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Delousing unit

Field of the invention

[0001] The present invention relates to a delousing unit having jet nozzles for delousing fish.

Background art

[0002] Sea lice on farmed fish is a huge problem, and consequently a lot of resources are expended on delousing fish. Following a delousing treatment, it may be necessary to wash the fish that have been deloused in order to flush away detached lice.

[0003] Exemplary methods for washing lice off fish are found in the patent literature, an example being WO 2021/201686 A1. This publication discloses a delousing unit at least comprising a body work supporting a canal having an angle of downward inclination relative to a horizontal plane. Metal ribs are arranged in parallel, said metal ribs forming a B-shaped track, with the back of the B forming an upper side of the two tracks. Nozzles are mounted for flushing fish to the ribs.

[0004] The patent document NO304171NO discloses an arrangement for delousing fish, said arrangement comprising a pool in which fish to be deloused are kept. From an end of the pool, a cleaning pipe runs vertically downward. The cleaning pipe is arranged concentrically inside an outer pipe. At a lower end thereof, the cleaning pipe has a bend. The outer concentric pipe is vertical and, arranged at a lower end thereof, has a filter for collecting lice. The cleaning pipe includes an open section in which four nozzles are arranged, said nozzles being arranged to wash lice off fish passing by in the substantially vertical cleaning pipe. Also, in the open section, lice that are removed may be carried to the outer concentric pipe so that lice can be collected in the filter at the bottom of this pipe.

[0005] US 2018/0255749 A1 discloses a delousing arrangement in which fish to be deloused are transported in an inclined pipe, in which pipe jet nozzles which will delouse the fish are arranged. Fish and lice from the fish will be transported together out of the pipe.

[0006] NO344621 B1 discloses delousing equipment for non-medicinal delousing. The delousing equipment is lowered into a net cage and comprises panels having openings through which the fish can swim, said panels being provided with jet nozzles to flush away lice.

[0007] It is a problem that a fairly high pressure is needed in view of what is desirable from an animal welfare standpoint.

Summary of the invention

[0008] The problems indicated above are solved according to the present invention by providing a delousing station comprising at least a transport track for fish to be deloused, the transport track being surrounded by jet nozzles oriented at several angles relative to fish being transported on the transport track.

[0009] In an embodiment, a delousing station may comprise at least:

a. a framework supporting two or more delousing units by means of support means, and wherein
    i. each delousing unit comprises a U-shaped chute having parallelly arranged ribs, said chute having an angle of downward inclination α relative to a horizontal plane,
    ii. the chute has an upper end and a lower end, a single endless nozzle manifold being arranged adjacent to and surrounding the lower end, said endless nozzle manifold being configured so as to project perpendicularly upwards relative to α, and
    iii. the nozzle manifold comprises at least two jet nozzles for delousing fish,
b. said two or more delousing units being arranged with a space between each other, adjacent delousing units including nozzles arranged so that a liquid flow from the nozzles will flow unhindered into the space between two adjacent delousing units, and the lower end of a U-shaped chute and an upper end of a downstream U-shaped chute being axially aligned with each other so that a linear transport track is formed, and the space between two adjacent delousing units having an extent that is small enough so that fish to be deloused will not fall into the space, and
c. at least one nozzle of each of the nozzle manifolds being arranged at a vertical level that is lower than an upstream adjacent lower end of a U-shaped chute.

[0010] In an embodiment, there is a step height between two adjacent delousing units.

[0011] The support means may comprise an upper bracket arranged in a delousing unit and a lower bracket arranged downstream of the upper bracket, each of the brackets being mounted to the ribs of the delousing unit and to the framework.

[0012] A delousing unit may comprise a first surrounding nozzle manifold arranged at the top of a chute.

[0013] At least one of the nozzle manifolds may comprise between six and eight jet nozzles spaced approximately equidistantly from each other 360º around the nozzle manifold, and the nozzle manifolds may have a centre that coincides with the transport track.

[0014] In an embodiment, the washing angles from the jet nozzles of the individual nozzle manifolds can be different from each other, which can be achieved by making the washing angle of the jet nozzles relative to the angle of incidence α adjustable.

[0015] The jet nozzles may comprise: a nozzle tip, wherein flow of water from the nozzle tip hits a parabolic surface for dispersing water from the nozzle tip, said parabolic surface projecting from the underside of the nozzle tip.

[0016] In an aspect of the present invention, the delousing station may comprise a pressure sensor measuring the pressure of one or more nozzle manifolds, with an output signal representative of the pressure in the nozzle manifold being used in a feedback loop for acting on a valve that adjusts the amount of fluid allowed into the nozzle manifold.

[0017] The angle of downward inclination α may be between 15º and 40º.

[0018] In an embodiment, the delousing station may include an upper nozzle manifold on which the nozzles are mounted at 80 - 100° relative to the direction of travel of fish being transported on the transport track, a second, downstream nozzle manifold which may have the nozzles oriented at 110 - 130° relative to the direction of travel of fish being transported on the transport track, i.e. against the direction of travel v of the fish, and a third, downstream nozzle manifold which may have the nozzles oriented at 45 - 70° relative to the direction of travel v of the fish, i.e. along the direction of travel of the fish.

[0019] Further advantages of the present invention will be apparent from the appended patent claims.

Brief description of the drawings

[0020] In the following, a brief description of the drawings is given in order to facilitate the understanding of the invention. The subsequent discussion refers to the accompanying drawings, in which:

[0021] Fig. 1 is a side view of a delousing station,

[0022] Fig. 2a is an oblique top perspective view of a delousing station,

[0023] Fig. 2b shows an exemplary framework supporting four delousing units according to a second embodiment, in which each delousing unit comprises a chute, of a delousing station. Only one manifold with nozzles is shown in order to clarify the figure,

[0024] Fig. 2c shows a sectional view of a delousing station according to a second embodiment,

[0025] Fig. 2d shows a sectional view of a second embodiment of a delousing station;

[0026] Fig. 2e shows a second embodiment of a delousing station viewed parallel to the direction of travel v,

[0027] Fig. 3a shows a nozzle manifold of an octagonal type including 8 nozzles, a single valve, and a gauge/pressure sensor viewed parallel to the direction of travel of fish sliding down a transport track,

[0028] Fig. 3b shows a nozzle manifold of an octagonal type including 8 nozzles, a single valve, and a gauge/pressure sensor viewed perpendicularly (from the side) to the direction of travel of fish sliding down the transport track,

[0029] Fig 4a shows a nozzle manifold of a circular type including 8 nozzles, a single valve, and a gauge/pressure sensor viewed parallel to the direction of travel of fish sliding down a transport track,

[0030] Fig. 4b shows a nozzle manifold of a circular type including 8 nozzles, a single valve, and a gauge/pressure sensor viewed perpendicularly (from the side) to the direction of travel of fish sliding down the transport track,

[0031] Fig. 5 shows the angle of downward inclination α of the transport track as well as the angle between the washing jets and transport track,

[0032] Fig. 6 shows an octagonal nozzle manifold having a feedback loop getting input signals from a pressure sensor for adjusting pressure by actuating a valve,

[0033] Fig. 7 shows an exemplary simple control loop for adjusting pressure/amount of water fed into a nozzle manifold,

[0034] Fig. 8 shows a schematic of a delousing station that includes three nozzle manifolds, with the direction of water jets from nozzles being indicated by arrows, and

[0035] Fig. 9 shows a nozzle having a dispersing arrangement in the form of a parabolic surface.

Detailed description of the invention

[0036] The present invention relates to a delousing station for delousing fish in which fish are transported down a downwardly sloping transport track. Surrounding the transport track one or more nozzle manifolds are provided, with nozzles of the one or more nozzle manifolds being distributed around the manifold so that the transport track, and hence fish to be deloused, can be washed from all sides, i.e. 360º around, so that detached or partially detached lice are removed from the fish and can be carried to a water treatment plant. In an example, seawater from a pumping system of a ship can be fed to one or more high-pressure pumps. The water pressure can be increased to 13-14 bar from the pump and fed to a manifold inlet below the delousing station by means of pipes and hoses. The pressure can be read for each nozzle manifold. The pressure and water flow can be adjusted using a valve and/or by way of frequency converters of one or more pumps. The water present with the fish on the transport track can be screened off and collected in a collection vessel and be transported to a water treatment system at a later point.

[0037] The present invention will now be described in more detail with reference to the accompanying drawings.

A first embodiment

[0038] Fig. 1a shows an exemplary delousing station 10. The delousing station comprises a chute 23 having a downward slope indicated by the arrow denoted by v. Fish to be deloused are entered from the highest part of chute 23 so that the fish slide down the chute. Downstream, three octagonal nozzle manifolds 15a, 15b, 15c are arranged.

[0039] Each nozzle manifold 15 is provided with several nozzles 16. In the example shown, seven nozzles 16 are mounted on each nozzle manifold. The nozzles 16 are spread around the manifold 15 so that fish can be washed from all sides.

[0040] Additionally, each nozzle manifold 15a, 15b, 156c has the nozzles oriented a few degrees differently. A first nozzle manifold 15a has the nozzles mounted at 90° relative to the direction of travel v of the fish. The centre nozzle manifold 15b has the nozzles oriented at 120° relative to the direction of travel v of the fish, that is, against the direction of travel v of the fish. The last nozzle manifold has the nozzles oriented at 60° relative to the direction of travel v of the fish, that is, in the direction of travel of the fish. The nozzles may be adjustable, e.g. by way of a ball joint, so that the washing angle towards fish present in the chute can be optimised.

[0041] In an embodiment, the nozzles are configured so as to ensure a low pressure, regardless of whether other nozzles become clogged. Figure 9 shows an example of such a nozzle.

[0042] The nozzle manifolds are provided with gauges 14a, 14b, 14c. The nozzle manifolds are fed with water from a manifold through branch pipes 12a, 12b, 12c. The manifold is fed through a manifold inlet 11. Branch pipes 12a, 12b, 12c may be provided with valves 13a, 13b, 13c.

[0043] The delousing station 10 is provided with a collection tank/vessel 17. Water from the delousing process will collect in the collection vessel.

[0044] Delousing units of the delousing station are carried by a framework 18.

[0045] Fig. 2 shows delousing station 10 viewed obliquely from above, parallel to the direction of travel v. It can be seen from the figure that the octagonal nozzle manifolds 15a, 15b, 15c surround a chute 23. Chute 23 is U-shaped and consists of a number of elongated tubular bodies 21 arranged in the direction of travel v. In the example of Fig. 2, the elongated tubular bodies are held in place by a number of brackets 22 engaged with the framework 18 and the elongated tubular bodies 21.

[0046] The elongated tubular bodies 21, which together form a U-shaped chute 23, causes little sliding friction for fish being transported down the chute 23, and at the same time washing water containing sea lice from fish will be drained off the chute 23.

[0047] Fig. 3a shows an octagonal nozzle manifold 15 including eight nozzles 16a - 16h. The octagonal nozzle manifold is viewed parallel to the direction of travel v. Fig. 2 schematically shows a gauge 14. The gauge can be replaced by a pressure sensor 14, or alternatively be a combination of a gauge and a pressure sensor. A pressure sensor will be able to provide information about the pressure to monitoring and/or control systems. At the bottom of the octagonal nozzle manifold, branch pipe 12 is shown. The branch pipe carries fluid from a manifold into nozzle manifold 15. The amount of water and pressure into the nozzle manifold can be adjusted using a valve 13.

[0048] Note that a fish 31 is shown in the centre of the octagonal nozzle manifold. The distance r between nozzles 16 and fish 31 is approximately the same for all nozzles 16. The bottom of chute 23 coincides with the centre of the octagonal nozzle manifold 15. The positioning of chute 23 in a centre of nozzle manifold 15 ensures equal washing conditions from all nozzles towards a fish 31 in chute 23.

[0049] Fig. 3b shows the same octagonal nozzle manifold 15 as Fig. 3a, but viewed from the side. The nozzles 16a – 16h for washing fish are shown to the left of the nozzle manifold itself. That is, downstream of the nozzle manifold pipe. In another embodiment, nozzles 16a - 16h may be mounted upstream of the nozzle manifold pipe. A combination of nozzles mounted upstream and downstream of the nozzle manifold pipe can also be envisioned.

[0050] It has been indicated that nozzles 16a - 16h are angularly adjustable relative to an angle of downward inclination α. Such angular adjustability makes it possible to optimize the flushing direction so that washing can be efficient without the water pressure having to be increased. Angular adjustability is optional; when the most efficient angles have been determined based on experience, then these angles can be fixed.

[0051] Fig. 3b also shows a gauge 14. As for other embodiments, the gauge may be combined with a pressure sensor or replaced by a pressure sensor.

[0052] Fig. 4a shows a circular nozzle manifold 45. Functionally, the circular nozzle manifold is similar to the octagonal nozzle manifold 15 shown in Fig. 3a. Note that also in this case the bottom of chute 23 is located in the centre and hence the fish is transported down chute 23 in the direction of travel v in the centre of nozzle manifolds 45.

[0053] Fig. 4b shows the circular nozzle manifold 45 viewed from the side. The only feature that distinguishes the circular nozzle manifold 45 from the octagonal manifold 15 of Fig. 3b is the shape. Both manifolds surround chute 23.

[0054] Fig. 5. shows an angle of downward inclination α of chute 23. The jet nozzles 16 are shown at an angle relative to the direction of travel v. As discussed initially, the angles of a first, second and third nozzle manifold may differ.

[0055] Fig. 6 shows an octagonal nozzle manifold for which a pressure sensor 64 forms part of a feedback loop 61 in that the signal from pressure sensor 64 communicates with valve 13 via a controller that is not shown in the figure. A control loop getting feedback from pressure sensor 64 can ensure an optimal water pressure to the jet nozzles. In addition, the signal may also be used for monitoring the pressure in the system.

[0056] Figs. 6 and 7 show examples of pressure control using a pressure sensor that provides an output signal representative of a pressure. Typically, the sensor output of a pressure transmitter will be selectable between 4 – 20 mA, 0 – 5 V, 1 – 5 V, 1 – 6 V, 0 – 10 V and 10 – 90% ratiometrically. The pressure sensor may include additional features provided by microcontrollers that offer diagnostic functions and intelligent performance functions.

[0057] A variable frequency drive (VFD) is a type of motor controller that operates an electric motor by varying the frequency and voltage of the power supply. A VFD also has the capacity to control ramp-up and ramp-down of the motor during start or stop, respectively. The frequency can be correlated with operating parameters from delousing station 10, such as the output signal of one or more pressure sensors. The output signal of pressure sensors can be transformed to frequencies representative of liquid pressure.

[0058] The frequency drive controls the frequency and voltage supplied to a motor, thus providing speed control of the motor.

[0059] Figs. 1 – 7 show valves for controlling liquid pressure and liquid flow. However, one or more pumps may be used for the same purpose. Liquid pressure and liquid flow can be efficiently controlled by way of one or more pumps which control liquid pressure and liquid flow into manifold inlet 11. The pumps used can be controlled by a variable frequency control of an AC induction motor. Variable frequency control provides an economically sound and operationally efficient solution for motor speed control.

[0060] Fig. 7 is a schematic view of a simple control loop.

[0061] In the above examples, octagonal and circular nozzle manifolds are discussed. However, the nozzle manifolds can be oval, for example, or have other shapes, the point being to optimize the washing effect by having a nozzle manifold that surrounds chute 23. Nevertheless, as indicated above, it is not the only advantage that the fish can be washed from all sides; it is also a point that the distance between nozzle and fish is the same from all nozzles of the same nozzle manifold so that the water pressure will be equal on all sides of the fish.

[0062] Fig. 8 shows a delousing station including three nozzle manifolds. From the figure, it can be seen that the jet direction 83 of water from the nozzles of the first nozzle manifold is partly co-current. For the second nozzle manifold, the direction of the water jets from nozzles 16 is oriented substantially perpendicular to the direction of travel v. The jet direction 81 of water jets from the third nozzle manifold is partly against the current.

[0063] The figure also shows that pressure sensors 14 are used for reading water pressure. The signals from the pressure sensors are shown communicating with a controller 85. Controller 85 may be a frequency converter which converts analogue or digital signals from the pressure sensors into variable frequency signals, whose frequencies are related to the value of the input signal. The frequency converter can be a standard VFD converter. Controller 85 controls the admission to pump 86. Pump 86 receives water from a reservoir 87.

[0064] The figure shows that the valves are controlled by controller 85. If the pressure and amount of liquid into the delousing unit is controlled by controller 85 communicating with pump 86, then valve control will be an option which could provide for individual pressure control in each of the nozzle manifolds 15a, 15b, 15c. Valves 13 are shown to receive admission from controller 85. However, they may also be manual valves. Also, valves 13 may include an actuator that enables control of the valves 13 from controller 85, or alternatively the actuator could be a separate part. The actuator is not shown in any of the drawings.

[0065] Fig. 9 shows details of a nozzle 16, said nozzle 16 comprising a nozzle tip and a parabolic surface 91 projecting from the underside of the nozzle tip. The curved parabolic surface causes a flow of water from the jet nozzle to be dispersed outwardly and to have a lower pressure than it has when it hits the parabolic surface. The solution contributes to an even and adequate washing pressure over the entire fish to be deloused. In cases where nozzles of a manifold become clogged, it will be a problem that the pressure in an open nozzle will increase and the fish may be subject to a "jet stream" to the skin. The particular solution including a parabolic surface makes sure fish to be deloused are not exposed to jet streams when other nozzles of the system/manifold become clogged.

[0066] The choice of number of nozzles of the nozzle manifolds can be made based on specific installations and needs.

[0067] Figs. 1 and 2a show three nozzle manifolds. However, any number from one nozzle manifold to more than three nozzle manifolds can be envisioned.

[0068] Chute 23 is shown provided with a number of elongated tubular bodies. This is one embodiment of numerous conceivable embodiments. It can be envisioned that chute 23 is formed by an elongated U-shaped plate having a number of openings. Mesh variants are also imaginable.

A second embodiment of a delousing station

[0069] In a second embodiment of the delousing station, a continuous chute is not used. In the second embodiment, the delousing station is divided into delousing units, which delousing units are arranged adjacent to each other to form an upper delousing unit and one or more downstream delousing units. Figs. 2b - 2e show details of the second embodiment. The delousing units exhibit a downward inclination α relative to a horizontal plane. Between each delousing unit there is a space, in which space nozzles 16 of nozzle manifolds are arranged. The manifold part itself surrounds a lower section of a chute of a delousing unit in the same manner as in the first embodiment of a delousing station. The positioning of the nozzles 16 in a space 26 ensures that washing water from the jet nozzles is not blocked by obstacles between a nozzle 16 and fish to be washed, resulting in an even water pressure on fish to be washed. The nozzles are arranged in such a manner that crossing of nozzle jets is minimized. This is achieved through a selective angling and orientation of nozzles 16, see figs. 2d and 2e.

[0070] A delousing unit comprises a U-shaped chute. The chute may exhibit parallelly arranged ribs having an angle of downward inclination α relative to a horizontal plane. Whether or not the ribs are parallelly arranged depends on the shape of the chute. The chute is U-shaped, so if the opening of the U varies, then the ribs will not necessarily be parallel. The chute has an upper end and a lower end. At said lower end and surrounding the chute, an endless nozzle manifold 15 is arranged, said endless nozzle manifold being configured so as to project perpendicularly upwards relative to α. Nozzle manifold 15 is arranged so that the nozzles 16 of a manifold 15 are arranged in a space 26 between two adjacent chutes. Nozzle manifolds 15 comprise at least two jet nozzles 16 for delousing fish, of which at least one nozzle 16 is arranged at a vertical level lower than an adjacent lower end of the U-shaped chute. This is clearly apparent from figure 2c, in which the lowermost nozzle 16 is located below the lowermost rib of adjacent chutes.

[0071] Fig. 2b shows four delousing units. A first, upper delousing unit 25a is shown furthest upstream. Adjacent to this delousing unit 25a, a second delousing unit 25b is arranged downstream of the first upper delousing unit. There is a step height 28 between the first, upper delousing unit 25a and the second delousing unit 25b. Similar step heights 28 exist between adjacent downstream delousing units 25. A third delousing unit 25c is arranged downstream of the second delousing unit 25b. A fourth delousing unit 25d is arranged downstream of the third delousing unit. Even though Fig. 2b shows four delousing units 25a - 25d, a delousing station may include fewer or more delousing units. Fig. 2b shows only one nozzle manifold 15a. However, nozzle manifolds 15 could be arranged adjacent to all spaces 26 shown. Each delousing unit is shown to have brackets 22.

[0072] A delousing unit comprises a chute, which chute is held together by two brackets 22, with a single nozzle manifold 15 being arranged adjacent to and surrounding an end of the chute. Nozzles 16 of nozzle manifold 15 have nozzle jets which will not be obstructed by objects when washing fish.

[0073] Fig. 2c is a sectional view of a delousing unit, showing nozzles 16 and a nozzle manifold. The parabolic surface 91 for nozzles 16 is shown. The figure further shows that nozzles 16 are arranged so as to form a water veil 27. Said water veil 27 shows that water jets are not much dispersed parallel to the v-direction.

[0074] Fig. 2d shows a perspective sectional view of a delousing station 20. The figure shows nozzle manifolds 15 including nozzles, and water veils 27 from nozzles 16 are shown for the first 15a and second nozzle manifolds 15b.

[0075] Fig. 2e shows a delousing station 20 viewed parallel to a v-direction.

[0076] The second embodiment of a delousing station 20 may use the same types of nozzle manifolds 15 as the first embodiment of a delousing station 10, which also applies to brackets 22, nozzles 16, framework 18, valves 13, and so on. What distinguishes the first and second embodiments is the sectioning. Where the first embodiment of a delousing station shows a single continuous chute including one or more nozzle manifolds, the second embodiment of a delousing station 20 shows the delousing station to be comprised of two or more delousing units as seen in Fig. 2b.

[0077] Reference numerals

10	A first embodiment of a delousing station for delousing fish including water vessels for collecting water used for delousing
11	Manifold inlet
12	Branch pipe from manifold to surrounding nozzle manifolds
12a	First branch pipe from manifold to the surrounding nozzle manifolds, the first branch pipe being the branch pipe closest to the manifold inlet.
12b	Second branch pipe from manifold to surrounding nozzle manifolds
12c	Third branch pipe from manifold to surrounding nozzle manifolds. The delousing station may comprise one or more nozzle manifolds.
13	Valve
13a	First valve, between manifold and nozzle manifold, the first valve being located closest to the manifold inlet
13b	Second valve, between manifold and nozzle manifold, the first valve being located closest to the manifold inlet
13c	Third valve, between manifold and nozzle manifold, the first valve being located closest to the manifold inlet
14	Gauge or pressure sensor for reading nozzle manifold pressure.
14a	First gauge or pressure sensor for reading nozzle manifold pressure
14b	Second gauge or pressure sensor for reading nozzle manifold pressure
14c	Third gauge or pressure sensor for reading nozzle manifold pressure.
15	Octagonal nozzle manifold, said nozzle manifold being a manifold surrounding a fish transport track and comprising two or more jet nozzles, typically 4 – 8 nozzles.
15a	First nozzle manifold.
15b	Second nozzle manifold.
15c	Third nozzle manifold.
16	Nozzle of nozzle manifold. The nozzles may be oriented a few degrees differently relative to the direction of travel of the fish to be deloused. The nozzles can be connected to joints such as ball joints, for example, in order to make the direction of the water jet adjustable.
16a-16h	First through eighth nozzle of an eight nozzle manifold.

17	Collection tank/vessel for water having been used for delousing. Water from the collection tank can be directed to a water treatment system.
18	Framework of delousing station.
20	A second embodiment of a delousing station.
21	Elongated tubular bodies, with several elongated tubular bodies forming a chute for fish to be deloused. A space exists between neighbouring tubular bodies so that washing water can be drained towards the collection tank 17 and so that a rib network is formed.
22	Brackets mounted to the framework 18 and keeping the elongated tubular bodies in place.
22a	First upper bracket mounted to framework 18 and keeping the elongated tubular bodies of the first upper delousing unit in place.
22b	First lower bracket mounted to framework 18 and keeping the elongated tubular bodies of the first upper delousing unit in place.
22c	Upper bracket of second delousing unit.
22d	Lower bracket of second delousing unit.
22e	Upper bracket of third delousing unit.
22f	Lower bracket of third delousing unit.
22g	Upper bracket of fourth delousing unit.
22h	Lower bracket of fourth delousing unit.
23	Chute for transporting fish through the delousing station, comprising several elongated tubular bodies arranged parallel to the direction of travel v of fish transported along the chute. The chute may also be implemented without any elongated tubular bodies. The chute should have a U-shape and extend along the entire length of delousing station 10, and also have adequate drainage so that nozzles below the chute are also able to wash fish transported on chute 23.
24	Area of coverage of water jets from seven nozzles of an octagonal nozzle manifold 15a, 15b, 15c - shown in dark grey with black lines.
25a	First, upper delousing unit, said upper delousing unit comprising a plurality of elongated tubular bodies 21 arranged as parallel ribs, an upper 22a, and a lower 22b bracket for mounting the ribs to a framework.

25b	Second delousing unit, said second delousing unit comprising a plurality of elongated tubular bodies 21, an upper 22c, and a lower 22d bracket.
25c	Third delousing unit, said third delousing unit comprising a plurality of elongated tubular bodies 21, an upper 22e, and a lower 22f bracket.
25d	Fourth, lower delousing unit, said fourth lower delousing unit comprising a plurality of elongated tubular bodies 21, an upper 22g, and a lower 22h bracket.
26a	First upper space, located between the first, upper delousing unit and the second delousing unit.
26b	Space, located between the second and third delousing units.
26c	Space, located between the third and fourth delousing units.
27	Water veil, produced by a plurality of nozzles.
28	Step height. A lower end of a delousing unit has a "step height" to an upper end of a downstream delousing unit.
31	Fish located in the chute for delousing. Note that the distance between the fish and nozzles 16 is approximately equal for all nozzles.
45	Circular nozzle manifold, said nozzle manifold surrounding a transport track for fish and including two or more jet nozzles, typically 4 – 8 nozzles.
61	Feedback loop between pressure sensor 15, a controller (not shown, but may be located in the valve housing) and valve 13.
81	Direction of water jet from the third nozzle manifold. The water jet is directed partly against the current.
82	Direction of water jet from the second nozzle manifold. The water jet is approximately perpendicular to chute 23 – the direction of travel v.
83	Direction of water jet from the first nozzle manifold. The water jet is directed co-currently.
85	Controller, which may be a frequency converter for controlling the pump/pump motor
86	Pump. A VFD controlled pump in one embodiment.
87	Water reservoir
91	Parabolic surface for dispersing water from the nozzle opening.

92a – 92e	Water from the parabolic surface exhibiting low pressure and wide spread.
93	Water flow from nozzle opening.
R	Radial distance between a fish transported down chute 23 in the direction of travel v of fish.
V	Direction of travel of fish to be deloused.

Claims

1. A delousing station (10, 20) comprising at least:
    a. a framework (18) supporting one or more delousing units by means of support means (22), and wherein
        i. each delousing unit comprises a U-shaped chute having ribs, said chute having an angle of downward inclination α relative to a horizontal plane,
        ii. said chute has an upper end and a lower end, a single endless nozzle manifold (15) being arranged adjacent to and surrounding the lower end, said endless nozzle manifold (15) being configured so as to project perpendicularly upwards relative to α, and
        iii. said nozzle manifold (15) comprises at least two jet nozzles (16) for delousing fish,
    b. said one or more delousing units being arranged with a space (26) between each other, adjacent delousing units including nozzles (16) arranged so that a liquid flow from the nozzles will flow unhindered into the space (26) between two adjacent delousing units, and the lower end of a U-shaped chute and an upper end of a downstream U-shaped chute being axially aligned with each other so that a linear transport track is formed, and the space (26) between two adjacent delousing units having an extent that is small enough so that fish to be deloused will not fall into the space (26), and
    c. at least one nozzle (16) of each of the nozzle manifolds (15) being arranged at a vertical level that is lower than an upstream adjacent lower end of a U-shaped chute.
2. A delousing station according to claim 1 wherein the ribs are arranged in parallel.
3. A delousing station according to claim 1 or 2 wherein a step height (28) exists between two adjacent delousing units.
4. A delousing station according to any one of claims 1 – 3, wherein the support means comprise an upper bracket (22, 22a, 22c, 22e, 22g) arranged in a delousing unit and a lower bracket (22, 22b, 22d, 22f , 22h) arranged downstream of the upper bracket, each bracket being mounted to the ribs (21) of the delousing unit and to the framework (18).
5. A delousing station according to any one of claims 1 – 4, wherein a delousing unit comprises a first surrounding nozzle manifold (15) arranged at the top of a chute.

6. A delousing station according to any one of the preceding claims, wherein at least one of the nozzle manifolds (15) comprises between six and eight jet nozzles (16) spaced approximately equidistantly from each other 360º around the nozzle manifold (15).
7. A delousing station according to any one of the preceding claims, wherein the nozzle manifolds (15) have a centre that coincides with the transport track.
8. A delousing station according to any one of the preceding claims, wherein the washing angle from the jet nozzles (16) of the individual nozzle manifolds (15) are different from one another.
9. A delousing station according to any one of the preceding claims wherein the washing angle of the jet nozzles (16) relative to the angle of downward inclination α is adjustable.
10. A delousing station according to any one of the preceding claims wherein the jet nozzles (16) comprise: a nozzle tip (93), wherein water flow from the nozzle tip (93) hits a parabolic surface (91) for dispersing water from the nozzle tip (93), said parabolic surface (91) projecting from the underside of the nozzle tip (93).
11. A delousing station according to any one of the preceding claims wherein a pressure sensor (14) measures the pressure of one or more nozzle manifolds (15) and wherein an output signal representative of the pressure in the nozzle manifold (15) is used in a feedback loop for acting on a valve (13) that adjusts the amount of fluid allowed into the nozzle manifold (15).
12. A delousing station according to any one of the preceding claims wherein the angle of downward inclination α is between 15º and 40º.
13. A delousing station according to any one of the preceding claims wherein an uppermost nozzle manifold (15) has the nozzles mounted at 80 - 100° relative to the direction of travel of fish transported on the transport track, a second, downstream nozzle manifold has the nozzles oriented at 110 - 130° relative to the direction of travel of fish being transported on the transport track, i.e. against the direction of travel v of the fish, and a third, downstream nozzle manifold has the nozzles oriented at 45 - 70° relative to the direction of travel v of the fish, i.e. in the direction of travel of the fish.

Abstract

The present invention relates to a delousing station comprising at least:

a. a framework supporting two or more delousing units, said delousing units including a chute having an angle of downward inclination α relative to a horizontal plane,
b. said delousing units comprising endless nozzle manifolds for washing fish being transported in the chutes of the delousing units, and
c. said nozzle manifolds comprising at least two jet nozzles for delousing fish, with at least one nozzle being able to wash the underside of fish being transported in the chutes.

Fig. 1

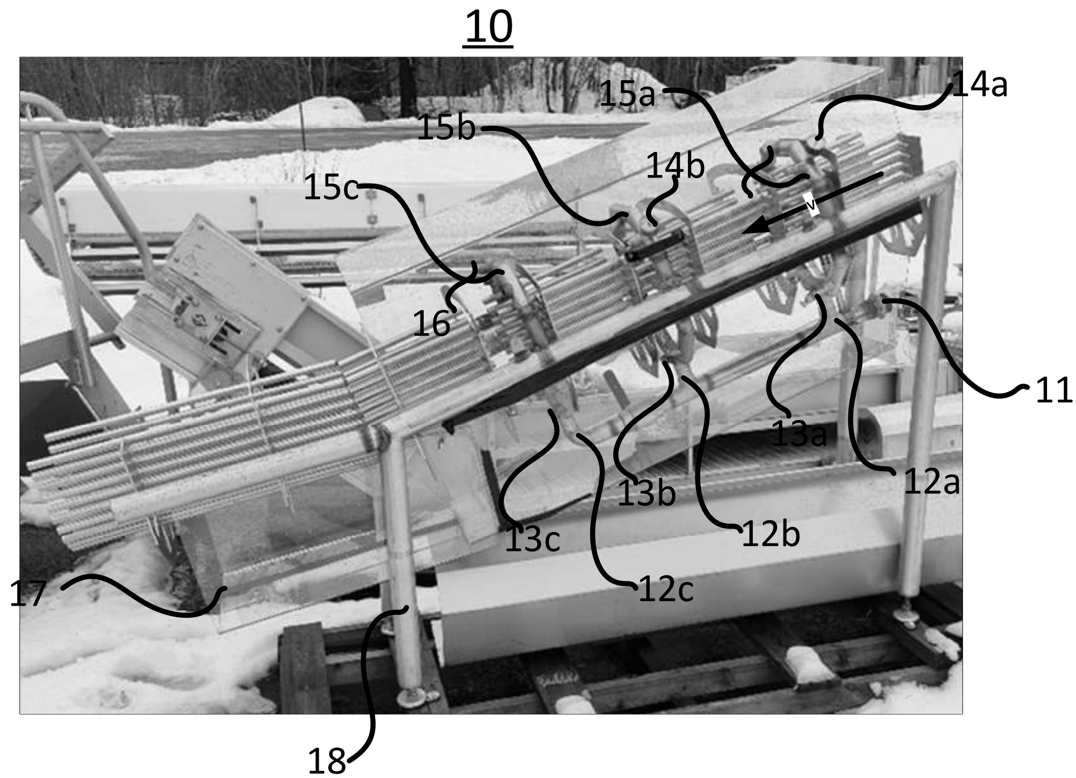

Fig. 1

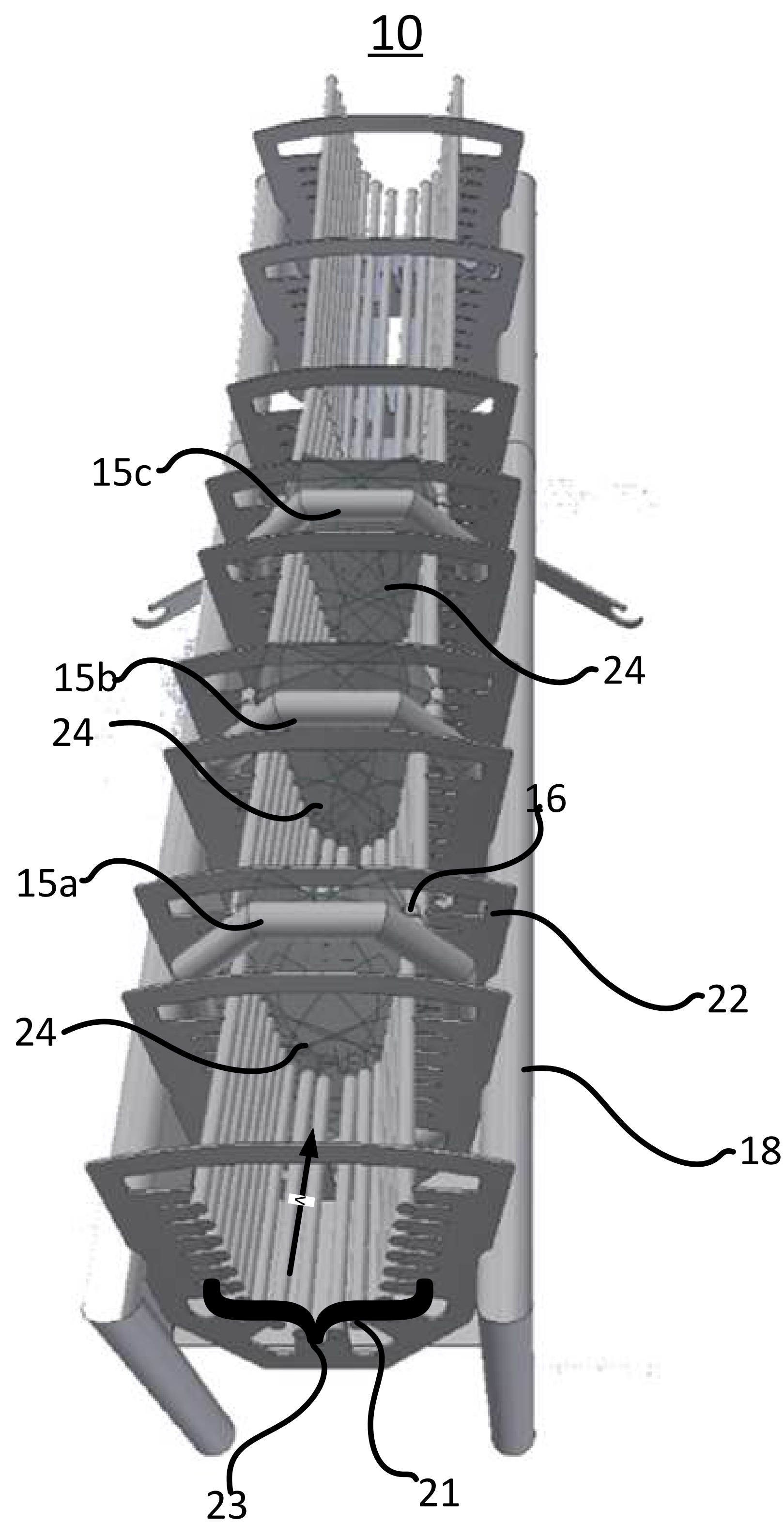

Fig. 2a

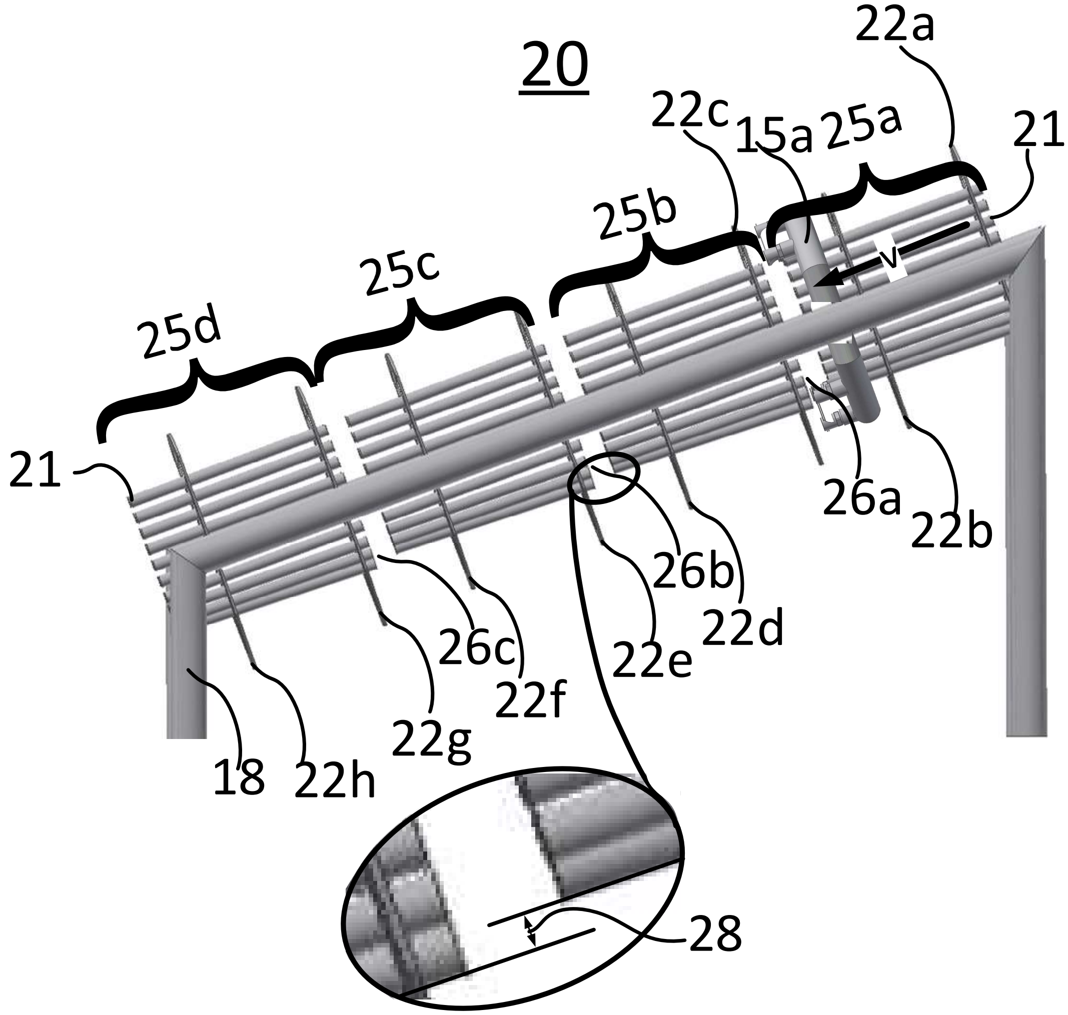
20
22a
22c
15a
25a
21
25b
v
25c
25d
21
26a
22b
26b
22d
26c
22f
22e
22g
18
22h
28

Fig. 2b

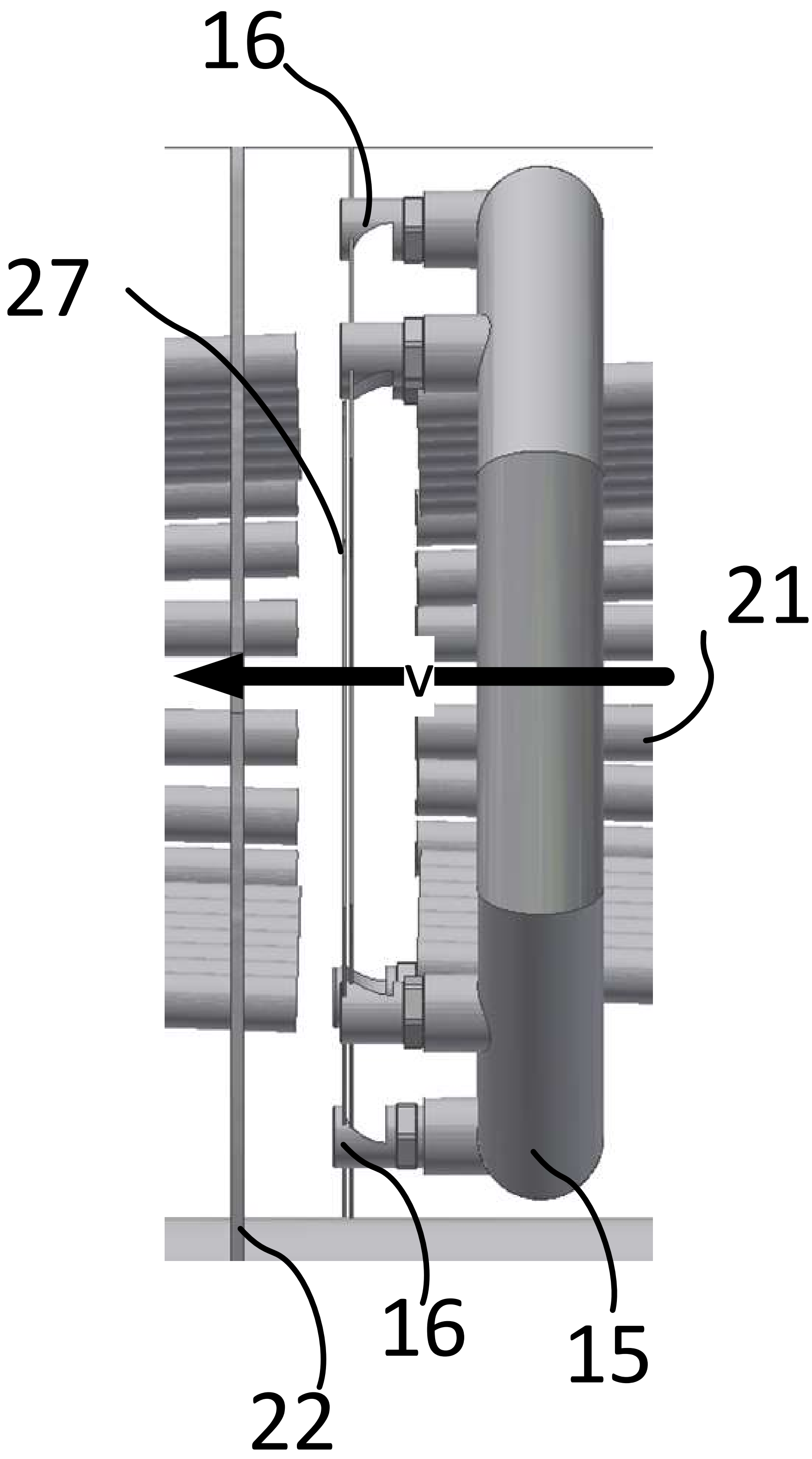

Fig 2c

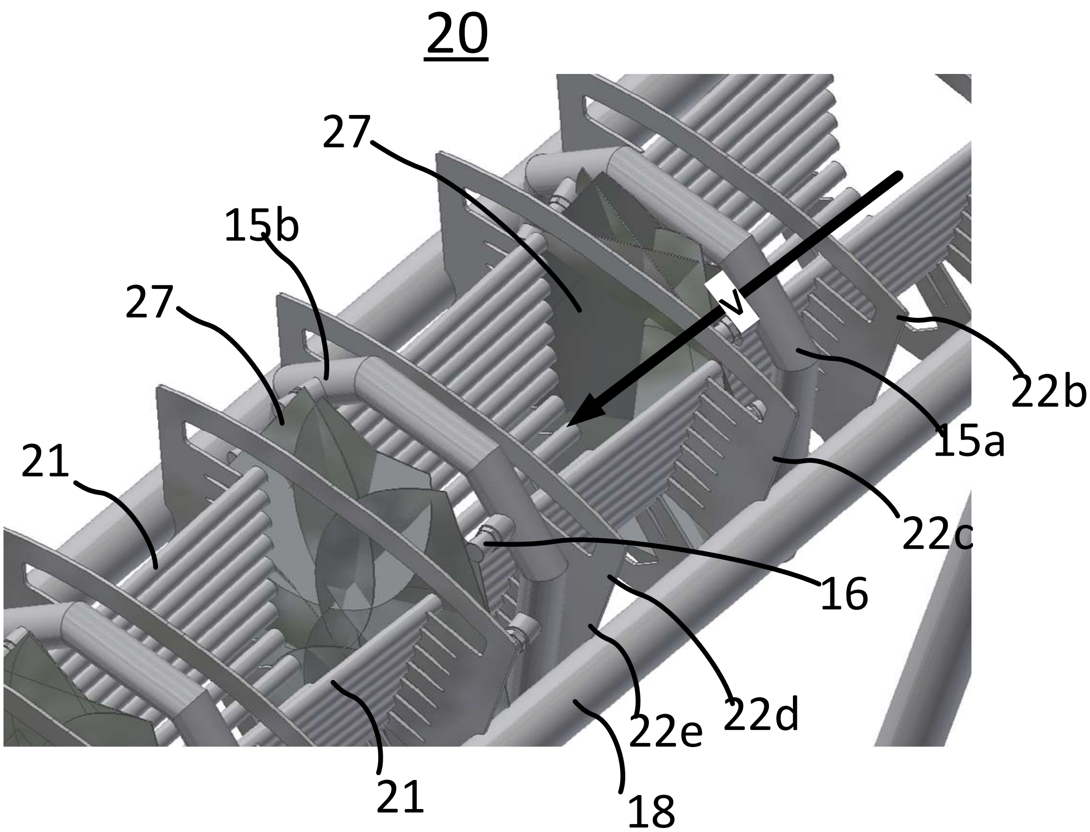

Fig 2d

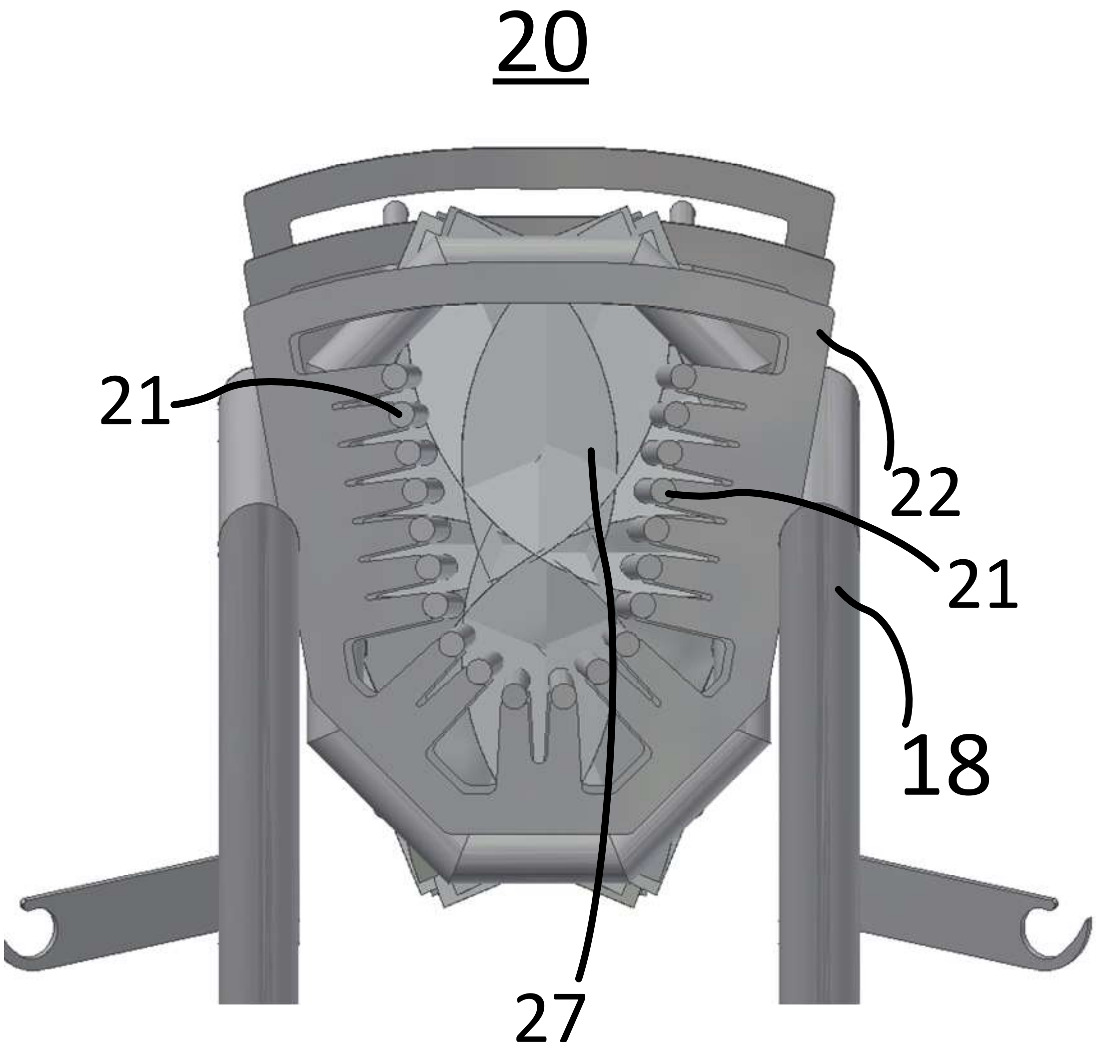

Fig 2e

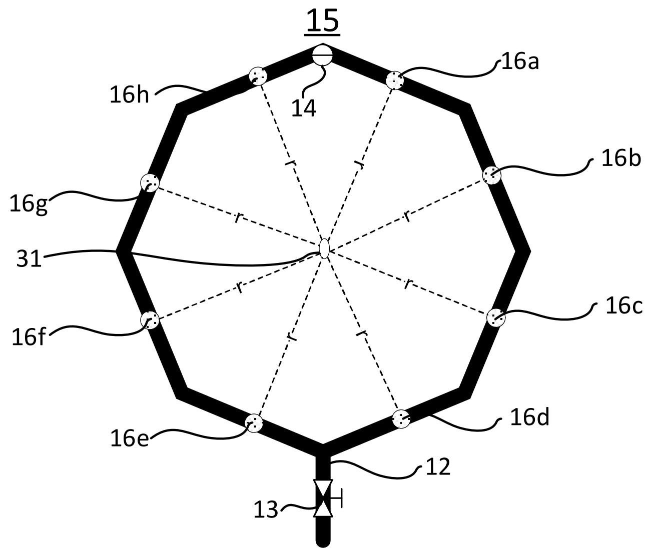

Fig. 3a

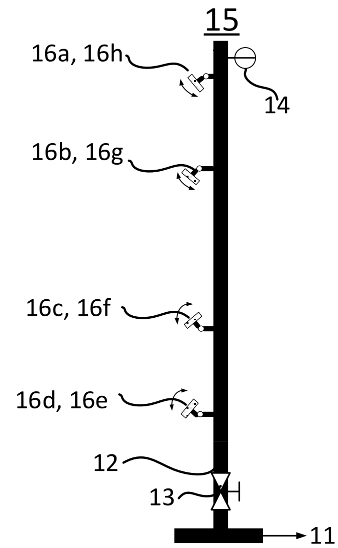

Fig. 3b

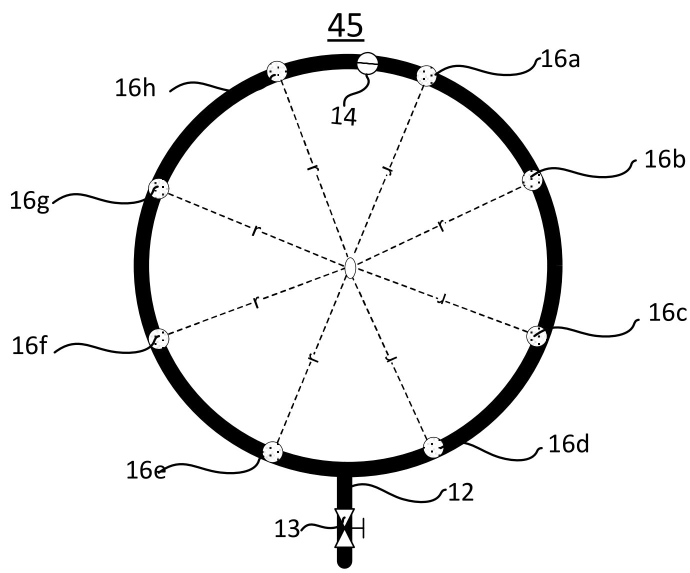

Fig. 4a

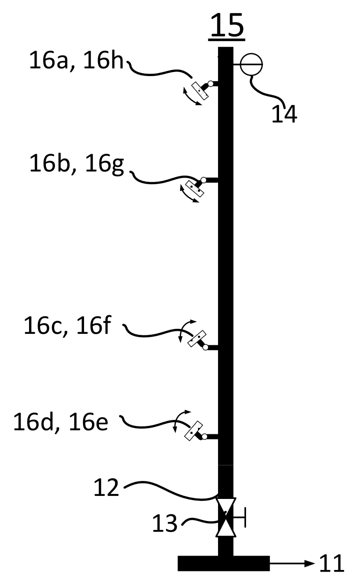

Fig. 4b

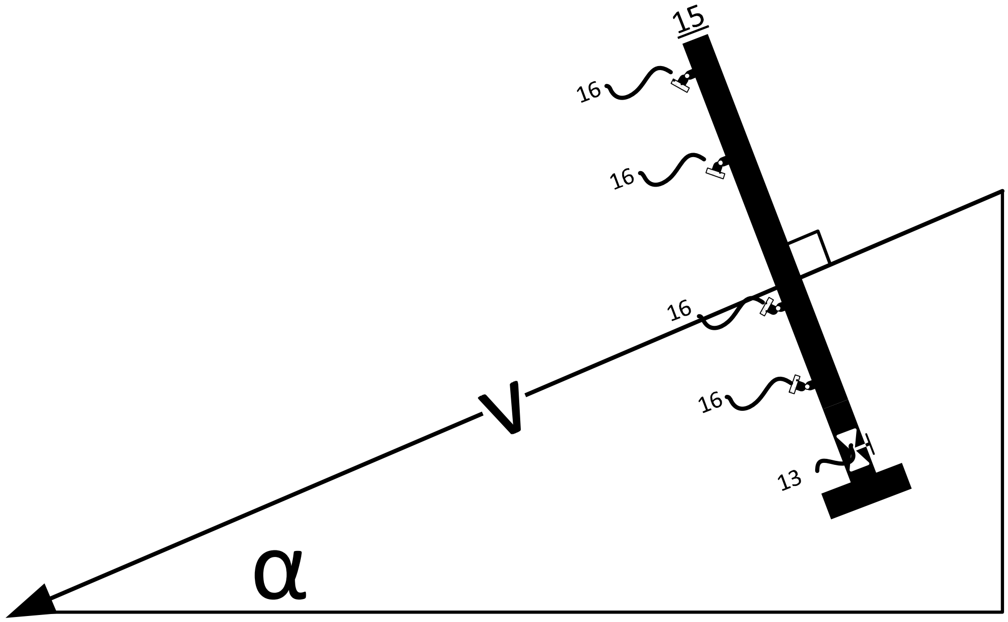

Fig. 5

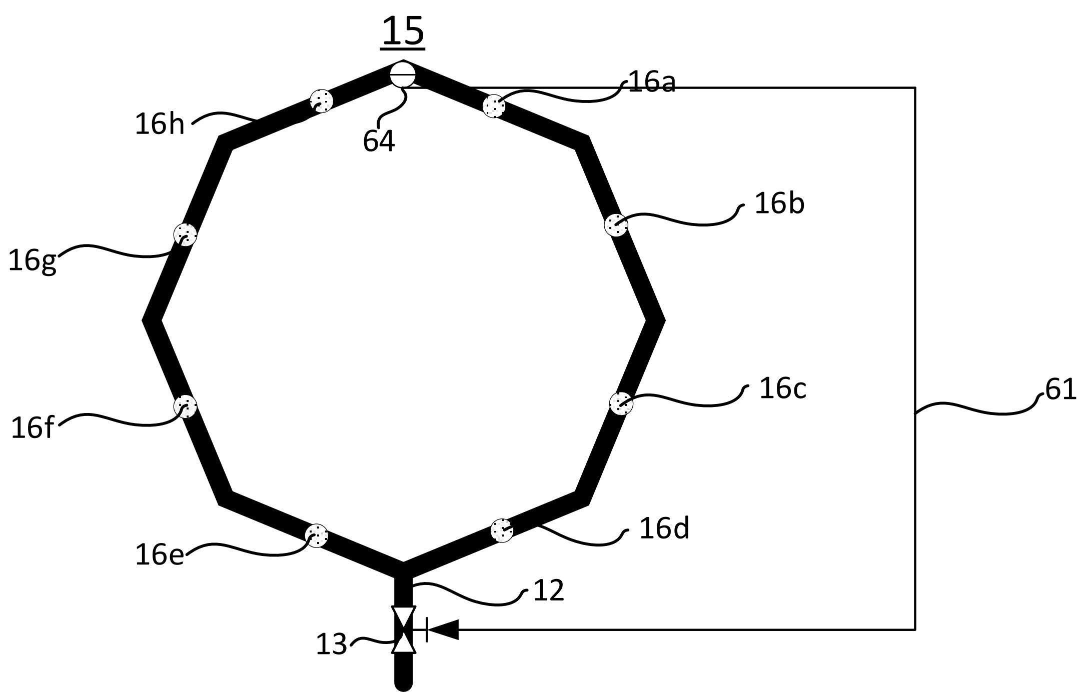

Fig. 6

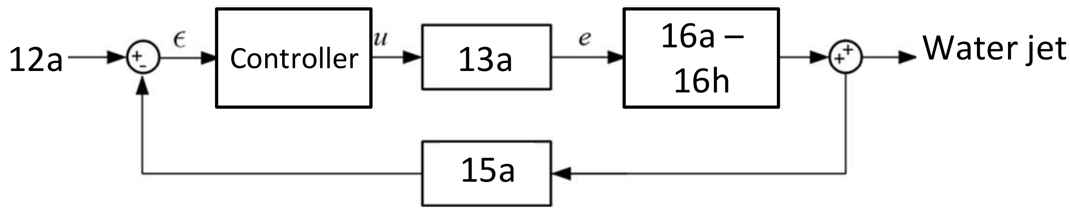
12a
ϵ
Controller
u
13a
e
16a –
16h
Water jet
15a

Fig. 7

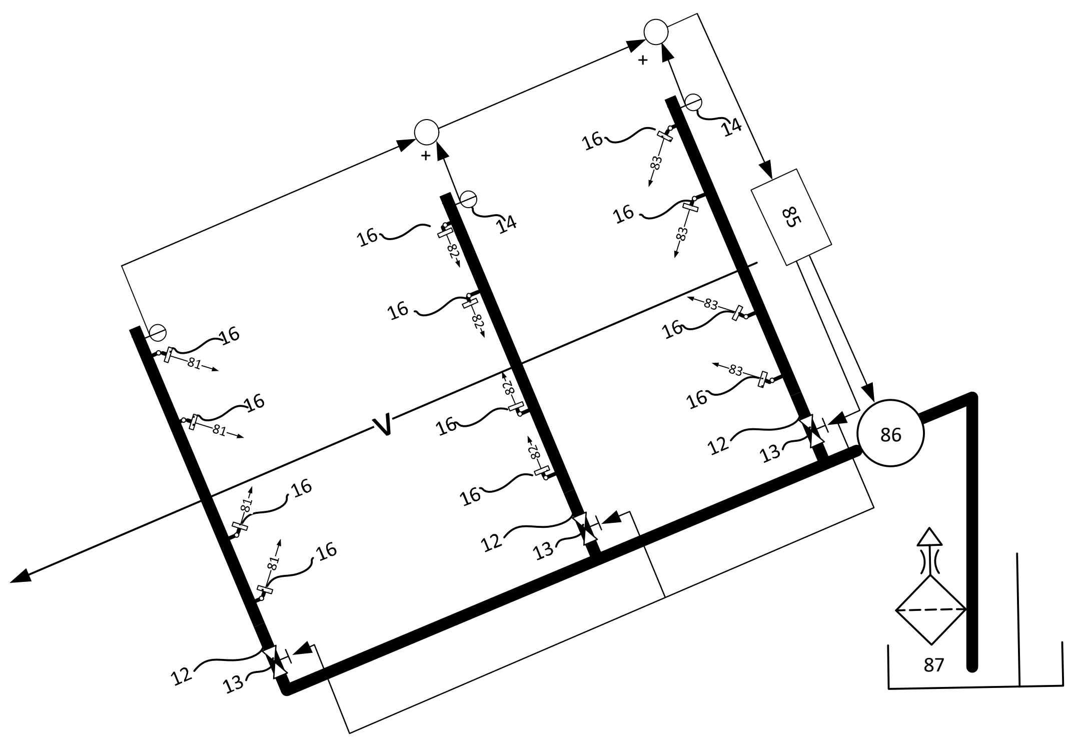
14
14
16
82
83
85
86
87
81
V
12
13

Fig. 8

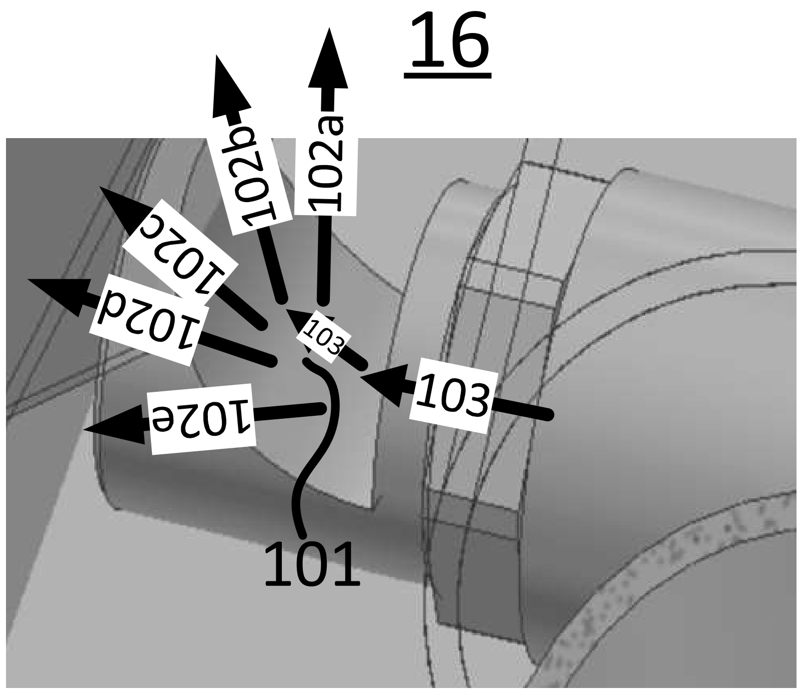

Fig. 9