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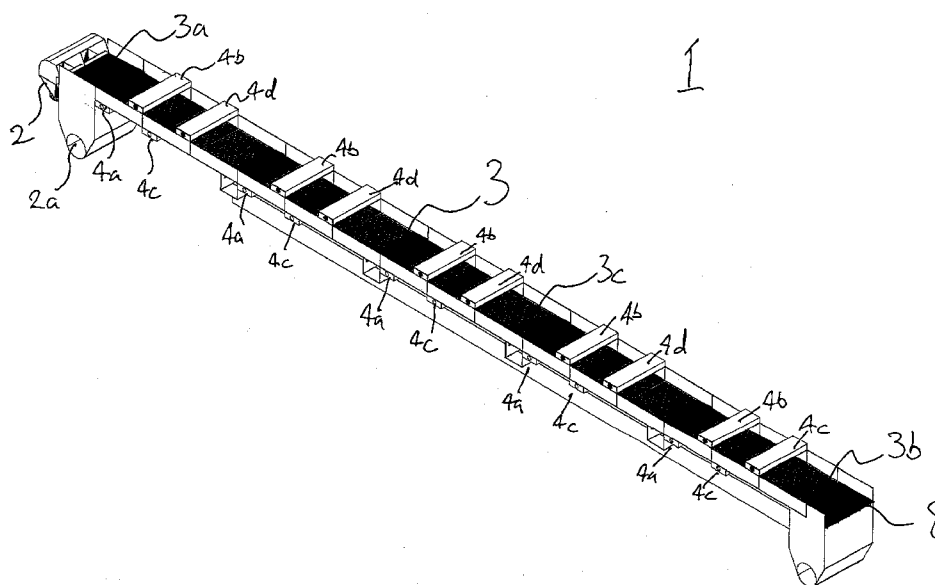


Fig. 1

(57) Abstract: An arrangement for removing parasites on marine organisms, such as live fish, comprising: an inlet (2) for receiving said marine organisms, a channel (3) for receiving said marine organisms from said inlet (2) at a first end (3A) and conveying said marine organism towards a second end (3B), wherein the channel (3) is perforated at its bottom (3C) for removing any excess water in the channel (3), a plurality of nozzles (4A, 4B) for discharging jets of water on the conveyed marine organisms, a container (5A, 5B) for collecting the discharged water from the plurality of nozzles (4A, 4B) and any parasites and particles in the discharged water, and a second outlet (8) at the second end (3B) of the channel (3) for discharging said marine organisms from the channel (3).

RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, ME, 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).

Declarations under Rule 4.17:

- *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

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

ASSEMBLY AND METHOD FOR DELOUSING FISH**Technical Field**

[0001] The present invention relates to a technical solution for the removal of parasites from fish, or specifically an assembly for removing sea lice from fish in a body of water.

Background Art

[0002] Fish farming is a mainstay with regards to providing large quantities of commercially bred fish in sea water, such as salmon and trout, as food to consumers.

[0003] However, a challenge in the fish farming industry is to continuously maintain the health and wellbeing of ones bred fish stock, so that the bred fish upholds a preferred meat quality and visual appearances for buyers and consumers. A potential disruptor of the health and wellbeing of bred fish is the occurrence of marine parasites, such as sea lice.

[0004] Sea lice are small parasitic crustaceans which attaches itself on to a fish, e.g. salmon or trout. Sea lice feeds on the slime, skin and blood of a fish, creating lesions which makes the fish susceptible for viruses, bacterial infections and fungi. Said lesions, in the form of open wounds, also affects the saline balance of the fish, wherein open wounds due to sea lice attacks makes the fish further susceptible for attaining lethal levels of salt from the surrounding sea water, increasing its stress levels and lack of appetite. Furthermore, should the fish survive a sea lice infection or several, the saline imbalance may negatively impact the growth rate of the fish.

[0005] Fish pens, artificial enclosures for bred fish in a body of water, wherein the enclosures are made of netting on a frame, are primarily located near and along the coast providing the optimal breeding and growth condition for bred fish such as salmon, however, the coast is also the natural habitat of sea lice. Therefore, it is not surprising that sea lice provide a significant challenge for fish farmers when cultivating fish.

[0006] Fish farmers have several alternatives of treatment for removing sea lice, or delousing, on fish, i.e. mechanical treatment by rinsing or brushing bred fish with sea or saltwater, medical treatment by providing live bred fish into a separate sea water filled container, which includes chemical compounds, intended to kill of the sea lice,

and thermal treatment, which is similar to the medical treatment, but utilizes warm water on sea lice infected fish, wherein the water is hot enough, approximately 28° C to 34° C, to kill off the sea lice.

[0007] Unfortunately, said treatments have in common that they each result a varying degree of damage and mortality rate among the bred fish, if not also providing detrimental stress on the fish when undergoing said treatments. Some the treatments may over time not be as effective in removing the sea lice, such as medical delousing, of which some sea lice may be developed a resistance against said chemical compounds. Concerning thermal delousing, research have shown that exposure to water at 28° C and above fish are shown to have erratic movements when exposed to water at those temperatures due to experiencing pain.

[0008] Another drawback of said treatments is that over the time water in the container might be contaminated with harmful bacteria, or saturated with compounds such as nitrogen, carbon dioxide, from previous treated fish due to extensive use of the container, affecting incoming fish.

[0009] Alternative means of delousing, such as using secondary fishes with the bred fish, such as wrasses or lumpfish, which eats the sea lice in the fish pen. Arguably using secondary fishes for delousing provides a lower mortality rate on commercially bred fish. However, the actual secondary fish may themselves have a high mortality rate during its use, transport and storage, for delousing bred fish, thus the use of such may not be sustainable, especially such secondary must either be caught in wild or be bred themselves.

[0010] There are prior art concerning delousing process of fish, such as NO345380B1, a Norwegian patent, describing a process where the fish is provided to swim in against a flow of treated water within a tube. US9301498B2, an American patent, describes a similar process where the fish either slides or swims downward in a bent u-shaped tube filled with treated water at 30° C. WO2015143549A1, another American patent, describing a process where the fish also slides downward, while simultaneously the fish is showered with warm water, indicating thermal treatment wherein warm water is provided on to the fish in order to remove sea lice.

[0011] Other prior art such as WO2015043603 A1 and WO 9824304 describes a delousing process wherein the fish is in the same water at all times during

processing. WO 2016189146 A1 is another prior art for delousing fish, but it is not specific regarding whether infected fish is completely out-of-water during the delousing process when utilizing nozzles with jets of water or air to remove any parasites.

[0012] Norwegian patent NO339015 B1 also describes a delousing process where the fish is out of water utilizing discharged water from nozzles on the fish for delousing, however, NO339015 B1 does not disclose the source of water being discharged on the fish, nor do they disclose what happens to the water after being discharged on the fish.

[0013] However, although some prior art describes a process in removing sea lice in the treated water, none of the mentioned prior art take into account what to do with the treatment water which may also be contaminated with viruses, harmful bacteria, other parasites, etc., brought in by an initial batch of bred fish, which may adversely affect latter batches of bred fish.

[0014] The treated water may also over time be over saturated with carbon dioxide and nitrogen released by said initial batches of fish through their gills, which is unfavorable to latter batches unable to release said compounds into the over saturated water. Not to mention the risk of low levels of dissolved oxygen, which may also be a factor which can increase the stress levels, if not the mortality rate, of latter batches.

[0015] It is therefore coveted to disclose a technical solution which successfully removes sea lice off of the fish in way which controls the manner and the amount of treated water provided to the fish and wherein the treated water itself is not harmful to fish treated with it.

Summary of invention

[0016] The object of the present is to provide a system and a method for treating fish covered with sea lice, wherein the sea lice is removed from the fish in a non-harmful manner to the fish.

[0017] The present invention is aimed at solving the objects as stated above and this is achieved in the accompanying claims. These and other objects is achieved by an arrangement for removing parasites on marine organisms, such as live fish, comprising an inlet for receiving said marine organisms, a channel for receiving said

marine organisms from said inlet at a first end and conveying said marine organism towards a second end wherein the channel is perforated at its bottom for removing any excess water in the channel, a plurality of nozzles for discharging spray or jets of water on the conveyed marine organisms for removing parasites on the conveyed marine organisms, wherein the channel is perforated at its bottom for removing any discharged water from the plurality of nozzles in the channel, a container for collecting the discharged water from the plurality of nozzles and any parasites and particles in the discharged water, wherein the container is in communication with a circulation pump, wherein the circulation pump is in communication with a water treatment unit, and a second outlet at the second end of the channel for discharging said marine organisms from the channel, wherein the circulation pump provides the water in the container to the water treatment unit for treating the provided water, wherein the water treatment unit is in communication with the plurality of, wherein the cleansed water is further provided by the circulation pump to the plurality of nozzles for discharging jets of water on the conveyed marine organisms in the channel.

[0018] Said water treatment unit is wherein the the water treatment unit is a filtering device for cleansing water.

Said channel is preferably inclined at a predetermined angle for conveying said marine organisms from the first end to the second end by gravity.

Said first end preferably includes a first outlet for removing any excess water accompanying said marine organisms from the inlet.

Said plurality of nozzles preferably comprise a first and a third nozzle for discharging spray or jets of water from below on the marine organisms, and a second and a fourth nozzle for discharging jets of water from above on the marine organisms.

Said plurality of nozzles preferably provide spray or jets of water on the marine organisms at a predetermined temperature, angle, pressure, volume or duration. Said arrangement preferably includes least two pluralities of nozzles, at least two containers, at least two circulation pumps and at least two water treatment units.

Said container preferably provides the collected water to a water treatment unit by a circulation pump for treating the collected water, wherein the treated water is cleansed from any parasites, bacteria, viruses and compounds harmful to the marine

organisms, wherein said water treatment unit provides treated water to the plurality of nozzles.

A method for removing parasites on marine organisms, such as live fish, wherein said removal of parasites comprise of the following steps; wherein it provides marine organisms at a first end of a channel for conveying towards a second end, discharges spray or jets of water at a predetermined temperature on the marine organism by a plurality of nozzles, removes excess discharged water in the channel through perforations in a bottom of the channel, collects the excess discharged water in a container, provides the water in the container towards a water treatment unit with a circulation pump for cleansing the water from any parasites, bacteria, viruses and any compounds deriving from the marine organisms, such as carbon dioxide and sulphur, provides the cleansed water from water treatment unit to the plurality of nozzles with the circulation pump, discharges marine organism at the second end at an outlet.

Said method may further include a channel that is preferably inclined at a predetermined angle for conveying said marine organisms from the first end to the second end by gravity.

Said method may further include having the removed excess discharged water to be collected in a container, wherein said collected water is provided by a circulation pump to a water treatment unit for cleansing any parasites, bacteria, virus and compounds harmful to the marine organisms in the collected water, wherein said cleansed water is then provided to the plurality of nozzles.

Said method may further include having the plurality of nozzles comprise a first and a third nozzle for discharging jets of water from below on the marine organisms, and a second and a fourth nozzle for discharging jets of water from above on the marine organisms.

Brief description of drawings

[0019] Figure 1 illustrates a perspective of an embodiment of the invention,

[0020] Figure 2 illustrates a schematic side view of an embodiment of the invention,

[0021] Figure 3 illustrates the channel unit of an embodiment of the invention at a predetermined angle.

Detailed description of the invention

[0022] Figure 1 and figure 2 shows an embodiment of the invention illustrating an arrangement **1** for cleansing or removing parasites, such as sea lice, from marine organisms, such live fish e.g. salmon or trout, infected with said parasites. The arrangement **1** is intended to provide a non-harmful process for removing parasites from marine organisms.

[0023] The arrangement **1** includes an inlet **2** for receiving infected marine organisms, wherein the inlet **2** then provides the marine organisms on a first end **3a** of the channel unit **3** for conveying the marine organisms from the first end **3a** to the second end **3b** of the channel unit **3**.

[0024] The bottom **3c** of the channel unit **3** is perforated for allowing any excess water that accompanied the marine organism on to the channel unit **3** to be discarded away from the marine organisms. Said perforations further assist in separating the marine organisms from any water on the channel unit **3** that would adversely affect the marine organisms by being exposed in the water, or more specifically any gills of the marine organism. E.g. any water born bacteria, viruses or the like can easily enter the fish than through the skin of the fish. In addition cold or warm water would also affect the temperature of the fish, that may be a traumatic experience for the fish.

[0025] The first end **3a** of the channel unit **3** can also include a first outlet **2a** which collects and further discards any excess water that accompanied the infected marine organisms from the inlet **2**. Said excess water can be provided to an initial water treatment unit **20** for preparing/cleaning the water.

[0026] As shown in figure 3, the marine organisms are conveyed on the channel unit **3** by gravity and the channel unit **3** is positioned at an angle α , wherein an end **3a**, **3b** of the channel unit **3** is either lifted or lowered. The marine organisms are conveyed

on the channel unit **3** by sliding down from the first end **3a** to the second end **3b** of the channel unit **3**. Said angle α of the channel unit **3** can be a predetermined angle α for managing the sliding speed of the marine organisms on the channel unit **3**. Adjusting the sliding speed can be managed by further lifting or lowering either the first end **3a** or the second end **3b** of the channel unit **3**.

[0027] The channel unit **3** further includes a plurality of nozzles **4a, 4b, 4c, 4d** which provides spray or jets of water on the marine organisms from above and below the marine organisms relative to channel unit **3**. More specifically, in an embodiment, a first **4a** and a third nozzles **4c** provide spray or jets of water from below on the marine organisms, and a second **4b** and fourth nozzles **4d** provide spray or jets of water from above on the marine organisms at a predetermined water pressure, water temperature or a combination thereof. Optionally, in another embodiment (not shown), additional nozzles on the channel unit **3** can provide jets of water towards at least one side of the marine organisms.

[0028] Said angle α of the channel unit **3** can be adjusted in a predetermined manner for managing the sliding speed of the marine organisms on the channel unit **3**, wherein the sliding speed of the marine organisms along the channel **3** determines the marine organism's exposure time to the water spray or jet from the plurality of nozzles **4a, 4b, 4c, 4d**.

[0029] Said spray or jets of water can be a continuous spray or jet or a predetermined intermittent spray or jet of water on the marine organisms. In an embodiment of the invention each nozzle of the plurality of nozzles **4a, 4b, 4c, 4d** can provide a spray or jet of water which can impact the marine organisms at a predetermined angle as found necessary for removing the parasites on the marine organisms. In another embodiment of the invention, the shape of the spray or jet of the water from each nozzle of the plurality of nozzles **4a, 4b, 4c, 4d**, which impacts the marine organisms, can also be adapted as found necessary for removing said parasites. The temperature of said spray or jets of water is set at predetermined warm temperature.

[0030] Said parasites grip on the exterior of the marine organism, e.g. the skin of the marine organisms, wherein as the marine organisms slide down the channel unit **3** the parasites, e.g. sea lice, are mechanically removed by the spray or jets of water and the temperature water from the plurality of nozzles **4a, 4b, 4c, 4d**. The removed

parasites and excess water, which is now considered contaminated water, are drained through the perforated bottom **3c** of the channel unit **3**, wherein said removed parasites and contaminated water is collected by container **5a, 5b, 5c, 5d, 5e** positioned below the channel unit **3** and the plurality of nozzles **4a, 4b, 4c, 4d**.

[0031] Said contaminated water is provided to a water treatment unit **7a, 7b, 7c, 7d, 7e**, by a circulation pump **6a, 6b, 6c, 6d, 6e**, preferably, but not limited to, circulating said contaminated water at 400 cubic meter per hour at a pressure of 1.5 bar. Said a water treatment unit **7a, 7b, 7c, 7d, 7e** cleanses the contaminated water from any parasites, bacteria, viruses or any harmful additives to the marine organisms. The water treatment unit **7a, 7b, 7c, 7d, 7e** can also reduce compounds that is saturated in the contaminated water, such as CO₂ and sulfur, which may be harmful for the subsequent batches of marine organisms provided on the channel unit **3**.

[0032] The water treatment unit **7a, 7b, 7c, 7d, 7e** can be a filtering device for cleansing/filtering the contaminated water. The cleansed water from the water treatment unit **7a, 7b, 7c, 7d, 7e** is then provided back to the plurality of nozzles **4a, 4b, 4c, 4d** for cleansing subsequent marine organisms provided on the channel unit **3**. Heating of the cleansed water at a predetermined temperature is provided by the water treatment unit **7a, 7b, 7c, 7d, 7e**.

[0033] As the marine organisms are cleansed and is conveyed past the plurality of nozzles **4a, 4b, 4c, 4d**, the marine organisms reach the second end **3b** of the channel unit **3** including a second outlet **8** which disposes the cleansed marine organisms away from the channel unit **3**.

[0034] A benefit with this inventive technical solution, in comparison with the mentioned prior art, is that marine organisms are not idle in the same water with other marine organisms.

[0035] Being contained in the same water while they are being cleansed of parasites, runs the risk the marine organisms infecting each with parasites, bacteria, viruses or a combination thereof. Or the marine organism may be injured by being in a water that is laden with harmful compounds to the fish, such as sulphur or CO₂.

[0036] In this arrangement **1** the marine organisms are neither submerged or partially submerged in the same water, instead the contaminated water is being discarded by the channel unit **3**, and the provided water from the plurality of nozzles

4a, 4b, 4c, 4d, preferably only affects the exterior of the marine organisms. This is clearly beneficial for marine organisms that have gills, wherein in the present invention, the gills of the marine organisms are not as exposed to the warm cleansing water. Marine organism submerged and exposed water have their gills exposed to the water, wherein the gills provide access to the marine organisms' cardiovascular system that may lead to any warm or contaminated water can overheat and stress the marine organisms. Another benefit of the present invention is that subsequent batches marine organisms are provided with cleansed water from the plurality of nozzles **4a, 4b, 4c, 4d**.

[0037] As shown in figure 1, an embodiment of the present invention can also include at least an additional subsequent set of plurality of nozzles **4a, 4b, 4c, 4d**, wherein each additional set have each their own set of container **5b, 5c, 5d, 5e**, circulation pump **6b, 6c, 6d, 6e**, water treatment unit **7a, 7b, 7c, 7d, 7e**.

[0038] The added features, but non exhaustive features, with additional subsystems of plurality of nozzles **4b, 4c, 4d, 4e** container **5b, 5c, 5d, 5e**, circulation pump **6b, 6c, 6d, 6e**, water treatment unit **7b, 7c, 7d, 7e**, allows the arrangement **1** to for instance arrange different regimes for cleansing the marine organisms from parasites at different water temperatures and pressures, depending on the size or species of marine organisms. E.g mentioned redundancies also allows for maintenance on the first set plurality of nozzles **4a, 4b, 4c, 4d** or perhaps one of the circulation pumps **6b, 6c, 6d, 6e**, which reduces the risk of downtime of the arrangement **1**.

[0039] Each water treatment unit **7a, 7b, 7c, 7d, 7e** is connected to the initial water treatment unit **20**.

CLAIMS

1. An arrangement (1) for removing parasites on marine organisms, such as live fish, comprising;

- an inlet (2) for receiving said marine organisms,
- a channel (3) for receiving said marine organisms from said inlet (2) at a first end (3a) and conveying said marine organism towards a second end (3b),
- a plurality of nozzles (4a, 4b, 4c, 4d) discharging jets of water on the conveyed marine organisms for removing parasites on the conveyed marine organisms,

wherein the channel (3) is perforated at its bottom (3c) for removing any discharged water from the plurality of nozzles (4a, 4b, 4c, 4d) in the channel (3),

- a container (5a, 5b, 5c, 5d, 5e) for collecting the discharged water from the plurality of nozzles (4a, 4b, 4c, 4d) and any parasites and particles in the discharged water,

wherein the container (5a, 5b, 5c, 5d, 5e) is in communication with a circulation pump (6a, 6b, 6c, 6d, 6e),

wherein the circulation pump (6a, 6b, 6c, 6d, 6e) is in communication with a water treatment unit (7a, 7b, 7c, 7d, 7e),

and

- a second outlet (8) at the second end (3) of the channel (3) for discharging said marine organisms from the channel (3),

characterized in that,

the circulation pump (6a, 6b, 6c, 6d, 6e) provides the water in the container (5a, 5b, 5c, 5d, 5e) to the water treatment unit (7a, 7b, 7c, 7d, 7e) for treating the provided water,

wherein the water treatment unit (7a, 7b, 7c, 7d, 7e) is in communication with the plurality of nozzles (4a, 4b, 4c, 4d),

wherein the cleansed water is further provided by the circulation pump (6a, 6b, 6c, 6d, 6e) to the plurality of nozzles (4a, 4b, 4c, 4d) for

discharging jets of water on the conveyed marine organisms in the channel (3).

2. Arrangement (1) according to claim 1, wherein the the water treatment unit (7a, 7b, 7c, 7d, 7e) is a filtering device for cleansing water.
3. Arrangement (1) according to any one of the previous claims, wherein said channel (3) is inclined at a predetermined angle (α) for conveying said marine organisms from the first end (3a) to the second end (3b) by gravity.
4. Arrangement (1) according to any of the previous claims, wherein the first end (3a) includes a first outlet (2a) for removing any excess water accompanying said marine organisms from the inlet (2).
5. Arrangement (1) according to any of the previous claims, wherein the plurality of nozzles (4a, 4b, 4c, 4d) comprise a first (4a) and a third nozzle (4c) for discharging jets of water from below on the marine organisms, and a second (4b) and a fourth nozzle (4d) for discharging jets of water from above on the marine organisms.
6. Arrangement (1) according to any of the previous claims, wherein said plurality of nozzles (4a, 4b, 4c, 4d) provide jets of water on the marine organisms at a predetermined temperature, angle, pressure, volume or duration.
7. Arrangement (1) according to claim 6, further including at least two pluralities of nozzles (4a, 4b, 4c, 4d), at least two containers (5a, 5b, 5c, 5d, 5e), at least two circulation pumps (6a, 6b, 6c, 6d, 6e) and at least two water treatment units (7a, 7b, 7c, 7d, 7e).
8. A method for removing parasites on marine organisms, such as live fish, wherein said removal of parasites comprise of the following steps;

characterized by;

- providing marine organisms at a first end (3a) of a channel (3) for conveying towards a second end (3b),
- discharge jets of water at a predetermined temperature on the marine organisms by a plurality of nozzles (4a, 4b, 4c, 4d),
- removing excess discharged water in the channel (3) through perforations in a bottom (3c) of the channel (3),

- collecting the excess discharged water in a container (5a, 5b, 5c, 5d, 5e),
- provide the water in the container (5a, 5b, 5c, 5d, 5e) towards a water treatment unit (7a, 7b, 7c, 7d, 7e) with a circulation pump (6a, 6b, 6c, 6d, 6e) for cleansing the water from any parasites, bacteria, viruses and any compounds deriving from the marine organisms, such as carbon dioxide and sulphur,
- provide the cleansed water from water treatment unit (7a, 7b, 7c, 7d, 7e) to the plurality of nozzles (4a, 4b, 4c, 4d) with the circulation pump (6a, 6b, 6c, 6d, 6e),
- discharging marine organisms at the second end (3b) at an outlet (8).

9. Method according to claim 8, wherein the channel (3) is inclined at a predetermined angle (α) for conveying said marine organisms from the first end (3a) to the second end (3b) by gravity.

10. Method according to claim 8 or claim 9, wherein the plurality of nozzles (4a, 4b, 4c, 4d) comprise a first (4a) and a third nozzle (4c) for discharging jets of water from below on the marine organisms, and a second (4b) and a fourth nozzle (4d) for discharging jets of water from above on the marine organisms.

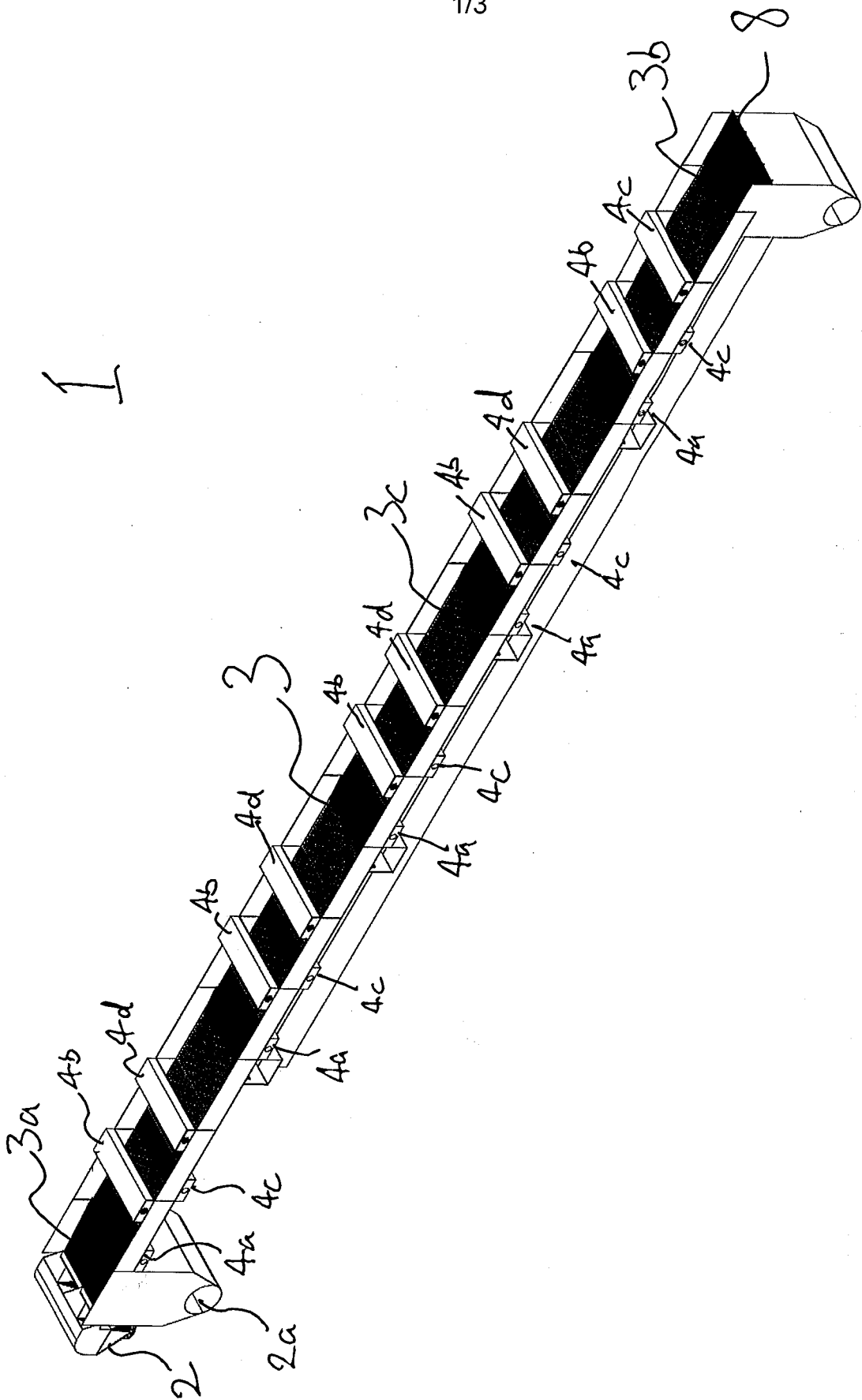


Fig. 1

1

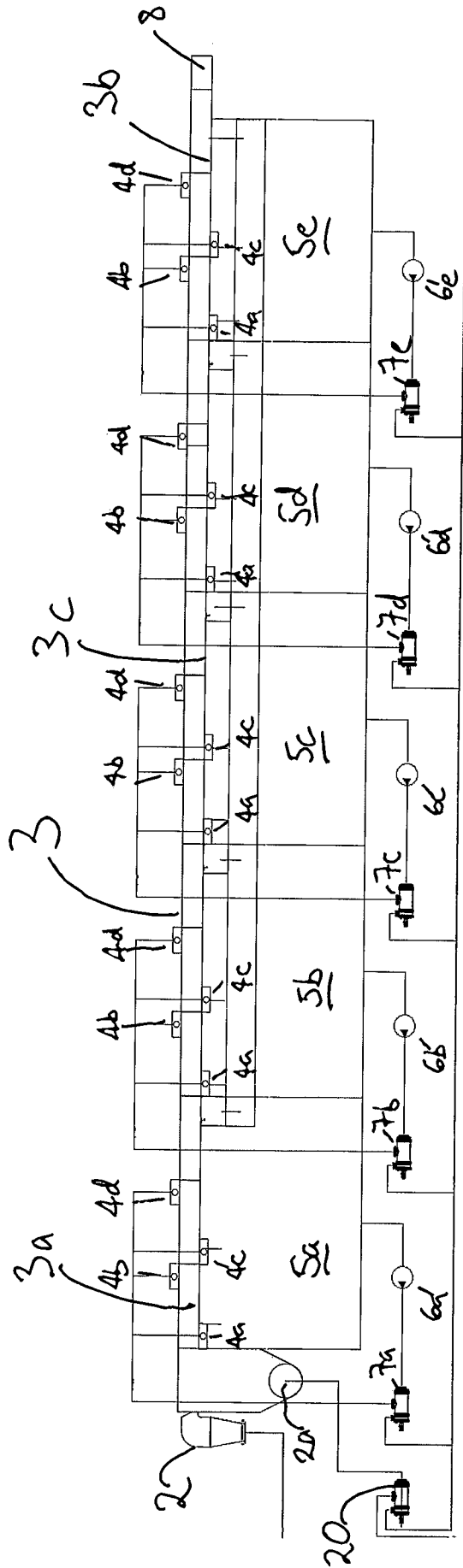


Fig. 2

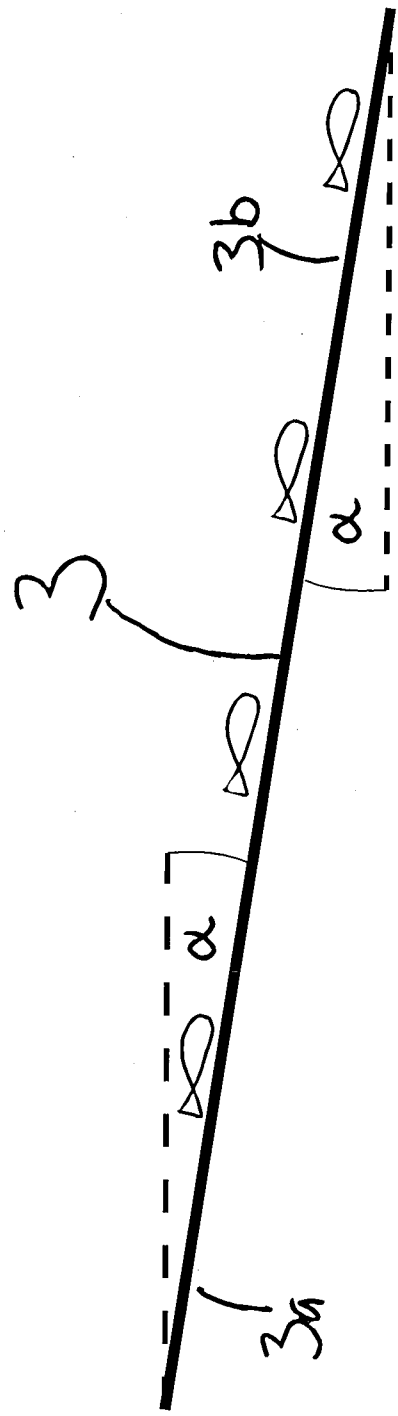


Fig. 3

INTERNATIONAL SEARCH REPORT

International application No
PCT/NO2023/050133

A. CLASSIFICATION OF SUBJECT MATTER

INV. A01K61/13

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)

A01K

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	US 2019/269107 A1 (ÁLVAREZ GATICA RAÚL HERNÁN [CL]) 5 September 2019 (2019-09-05)	1-4, 6-9
Y	paragraphs [0027] - [0034]; figure 1 -----	5, 10
Y	WO 2016/189146 A1 (HANSEN EY BJØRN [DK]) 1 December 2016 (2016-12-01)	5, 10
A	claims 1, 2; figure 4 -----	1, 8
A	WO 2010/087722 A1 (FEED CONTROL NORWAY AS [NO]; KYRKJEBOE JAN ERIK [NO]) 5 August 2010 (2010-08-05) page 6, line 28 - page 7, line 21 page 10, line 27 - page 11, line 14 figures 1-4 -----	1-10



Further documents are listed in the continuation of Box C.



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Date of the actual completion of the international search

20 December 2023

Date of mailing of the international search report

11/01/2024

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INTERNATIONAL SEARCH REPORT

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