less than the bubble intensity I elsewhere in the bubble screen 2.

In use, plastic waste may be recovered from the watercourse by intercepting plastic waste on the bubble screen and guiding it along the

bubble screen towards a collection area at a downstream part of the bubble screen near the guide element. A bubble intensity of the downstream part of the bubble screen that is less than the bubble intensity elsewhere in the bubble screen may be provided to mitigate the formation of eddies near the collection area so as to prevent accumulation and/or build-up of plastics in the collection area's vicinity.

Particles, in particular plastics P, move in the water flow direction F, in particular downstream towards e.g. a further watercourse, sea or ocean (not shown). The plastics P are intercepted by the bubble screen 2 and are gradually moved downstream towards the catchment system 6 at the collection area 5. In certain cases, at least part of the water and thus the plastics P may move in a substantially opposite flow direction, for instance due to tidal influences or relatively strong winds (not shown). In such cases a further collection area may be provided, optionally with a collector, at an opposite part of the bubble screen 2 relative to the downstream part 4 of the bubble screen 2 that is provided with the catchment system 6 at the collection area 5.

The downstream part 4 of the bubble screen 2 curves, in particular convexly, towards the collection area 5. However, any change in gradient between the downstream part 4 of the bubble screen relative to the rest of the bubble screen 2 may be conceived, such as a stepped or abrupt change.

At least one side 7 of the catchment system 6 that is provided as the collector, presents a meshed wall. The meshed wall is configured to sieve out particles, in particular plastics P, whilst allowing water to pass through. The meshed wall may e.g. have a sieve or so-called mesh size in the range between circa 0.1-50 mm, such as between circa 0.3-25 mm or between circa 0.5-20 mm. Additionally or alternatively, the meshed wall is configured to sieve out particles with a particle or so-called screen size in the range between 0.1-1000 mm, such as having a screen size greater than circa0.3

mm or greater than circa 0.5 mm. The screen size is to be construed as sieving out at least circa 90% of particles with a certain particle size.

In the exemplary embodiment, a gas, in particular compressed gas, is supplied to the bubble screen 2 from a pressure supply 8 provided at the downstream part 4 of the bubble screen 2. Advantageously, the pressure supply 8 may be provided at an upstream part of the bubble screen 2, that is to say on a side opposite to the one shown here.

Fig. 2 shows a watercourse having a width W that is wider in a direction substantially transverse to the water flow direction F than the width w of the watercourse of Fig. 1. In this exemplary embodiment, the bubble screen 2 is provided with a partial overlap 9. In particular, the partial overlap 9 forms a cascade 10 at a transition T of the bubble screen 2. This way, a gap forming in the bubble screen at the transition T may be counteracted and hence the risk of particles, in particular plastics P, slipping through the bubble screen 2 is mitigated. In addition, as the cascade 10 transitions downstream in the flow direction F, guidance of the plastics P downstream along the bubble screen 2 may be promoted.

Fig. 3 shows a watercourse 1 provided with a bridge B having a support pillar S within the watercourse 1. In this exemplary embodiment, both the water guide element 3' and another water guide element 3" are each formed by a distinct bubble screen 2. Here, the bubble screen 2 shown on the right hand side of Fig. 3 as seen in a water flow direction F extends substantially from an embankment 3 to the other bubble screen 2 shown on the left hand side of Fig. 3. The other bubble screen 2 in turn extends substantially from an embankment 3 to the bubble screen 2. A collection area 5 is provided on the right hand side of the support pillar S, but could also have been provided on the left hand side or an end of the support pillar S. Particles, in particular plastics P, are intercepted by the bubble screens and are guided downstream towards the collection area 5 which is provided with a catchment system 6.

Fig. 4 shows a bubble screen device 12 for aerating a liquid. The bubble screen device 12 comprises a first portion 13 that is provided with a conduit arrangement 14. In this exemplary embodiment, the conduit arrangement 14 is substantially formed of a plastic material, such as PVC, LDPE, HDPE and the like. The conduit arrangement 14 presents a plurality of apertures 15 along at least part of the conduit arrangement 14. Substantially each aperture of the plurality of apertures 15 is configured to allow passage of a gas, in particular whilst counteracting ingress of water.

The bubble device 12 further comprises a second portion 16 extending along the first portion 13, in particular substantially the entire first portion 13. The second potion 16 is provided with a substantially solid ballast 17 as a ballast module. The ballast 17 is arranged to submerge the bubble screen device 12 in a liquid, in particular water. Additionally or alternatively, the ballast module may include one or more anchor elements e.g. disposed with fixed or variable interspace along at least a part of the first portion 13.

The bubble screen device 12 comprises an aeration module 18 arranged to regulate an aeration capability of a part 19 of the conduit arrangement 14 presenting apertures to be less than the aeration capability elsewhere in the conduit arrangement 14 presenting apertures. In this exemplary embodiment, the aeration module 18 comprises a constriction 20. The constriction 20 is provided on the conduit arrangement 14 and is arranged to constrict fluid flow through part of the conduit arrangement 14. In particular, the constriction 20 is provided as a clamp device on an outer periphery 21 of a mantle surface 22 of the conduit arrangement 14. The aeration module 18 in this exemplary embodiment further comprises an increase in aperture size between two sequences of subsequent apertures of the plurality of apertures 15. A first sequence of subsequent apertures 23 comprises apertures of a first size and a second sequence of subsequent apertures 24 comprises apertures of a second size that is larger than the

first size. Of course the aeration module 18, may be provided as either the constriction 20 or the increase in aperture size between the two sequences.

The conduit arrangement 14 and the ballast 17 are secured together, in particular they are secured together by welding. Additionally or alternatively, other means of securing such as adhesive or snap connection may be utilized.

Additionally or alternatively, a constriction 20 as an aeration module 18 may be provided on an inner periphery 25 of a mantle surface 22 of a conduit arrangement 14 (not shown). For instance, the constriction 20 may be an adjustable valve or a flange extending radially inwardly from the inner periphery 25 of the mantle surface 22 or the like.

Fig. 5 shows a bubble screen device 12 with a first portion 13 provided with a conduit arrangement 14 presenting a plurality of apertures 15 there along. Substantially each aperture is configured to allow passage of gas, in particular whilst counteracting ingress of water. The bubble screen device 12 is further provided with a second portion 16 comprising a ballast module 17 for submerging the bubble screen device in a liquid. The bubble screen device 12 also comprises an aeration module 18. The aeration module 18 comprises a divergent conduit section 26 forming part 19 of the conduit arrangement 14 having less aeration capability than the aeration capability elsewhere in the conduit arrangement (not shown). Alternatively, the divergent conduit section 26 may be in fluid connection with said part 19 of the conduit arrangement 14.

In addition, the aeration module 18 of Fig. 5 comprises an increase in interspace between subsequent apertures of the plurality of apertures 15 such that the aeration capability of said part 19 of the conduit arrangement 14 is less than the aeration capability elsewhere in the conduit arrangement presenting apertures (not shown).

Fig. 6 shows a bubble screen device 12 according to another aspect of the invention. In this exemplary embodiment, the aeration module 18

comprises a further conduit segment 27 as part of the conduit arrangement 14. Also, more than one further conduit segment may be provided, e.g. two, three, four, or more (not shown). The further conduit segment 27 presents a further plurality of apertures 28 along at least part of its length. Similarly as the plurality of apertures 15 described above, substantially each aperture of the further plurality of apertures 28 is configured to allow passage of gas, in particular whilst counteracting ingress of water. Part 29 of the at least one further conduit segment 27 extends along part 30 of the conduit arrangement 14 presenting apertures, such that a part of the further plurality of apertures 28 overlaps with a part of the plurality of apertures 15. In this exemplary embodiment, an end of the conduit arrangement 14 is provided with a plug and gas is provided from an opposite end. Also, a further end of the further conduit arrangement 27 is provided with a plug and gas is provided from the top right hand side of the schematic drawing. However, a construction wherein both the conduit arrangement 14 and the further conduit arrangement 27 extend are both provided with gas from the same end, e.g. from the bottom left hand side of the schematic drawing, and wherein the further conduit arrangement 27 extends beyond the part 30 of the conduit arrangement 14 may also be contemplated.

Part 30 of the conduit arrangement 14 presenting apertures and part 29 of the further conduit segment 27 are disposed adjacent to each other.

The bubble screen device 12 comprises an orientation module 31 arranged to orientate at least part 30 of the conduit arrangement 14 presenting apertures and to further orientate at least part 29 of the further conduit segment 27 presenting the further plurality of apertures 28. In this exemplary embodiment, the apertures are orientated by the orientation module 31 towards a side of the bubble screen device 12, in particular such that in use, the apertures are facing upstream in the water flow direction. Additionally or alternatively, more than one orientation module may be

provided e.g. for each at least part of each further conduit segment. The orientation module may comprise an anchoring element (not shown).

Preferably, any one or all of the exemplary embodiments described above may further comprise at least one pressure supply that is in fluid connection with the conduit arrangement (not shown). In particular, wherein the at least one pressure supply is configured to supply compressed gas. Additionally or alternatively, the bubble screen device may be provided with a manifold that is arranged to divide a gas supplied from at least one pressure supply into the conduit arrangement (not shown). In particular, when a further conduit segment is provided as part of the conduit arrangement, the manifold may divide a gas supplied from a pressure source into the conduit arrangement and the further conduit segment.

It will be clear to the skilled person that the invention is not limited to the exemplary embodiments represented here. Many variations are possible. For example, different aspects of the described aeration module may be implemented in isolation or may be combined. A further conduit segment as part of the conduit arrangement may e.g. be in fluid connection with a further pressure supply and/or be provided with apertures having an increased aperture size with respect to aperture size of the plurality of apertures. For instance, substantially each or at least one aperture of the (further) plurality of apertures may comprise a nozzle, in particular as aeration module.

Such variations shall be clear to the skilled person and are considered to fall within the scope of the invention as defined in the appended claims.

LIST OF REFERENCE SIGNS

1.	Watercourse
2.	Bubble screen
3., 3'.	Water guide element
4.	Downstream part
5.	Collection area
6.	Collector
7.	At least one side
8.	Pressure supply
9.	Overlap
10.	Cascade
11.	Upstream end
12.	Bubble screen device
13.	First portion
14.	Conduit arrangement
15.	Plurality of apertures
16.	Second portion
17.	Ballast module
18.	Aeration module
19.	Part of the conduit arrangement
20.	Constriction
21.	Outer periphery
22.	Mantle surface
23.	First sequence of subsequent apertures
24.	Second sequence of subsequent apertures
25.	Inner periphery
26.	Divergent conduit section
27.	Further conduit segment
28.	Further plurality of apertures

29. Part of the at least one further conduit segment
30. Part of the conduit arrangement presenting apertures
31. Orientation module

F. Flow direction
P. Particles, in particular plastics
w. Width
W. Wider width relative to width w
T. Transition
I. Bubble intensity

Claims

1. Watercourse with water flowing in a flow direction, wherein the watercourse comprises a bubble screen provided at an angle relative to the water flow direction, wherein the bubble screen substantially extends from a water guide element to another water guide element, wherein a downstream part of the bubble screen is provided with a collection area, and wherein a bubble intensity of the downstream part of the bubble screen is less than the bubble intensity elsewhere in the bubble screen.

2. Watercourse according to claim 1, wherein the downstream part of the bubble screen curves, in particular convexly, towards the collection area.

3. Watercourse according to claim 1 or 2, wherein the collection area comprises a collector, in particular a catchment system.

4. Watercourse according to claim 3, wherein at least one side of the collector presents a meshed wall that is configured to sieve out particles and to allow water to pass through.

5. Watercourse according to any of the preceding claims, wherein the bubble screen is provided with at least one partial overlap, in particular wherein the at least one partial overlap forms a cascade in the bubble screen.

6. Watercourse according to any of the preceding claims, wherein the bubble screen comprises a pressure supply that is configured to supply compressed gas to the bubble screen, in particular wherein the pressure supply is coupled to an upstream end of the bubble screen.

7. Bubble screen device for aerating liquid, in particular for use in a watercourse according to any of claims 1-6, comprising:

- a first portion provided with a conduit arrangement presenting a plurality of apertures along at least part of the conduit arrangement,

wherein substantially each aperture of the plurality of apertures is configured to allow passage of a gas,

- a second portion extending along at least part of the first portion and provided with a ballast module that is arranged to submerge the bubble screen device in a liquid, in particular water, and

- an aeration module arranged to regulate an aeration capability of a part of the conduit arrangement presenting apertures to be less than the aeration capability elsewhere in the conduit arrangement presenting apertures.

8. Bubble screen device according to claim 7, wherein the aeration module comprises a constriction provided on the conduit arrangement that is arranged to constrict fluid flow through part of the conduit arrangement, in particular wherein the constriction is provided as a valve.

9. Bubble screen device according to claim 8, wherein the constriction is provided on an inner periphery of a mantle surface of the conduit arrangement.

10. Bubble screen device according to claim 7 or 8, wherein the constriction is provided on an outer periphery of a mantle surface of the conduit arrangement.

11. Bubble screen device according to any of claims 7-10, wherein the aeration module comprises a divergent conduit section forming and/or in fluid connection with said part of the conduit arrangement.

12. Bubble screen device according to any of claims 7-11, wherein the aeration module comprises at least one friction element arranged in said part of the conduit arrangement.

13. Bubble screen device according to any of claims 7-12, wherein the aeration module comprises at least one textured surface on and/or extending at least partially along an inner periphery of a mantle surface of said part of the conduit arrangement, the at least one textured surface being rough

compared to an adjacent portion of the inner periphery of the mantle surface of the conduit arrangement.

14. Bubble screen device according to any of claims 7-13, wherein the aeration module is provided as or comprises an increase in interspace between subsequent apertures and/or sequence of subsequent apertures of the plurality of apertures along the conduit arrangement, in particular said part of the conduit arrangement.

15. Bubble screen device according to any of claims 7-14, wherein the aeration module is provided as or comprises an increase in aperture size between subsequent apertures and/or sequence of subsequent apertures of the plurality of apertures along the conduit arrangement, in particular said part of the conduit arrangement.

16. Bubble screen device according to any of claims 7-15, wherein the aeration module comprises a temperature device that is configured to regulate at least a temperature inside the conduit arrangement, in particular said part of the conduit arrangement.

17. Bubble screen device according to any of claims 7-16, wherein the aeration module comprises at least one further conduit segment as part of the conduit arrangement presenting a further plurality of apertures along at least part of its length, wherein:

- substantially each aperture of the further plurality of apertures is configured to allow passage of a gas,

- part of the at least one further conduit segment extends along part of the conduit arrangement presenting apertures, such that a part of the further plurality of apertures overlaps with a part of the plurality of apertures.

18. Bubble screen device according to claim 17, wherein at least the part of the conduit arrangement presenting apertures and at least the part of the at least one further conduit segment presenting apertures are disposed adjacent to each other.

19. Bubble screen device according to any of claims 7-18, wherein the conduit arrangement comprises a loop and a portion of the conduit arrangement is looped back onto itself.

20. Bubble screen device according to any of claims 7-19, comprising an orientation module arranged to orientate at least the part of the conduit arrangement presenting apertures, in particular in combination with at least one further conduit segment according to claim 17-19, wherein the orientation module is arranged to further orientate at least the part of the further conduit segment presenting the further plurality of apertures.

21. Bubble screen device according to claim 20, wherein the orientation module comprises an anchoring element.

22. Bubble screen device according to any of claims 7-21, further comprising at least one pressure supply that is in fluid connection with the conduit arrangement, in particular wherein the at least one pressure supply is configured to supply compressed gas.

23. Bubble screen device according to any of claims 7-22, provided with a manifold that is arranged to divide a gas supplied from at least one pressure supply into the conduit arrangement.

24. Method for recovering plastic waste from a watercourse, in particular using a watercourse or bubble screen in accordance with any of the preceding claims, the method comprising:

- providing a bubble screen that extends between a water guide element and another water guide element of the waterway such that it is at an angle relative a water flow direction of the waterway,
- intercepting plastic waste on the bubble screen and guiding it along the bubble screen towards a collection area at a downstream part of the bubble screen near the guide element, and
- providing a bubble intensity of the downstream part of the bubble screen that is less than the bubble intensity elsewhere in the bubble screen to mitigate the formation of eddies near the collection area so as to

prevent accumulation and/or build-up of plastics in the collection area's vicinity.

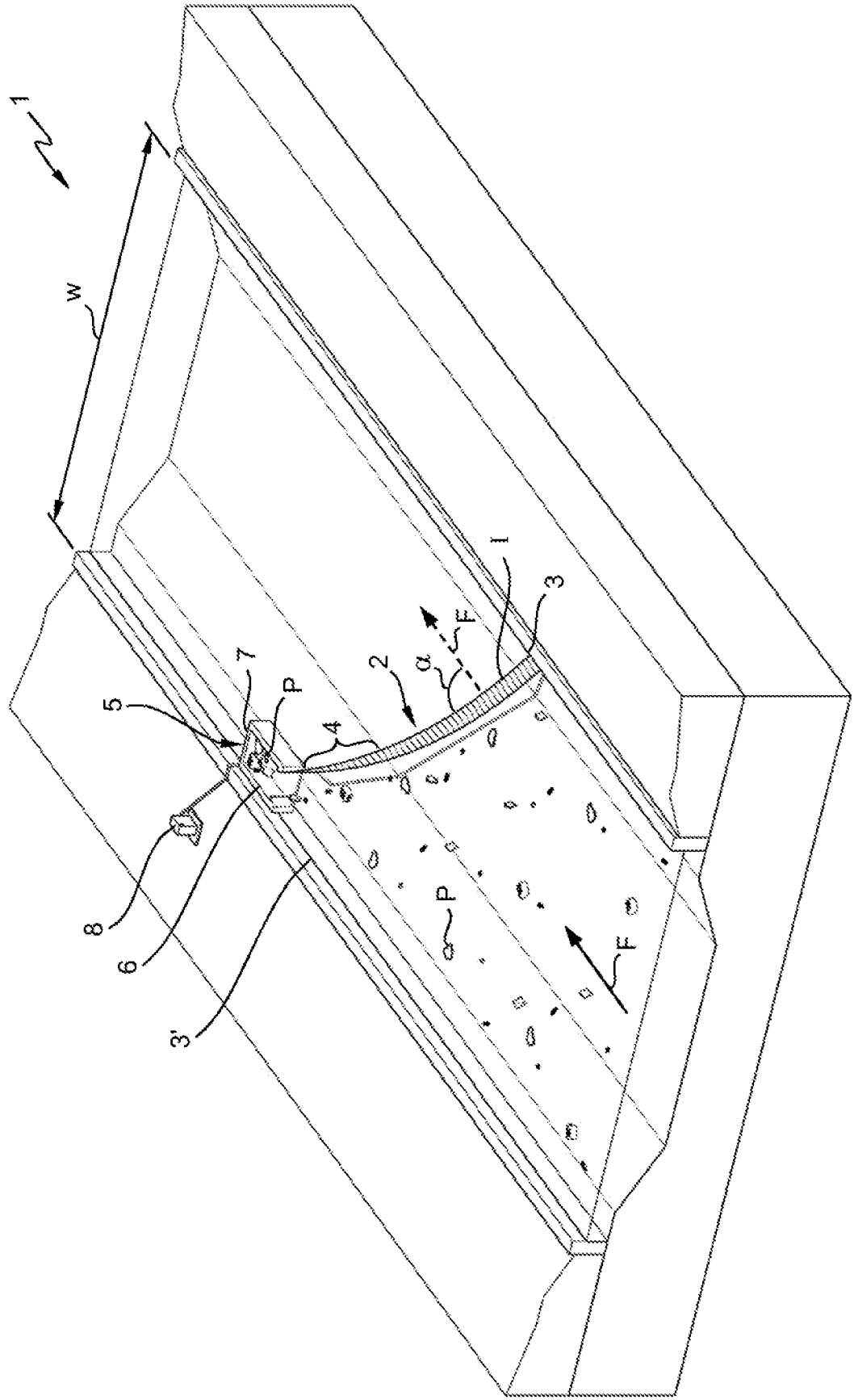

FIG. 1

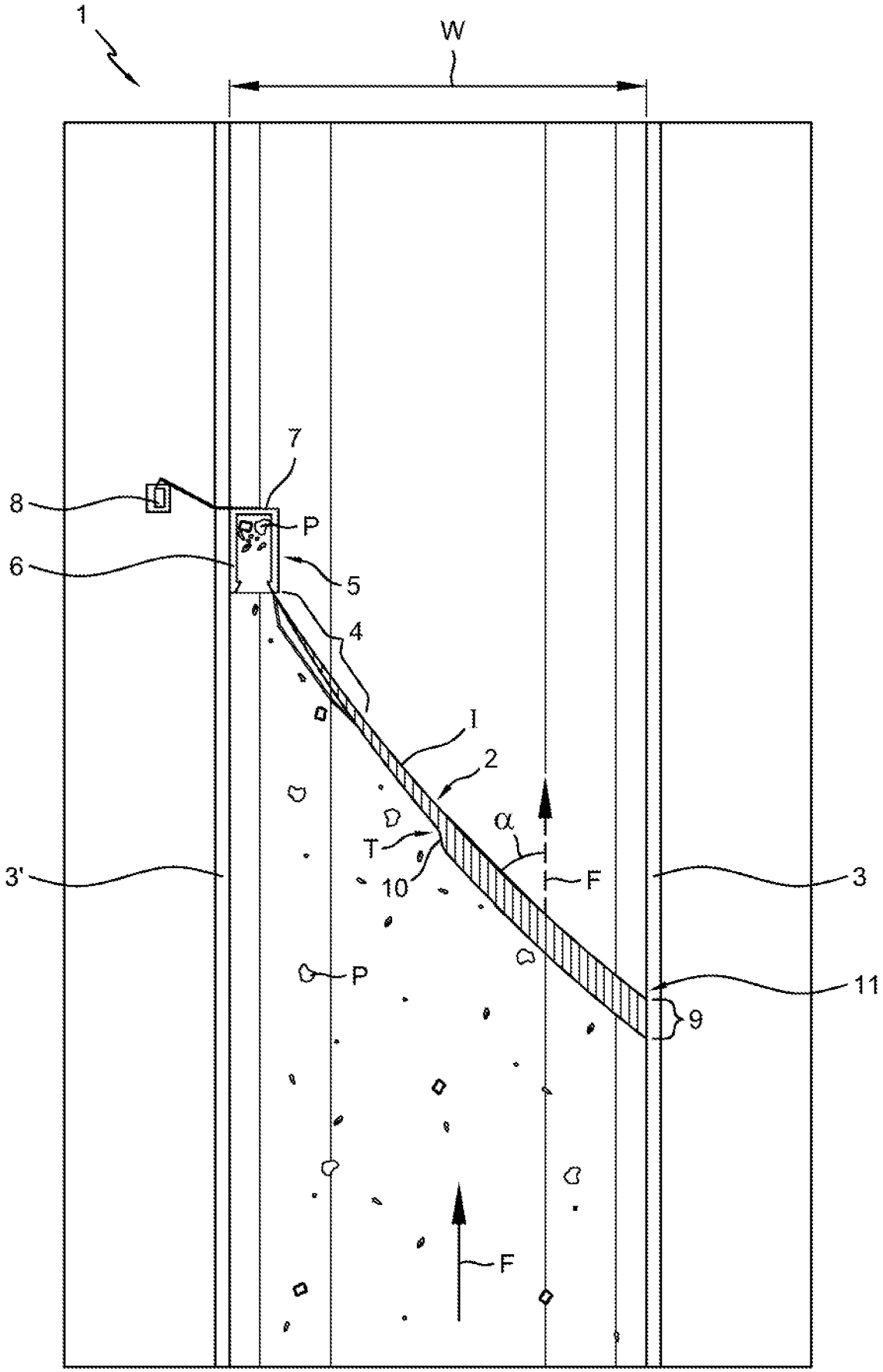

FIG. 2

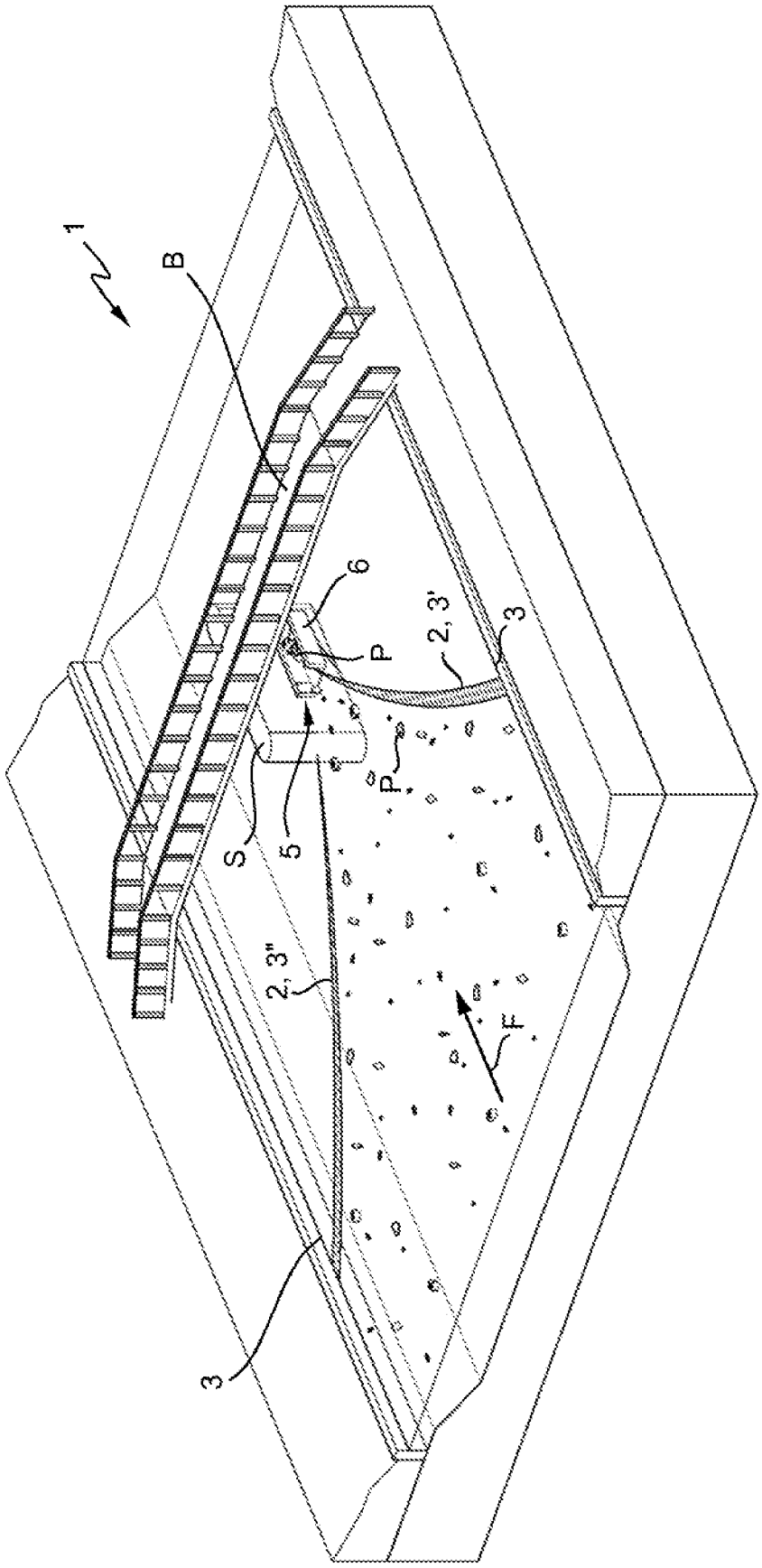

FIG. 3

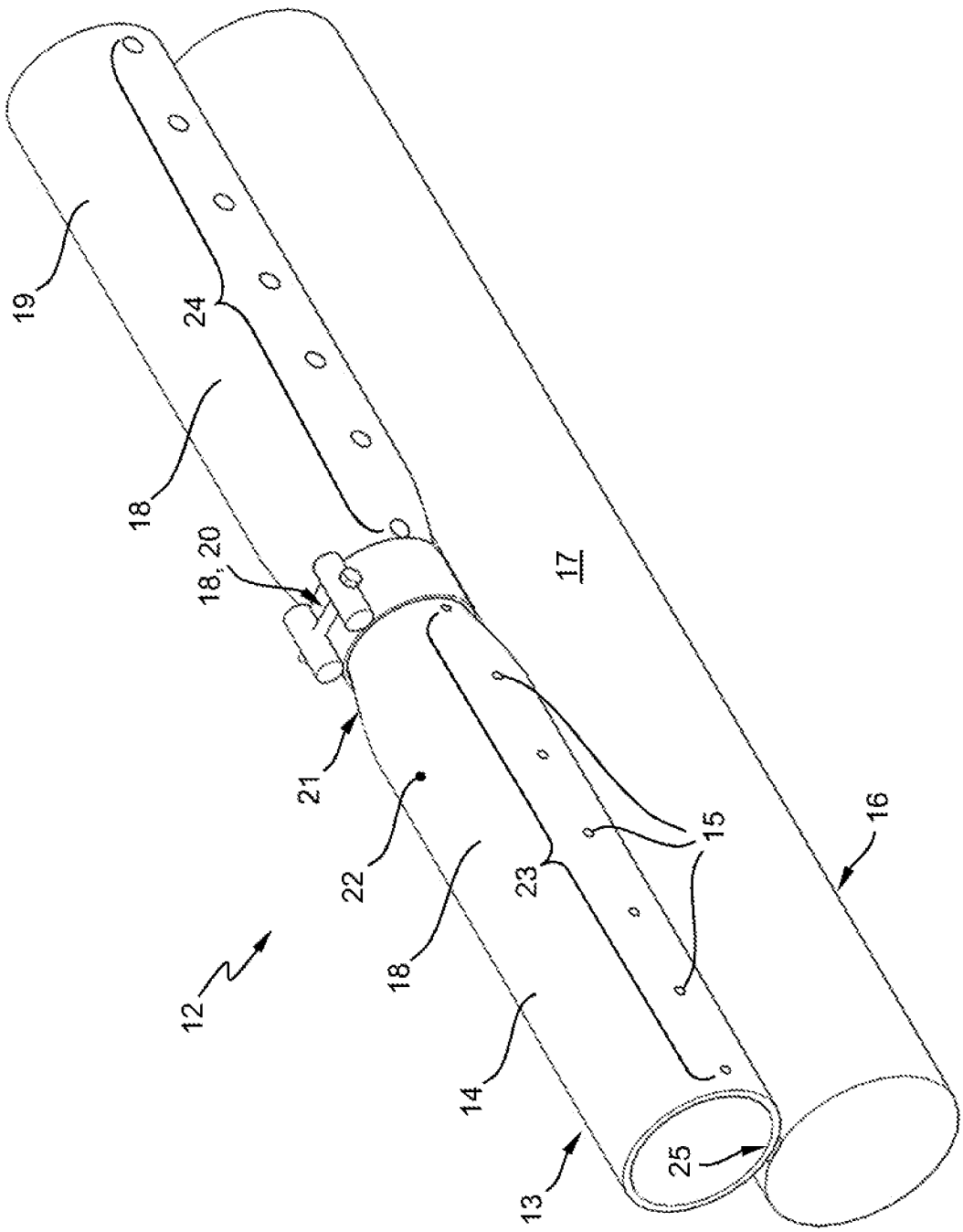

FIG. 4

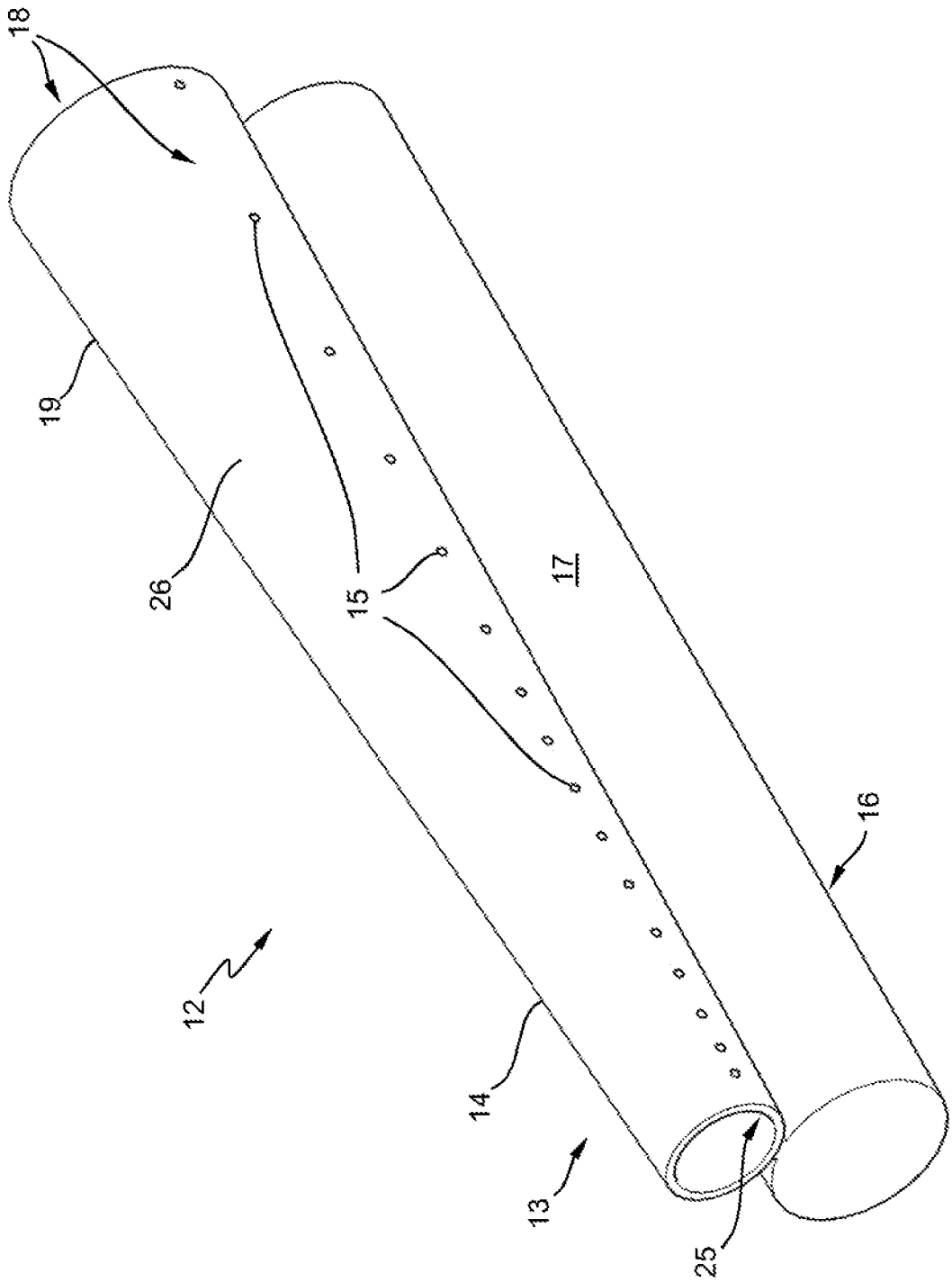

FIG. 5

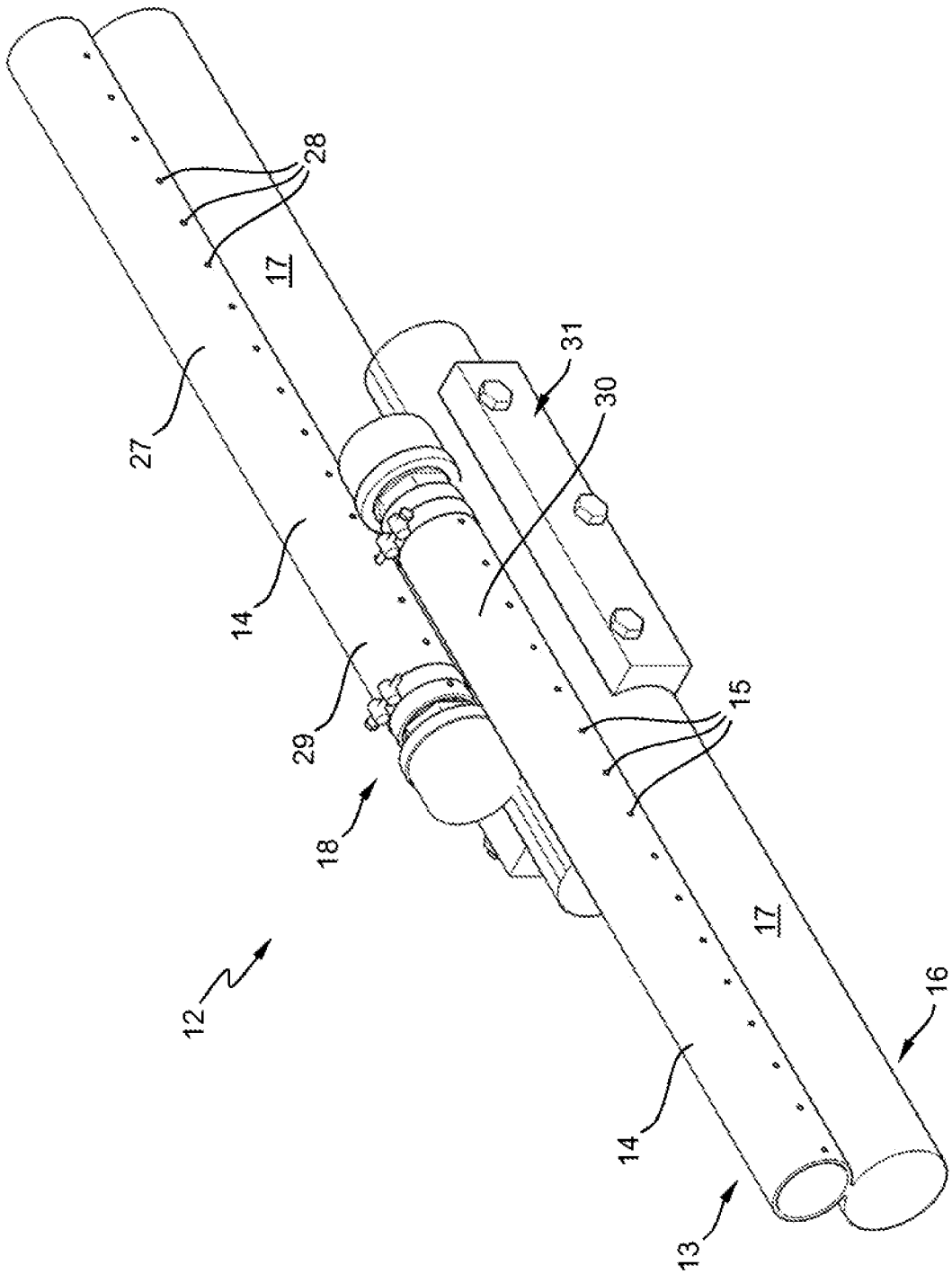

FIG. 6

INTERNATIONAL SEARCH REPORT

International application No
PCT/NL2020/050633

A. CLASSIFICATION OF SUBJECT MATTER
INV. E02B1/00 E02B15/00
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
E02B E02C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y A	JP H06 146248 A (AQUA TEC KK) 27 May 1994 (1994-05-27) paragraphs [0004], [0005], [0007], [0008], [0009]; claims; figures 1,3,4,5	1,3,4,6 2,5 24
Y	CN 207 193 929 U (YUNNAN WENBO ENVIRONMENT TREAT ENGINEERING CO LTD) 6 April 2018 (2018-04-06) claims; figure 1	2
Y A	JP H02 112511 A (NIPPON SOLID CO LTD) 25 April 1990 (1990-04-25) the whole document	5 1,6,24
A	FR 2 177 418 A5 (BLUM ALFRED [FR]) 2 November 1973 (1973-11-02) the whole document	1,6,24

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
4 March 2021	15/03/2021

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Fordham, Alan

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Form PCT/ISA/210 (second sheet) (April 2005)

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	RU 2 217 549 C2 (ESIN A I; KOSHKIN A N) 27 November 2003 (2003-11-27) paragraphs [0005] - [0012], [0016] - [0022]; figures	1,6,24
A	JP S57 140415 A (SATO YASUO) 31 August 1982 (1982-08-31) the whole document	1,6,24
A	GB 2 088 448 A (SECR DEFENCE) 9 June 1982 (1982-06-09) page 1, line 21 - line 39 page 2, line 8 - line 17; claims; figures	1,6,24
A	CA 2 522 121 A1 (PARIS MARIO [CA]) 4 April 2007 (2007-04-04) the whole document	1,6,24
X Y A	DE 10 33 077 B (GEORG SCHUBACK) 26 June 1958 (1958-06-26) paragraph [0004] - paragraph [0009]; figures	7-13,22, 23 17-21 1
Y A	BR PI0 802 735 A2 (DT ENGENHARIA DE EMPREENDIMENTOS LTDA [BR]) 11 May 2010 (2010-05-11) claims; figures	17,18, 20,21 1,7,24
Y A	US 3 744 254 A (FENNELLY R) 10 July 1973 (1973-07-10) column 1, line 56 - line 60; figure 1	19 7
X A	JP S51 108332 U ([UNKNOWN]) 30 August 1976 (1976-08-30) the whole document	7,14,22, 23 1
A	US 3 593 526 A (FAY JAMES ALAN ET AL) 20 July 1971 (1971-07-20) the whole document	1,7,8, 22,23
A	CN 110 050 730 A (CHINA THREE GORGES CORP) 26 July 2019 (2019-07-26) the whole document	1,7,24

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NL2020/050633

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☒ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-6, 24

   Waterway comprising bubble curtain and method of recovering plastic from a watercourse

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2. claims: 7-23

   Bubble curtain device per se with tube arrangement, said tube arrangement characterised by various alternative or mutually combinable aeration modules, the modules producing portions of the tube arrangement with differing aeration capabilities.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/NL2020/050633

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