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(54)	Title	**Device for collecting cleaner fish**
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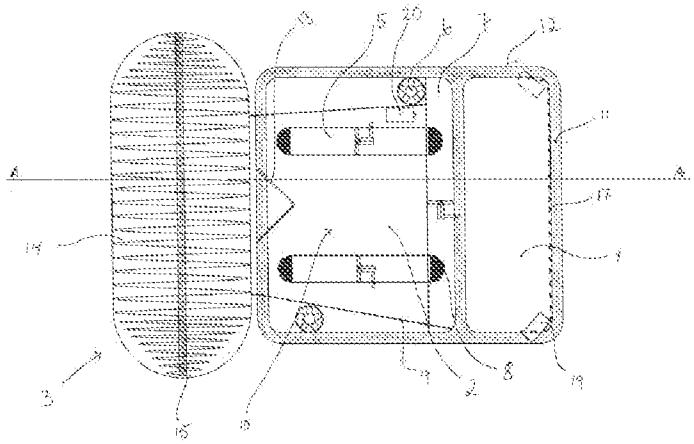
(57)	Abstract	

A submersible, remotely controlled device for collecting fish from an aquaculture enclosure, comprising an entrance section, a transfer chamber and a collection means. The transfer chamber is arranged between the entrance section and the collection means, and comprises further at least three thrusters creating waterflow for moving the device,

- at least one first thruster is arranged to create a flow from the entrance section to the collection means,
- at least one second thruster is arranged to create a flow crosswise to the transfer chamber, and
- at least one third thruster is arranged to create a flow perpendicular to the flow from the first and second thrusters.

The at least one first thruster is arranged inside the transfer chamber, and the second and third thrusters are arranged to create a waterflow outside of the transfer chamber.



Device for collecting cleaner fish

The present invention is related to a submersible, remotely controlled device for collecting fish from an aquaculture enclosure, a collection means to be used with the device, and a method to collect fish from an aquaculture enclosures, according to the characterizing part of the independent claims.

Background

Sea lice including *Lepeophtheirus salmonis* and *Caligus elongatus* are considered to be one of the most important disease problems in farming of salmonids, especially in Atlantic salmon and rainbow trout. Fish infected by lice grows slower and needs treatment to get rid of the lice, and if slaughtered while having lice or cuts, the fish meat will be classified lower, and receive a lower price. In addition to the evident problems of fish welfare and health as the sea lice infections represent, both the treatments and the lower growth and classification contribute to the economic losses for the owner. The annual loss has recently been estimated to €300 million and the aquaculture industry relays heavily on a few chemotherapeutants for lice control.

In order to reduce the problems related to sea lice, an alternative to chemo-therapeutants is to to add cleaner fish, such as species of wrasse or lumpsuckers into the fish cage for delousing of the fish. The cleaner fish such as the lumpsuckers will eat the sea lice from the fish's skin, and thus clean the farmed fish and reduce the infection rates. The use of cleaner fish is generally considered as an environmentally friendly method and not stressful to the fish.

As cleaner fish keeps the farmed fish healthy, they are very valuable to the fish farming industry, but the cultivation of most types of cleaner fish is laborious and costs intensive. Cleaner fish are fragile and should be handled more gently than farmed fish, as they may not survive the treatment given to farmed fish, for instance treatment with fresh water or even the transportation which may involve pumping and pressure differences. Thus, there is a need both upon slaughter of the farmed fish but also upon treatment or other handling of the farmed fish, to efficiently and

gently separate the cleaner fish from the farmed fish. Removal of the cleaner fish in a way ensuring the health of the fish is also a requirement for the Norwegian government.

Most cleaner fish retreat to places to hide and rest occasionally, and special hide-outs have been designed for this purpose. Before the treatment and/or removal of farmed fish starts, it is however, normal to remove the hide-outs for the cleaner fish. Farmed fish normally swim in circles at a distance from the fish cage wall, and therefore the cleaner fish seek to the wall of the fish cage for rest. When the fish cage is made of net or other perforated material, water will also flow through the wall and create a current, which attract the cleaner fish to the wall. When cleaner fish are to be collected after the hide-outs are removed, it is thus preferred to seek along the wall of the fish cage.

Several devices are known for separating cleaner fish from farmed fish in a flow of fish, but a premise to these devices is that the cleaner fish are pumped and transferred from the fish cage to the device, and in most devices without being submerged in water at all times. However, this handling is not always healthy for the more fragile cleaner fish, and an extra step for removing the cleaner fish from a flow of cleaner fish and farmed fish, causes an extra step for the farmed fish which may not be desirable to the farmed fish either.

In WO2017/216512 it is described a device to be connected to a ROV, for catching and killing free swimming lionfish in the sea, and in WO2019/135070 it is described another device to be connected to a ROV, for collection and retrieval of dead or diseased fish from an aquaculture enclosure. Both devices are operated by manoeuvring the ROV to position a mouth around a fish, activating a suction, and then suck the fish into the device and into a collection bag. This is a time consuming method which removes one or a few fish at the time. The device is not designed to protect the sucked fish, rather the opposite, and the cleaner fish may be harmed by the device. Further, if the device is used in a fish cage having walls of a net, the ROV may get entangled into the walls, and create a hole. The result may be catastrophic

as the farmed fish may escape, and therefore such devices are not advisable to be used in fish cages. Even if the device is prevented from creating holes in the wall, they may get entangled in ropes and lines running in the cage, and either disturb or destroy other equipment or the device itself. These are well known problems to a skilled person.

Another problem arises when the cleaner fish are lumpfish, as lumpfish may fasten themselves on any flat surface by a pelvic adhesive disk. When the lumpfish are transferred, and the water flow is sufficiently low, the cleaner fish may suck themselves fast to the inside of a fish pump, to any transfer pipe or any other flat surface which will cause a clog to the system. They may also be stuck inside the walls of a fish carrier ship, and not leave the tank together with the rest of the fish. When the cleaner fish are lumpsuckers, this will be a problem with all devices mentioned above, as they have low waterflow and flat surfaces.

The main object of the invention is to separate living cleaner fish from the living farmed fish, in particular salmonids, in a gentle way, keeping the cleaner fish healthy and alive. Another object is to remove the cleaner fish while still being in the fish cage. Yet another object is that the cleaner fish may be collected in separate containers to be transferred to a new fish cage and/or farming site. The separation of cleaner fish from living fish should be fast, and more fish should be collected at the same time. A general fish cage for farming Norwegian salmon or trout may comprise 8000-20.000 cleaner fish in addition to the farmed fish, and an object of the invention is to remove most of the cleaner fish in such a cage within hours.

Another object of the present invention is to reduce the number of times the cleaner fish needs to be handled. As the fish are fragile, any handling may cause harm to the fish, and mortality may increase. Finally, an object of the present invention is to supervise the cleaner fish at all times during collection.

The invention

The objects above are met by a device, a container and a method according to the characterizing parts of the independent claims. Further advantageous features are stated in the dependent claims.

The invention relates to a submersible, remotely controlled device for collecting fish from an aquaculture enclosure, such as a fish cage and/or net cage. The device comprises an entrance section, a transfer chamber and a collection means, wherein the transfer chamber is arranged between the entrance section and the collection means in such a way that a flow of water and fish may flow through the entrance section and the transfer chamber and into the container.

The device further comprises at least three thrusters creating waterflow for moving the device,

- at least one first thruster is arranged inside the transfer chamber, to create a flow through the entrance section towards the collection means,
- at least one second thruster is arranged to create a flow crosswise to the transfer chamber, and
- at least one third thruster is arranged to create a flow perpendicular to the flow from the first and second thrusters,

wherein the at least one first thruster is arranged inside the transfer chamber, and the second and third thrusters are arranged to create a waterflow outside of the transfer chamber.

The first thruster will move the device in longitudinal direction, that is along a line from the receiving section to the collection means. The second thruster, being arranged to create a flow crosswise to the transfer chamber, will move the device in crosswise direction, i.e. movement in the same plane as the movement created by the first thruster, and the third thruster arranged to create a flow perpendicular to the flow from the first and second thrusters, will move the device in the third direction.

The entrance section has an outer opening facing the environment of the device, in the forward direction, and an inner opening facing or being attached to the transfer chamber. The transfer chamber is arranged in a similar way, having an inner opening facing or being attached to the entrance section, and an outer opening facing or being attached to the collection means. When no means is attached to the device, the outer opening of the transfer chamber will face the environment of the device. The collection means has an opening facing or being attached at the outer opening of the transfer chamber. The collection means may be attached or fasted at the outer opening of the transfer chamber by any suitable means, such as magnetic lock, cabinet catch, velcro or the similar, which is obvious to a skilled person.

When the device is in use in a fish cage, and an outer opening of the entrance section is turning towards the wall of the fish cage, the first thrusters will thus move the entrance section along the wall of the fish cage, in the following referred to as forward and backward movement, respectively. The second thrusters will move the device sideways at the same depth, at a direction substantially perpendicular to forward/backward, in the following this movement will be referred to as sideways movement. The third thruster will move the device vertically in the water, in the following the movement is referred to as up and down.

In a preferred position during use, an outer side of the device is positioned along the wall of the fish cage, and movement forward/backward may be regulated by both the first and second thrusters, as the first thrusters move the device, but friction between the wall and the device may be regulated by the second thruster, forcing the device to the wall, and thereby reducing the rate of forward/backward movement. In this way, suction created by the first thrusters may increase without increasing the speed of the movement of the device. The suction should be regulated according to the amount and type of fish to be collected.

All thrusters have one suction side and one blow side, and the suction side of the first thruster should be arranged towards the entrance section, creating a flow from the entrance section through the thruster towards the collection means, when the

device is moved forward. By arranging the first thruster inside the transfer chamber, all flow generated by the thruster will go through the entrance section, and therefore less flow is necessary to create sufficient suction to transport the cleaner fish into the device. Further, the water will be drawn through the entrance section and transfer chamber, and led to the collection means in a straight line, which gives a smooth and laminar flow. As less flow is necessary, and since the created flow is laminar, less power is used by the thruster to create sufficient suction to draw the cleaner fish into the device. Besides, the smooth and laminar flow along a straight line will not harm the cleaner fish.

In a preferred embodiment two thrusters are used in each direction, to achieve better control of the movement and to avoid roll and/or pitch of the device. The number of thrusters in each direction may be regulated depending on the expected location for use of the device, as more thrusters may be an advantage at locations with more wind and current. This will of course, also depend on the power and size of the thrusters installed.

The invention further relates to a method to collect fish in an aquaculture enclosure, the method comprises the following steps

- launching a device according to the invention into the enclosure,
- positioning and moving the device against a wall or the similar in the enclosure, by operating the at least three thrusters, and
- releasing the container once sufficient fish is collected.

In a preferred embodiment, the method further comprises a step for fastening a container to the device, and, if the container is collapsible, possibly expand it, before the device is launched or positioned. In a more preferred embodiment, the method further comprises continuously monitoring the front of the device by cameras in the entrance section, in order to monitor whether any cleaner fish is in front of the device.

The device will be launched from the surface, and controlled by a controller on the surface. The thrusters may be hydraulic or electric, and sufficient supply of power must be transferred from the surface through a wire. Wires for transferring photos, videos etc may also be connected to the device and to a control point above the surface.

When the device is in use, the outer opening of the entrance section is positioned close to cleaner fish, or an area where cleaner fish are expected to be found, such as along the fish net of a fish cage, by the at least three thrusters. When the at least one first thruster is run in forward direction, a flow will be generated from the entrance section to the collection means, and thereby any cleaner fish nearby the opening of the entrance section will be sucked into the device and into the collection chamber.

A number of cameras may be arranged at the device, preferably at the entrance section of the device, to detect the cleaner fish, and in the transfer chamber to detect any fish not entering the collection means and/or detecting any fish other than cleaner fish accidentally being sucked into the device. In an alternative embodiment, cameras may even be installed in the collection means. In a preferred embodiment the cameras are IR cameras, not depending on extra light, as light may scare the cleaner fish away from the device.

The second and third thrusters should be arranged in such a way that the water flow generated by them, is not flowing into the entrance section, transfer chamber, and/or collection means. This may be achieved by arranging the thrusters on the outside of the device, or more preferably by arranging the second and third thrusters inside pipes, so that the water flow is generated through the pipe, and by arranging the ends of the pipes outside of the device. When the second and third thruster are arranged inside pipes, the thrusters may be arranged inside the transfer chamber, together with the first thruster. In this way the flow generated by the second and third thruster will be used for movement of the device only, and the flow through the

transfer chamber will not be disturbed by the flow generated from the second and third thruster.

In a preferred embodiment, the first thruster is also arranged in a pipe, having the suction end towards the entrance section and the blow end towards the collection means when the device is moving forward, as said above. By arranging the thrusters in pipes, a more laminar and efficient flow will be achieved, and the possibility of cavitation formation is reduced. If more than one first thruster is used, it is an advantage to arrange them in pipes, as the flow from each thruster will not interfere with the flow from the other. Formation of cavitation and turbulence may both disturb and harm the fish, but it may also increase tear and wear to the device itself.

The collection means may be a collection tube for transferring water and collected fish to the surface, or a collection container having apertures to let the water flow through, or the container is made of a material letting the water flow through, while retaining the cleaner fish, such as a net. In such an embodiment, the water will flow in a straight line from an opening of the entrance section, through the entrance section, transfer chamber and collection container, and any cleaner fish caught in the flow will be handled carefully and retained in the collection container. As less flow is necessary when the thruster creating the flow is arranged inside the transfer chamber, less forces are acting on the fish, and the flow is less likely to harm the fish.

In a preferred embodiment, the device comprises a frame and an outer shell, fastened to parts or the whole of the frame. The frame may be constituted by any suitable parts, pipes, bars or the similar to keep the shape of the device. In an alternative embodiment, the frame is hollow and used to regulate the buoyancy of the device. When the thrusters are arranged in pipes, the pipes may constitute parts of the frame, and the outer shell may be fastened to the pipes, however, without interfering with the flow inside the pipe. In a preferred embodiment, the device should have slightly positive buoyancy, sufficient to rise the device to the surface of

the sea for instance if the thrusters stop by clogging or otherwise, of the device is broken in any way.

The entrance section and the transfer chamber of the device should preferably be covered by the shell and the shell should provide a smooth and even surface to the device to prevent that the device will entangle in the fish cage itself, and/or ropes, lines and other equipment in the fish cage. Further, the shell should be substantially water tight, so that all the water entering the entrance section will flow through the device and out of the collection means. When the second and third thrusters are arranged in pipes inside the device, holes must be arranged at convenient places of the shell, to allow the water to flow through the second and third thruster. The collection means may be arranged totally outside of the shell or partly inside of the shell but leaving parts where water flows out of the means outside, depending on the desired use of the device.

In a preferred embodiment, the shell comprises a number of plates arranged adjacent to each other, possibly fastened to each other by tongue and groove or the corresponding, to achieve a substantially water tight connection. Any suitable connection may be used between the plates, and/or between the plates and the frame, which is obvious to a skilled person.

In a preferred embodiment, the second and third thrusters are arranged in pipes crossing the transfer chamber, and the pipes constitutes parts of the frame of the device.

In a preferred embodiment, an inner space of the device is defined inside the entrance section and transfer chamber, by guiding walls. The guiding walls should preferably protrude from the outer opening of the entrance section to the outer opening of the transfer chamber, whereby the collection means is fastened. The walls may be inclined towards the collection means, gradually reducing the cross section of the inner space, which will gradually increase the rate of the flow through the device. Water may pass through or between the walls, but fish may not. The

guiding walls may be plates, such as metal plates or plastic plates, arranged to guide fish and water entering the entrance section to the collection means. If the cleaner fish are lumpfish, then the walls should not be smooth as the lumpfish may suck themselves to a smooth surface as described above. In an alternative embodiment, the walls are plates covered with a non-smooth surface, such as a net to prevent that lumpfish sucks onto the plates.

In a preferred embodiment the collection means is a container, and more preferably the container is releasably fastened to the transfer chamber, and once sufficient fish are collected in one container, the container may be released and replaced by an empty container. In a more preferred embodiment, the fastening may be released remotely. This is especially an advantage if the cleaner fish are sensitive for rising to the surface, and should be risen slowly. By releasing the collection container remotely, the collection container may be released at any depth and be risen slowly, while the device may return to the surface once the container is released, to be attached to a new container and to start collecting more fish.

In a preferred embodiment, the collection container may be provided with positive buoyancy, wherein the buoyancy is adjusted to the type of cleaner fish, to ensure that the rate of the rise to the surface will be suitable to the fish. In an alternative embodiment, the collection container is provided with driving means, to control the rising of the container and/or to move the container at the surface of the water. When the collection container reaches the surface of the water, it may be far from the edge of the fish cage, and when the container is provided with driving means, the container may easily and smoothly be moved towards the position for emptying or handling the container. This will reduce manual work for the operator, and reduce the risk for harming other equipment in the fish cage. The driving means should preferably remotely controlled.

In a preferred embodiment, a one-way entrance is arranged between the transfer chamber and the collection means, allowing fish and water to enter the collection means from the transfer chamber, but preventing fish from swimming out of the

collection means. In a more preferred embodiment, when the collection means is a collection container, the one-way entrance is a part of the collection container, and if the container is released from the device, it will be closed and the fish contained therein cannot escape.

The one-way entrance may be constituted by an opening and a lip covering the opening at the downstream end. When water is flowing through the opening, the lip will be forced by the flow to move out of position and the opening will be open. When water is trying to flow in opposite direction, the flow will force the lip towards the opening, and thus cover it and prevent any water from flowing in that direction. In an alternative embodiment the one-way entrance comprises means being prestressed in closed position, and thus the entrance will only be open when the flow is stronger than the prestressing. One-way entrances in general is well known to skilled persons, and thus not described any further in this application.

In an alternative embodiment, a further one-way entrance is arranged at the outer opening of the transfer chamber, cooperating with a one-way entrance at the collection container, once the collection container is fastened to the device. When the collection container is released from the device, the one-way entrance at the end of the transfer chamber should be closed, and any fish entering the entrance section will be contained in the transfer chamber until a new collection container is fastened to the device.

When two first thrusters are arranged in pipes in the transfer chamber, a division member may be arranged at a downflow end of the transfer chamber, wherein the collection means is fastened. The division member should be arranged at a symmetry line between the thrusters, to divide the flow entering the collection means in two parts, both leading into the collection means. By arranging a division member in this way, the flow of water from the two thrusters will interfere less with each other, and a laminar and straight flow will be maintained even with two first thrusters. The division member should preferably be shaped as a wedge, having the tip towards the entrance section.

In a preferred embodiment, the collection means is a collapsible container, being expanded once attached to the device in case it is removable, and/or by the water flow when the device is used. In a more preferred embodiment, the container has expansions means such as a frame comprising a number rings arranged at a distance from each other, around the same axial axis and a longitudinal inflatable spacer keeping the rings at distance from each other. In collapsed condition, the spacer is deflated and thereby the rings may be arranged in a stack. The rings may be replaced by one or more helixes. When the container is to be used, the longitudinal spacer will be inflated, the rings will be separated, and the container will be expanded. The expansion means and/or frame of the container may be filled with air or water to regulate the buoyancy of the container, and a separate water or air pump may be used to this. Such a separate pump may be a part of the device, or a supply pipe may be arranged from above the water. In a preferred embodiment, the longitudinal spacer is provided with a valve, and once inflated it will stay inflated until the valve is opened. This means that the collection container will stay expanded even when released from the device.

In an alternative embodiment, the collection container is divided in separate rooms, and the collected fish are separated by size or other criteria into these rooms. The sorting may for instance be performed by partition walls having openings of different size. In yet another embodiment, a part of the container is provided with a water tight area, and when the container is lifted out of the water, the water tight part will be at the bottom, leaving the fish in water at all times.

The invention further relates to a collection container as described herein. The container comprises fastening means to be fastened to device according to the invention, and an opening with a one-way valve. At least a part of the wall is permeable to water. In a preferred embodiment the walls of the container are made of a net having mesh size smaller than the fish to be collected.

In a preferred embodiment of the device according to the invention, the outer opening of the entrance section is inclined to the flow direction of the first thrusters, in such a way that an outer wall on one side of the entrance section will be longer than an opposite wall. As the opening is inclined to the section, it will create a triangular part in front, and the area of the opening will be larger than if the opening was not inclined. When the device is in use, the device will be aligned with the wall of the fish cage, whereby the shorter wall of the entrance section will be aligned to the fish cage, and the longer opposite wall of the entrance section will be protruding at a distance from the wall. In this way, the opening of the entrance section will be inclined to the wall of the fish cage. If any fish are scared by the device, it is likely to move out from the wall, and as the opening is inclined, it will be caught into the opening and sucked into the device. By arranging the opening inclined, both the area of the opening increases, and the number of collected fish increases.

In a preferred embodiment, a number of water nozzles are arranged at the outer opening of the entrance section. The nozzles are arranged to spray water directly across the opening or slightly angled towards the transfer chamber, creating a water curtain across the whole opening. The flow may be regulated from nothing to quite strong, yet not strong enough to hurt the fish when passing through, which is obvious to a skilled person. The nozzles may be arranged along one or more, possible all, edges of the opening. If any cleaner fish in the transfer chamber, is trying to get out of the device, they will be repelled by this water curtain, and not leave the device. Water may be supplied to the nozzles by a separate pump being a part of the device, or a supply pipe may be arranged from above the water. Such a separate pump may further inflate/deflate a longitudinal spacer of the collection container, as described above.

Farmed fish may also accidentally be sucked into the device, for instance if farmed fish are in front of the opening. Salmonids as salmon and trout, prefer however, to swim counter current, and will thus swim away from the opening rather than being sucked into it. If they do get in, they would swim out of the device before they enter the collection means. A number of nozzles spraying water across the opening as

described above, may attract the salmonids even more, and thereby contribute to them leaving the device.

Description of a preferred embodiment of the invention.

The following description of an exemplary embodiment refers to the drawings, and the following detailed description is not meant or intended to limit the invention. Instead, the scope of the invention is defined by the appended claims.

Reference throughout the specification to “one embodiment” or “an embodiment” means that a particular feature, structure, or characteristic described in connection with an embodiment is included in at least one embodiment of the subject matter disclosed. Thus, the appearance of the phrases “in one embodiment” or “in an embodiment” in various places throughout the specification is not necessarily referring to the same embodiment. Further, the particular features, structures or characteristics may be combined in any suitable manner in one or more embodiments.

A preferred embodiment of the invention will in the following be described in more detail with reference to the following figures, where
Figure 1 shows a vertically cross section of a device according to the present invention, taken along line B-B of Figure 2, and
Figure 2 shows a horizontally cross section taken along line A-A of Figure 1.

The figures are for illustrating the invention only, and the different parts may not be in the same scale, and the the parts may not be arranged exactly at the same spot in the two figures.

Figure 1 shows a vertical cross section of a device according to the present invention. Vertical refers to the position when the device is in use in a fish cage, and the cross section line is indicated in Fig. 2 as line B-B. Figure 2 shows the same device in a horizontal cross section, taken along the line A-A of Figure 1. The cross sections are thus taken along planes being perpendicular to each other.

The shown device is designed to be used in a fish cage to collect cleaner fish, such as lumpfish or wrasses, before the farmed fish are removed from the fish cage, or before any chemicals or fresh water is added to the fish cage for treating the farmed fish. As the cleaner fish are likely to rest along walls of the fish cage, the shown embodiment is designed to move along a wall, and in Figure 2 a fish cage wall 100 is indicated to show the device when in use. The device is connected to the surface by a wire (not shown), to transfer power, electricity, videos, photos etc.

The device comprises an entrance section 1, a transfer chamber 2 and a collection means shown as a collection container 3. The entrance section comprises an outer opening 4 wherein the fish to be collected will enter, and the collection container 3 is releasably fastened at an outer opening of the transfer chamber. The collection container may be fasted by any suitable means which is obvious to a skilled person, and is simply illustrated as two parallel lines 16 in the Figures. The collection container is made of perforated material such as a net having a mesh size smaller than the fish to be collected.

The device further comprises six thrusters, two first thrusters 5 to move the device forwards and backwards along a wall of the cage, two second thrusters 6 to move the device horizontally sidewise in the fish cage (towards and away from the wall of the cage in Figure 2), and two third thrusters 7 to move the device vertically up and down in the cage. The thrusters are controlled individually to move the device in three directions. In the shown embodiment, the thrusters are propellers arranged in a pipe, and the ends of the pipe are covered with a grid or the similar to prevent the fish to enter the pipe and get in touch with the propeller. In the figures the grid is shown as a black semicircle 8, simply to ease the illustrating.

An inner space 10 of the device, inside the entrance section 1 and transfer chamber 2, is defined by four guiding walls 9, protruding from the outer opening 4 of the entrance section to the outer opening of the transfer chamber 2 whereby the

collection container 3 is fastened. The walls 9 are inclined towards the collection container, gradually reducing the cross section of the inner space 10.

The first thrusters 5 are arranged inside the inner space 10, while the second 6 and third thrusters 7 are arranged outside of the inner space. When the thrusters are running, only the first thrusters will arrange flow through the inner space of the device.

In the shown embodiment, the device has a frame 11, preferably made of steel or plastic pipes, possibly filled with air to increase the buoyancy of the device. A number of plates, constituting an outer shell 12, is arranged on the outside of the frame 11. In this way, the device has a smooth and even outside and will not get entangled in fish cage itself, nor ropes, lines and the similar in the fish cage. The second 6 and third 7 thrusters are all arranged inside the shell, but the ends of the pipes of the thrusters are arranged at the shell, leaving a opening in the shell to allow water to flow into the pipe. These openings are also covered by a grid.

In the shown embodiment, at the outer opening of the transfer chamber, where the collection container is connected, a division member 13 is arranged. The division member is designed as a wedge shaped element and arranged between the two first thrusters 5, to divide the flow entering the collection container 3 in two parts. The collection container is provided with two separate openings (not shown) both having a one-way entrance (not shown) to receive the flows separated by the division member.

In the shown embodiment, the collection container is collapsible, and has a frame comprising a number rings 14 arranged at a distance from each other, around the same axial axis. The container further has a longitudinal inflatable spacer 15 keeping the rings at distance from each other once inflated. In collapsed condition, the spacer is deflated and thereby the rings may be arranged in a stack. In the shown embodiment, the longitudinal spacer 15 is inflated by water from a water pump 18, and once the spacer is inflated, the rings will be separated, and the container is

expanded. The spacer is provided with a one-way valve (not shown) and once it is inflated it will stay inflated until the valve is opened.

In the shown embodiment, the outer opening 4 of the entrance section 1 is inclined to the flow direction of the first thrusters, in such a way that a part being farthest from the fish cage wall 100 is longer than a part being closest to the fish cage wall. Further, a number of water nozzles 17 are arranged at edges surrounding the outer opening of the entrance section. The nozzles also receives water from the water pump 18 mentioned above and spray water directly across the opening, creating a water curtain (not shown) across the whole opening.

A number of cameras are arranged at the entrance section of the device, in Figure 1 it is shown two IR cameras 19. The cameras send photos and/or videos of the surroundings in front of the opening 4, to an operator above the surface of the sea, and based on this information, the operator runs all six thrusters to manoeuvre the device to a good position to collect cleaner fish. Another camera 20 is arranged in the transfer chamber to monitor the inner space 10 of the device.

The example above is given to illustrate the invention and should not be used to interpret the following claims limiting. The scope of the invention is not limited by the example give above, but the following claims.

Claims.

1. A submersible, remotely controlled device for collecting fish from an aquaculture enclosure, the device comprises an entrance section (1), a transfer chamber (2) and a collection means (3), wherein the transfer chamber (2) is arranged between the entrance section (1) and the collection means (3), the device further comprises at least three thrusters (5, 6, 7) creating waterflows for moving the device, **characterized** in that

each thruster is arranged in a pipe wherein

- the ends of the pipe of the at least one first thruster (5) is inside the transfer chamber (2), and the thruster is arranged to create a flow from the entrance section (1) to the collection means (3),
- the ends of the pipe of the at least one second thruster (6) is outside of the transfer chamber (2) and the thruster is arranged to create a flow crosswise to the transfer chamber (2), and
- the ends of the pipe of the at least one third thruster (7) is outside of the transfer chamber (2) and the thruster is arranged to create a flow perpendicular to the flow from the first (5) and second thrusters (6), and further

in that the entrance section (1) has an outer opening (4), being the front end of the device, wherein the opening is inclined to the water flow of the first thruster.

2. A device according to claim 1, **characterized** in that a one-way entrance is arranged between the collection means (3) and transfer chamber (2).

3. A device according to any of the preceding claims, **characterized** in that the collection means (3) is a collection container releasably attached to the device.

4. A device according to claim 3, **characterized** in that the collection container (3) is collapsible.

5. A device according to any of the preceding claims, **characterized** in that the

entrance section (1) has an outer opening (4), being the front end of the device, wherein a number of water nozzles (17) arranged angular to the opening (4) of the entrance section, creating a water curtain across the opening.

6. Method to collect fish in an aquaculture enclosure, **characterized** comprising the following steps
- launching a device according to any one of claims 1-5 into the enclosure,
- positioning and moving the device against a wall (100) or the similar in the enclosure, by operating the at least three thrusters (5, 6, 7) arranged perpendicularly to each other, and
- releasing the container (3) once sufficient fish is collected.

7. Method according to claim 6, **characterized** by further comprising a step for fastening a container (3) to the device, and possibly inflating it, before launching or positioning the device.

8. Method according to claim 6 or 7, **characterized** by further comprising a step for continuously monitoring the front of the device by cameras (19) in the entrance section.

Patentkrav

1. Nedsenkbar, fjernstyrt anordning for samling av fisk fra en oppdrettsinnhegning, anordningen omfatter en inngangs-seksjon (1), et overføringskammer (2) og et oppsamlingsmiddel (3), idet overføringskammeret (2) er arrangert mellom inngangs-seksjonen (1) og oppsamlingsmiddelet (3), anordningen omfatter videre i det minste tre thrustere (5, 6, 7) som danner vannstrømmer for å bevege anordningen, **karakterisert** ved at

hver thruster er arrangert i et rør, hvor

- endene av røret for den i det minste ene første thrusteren (5) er inne i overføringskammeret (2), og thrusteren er arrangert for å danne en strøm fra inngangs-seksjonen (1) til oppsamlingsmiddelet (3),
- endene av røret for den i det minste ene andre thruster (6) er utenfor overføringskammeret (2) og thrusteren er arrangert for å danne en strøm som er på tvers av overføringskammeret (2), og
- endene av røret for den i det minste ene tredje thruster (7) er utenfor overføringskammeret (2) og thrusteren er arrangert for å danne en strøm som er vinkelrett på strømmen fra den første (5) og andre thrusteren (6), og videre

ved at inngangs-seksjonen (1) har en ytre åpning (4), som er fremre ende av anordningen, idet åpningen er skråstilt i forhold til vannstrømmen fra den første thrusteren.

2. Anordning i samsvar med krav 1, **karakterisert** ved at en en-veis inngang er arrangert mellom oppsamlingsmiddelet (3) og overføringskammeret (2).

3. Anordning i samsvar med et av de foregående krav, **karakterisert** ved at oppsamlingsmiddelet (3) er en oppsamlingsbeholder som er løsbart festet til anordningen.

4. Anordning i samsvar med krav 3, **karakterisert** ved at oppsamlingsbeholderen (3) er sammenleggbar.

5. Anordning i samsvar med et av de foregående krav, **karakterisert** ved at inngangs-seksjonen (1) har en ytre åpning (4), som er fremre ende av anordningen, idet et antall vanndyser (17) er arrangert i vinkel til åpningen (4) av inngangs-seksjonen, og danner en vanngardin over åpningen.

6. Framgangsmåte for å samle fisk i en oppdrettsinnhegning, **karakterisert** ved å omfatte de følgende trinn
- sette ut en anordning i samsvar med et av kravene 1-5 i innhegningen,
- posisjonere og bevege anordningen mot en vegg (100) eller lignende i innhegningen, ved å styre de i det minste tre thrusterne (5, 6, 7) som er arrangert vinkelrett på hverandre, og
- frigjøre beholderen (3) når tilstrekkelig fisk er samlet.

7. Framgangsmåte i samsvar med krav 6, **karakterisert** ved å ytterligere omfatte et trinn for å feste en beholder (3) til anordningen og eventuelt blåse den opp, før anordningen settes ut eller posisjoneres.

8. Framgangsmåte i samsvar med krav 6 eller 7, **karakterisert** ved å omfatte et ytterligere trinn for kontinuerlig overvåkning av fronten av anordningen ved kameraer (19) i inngangs-seksjonen.

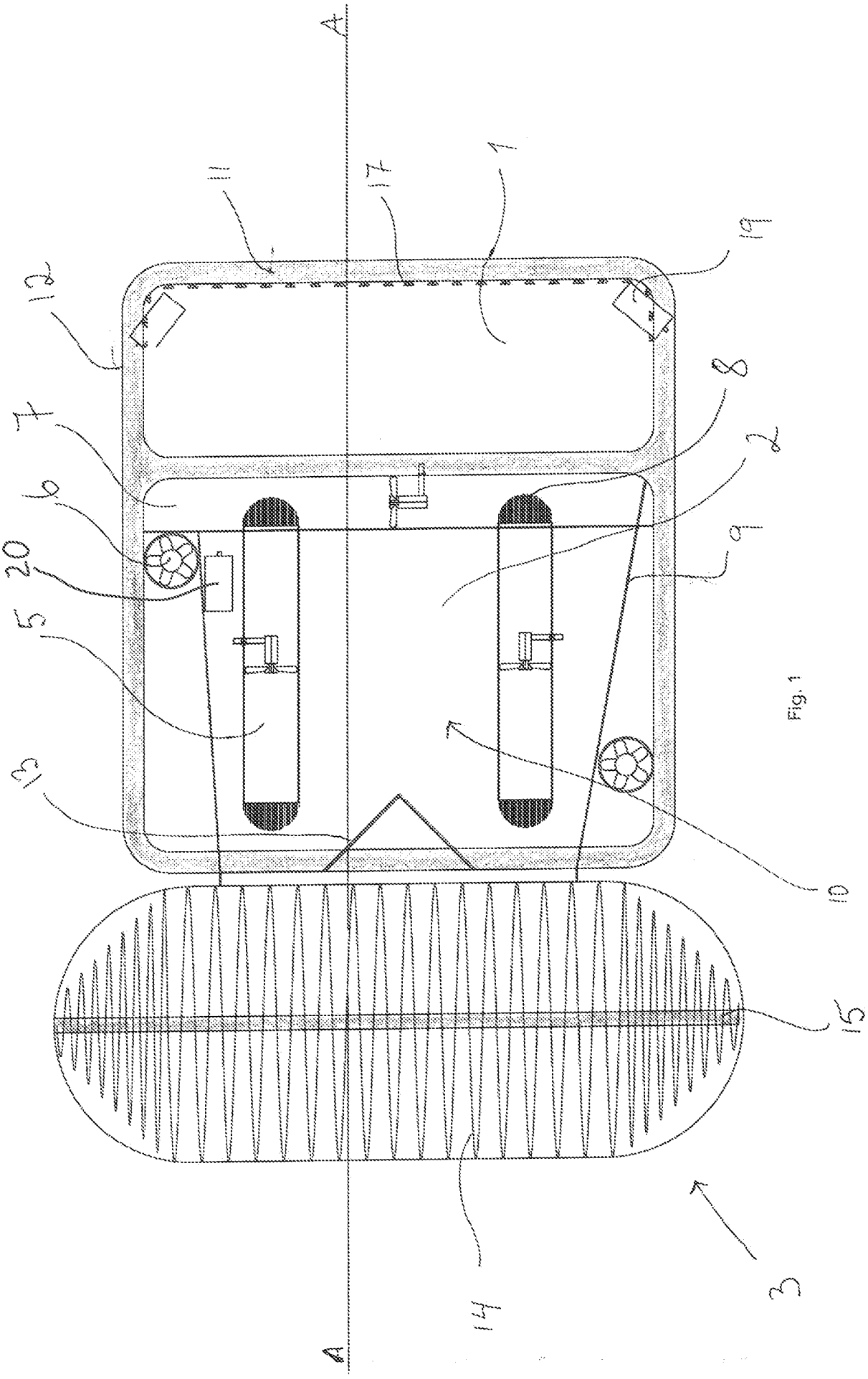


Fig. 1

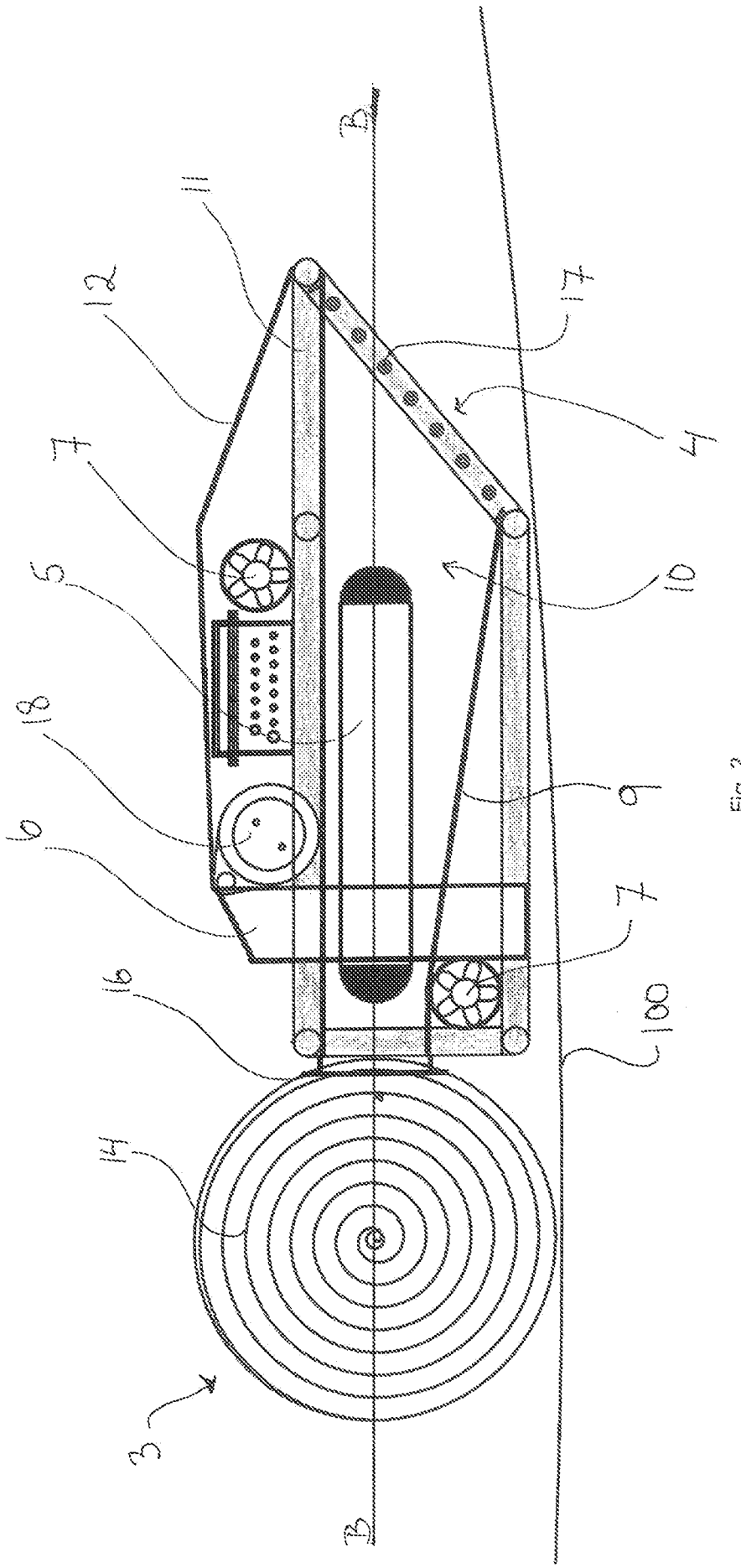


Fig. 2