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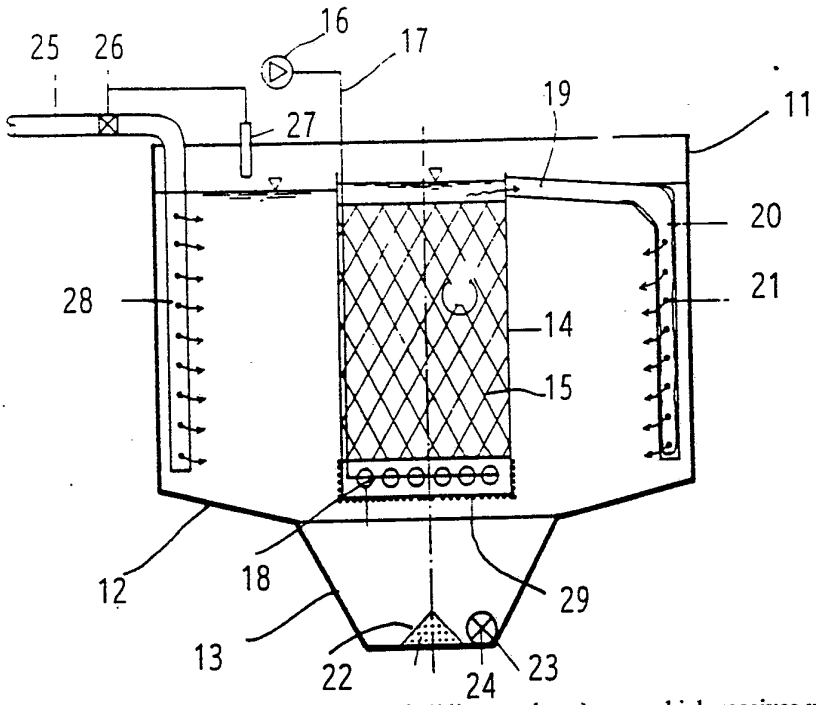

(57) Abstract

A device consisting of a unit for fish farming, includes a tank (11) or a closed cage which receives water through a water supply pipe (25) or a pump. A filter element (15) is centrally located and submerged in the water volume inside a vertical chamber (14). The bottom surface of the filter element is supplied with air which rises and carries water with it through the filter, which is preferably of a biological type. The biofilter is a lightweight, plastic medium with a large specific surface. When correctly designed, the biofilter can act as a growing surface for a culture of microorganisms which break down the organic matter and ammonia in the water. Recirculation reduces water consumption, polluted water discharge and the energy required for heating.

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Fish cultivation tank

The invention concerns a fish cultivation tank of the type described in Claim of Patent 1, for the production of smolt or fish for consumption.

Background to the invention:

Fish in a fish tank generally grow faster the higher the temperature of the water. This applies upto a specific upper temperature. For salmon this boundary is about 15-20°C.

Consequently, to achieve maximal growth or production in a climate such as in Norway, there is a need for water heating throughout much of the year. Since heating is expensive, energy costs can be reduced considerably if the water could be reused.

This will also reduce both the consumption of inlet water and the amount of polluted waste water discharged.

Systems of water reuse or recirculation necessitate the removal of pollution caused by spills of feed and fish excretion. This is necessary to prevent the pollution being concentrated in layers which result in reduced rates of growth, or the death of fish.

Water in recirculation units is traditionally treated by a series of separate processes, this makes such plants complex both in terms of design and operation.

Existing recirculation units are based on a series of water treatments, such as: heating, aeration, particle removal, ammonia removal and disinfection. This has made such units complex and often their efficiency depends on how well the various units are designed for the water quality that requires treatment.

Current knowledge about how to design such water treatment units in recirculation plants for fish farming is extremely restricted. The design criteria which have been used has usually been derived from other qualities of water such as drinking water or municipal waste water. This has led to design errors in existing recirculation units used in aquaculture which have been the cause of numerous operational problems.

Traditional recirculation plants consist of many components and fish farmers without training in the operation of treatment units find them complicated, hard to grasp and difficult to operate.

Conventional recirculation tanks treat a stream of water collected from a large number of fish tanks. This means that specific types of pollution created by feed and the fish have to be transported a long way to the treatment unit. Thus the particles are exposed to erosion and dissolution processes which make the pollution hard to remove in particle form. Another difficulty is that the periodic removal of deposits and fouling from transport pipes create load peaks which cause operational difficulties in the plant. Apart from the capital costs, conventional recirculation plants also necessitate operational costs associated with the individual treatment units.

The cage systems currently used in fish farms also suffer from a number of drawbacks. Since a cage is an open system one is dependent on the natural variations in water temperature and water quality in general. Poor

feed utilization results in sludge under the cages, which is detrimental to the environment for the fish. Fish have been destroyed by jellyfish, algae, micro-organisms as well as low water temperatures. A closed unit with land-based tanks or sealed cages based on the present invention will reduce these problems connected with the environment and disease whilst increasing feed utilization and the growth of the fish.

Purpose of the invention

The main purpose of the invention is to create a unit which utilizes all the advantages associated with water recirculation. The unit is very simple, inexpensive to manufacture and requires minimal maintenance. The objective is to minimize labour costs, water consumption/discharge and the heating requirements, so that fish can be farmed at a lower cost than at present. The invention offers all the advantages of a closed plant for fish farming applications.

Principle of the invention

The main aspects of the invention are given in the characterizing part of Claim of Patent 1, which defines the basic configuration of the system.

Other aspects of the invention are stated in the subsidiary claims.

Example.

The invention will be explained in more detail with reference to the illustrations, where:

Figs. 1-3 respectively show a vertical section (A) and a plane overhead perspective (B) of three means of designing a fish tank in accordance with the present invention.

In Fig. 1 the design shows a fish tank 11 with a regular octagonal or circular horizontal section and a bottom 12 which inclines towards a sunken area 13. In the centre of the tank 11 there is a cylindrically-shaped chamber 14 which has an equivalent octagonal or circular horizontal section, without a top or bottom. A biological filter or "biofilter" 15 is located in the chamber 14 to remove pollution from the water. The biofilter 15 consists of a thin-walled, plastic medium with a large specific surface which can be used to provide a surface for the cultivation of specified types of microorganisms.

A fan or air pump 16 is connected to a pipe 17 which supplies air to the bottom of the biofilter, where it is spread by means of nozzles or diffusers 18. This air injection creates a rising column of water in the biofilter 15. This means that water is pumped from the lower area of the tank, through the biofilter and led from here back into the tank, thus the biofilter acts as an air lift pump and hereby provides internal cleansing and water recirculation.

To ensure that the water return completes a circular path in the tank, the water that flows through the biofilter at the top of the filter chamber 14 is led along a horizontal channel 19 and down a perforated distribution pipe 20. A disposable filter bag 21 can be located inside the distribution pipe 20. This filter could be made of textile and has the function of removing particles from the water before they flow out of the distribution pipe 20 into the tank.

In the sunken area 13 at the base of the tank there is a cone 22 which has the function of creating eddies, in addition there is a horizontal outlet pipe 23 with a magnetic valve 24 controlled by a timer. This valve ensures that particles are removed from the sunken area

13, which forms a pocket where sludge can collect. In a closed cage, the magnetic valve can be replaced by a suction pipe from a pump placed above the level of the water.

A supply pipe 25 is used for water replenishment, this has a valve 26 which is controlled by a water-level sensor 27. Leading vertically downwards from the valve 26 is an inlet pipe 28. This pipe is perforated and located close to the wall of the tank.

The filter chamber 14 is closed at the bottom by a grid 29 which allows the water through its mesh to the biofilter 15. The mesh prevents fish from entering this area.

An alternative means of design is shown in Fig. 2 where the equivalent parts are given the same references as in Fig. 1.

The filter chamber 14' has a double wall on two opposite sides, 31 and 32 respectively. This creates two overflow slits 33 and 34 which are connected by pipes 35 and 36 to two perforated vertical distribution pipes 37 and 38. A meshed grid 39 is located between the main part of the bottom 12' and the filter chamber 14', the mesh permits particles to pass through but hinders fish from entering the sludge pocket 13'.

Fresh water is supplied by two supply pipes 40 and 41 to below the vertical distribution pipes 37 and 38, these are controlled in a similar way to the example above.

Fig. 3 presents a design which is intended for use in existing fish tanks. The reference numbers are once again the same as in Fig. 1. The main difference with this design is the construction of the central filter unit 42. On the two opposing sides of the filter

chamber 14" there are double walls 31 and 32 which each have a vertical outflow slit 43 and 44 at opposing corners. Two guide plates 45 and 46 extend outwards as continuations of the respective walls. These will enable the recirculated water to flow into the fish tank from two sides of the filter chamber without requiring transfer pipes.

With a unit which is designed in accordance with the invention, such as that described in the examples, the biological filter 15 will remove unwanted pollutants from the water such as primary organic matter and ammonia. The object of forcing the water outwards from the central filter element into the peripheral areas of the tank is to get the water in the tank into circular motion. The quantity of recirculated water can be altered by varying the air flow and the water level so as to regulate the water velocity in the tank at an optimal value for a specific type and size of fish.

The biofilter is a lightweight, plastic medium with a large specific surface. If the design is correct, the biofilter will produce a culture of microorganisms which can break down organic matter and ammonia in the water. The ammonia is excreted by the fish and will exist in water in chemical equilibrium with unionized ammonia. Unionized ammonia is toxic for fish even in extremely low concentrations (25 µg/l). The oxygen that the fish and these microorganisms consume is balanced by the incoming airstream.

The invention has devised a simple way to reuse the heated water, which is straightforward in terms of size and operation.

Operational costs are primarily connected to the running cost of the air blower. If the degree of recirculation is very high and the incoming water has low alkalinity, it may be necessary to add a base to

the water.

With a unit designed in accordance with the invention there will be drastic reductions in the consumption of energy and inlet water as well as the amount of polluted discharge water.

Even with restricted water flow into the tank, the internal recirculation will be able to create satisfactory water velocity in the tank, this in turn provides a comfortable environment for the fish.

Particles are removed in the same unit as they are created. A considerable amount of the pollution can be removed in the form of particles without the unfortunate consequences of erosion and dissolution.

The fish farmer does not face the choice of recirculation or not. He/she can just start with a fish tank, learn to use the process and expand operations as he/she decides.

The invention can theoretically restrict the spread of diseases to only the tank with the infected fish.

A fan or air blower is the only piece of powered equipment required by the system. This makes it economically feasible to have a reserve power unit, thus making the system extremely reliable. Another matter is if there is a failure in the supply of water from the outside, with the present invention it will take a long time before any damage is caused. Similarly, periods with poor water quality in the incoming water will be cancelled out and counterbalanced in the tank.

The practical design of the tank and the filter element in the example can be varied considerably.

Apart from the production of smolt, the system can also be used for fish farming in seawater, either using a tank on land or a closed cage where the biofilter is placed centrally in the cage as described above.

Claim of Patent:

1. A device including a unit for fish farming, consists of a tank (11) or a closed cage which receives water through a water supply pipe (25) and where integrated with the tank there is a unit for the biological filtration of recirculating water, c h a r a c t e r i z e d by a filter element, which is preferably centrally located and submerged in the water volume inside a vertical chamber (14), in a way that the bottom surface of the filter element is supplied with air which rises and carries water with it though the filter.

2. A device in accordance with Claim of Patent 1 is c h a r a c t e r i z e d by a filter element (15) consisting of a biological filter, which preferably is made of a thin-walled plastic medium with a large specific surface which can act as a growing surface for nitrifying microorganisms.

3. A device in accordance with Claims of Patent 1 or 2 is c h a r a c t e r i z e d by water which is led through the filter element (15) being fed into one or more perforated vertical distribution pipes (20,; 37, 38) at the edge of the tank.

4. A device in accordance with Claim of Patent 3 is c h a r a c t e r i z e d by the transfer from the upper edge of the filter element (15) to the distribution pipe (20) or distribution pipes, by means of an overflow channel (19).

5. A device in accordance with Claim of Patent 3 is c h a r a c t e r i z e d by that at least on one side of the chamber (14') which contains the filter element (15') there is a double wall (31) which forms a overflow chamber (32) for

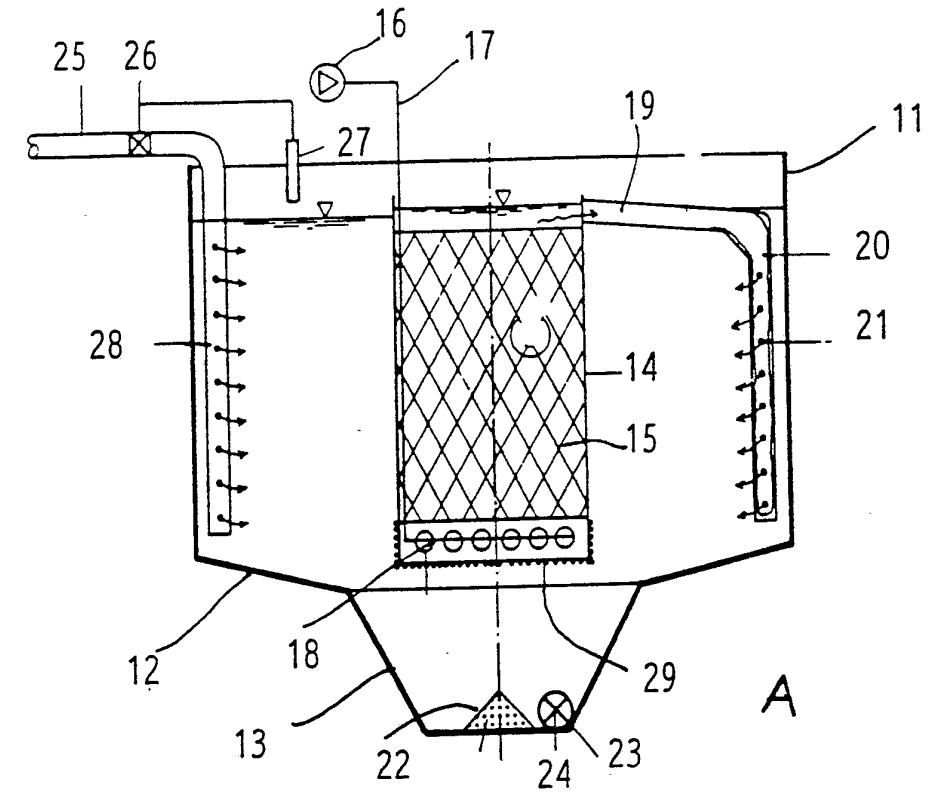
recirculated water which is connected by a pipe (35) to a distribution pipe (37).

6. A device in accordance with Claims of Patent 1 or 2 is c h a r a c t e r i z e d by a chamber (14") which contains a biofilter element (15") is equipped with an overflow chamber on at least one side, with a vertical outflow slit (43) into the fish tank.

7. A device in accordance with one of Claims 1-6 is c h a r a c t e r i z e d by an inlet into the filter element (15) which has a grid (29, 39) to prevent fish entering the filter element.

8. A device in accordance with one of Claims 1-7 is c h a r a c t e r i z e d by air injection at the bottom of the filter element (15) by an air diffuser (18) using known methods.

9. A device in accordance with one of Claims 1-8 is c h a r a c t e r i z e d by a sunken area (13) with an outlet pipe (23) for the collection and removal of sludge and particles, which is located beneath the filter element (15) at the base (12) of the fish tank.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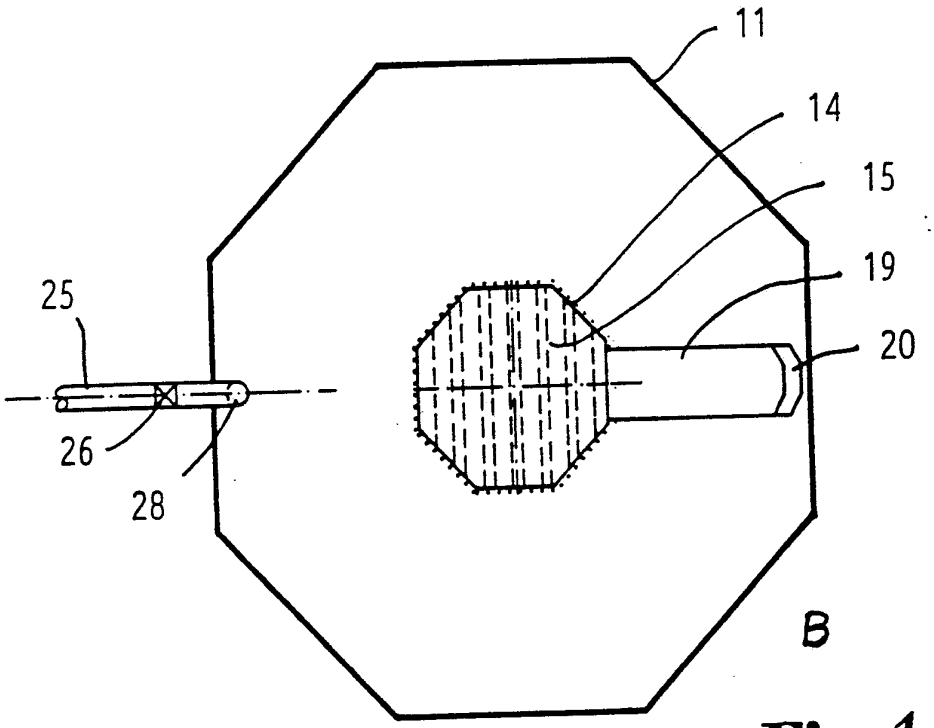
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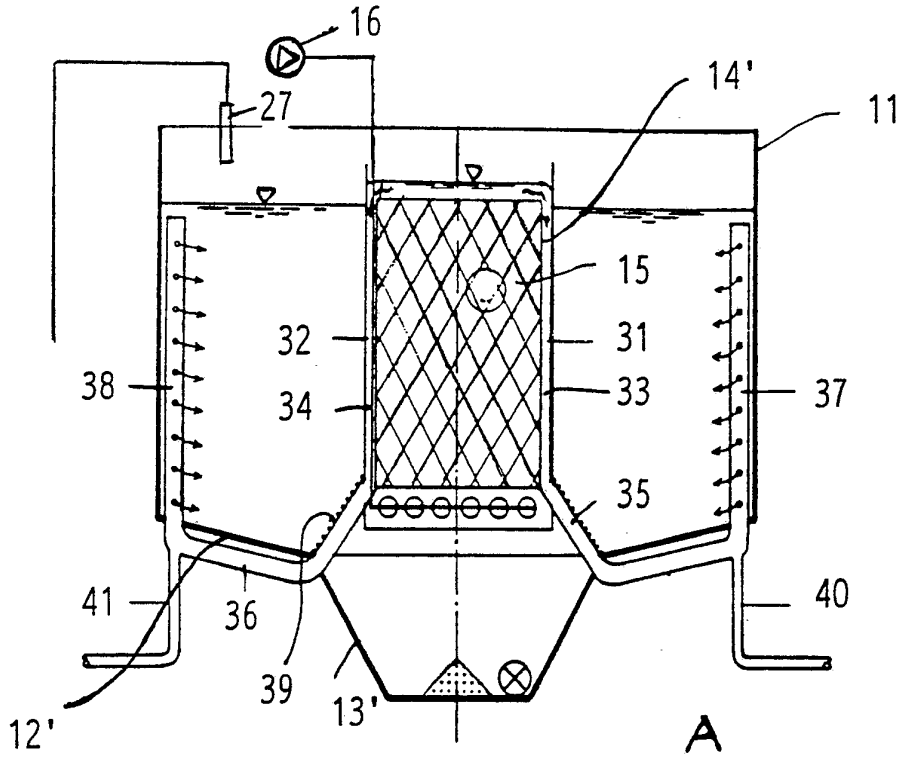
Fig. 1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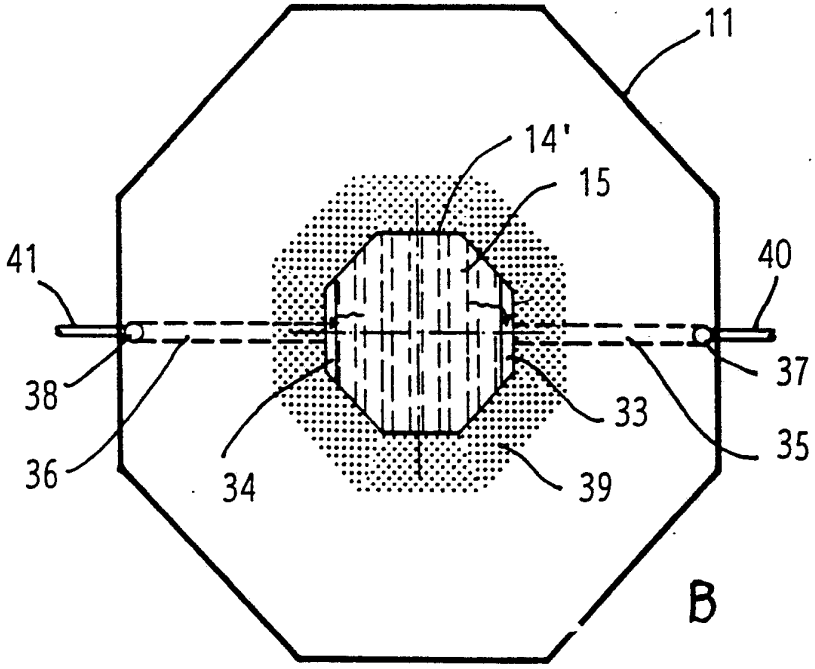
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Fig. 2

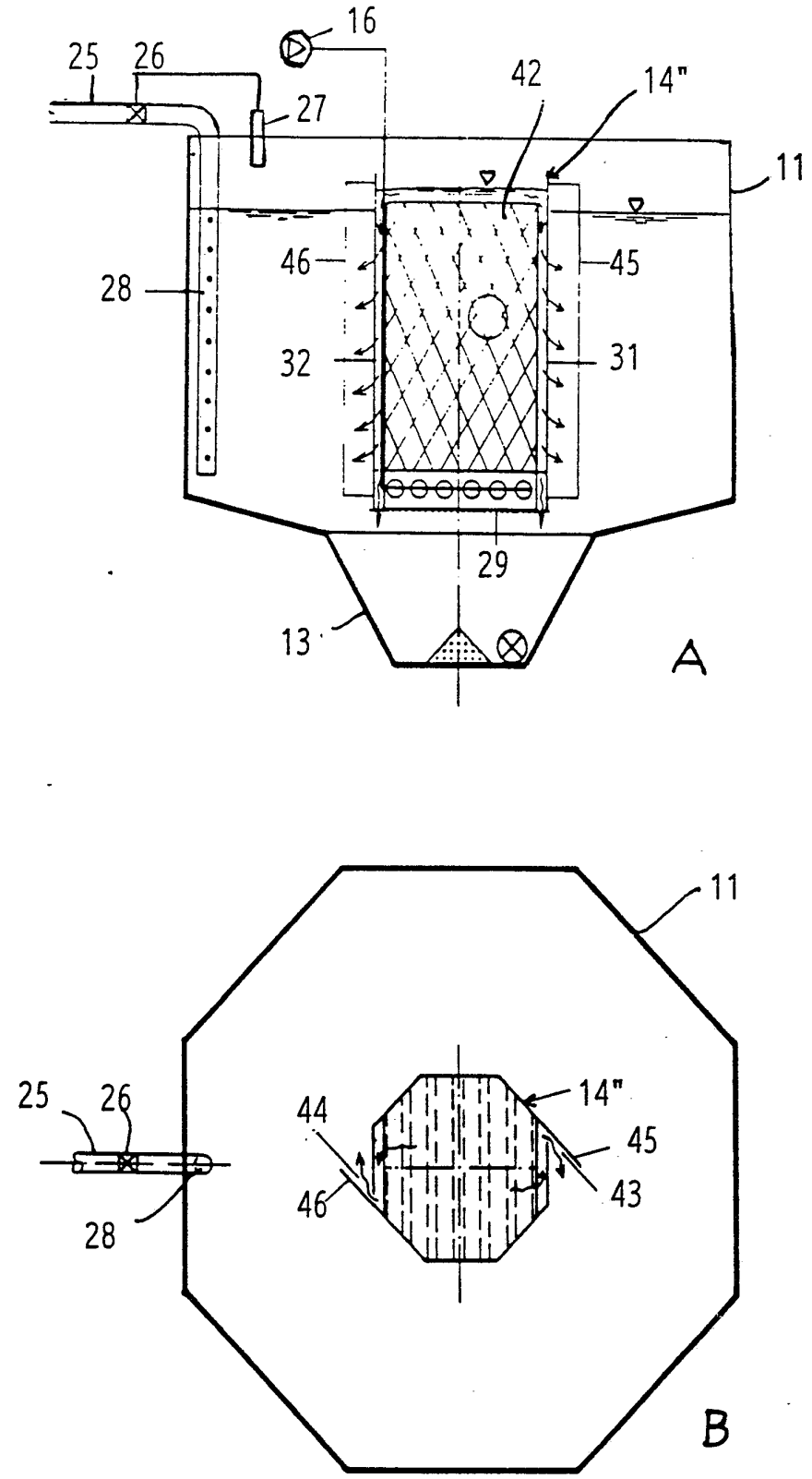

Fig. 3

INTERNATIONAL SEARCH REPORT

International Application No PCT/N088/00050

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC 4

A 01 K 61/00

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC 4	A 01 K 61/00, 63/00, /04
US Cl	119:3, 5

Documentation Searched other than Minimum Documentation to the Extent that such Documents are included in the Fields Searched [8]

SE, NO, DK, FI classes as above.

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category *	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
X	Aqua Teknikk 86, 21 august 1986. (B. Rusten and B. Eikebrokk), "Intensivering av smoltproduksjon ved resirkulering av vannet".	1-4 8-9
X	EP, A2, 151 852 (SUISAKU KABUSHIKI KAISHA) 21 August 1985 See fig. 1, p. 4 l 16 - p. 5 l. 3 & JP, 60153910 US, 4552657	1-2
P	GB, A, 2 195 910 (CHI-LOK TONG) 20 April 1988	1
A	US, A, 4 211 183 (DAVID P. HOULT) 8 July 1980 & GB, 2001831 JP, 54040196	1-9
A	GB, A, 1 329 962 (GRAHAM FREDERICK COX) 12 September 1973	1-9

* Special categories of cited documents: [10]

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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
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Swedish Patent Office	Kerstin Boije Jänson

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