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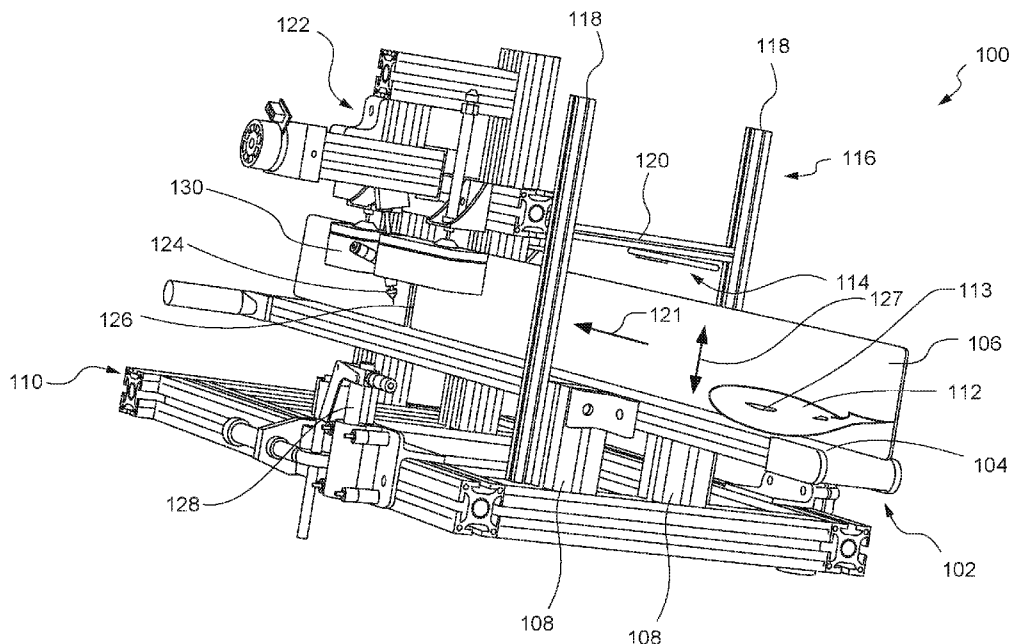


Fig. 1

(57) Abstract: An apparatus for injecting fish comprises a conveyor comprising a conveying portion for carrying 502 a fish lengthways, a fish detection module configured to determine 504 information about the fish carried by the conveying portion, a position determination module configured to determine 506 an injection position along the fish's longitudinal axis using the determined information, an injection device operable to inject the fish and a controller configured to: actuate the conveyor to move the fish to longitudinally align 508 the injection position to the injection device, actuate the conveyor to pause 508 the conveying portion when the injection position is longitudinally aligned to the injection device, operate the injection device to inject 510 the fish with the injection position thereby aligned, and resume 512 the conveying portion after injecting the fish.



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APPARATUS FOR INJECTING FISH

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Field of Invention

The present invention relates to an apparatus for and method of injecting fish, in particular, for vaccinating fish by injection.

10 Background of the Invention

The process of vaccinating live fish via injection is costly and labour-intensive. Existing machines for fish injection are operated semi- or fully automatically with the aim of reducing such cost and labour. To achieve this, a conveyor belt is deployed to transport a fish into a holder or a trough, wherein the fish is injected by an injection
15 device. The fish is held inside the holder or trough with its nose flush against a stopper.

With existing machines, to carry out an injection at a correct location on a fish, an injection device requires many degrees of freedom, wherein full three-dimensional
20 alignment of the injection device against the fish is necessary. This means that existing machines are complex, with many interconnected parts, resulting in increased mechanical complexity of the machines. Additionally, a complex vision system is usually required to help identify the location accurately, further increasing the complexity and consequently the costs of operating and maintaining the
25 machines.

There is a need to provide an apparatus for fish injection that overcomes at least some of the problems identified above.

30 Summary of invention

It is desirable to provide an apparatus for injecting fish that is small-scale, simple to operate and maintain, and at a comparatively lower cost. It is also desirable to provide an apparatus that supports dual intra-peritoneal and intra-muscular injections.

According to a first aspect of the present invention, there is provided an apparatus for injecting fish, comprising:

- 5 - a conveyor comprising a conveying portion for carrying a fish lengthways;
 - a fish detection module configured to determine information about the fish carried by the conveying portion;
 - a position determination module configured to determine an injection position along the fish's longitudinal axis using the determined information;
10 - an injection device operable to inject the fish; and
 - a controller configured to actuate the conveyor to move the fish to longitudinally align the injection position to the injection device, and configured to operate the injection device to inject the fish with the injection position thereby aligned.

15

Preferably, the injection device is fixed in use with respect to the fish's direction of travel but moveable in a transverse plane, orthogonal to the direction of travel of the fish.

- 20 Preferably, the conveyor comprises a guiding portion arranged at an angle to the conveying portion, forming a V-shaped conveyor.

Preferably, in use, the conveying portion is tilted so that, when the fish is carried by the conveying portion, the fish is in contact with the guiding portion due to the force
25 of gravity.

Preferably, the guiding portion comprises a smooth wall for the fish to slide along when the fish is carried by the conveying portion.

- 30 Preferably, the guiding portion is stationary with respect to the conveying portion.

Preferably, in use, the conveying portion is level.

Preferably, the apparatus further comprises a biasing member to urge the fish against the guiding portion when the fish is carried by the conveying portion.

5 Preferably, the injection device comprises a first injector operable to inject into the belly of the fish.

Preferably, the guiding portion comprises at least one gap through which the first injector injects into the belly of the fish.

10 Preferably, the conveying portion comprises a conveyor belt.

Preferably, the injection device comprises a second injector arranged above the conveyor to inject into a top side of the fish.

15 Preferably, the injection device comprises a third injector arranged below the conveyor to inject into an underside of the fish.

20 Preferably, the conveying portion comprises at least one gap extending longitudinally, parallel to the fish's direction of travel, through which the third injector injects into the underside of the fish.

Preferably, the apparatus further comprises a clamp to hold the fish in place on the conveying portion when the injection position is longitudinally aligned to the injection device.

25 Preferably, the apparatus further comprises actuators for moving the injection device in a transverse plane, orthogonal to the fish's direction of travel.

30 Preferably, the apparatus further comprises a conveyor encoder to determine conveying motion of the conveying portion and the determined conveying motion is used by the controller to longitudinally align the injection position to the injection device.

Preferably, the controller is configured to actuate the conveyor to pause the conveying portion when the injection position is longitudinally aligned to the injection device and resume the conveying portion after injecting the fish.

5 According to a second aspect of the present invention, there is provided a method of injecting fish, comprising the steps:

- carrying a fish by a conveyor;
- determining information about the fish carried by the conveyor;
- determining an injection position along the fish's longitudinal axis using the
- 10 determined information;
- actuating the conveyor to move the fish to longitudinally align the injection position to an injection device; and
- operating the injection device to inject the fish.

15 Preferably, the method further comprises fixing the injection device with respect to the fish's direction of travel on the conveyor but moving the injection device in a transverse plane, orthogonal to the direction of travel.

20 Preferably, actuating the conveyor comprises pausing the conveying portion when the injection position is longitudinally aligned to the injection device and resuming the conveying portion after injecting the fish.

Preferably, the method further comprises injecting into the fish's belly.

25 Preferably, the method further comprises injecting into a top side of the fish.

Preferably, the method further comprises injecting into an underside of the fish.

30 Preferably, the method further comprises clamping the fish in place on the conveying portion when the injection position is longitudinally aligned to the injection device.

Preferably, the method further comprises determining conveying motion of the conveyor and using the determined conveying motion to longitudinally align the injection position to the injection device.

Preferably, operating the injection device comprises moving the injection device in a transverse plane, orthogonal to the longitudinal axis of the fish.

- 5 Preferably, the method further comprises arranging the conveyor at an angle with respect to the force of gravity.

Brief description of drawings

Embodiments of the present invention will now be described, by way of example
10 only, with reference to the drawings, in which:

Figure 1 illustrates, in schematic form, a perspective view of an apparatus for injecting fish in accordance with an embodiment of the present invention.

- 15 Figure 2 illustrates, in schematic form, a view of the apparatus for injecting fish of Figure 1, facing the direction of travel of the fish.

Figure 3 illustrates, in schematic form, a plan view of the apparatus for injecting fish of Figure 1.

20

Figure 4 is a diagram illustrating the operation of the apparatus of Figures 1 to 3 to vaccinate a fish.

- 25 Figure 5 is a flowchart of a method for injecting fish, in accordance with an embodiment of the present invention.

Description of embodiments

The apparatus according to embodiments of the present invention is suitable for vaccinating fish. In an example, two or more of the apparatuses may be placed in
30 parallel, allowing straightforward scaling up of the apparatus to multiple operators. Vaccination speeds of up to 1 fish/second are possible, but may be rate limited by the speed at which fish can be fed to the machine by an operator/robot.

A fish has three perpendicular axes, which are: anterior-to-posterior (head-to-tail) longitudinal axis, dorsal-to-ventral (belly) sagittal axis and (lateral) side-to-side transverse axis, wherein distance between anterior to posterior defines the length of the fish, distance between dorsal to ventral defines the body depth of the fish and
5 distance between two lateral sides defines the thickness of the fish.

In embodiments, for example as shown in Figures 1 to 3, an injection device is fixed in use with respect to the direction of travel of the fish but moveable in a transverse plane, orthogonal to the direction of travel of the fish. This configuration enables the
10 injection device to inject fish with different body thickness and depth, and meanwhile removes the necessity of deploying large numbers of component parts for performing full three-dimensional alignment of the injection device against the fish. This allows the apparatus to be manufactured with a small-scale and simple infrastructure at reduced cost while still providing accurate injection capability.

15 In embodiments, for example as shown in Figures 1 to 3, a position determination module is configured to determine an injection position, wherein the injection position represents an actual injection location on the fish's body at which the injection device injects the fish. When the injection position is longitudinally aligned to the injection
20 device, the injection position and the injection device lie in the same transverse plane, orthogonal to the direction of travel of the fish.

According to another example of the present invention (not shown), the determined injection position does not represent an actual injection location, e.g. it might be a
25 position at the tail of the fish. In such an example, when the injection position is longitudinally aligned to the injection device, the injection position and the injection device lie in two offset parallel transverse planes, orthogonal to the direction of travel of the fish.

30 Features described in the context of an embodiment may be provided separately or in any suitable combination to provide other embodiments.

In the Figures, elements labelled with reference numerals found in the preceding Figures represent the same elements as described for the respective preceding

Figure. For example, feature 104 in Figure 2 corresponds to the same feature 104 as described with reference to Figure 1.

Figure 1 illustrates a perspective view of an apparatus for injecting fish 100 in accordance with an embodiment of the present invention. A conveyor 102 supported by a plurality of legs 108 mounted on a first frame 110 located therebelow. The conveyor 102 in this example is a V-shaped conveyor, which has a conveying portion 104 and a guiding portion 106 arranged at an angle to the conveying portion 104. In this example, the conveying portion 104 is in the form of a conveyor belt and the guiding portion 106 is a static guiding portion. In another example, the conveying portion 104 or the guiding portion 106 comprises a plurality of rotatably mounted conveying rollers.

The conveying portion 104 carries a fish 112 lengthways. The fish 112 is received in a head-first orientation at one end of the conveying portion 104. Alternatively, the conveying portion 104 carries the fish 112 lengthways in a tail-first orientation. In either orientation, in this example, the fish 112 lies with its side against the conveying portion 104, wherein the belly of the fish is proximal to the guiding portion 106 and the dorsal fin 113 of the fish is distal to the guiding portion 106. An injection device 122 is arranged above and to a side of the conveyor 102 near the other end of the conveying portion 104.

With respect to Figure 1, a fish detection module 114 is configured to determine information about the fish 112 carried by the conveying portion 104. The determined information may be concerned with the presence of the fish 112 on the conveying portion 104, the orientation of the fish 112 and type, weight and size of the fish 112.

A second frame 116 is provided to support the fish detection module 114, which has a pair of parallel bars 118 spaced at a distance wider than the width of the conveyor and a middle bar 120 extending between the pair of parallel bars 118 to connect them, forming an H-shaped frame. The conveyor 102 is located between the pair of parallel legs 118, below the middle bar 120. The direction of travel 121 of the fish is substantially parallel to the longitudinal axis (321 in Figure 3) of the fish 112. The fish detection module 114 is attached to a side of the middle bar 120 facing downwardly,

so that when the fish 112 passes the fish detection module 114, the information about the fish 112 can be determined.

5 The fish detection module 114, in this example, comprises at least one sensor to determine the size of the fish by measuring length, body thickness and body depth of the fish. In another example, an algorithm is used to predict the body thickness of the fish from the measured length of the fish.

10 A position determination module (not shown) determines an injection position along the fish's longitudinal axis using the information determined by the fish detection module 114. The position determination module, in this example, predicts the injection position from the size of the fish using an algorithm. The position determination module can be implemented for example in a local embedded processing unit or on a remote computer or server. The injection position in this
15 example is determined in three-dimensional space.

The longitudinal axis of the fish, with the determined injection position, moves with the fish along the direction of travel. In embodiments, for example as shown in Figures 1 to 3, the conveyor is a linear conveyor. Thus, the direction of travel is
20 constant along the length of the conveyor from the fish detection module to the injection device. In another example, the direction of travel is not linear, for example with a curved conveyor. Whether the conveyor is linear or not, when the fish is at the injection device and the determined injection position is longitudinally aligned to the injection device, the direction of travel of the fish is substantially parallel to the
25 longitudinal axis of the fish.

Figures 2 and 3 illustrate the apparatus 100 in a view 200 facing the direction of travel of the fish and in a plan view 300, respectively.

30 With reference to Figures 1 to 3, the apparatus 100 allows intra-peritoneal and intra-muscular injections to be performed by a first injector 202 and a second injector 124. In this example, the first injector 202 injects into the belly of the fish at a first injection position 304 indicating an intra-peritoneal injection, and the second injector 124

injects into a top side of the fish at a second injection position 306 indicating an intra-muscular injection.

Figure 1 also shows a third injector 128 arranged below the conveyor 102 to perform
5 the intra-muscular injection into an underside of the fish 112, wherein the conveying portion 106 comprises a gap (not shown) through which the third injector 128 injects into the underside of the fish 112. In an example, the conveying portion 104
10 comprises at least two parallel conveyor belts spaced apart at a distance forming a gap therebetween. The gap extends longitudinally parallel to the direction of travel 121 of the fish and is dimensioned to receive the third injector 128 but prevent the fish from falling through. In this example, the injectors are needles. Any of the injectors may be implemented using a Kaycee® injection gun with a pneumatic actuation system. It will be understood that any suitable injectors may also be used.

15 Referring to Figure 1 in detail, the conveying portion 104 and the guiding portion 106 are arranged to form an angle of 90 degrees with respect to each other. In other examples (not shown), the conveying portion 104 and the guiding portion 106 may be arranged to form an angle more or less than 90 degrees. In other examples (not shown), the two portions may meet in, and/or the guide may be shaped as, a groove
20 shaped to engage with the belly of the fish to centre the belly for intra peritoneal injection. The shape of such a groove may change along the direction of travel to centre the fish's belly.

The apparatus 100 is configured to be oriented at an angle with respect to the
25 conventional level coordinate frame and the conveying portion 104 is tilted, forming a sloping conveying portion. In this configuration, when the fish 112 is carried by the conveying portion 104, the fish 112 is retained on the conveying portion 104 and its belly is in contact with the guiding portion 106 due to the force of gravity. This configuration not only minimises movement required for the first injector 202 to inject
30 the fish but also removes the requirement of human or mechanical intervention to guide the fish towards the guiding portion 106. Advantageously, a smaller number of component parts are needed to effect the movement, as a result, saving time and effort.

The guiding portion 106 has a smooth wall, along which the belly of the fish 112 slides when the fish 112 is carried by the conveying portion 104. A gap 126 is provided to the guiding portion 106 through which the first injector 202 injects into the belly of the fish 112. The gap 126 extends along a width direction 127 of the guiding
5 portion 106 to accommodate movement of the first injector 202 along the transverse axis of the fish 112 to inject the fish with varying thickness.

The guiding portion 106 in this example is a static guiding portion, and may be made of metal or plastic. In another example, the guiding portion 106 comprises a plurality
10 of conveyor belts having a gap therebetween, wherein the gap extends along the direction of travel 121 of the fish and accommodates movement of the first injector 202 along the transverse axis of the fish 112. In yet another example, the guiding portion 106 comprises a plurality of discontinuous sections, wherein the first injector 202 is receivable through a space between the sections so as to inject the fish. The
15 discontinuous sections of the guiding portion 106 may be stationary with respect to the conveying portion 104 or may comprise a plurality of rotatably mounted conveying rollers.

According to another example of the present invention (not shown), the apparatus
20 100 is oriented with the conventional vertical/horizontal coordinate frame, and the conveying portion 104 is substantially level. In this configuration, a biasing member (e.g. a smooth sprung plate) is provided to urge the belly side of the fish against the guiding portion 106 when the fish is carried by the conveying portion 104.

25 In Figures 2 and 3, with reference to the fish the first injector 202 is arranged behind the gap 126 on the guiding portion 106 through which the intra-peritoneal injection is performed. The second injector 124 is arranged above the fish 112 and performs the intra-muscular injection at an angle. The first 202 and second 124 injectors are fixed
30 in use with respect to the direction of travel 121 of the fish 112 but moveable in a transverse plane, orthogonal to the direction of travel 121 of the fish, to allow for variation in depth and thickness of the fish. A first sliding gantry 204, on which the first injector 202 is mounted, moves the first injector 202 to transversally align with the first injection position 304. A second sliding gantry 206, on which the second

injector 124 is mounted, moves the second injector 124 to sagittally align with the second injection position 306.

Referring to Figure 3 in detail, a controller 302 comprises a processor and a motor
5 controller and is configured to actuate the conveyor 102 with a motor to move the
fish lengthways to longitudinally align the first 304 and second 306 injection positions
to the first 202 and second 124 injectors, respectively. The first 202 and second 124
injectors lie in the same plane transverse to the direction of travel 121 of the fish 112.
A conveyor encoder determines conveying motion of the conveying portion 104 and
10 the determined conveying motion is used by the controller 302 to actuate the
conveyor as described above. For example, the determined conveying motion is
used to predict a distance of travel and/or a time duration of travel of the fish, which
determines the timing of operation of the controller 302. Operation of the controller
302 involves actuating the conveyor 102 to pause the conveying portion 104 when
15 the fish 112 is aligned, operate the injection device 122 to inject the fish and resume
the conveying portion 104 after injecting the fish 112. In an example, the injection
device 122 is operated directly by the controller 302. In another example, the
injection device 122 comprises its own controller which receives signals or
commands from the main controller 302 and operates the injection device
20 correspondingly.

If the fish and corresponding injection position move too far and overshoots along
the direction of travel, the controller may reverse the movement of the fish along the
direction of travel to properly align the injection position. When the fish and
25 corresponding injection position are aligned and before injections are performed, the
fish 112 is held in place on the conveying portion 104 by a clamp 130. The clamp
130 is provided on either side of the gap 126 on the guiding portion 106, so that the
fish 112 can be held in place at two contact points (e.g. head and tail), enabling a
firmer hold thus avoiding misplacement of the fish 112 before and during injections.
30 The clamp 130 may be made with any appropriate material (e.g. foam, silicone, etc)
that holds the fish in place without causing damage to the fish. In this example, the
clamp 130 is an integral part of the moveable injection device 122. In another
example, the clamp 130 is independently arranged on the apparatus 100.

As discussed above, where an injection position determined by the position determination module does not represent an actual injection location, the predicted distance of travel or the time duration of travel of the fish will be adjusted taking into account the distance along the direction of travel between the injection position and the actual injection location along the longitudinal axis of the fish, so that the injection device injects at the actual injection location on the fish's body.

According to another example (not shown), the conveying portion 104 carries the fish lengthways in the head-first or the tail-first orientation with the fish's side lying against the conveying portion 104, wherein the dorsal fin 113 of the fish is proximal to the guiding portion 106 and the belly the of the fish is distal to the guiding portion 106. In this example, dual intra-peritoneal and intra-muscular injections are performed by the second 124 and third 128 injectors, respectively. The second 124 and third 128 injectors lie in the same plane transverse to the longitudinal axis of the fish 112.

Figure 4 is a diagram of operation of an apparatus for vaccinating a fish, in accordance with embodiments of the present invention. The fish path 440, control flow 442 and pneumatic/hydraulic flow 444 are illustrated with thin, medium and thick-lined arrows respectively.

400: The fish are hand fed onto the conveying portion 104.

402: The fish is carried by the conveying portion 104 in the head-first orientation, with the fish's side lying against the conveying portion 104.

404: The information about the fish is determined using sensors in the fish detection module 114. The sensing may be concerned with the presence and/or the size of the fish. The injection position along the longitudinal axis of the fish is then determined using the determined information. Sensors may sense light, sound, position or weight for example. Other information or settings may be used to determine the injection position if the fish have been graded in advance.

406: The injection position along the longitudinal axis of the fish is received by the controller 302. In other examples, the controller may receive raw signals or data from the fish detection module and calculate the injection position, thus the position determination module may be implemented in one or more different components of
5 the apparatus.

408: Water is supplied from a water supply 456 to the conveying portion 104 and fish.

10 410: The conveying portion carrying the fish is paused when the injection position is longitudinally aligned to the injection device.

412: The injectors are moved to align with the injection position along at least one axis perpendicular to the direction of travel of the fish. This may involve actuating the
15 sliding gantries 204, 206 to move the injectors to align with the injection position along both transverse and sagittal axes for dual intra-peritoneal (IP) 202 and intra-muscular (IM) 124 injections.

414: Vaccine is prepared and distributed by the Vaccine Management System (VMS)
20 450.

416: Pneumatic power is supplied by compressor 452 to allow the injectors and clamp to be actuated.

25 418: The clamp 130 is actuated to hold the fish in place on the conveying portion before injecting the fish. The injectors 202, 124 are actuated to inject vaccine into the fish.

420: The fish is vaccinated and the injectors 202, 124 and clamp 130 are removed
30 from the fish. The conveying portion is resumed to carry the fish to a recovery chute 454.

Figure 5 illustrates a flowchart of a method of injecting a fish 500, in accordance with an embodiment of the present invention. The method may be implemented using the

apparatuses described with reference to Figures 1 to 4. The method 500 has the following steps.

At step 502, the fish, which has been anaesthetised, is carried by a conveyor
5 lengthways, preferably, but not necessarily, in a head-first orientation.

At step 504, information about the fish carried by the conveyor is determined. This step 504 may involve determining the size of the fish by measuring length, body thickness and body length of the fish.

10

At step 506, an injection position along the fish's longitudinal axis is determined using the determined information.

At step 508, the conveyor is actuated to move the fish to longitudinally align the
15 injection position to an injection device. This step 508 may involve pausing the conveying portion when the injection position is longitudinally aligned to the injection device and resuming the conveying portion after injecting the fish, at step 512.

At step 510, the injection device is operated to inject the fish. This step 510 may
20 involve performing the intra-peritoneal injection into the fish's belly, and/or the intra-muscular injection into a top side of the fish or into an underside of the fish.

In an example, the method 500 comprises fixing the injection device with respect to
25 the fish's direction of travel on the conveyor but moving the injection device in a transverse plane, orthogonal to the direction of travel. This step may occur before the step 502.

In another example, the method 500 comprises clamping the fish in place on the
30 conveying portion when the injection position is longitudinally aligned to the injection device. Clamping the fish may occur in the step 510 before injecting the fish, either simultaneously or sequentially but in no particular order.

Claims

1. An apparatus for injecting fish, comprising:
 - a conveyor comprising a conveying portion for carrying a fish lengthways;
 - 5 - a fish detection module configured to determine information about the fish carried by the conveying portion;
 - a position determination module configured to determine an injection position along the fish's longitudinal axis using the determined information;
 - an injection device operable to inject the fish; and
 - 10 - a controller configured to:
 - actuate the conveyor to move the fish to longitudinally align the injection position to the injection device;
 - actuate the conveyor to pause the conveying portion when the injection position is longitudinally aligned to the injection device;
 - 15 - operate the injection device to inject the fish with the injection position thereby aligned; and
 - actuate the conveyor resume the conveying portion after injecting the fish.
- 20 2. The apparatus of claim 1, wherein the injection device is fixed in use with respect to the fish's direction of travel but moveable in a transverse plane, orthogonal to the direction of travel of the fish.
3. The apparatus of claim 1 or claim 2, wherein the conveyor comprises a guiding
25 portion arranged at an angle to the conveying portion, forming a V-shaped conveyor.
4. The apparatus of claim 3, wherein, in use, the conveying portion is tilted so that, when the fish is carried by the conveying portion, the fish is in contact with the guiding portion due to the force of gravity.
- 30 5. The apparatus of claim 3 or claim 4, wherein the guiding portion comprises a smooth wall for the fish to slide along when the fish is carried by the conveying portion.

6. The apparatus of any of claims 3 to 5, wherein the guiding portion is stationary with respect to the conveying portion.

7. The apparatus of claim 3, wherein, in use, the conveying portion is level.

5

8. The apparatus of any of claims 3 to 7, further comprising a biasing member to urge the fish against the guiding portion when the fish is carried by the conveying portion.

10 9. The apparatus of any preceding claim, wherein the injection device comprises a first injector operable to inject into the belly of the fish.

10. The apparatus of claim 9, wherein the guiding portion comprises at least one gap through which the first injector injects into the belly of the fish.

15

11. The apparatus of any preceding claim, wherein the conveying portion comprises a conveyor belt.

12. The apparatus of any preceding claim, wherein the injection device comprises a second injector arranged above the conveyor to inject into a top side of the fish.

20

13. The apparatus of any preceding claim, wherein the injection device comprises a third injector arranged below the conveyor to inject into an underside of the fish.

14. The apparatus of claim 13, wherein the conveying portion comprises at least one gap extending longitudinally, parallel to the fish's direction of travel, through which the third injector injects into the underside of the fish.

25

15. The apparatus of any preceding claim, further comprising a clamp to hold the fish in place on the conveying portion when the injection position is longitudinally aligned to the injection device.

30

16. The apparatus of any preceding claim, further comprising actuators for moving the injection device in a transverse plane, orthogonal to the fish's direction of travel.

17. The apparatus of any preceding claim, further comprising a conveyor encoder to determine conveying motion of the conveying portion and the determined conveying motion is used by the controller to longitudinally align the injection position to the
5 injection device.

18. A method of injecting fish, comprising the steps:

- carrying a fish by a conveyor;
- determining information about the fish carried by the conveyor;
- 10 - determining an injection position along the fish's longitudinal axis using the determined information;
- actuating the conveyor to move the fish to longitudinally align the injection position to an injection device;
- actuating the conveyor to pause the conveying portion when the injection
15 position is longitudinally aligned to the injection device;
- operating the injection device to inject the fish; and
- actuating the conveyor to resume the conveying portion after injecting the fish.

20 19. The method of claim 18, further comprising fixing the injection device with respect to the fish's direction of travel on the conveyor but moving the injection device in a transverse plane, orthogonal to the direction of travel.

20. The method of claim 18 or claim 19, wherein actuating the conveyor comprises
25 pausing the conveying portion when the injection position is longitudinally aligned to the injection device and resuming the conveying portion after injecting the fish.

21. The method of any of claims 18 to 20, further comprising injecting into the fish's
30 belly.

22. The method of any of claims 18 to 21, further comprising injecting into a top side of the fish.

23. The method of any of claims 18 to 21, further comprising injecting into an underside of the fish.

24. The method of any of claims 18 to 23, further comprising clamping the fish in
5 place on the conveying portion when the injection position is longitudinally aligned to the injection device.

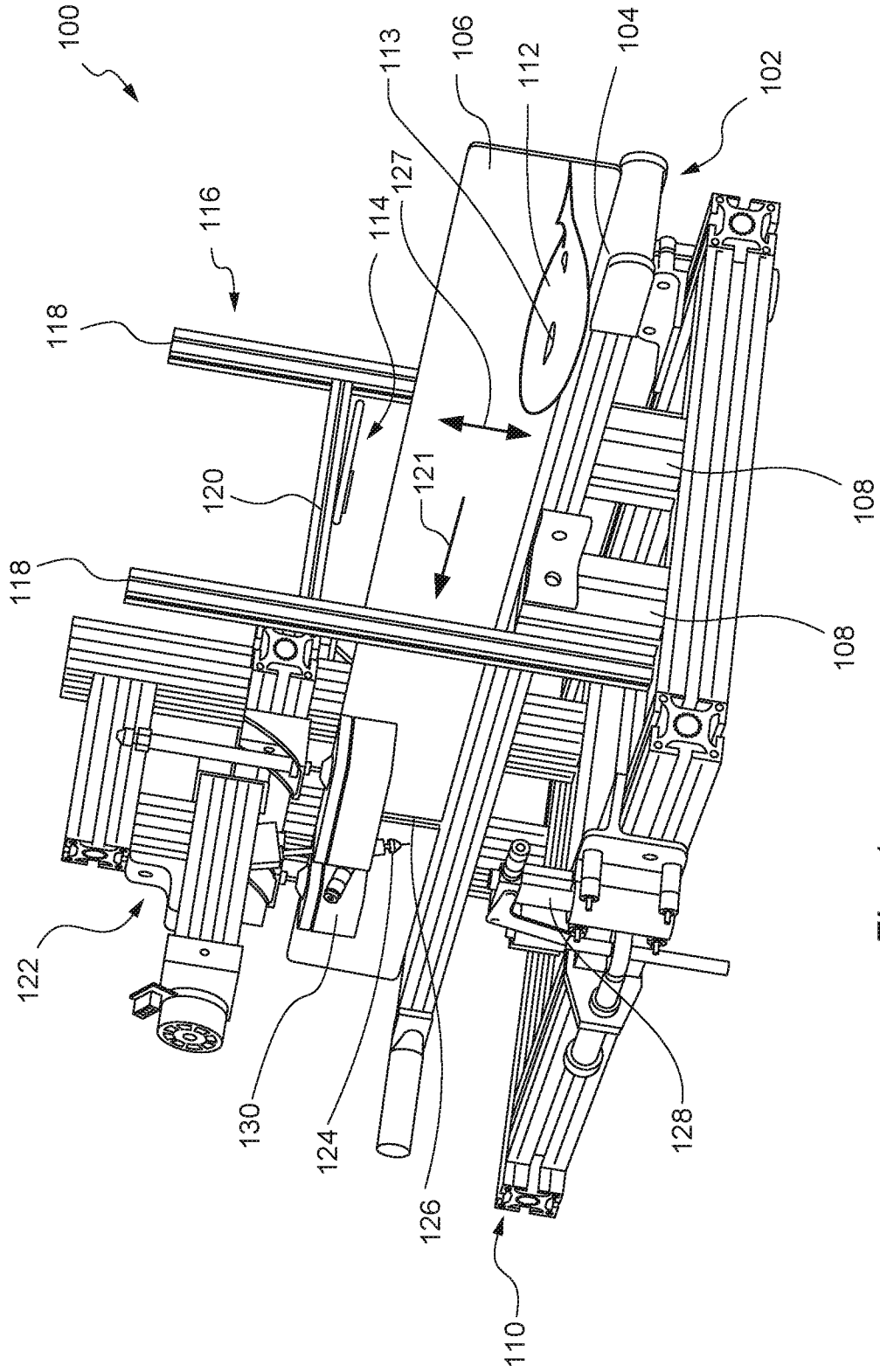


Fig. 1

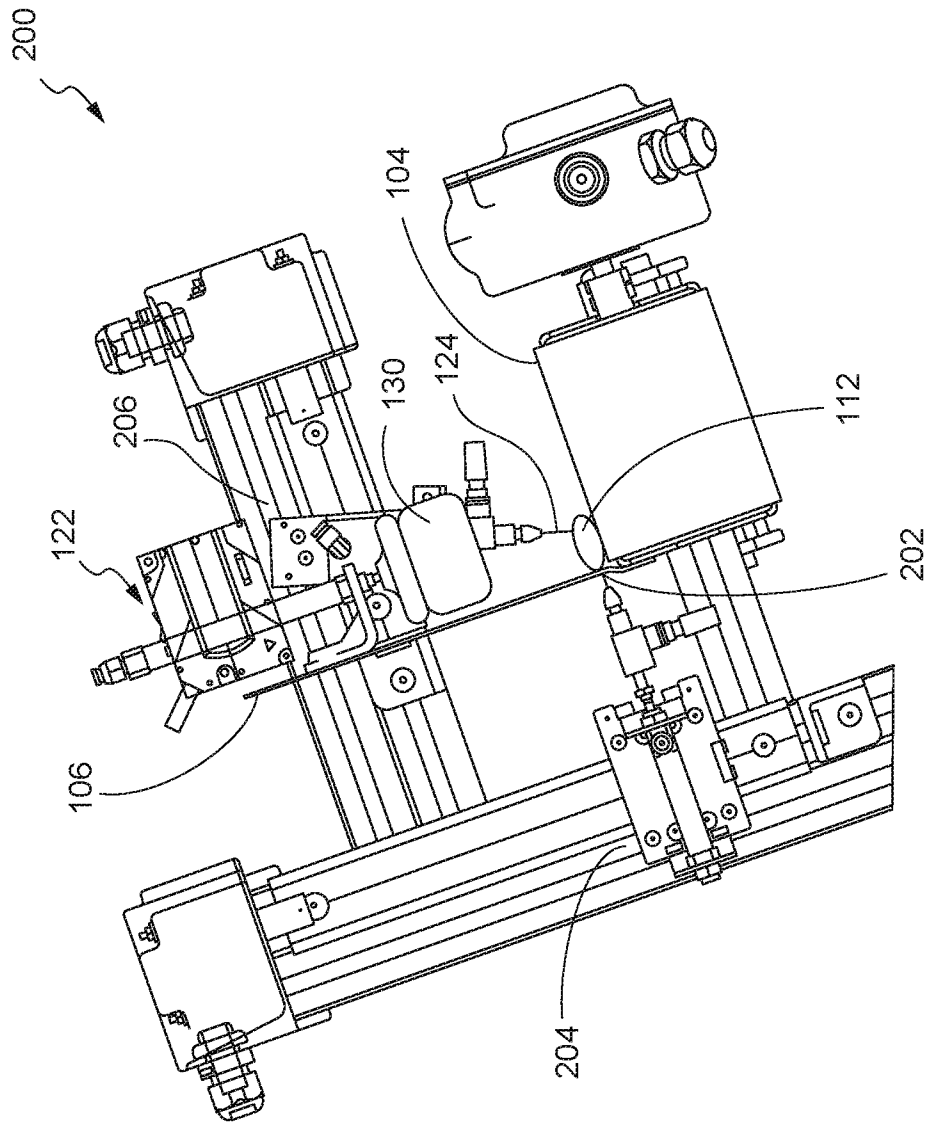


Fig. 2

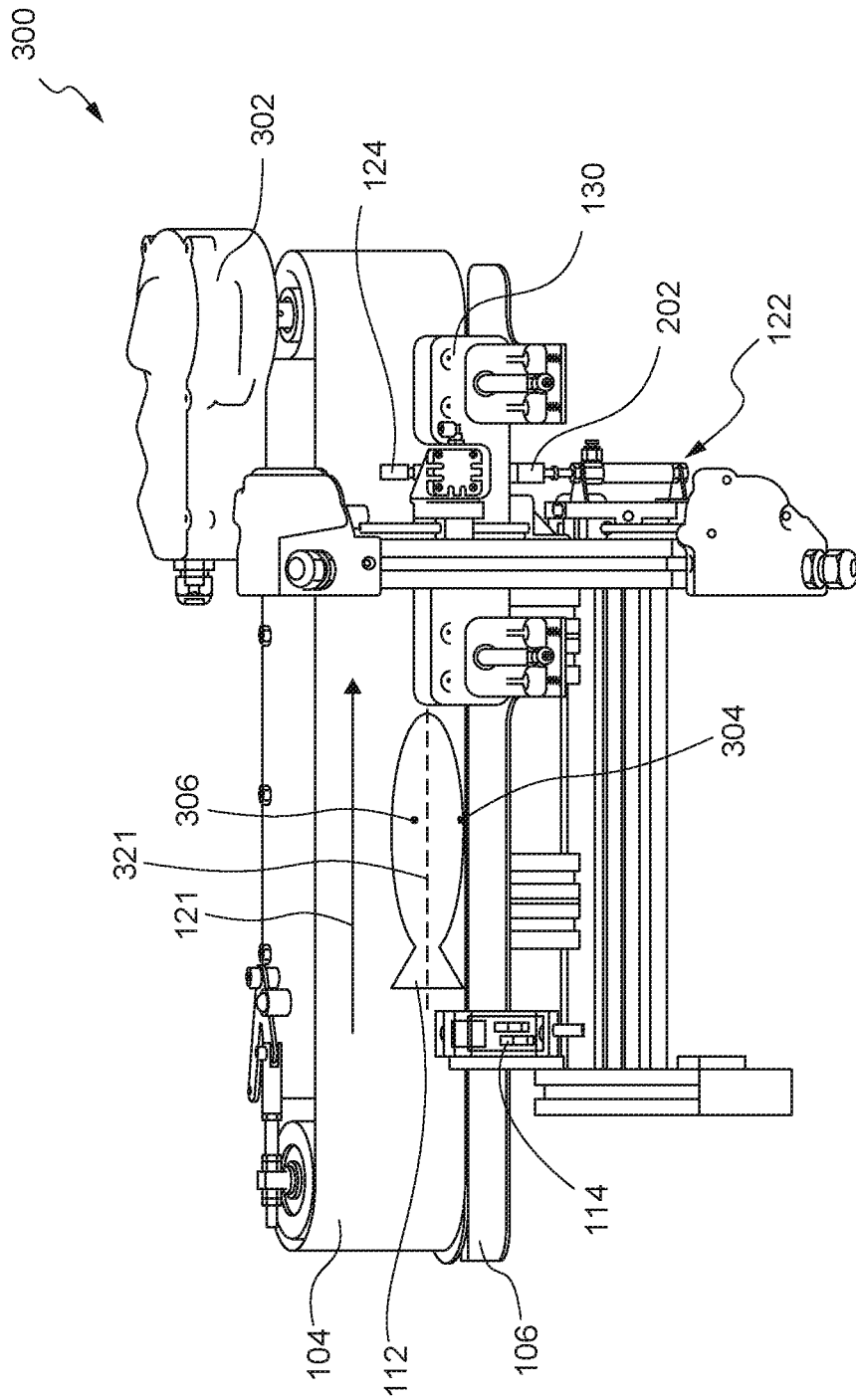


Fig. 3

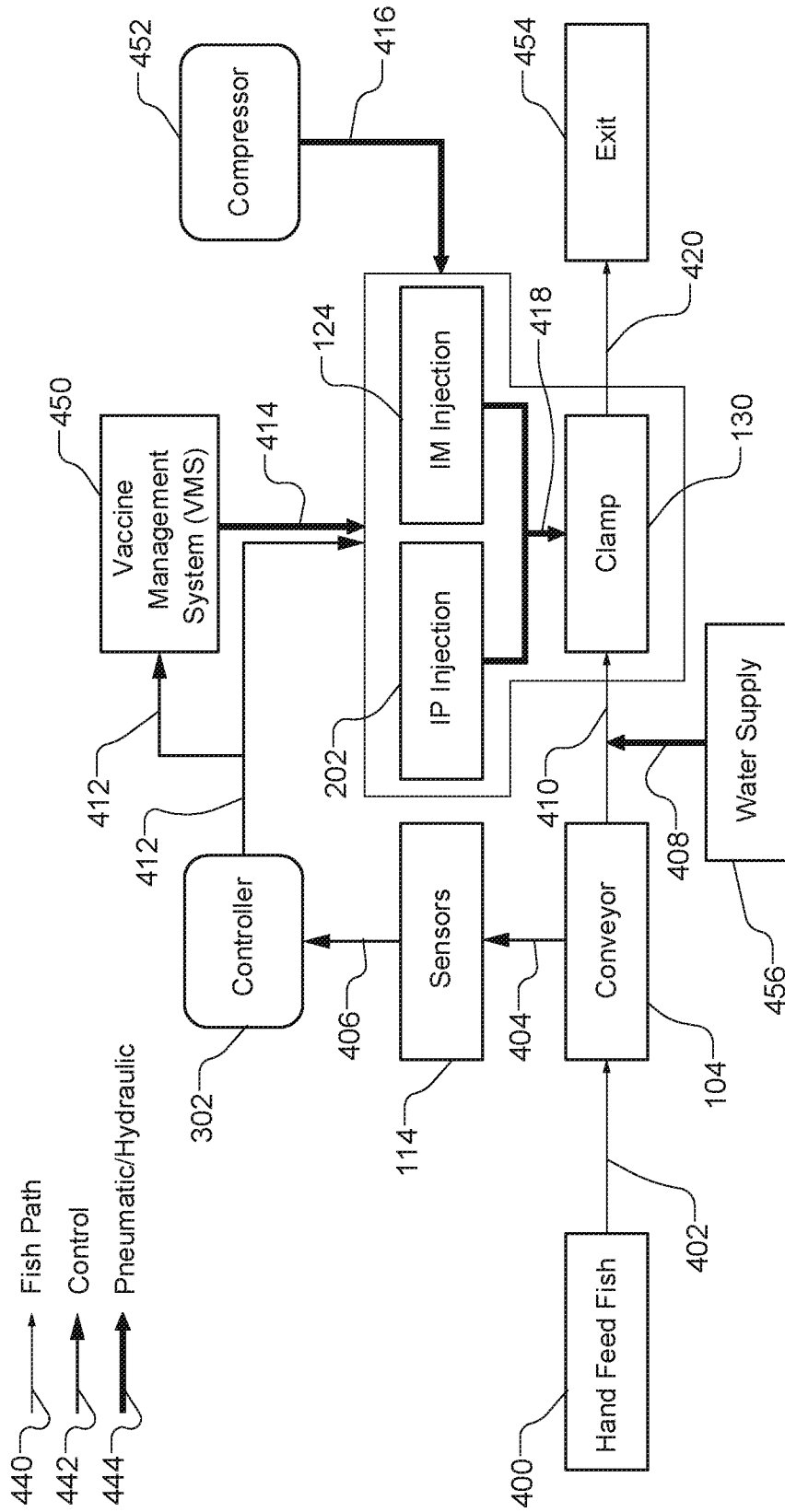


Fig. 4

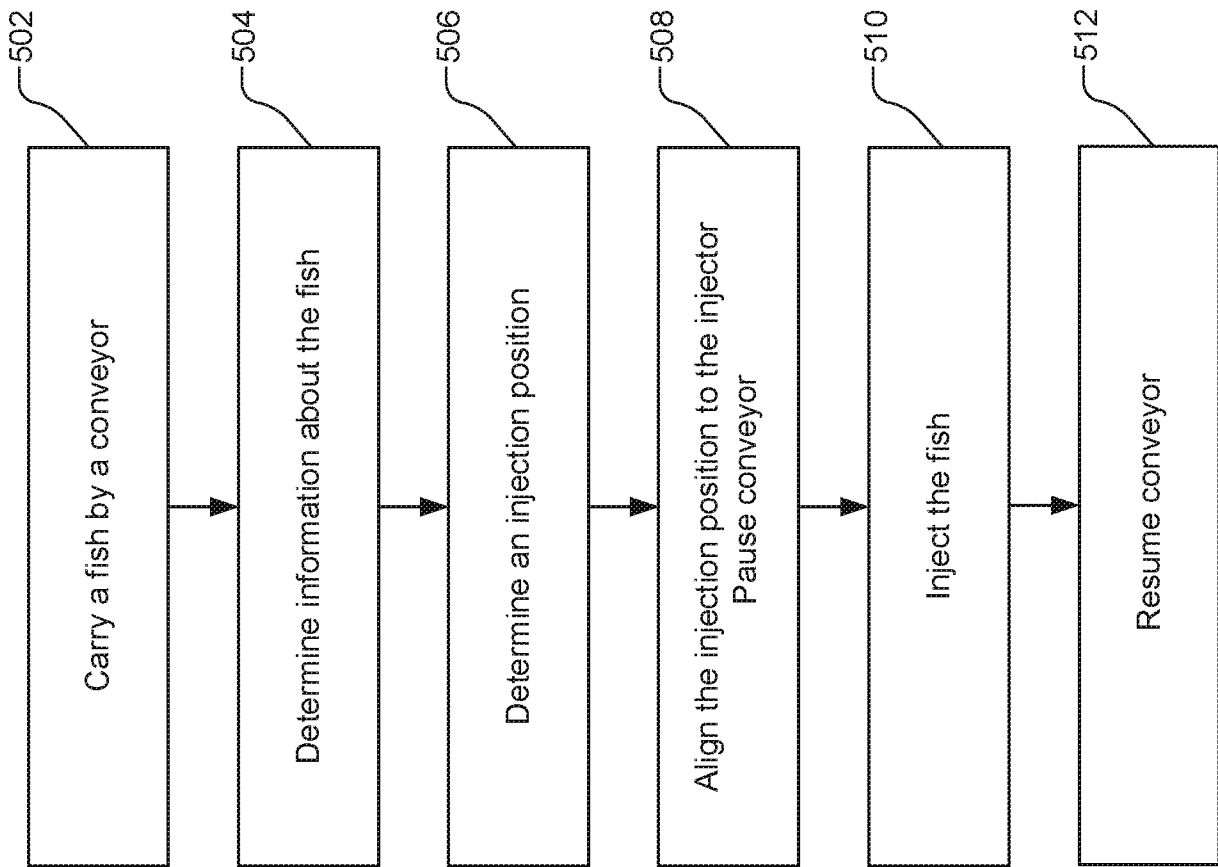


Fig. 5

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2021/052995

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	KR 101 071 880 B1 (NFRDI [KR]) 12 October 2011 (2011-10-12)	1-8, 11, 15-17
Y	[0001-0003, 0032]; claim 1; figures 1-6	9, 10
X	CN 111 406 679 A (UNIV QINGDAO AGRICULTURAL) 14 July 2020 (2020-07-14)	1-8, 11-17
	[0017, 0022, 0028, 0036]; claims 1, 2, 13, 5, 9; figures 1-4	
X	KR 101 278 630 B1 (NFRDI [KR]) 25 June 2013 (2013-06-25)	1-4, 7, 11, 15-17
	[0024, 0036-0037]; claim 1; figures 1-10, 16	
Y	CN 110 664 505 A (FISHERY MACHINERY & INSTRUMENT RES INST CAFS)	9, 10
	10 January 2020 (2020-01-10) claim 1	

Further documents are listed in the continuation of Box C.

See patent family annex.

* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier application or patent but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
- "&" document member of the same patent family

Date of the actual completion of the international search
15 March 2022

Date of mailing of the international search report
24/03/2022

Name and mailing address of the ISA/
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Authorized officer
Steinbock, Lorenz

INTERNATIONAL SEARCH REPORT

International application No.
PCT/GB2021/052995

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

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

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

2. Claims Nos.: **18-24**
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
see FURTHER INFORMATION sheet PCT/ISA/210

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

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

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

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

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

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

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

Remark on Protest

- The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box II.2

Claims Nos.: 18-24

1 Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

1.1 Rule 67.1(iv) PCT - Method for treatment of the human or animal body by surgery and therapy.

1.2 Independent method claim 18 and dependent claims 19-24 encompass the therapeutical step of injecting a vaccine into the body of a fish (Page 1, line 5-9 and respective claim 18) of a fish (Rule 6.4(b) PCT). Therefore, method claims 18-24 relate to a method for treatment of the human or animal body by surgery and therapy under Rule 67.1(iv) PCT.

1.3 Therefore, claims 18-24 are considered as methods for treatment of the human or animal body by surgery and therapy under Rule 39.1(iv) PCT.

1.4 No written opinion for such methods is required (Article 34(4) (a) (i) PCT, Rule 67.1(iv) PCT).

The applicant's attention is drawn to the fact that claims relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure. If the application proceeds into the regional phase before the EPO, the applicant is reminded that a search may be carried out during examination before the EPO (see EPO Guidelines C-IV, 7.2), should the problems which led to the Article 17(2) PCT declaration be overcome.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/GB2021/052995

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
KR 101071880	B1	12-10-2011	NONE
CN 111406679	A	14-07-2020	NONE
KR 101278630	B1	25-06-2013	NONE
CN 110664505	A	10-01-2020	NONE