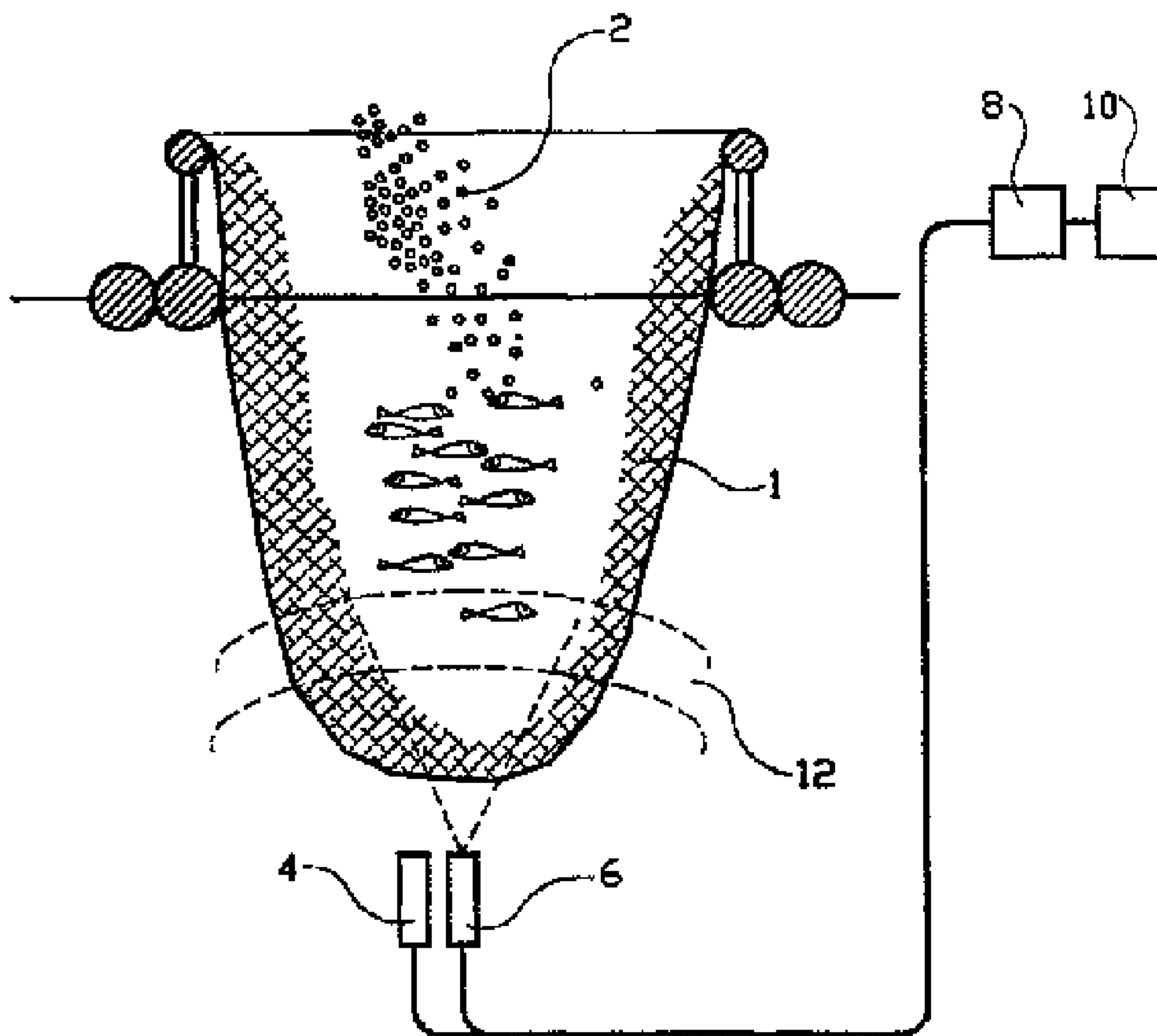




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(54) Titre : DETECTEUR D'ALIMENTS EXCEDENTAIRES  
 (54) Title: FEED WASTE DETECTOR



(57) Abrégé/Abstract:

A method and a device for detecting fodder waste/loss within a fish enclosure (1), where a sound transmitter (4) and a hydrophone (6) are disposed as an upwardly directed echo sounder close to the bottom of the enclosure (1). Sound echos from objects situated above the sound transmitter (4), are picked up by the hydrophone (6). A measuring unit (8) separates signals

**(57) Abrégé(suite)/Abstract(continued):**

from the hydrophone (6) into various frequency bands close to the transmitted sound frequency. The distance and amount of the objects are determined in a way similar to the one used in echo sounders. Sinking objects will cause reflected sounds having frequencies slightly higher than the transmitted frequency, so called Doppler effect, and the frequency difference is a measure of the sinking speed of the object. An analyzing unit (10) emphasizes frequencies corresponding to a characteristic sinking speed for the actual type of fodder (2) and gives signals about fodder waste/loss when a predetermined minimum amount of objects having the characteristic sinking speed are detected within a predetermined distance area.

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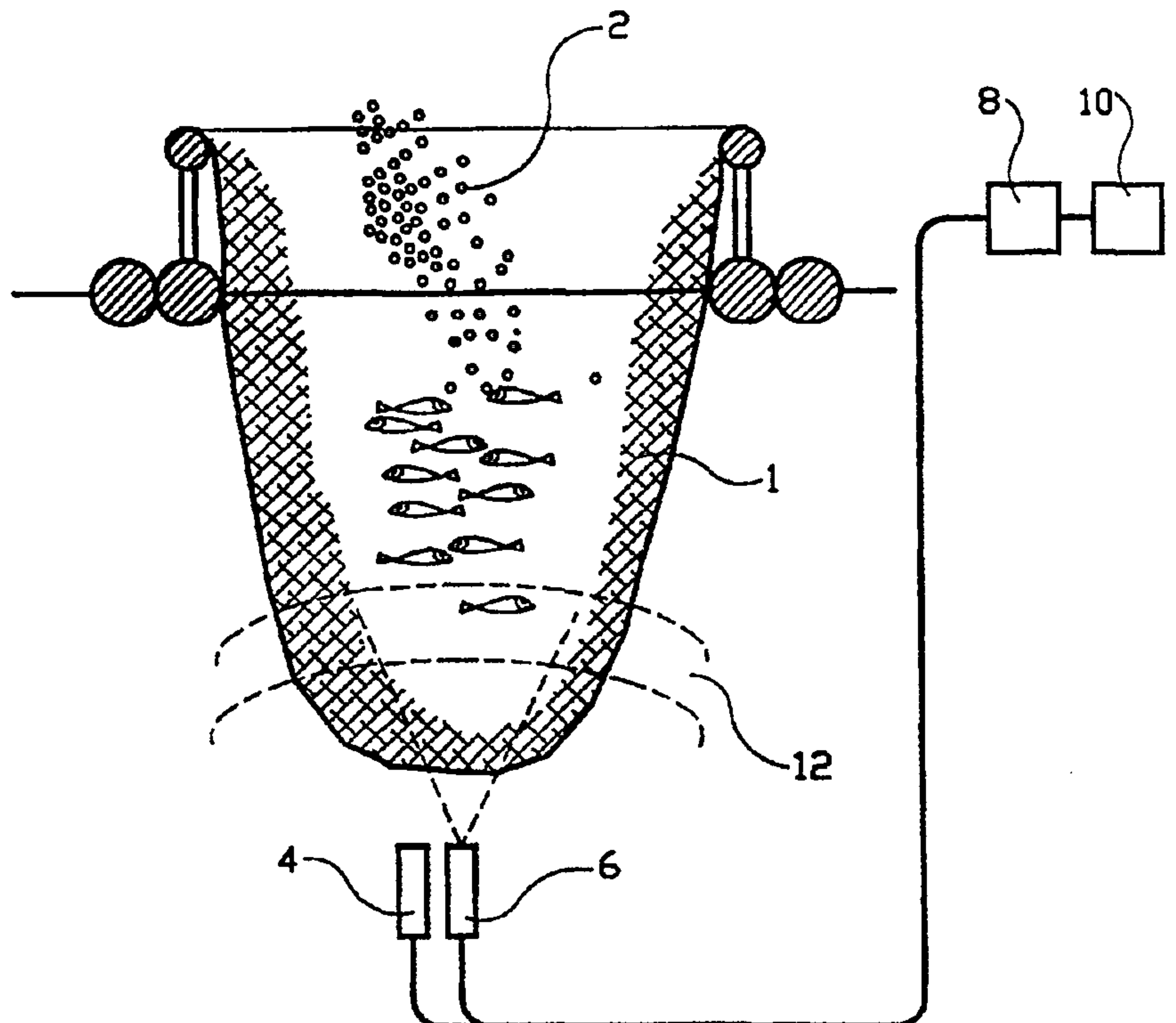
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<p>(21) International Application Number: PCT/NO95/00209 (22) International Filing Date: 8 November 1995 (08.11.95) (30) Priority Data: 944276 10 November 1994 (10.11.94) NO (71) Applicant (for all designated States except US): AKVA A/S [NO/NO]; Nordlysveien 4, N-4340 Bryne (NO). (72) Inventor; and (75) Inventor/Applicant (for US only): MOLAUG, Ole [NO/NO]; Tytebærholen 30, N-4340 Bryne (NO). (74) Agents: HÅMSØ, Borge et al.; Håmsø Patentbyrå, P.O. Box 171, N-4301 Sandnes (NO).</p>		<p>(81) Designated States: AL, AM, AT, AT (Utility model), AU, BB, BG, BR, BY, CA, CH, CN, CZ, CZ (Utility model), DE, DE (Utility model), DK, DK (Utility model), EE, ES, FI, FI (Utility model), GB, GE, HU, IS, JP, KE, KG, KP, KR, KZ, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (Utility model), TJ, TM, TT, UA, UG, US, UZ, VN, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG), ARIPO patent (KE, LS, MW, SD, SZ, UG).</p> <p><b>Published</b> With international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments. In English translation (filed in Norwegian).</p>

(54) Title: FEED WASTE DETECTOR

## (57) Abstract

A method and a device for detecting fodder waste/loss within a fish enclosure (1), where a sound transmitter (4) and a hydrophone (6) are disposed as an upwardly directed echo sounder close to the bottom of the enclosure (1). Sound echos from objects situated above the sound transmitter (4), are picked up by the hydrophone (6). A measuring unit (8) separates signals from the hydrophone (6) into various frequency bands close to the transmitted sound frequency. The distance and amount of the objects are determined in a way similar to the one used in echo sounders. Sinking objects will cause reflected sounds having frequencies slightly higher than the transmitted frequency, so called Doppler effect, and the frequency difference is a measure of the sinking speed of the object. An analyzing unit (10) emphasizes frequencies corresponding to a characteristic sinking speed for the actual type of fodder (2) and gives signals about fodder waste/loss when a predetermined minimum amount of objects having the characteristic sinking speed are detected within a predetermined distance area.



### Feed waste detector

The invention relates to a method and a device for detecting fodder loss and waste in connection with the breeding of fish.

Fodder loss and waste represent great losses of value in the breeding of fish and, moreover, fodder loss and waste result in pollution. It is important to the breeder to utilize the growth potential of the fish as good as possible, and to achieve this, the allotment of fodder must be close to maximum. External environmental changes, e.g. the seeping in of colder water, may rapidly reduce the appetite of the fish, thus causing excess feeding, resulting in fodder loss and waste, especially when automatic feeding machines are used. It is known to control the feeding in relation to water temperature and other factors, but these measures have not been sufficient to avoid waste and loss of fodder. One has tried to measure the appetite of the fish as a function of its activity and reaction to feeding, but this approach has not given a satisfactory result either. Therefore, a need for a device capable of detecting fodder loss and waste directly in order to reduce the supply of fodder, has existed since a long time ago.

Several devices for detecting waste and loss of fodder have been tried out. A known detecting device utilizes an echo sounder principle combined with a computer analyzing a relatively complex echo sounder image, but this device has not spread, firstly because it is too expensive and secondly because it does not give a reliable detection. The pollution problem was reduced upon the arrival of devices collecting fodder not eaten. Such devices for collecting fodder comprise a bag which is attached beneath the "fence" enclosing the fish. Also, it is known to dispose risers with gas lift or other form of pumping for transferring the fodder from the collecting bag to the surface. The equipment makes it difficult to work with the enclosure in connection with the daily operation of the breeding plant. Moreover, the collecting bags are less efficient in areas where currents are frequent. Due to the loss of the nutritive value arising when the fodder has been staying in water for some time, this collected fodder was seldom used a second time and, thus, the fodder loss and waste still represent an economic loss for the breeder, even in cases where pollution is reduced.

The object of the invention is to provide a method and a device for detecting loss and waste of fodder.

The object is obtained through features as defined in the following claims.

It is therefore an aim of the present invention to provide method for detecting fodder waste/loss in connection with the breeding of fish, comprising the steps of: providing a sound transmitter and a hydrophone, using said sound transmitter for transmitting sound waves having a first frequency through the water, the frequency of the

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transmitted sound waves being changed by objects moving towards or away from the sound transmitter, using said hydrophone for receiving the sound waves transmitted through the water, separating the received sound waves into different frequencies, and transferring information concerning said frequencies for analyzing purposes, wherein the vertical speed of objects situated at a distance beneath a surface of the water within an area of feeding is measured and compared with a sinking speed of fodder particles in order to control fish feeding in relation to the amount of fodder particles sinking in the water

It is therefore a further aim of the present invention to provide a method for detecting fodder waste/loss in connection with the breeding of fish, comprising the steps of: providing a sound transmitter and a hydrophone, using said sound transmitter for transmitting sound waves having a first frequency through the water, the frequency of the transmitted sound waves being changed by objects moving towards or away from the sound transmitter, using said hydrophone for receiving the sound waves transmitted through the water, separating the received sound waves into different frequencies, and transferring information concerning said frequencies for analyzing purposes, wherein the vertical speed of objects located at a distance beneath a top surface of the water within an area of feeding is measured by means of the Doppler effect, the fodder waste/loss being signaled when the amount of objects exhibiting a vertical speed substantially similar to the sinking speed of the fodder particles in water exceeds a predetermined value.

An exemplary embodiment of the invention is described in the following with reference to the attached drawing.

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In the figure, reference numeral 1 denotes a floating enclosure for fish, fodder being supplied from above. In the bottom or close to the bottom of the enclosure 1, possibly beneath the enclosure if it has a net bottom, a sound transmitter 4 and a hydrophone 6 have been disposed, both connected to an electronic measuring unit 8 and an electronic analyzing unit 10.

The measuring unit 8 is adapted to drive the sound transmitter 4, such that sound waves are transmitted in a similar way as known from echo sounders. The sound waves are substantially directed upwardly. The hydrophone 6 is adapted to pick up sound waves within a frequency band comprising the sound frequency transmitted from the sound transmitter 4. The measuring unit 8 is adapted to separate the sound received by the hydrophone 6 into different frequencies and to transfer information concerning existing frequencies to the analyzing unit 10.

Fodder, fish and other objects occupying positions above the sound transmitter 4, will reflect some of the transmitted sound energy picked up by the hydrophone 6 in a manner corresponding to that of an echo sounder. Objects moving in a direction towards or away from the sound transmitter 4, i.e. vertically, will additionally cause a change of frequency, the so-called Doppler effect. Thus, the frequency distribution of the received sound signal becomes a measure of vertical movement of objects located above the sound transmitter 4.

Fish feeder has a characteristic speed of sinking, frequently very low, and the analyzing unit 10 is adapted to react to frequencies correspondingly above the sound frequency transmitted by the sound transmitter 4. The analyzing unit 10 which advantageously can be realized by means of microprocessor electronics, is adapted to weigh the intensity of the existing sound frequencies and, on the basis thereof, to give a signal about fodder loss/waste upon a predetermined occurrence of frequencies higher than the sound frequency transmitted.

In order to avoid that sinking fodder close to the surface causes the development of a signal about fodder waste/loss, the analyzing unit 10 can advantageously be adapted to react only to sound waves reflected from objects located within a restricted area 12 from the hydrophone 6. As known per se, the distance is measured by measuring the running time for



the sound from the sound transmitter 4. By measuring the occurrence of sinking objects at several distances from the hydrophone 6, the analyzing unit 10 can compute how large a share of the fodder supplied to the fish that has been lost and, thus, give a graded signal to the automatic feeding machine, which can reduce the allotment of fodder correspondingly.

In the exemplary embodiment, the sound transmitter 4 and the hydrophone 6 are positioned below the enclosure 1, and the hydrophone 6 is adapted to react to approaching fodder particles. In connection with floating fodder which is allotted from below, the sound transmitter 4 and the hydrophone 6 can be directed downwardly and be positioned adjacent the surface. Of course, it is also possible to adapt the analyzing unit 10 to react to objects moving away from the hydrophone 6, and to position the sound transmitter 4 and the hydrophone 6 accordingly. In areas subjected to strong current, it may be necessary to place the sound transmitter 4 and the hydrophone 6 such that the fodder will be moving as straight as possible towards the hydrophone 6 or as straight as possible away from the same. If the current direction is varying, it might be necessary to dispose several sound transmitters 4 and/or a plurality of hydrophones 6, and to read the one or the ones best suited according to the current direction prevailing at the moment.

Normally, the sound transmitter 4 and the hydrophone 6 will be built together forming one unit. Information may, if desired, be transferred wirelessly between the measuring unit 8 and the sound transmitter 4 respectively the hydrophone 6 by means of sound signals or electromagnetic signals having an appropriate frequency, including light and radio waves.

## CLAIMS:

1. A method for detecting fodder waste/loss in connection with the breeding of fish, comprising the steps of: providing a sound transmitter and a hydrophone, using said sound transmitter for transmitting sound waves having a first frequency through the water, the frequency of the transmitted sound waves being changed by objects moving towards or away from the sound transmitter, using said hydrophone for receiving the sound waves transmitted through the water, separating the received sound waves into different frequencies, and transferring information concerning said frequencies for analyzing purposes, wherein the vertical speed of objects situated at a distance beneath a surface of the water within an area of feeding is measured and compared with a sinking speed of fodder particles in order to control fish feeding in relation to the amount of fodder particles sinking in the water.

2. A method as defined in claim 1, wherein the vertical speed of the objects is determined on the basis of a change of frequency caused by the speed of the objects relative to the hydrophone which receives the sound waves reflected by the objects in the water.

3. A method as defined in claim 2, wherein the vertical speed is measured only for objects located within a restricted area from the hydrophone.

4. A device for carrying out the method defined in claim 1, wherein said sound transmitter and said hydrophone are positioned below or above the feeding area

and are connected to a measuring unit, the measuring unit being connected to an analyzing unit adapted to transmit sound signals through the sound transmitter and to receive the sound signals from the hydrophone via the measuring unit, said analyzing unit reacting to sound frequencies higher and lower than the sound frequency transmitted by the sound transmitter.

5. A method for detecting fodder waste/loss in connection with the breeding of fish, comprising the steps of: providing a sound transmitter and a hydrophone, using said sound transmitter for transmitting sound waves having a first frequency through the water, the frequency of the transmitted sound waves being changed by objects moving towards or away from the sound transmitter, using said hydrophone for receiving the sound waves transmitted through the water, separating the received sound waves into different frequencies, and transferring information concerning said frequencies for analyzing purposes, wherein the vertical speed of objects located at a distance beneath a top surface of the water within an area of feeding is measured by means of the Doppler effect, the fodder waste/loss being signaled when the amount of objects exhibiting a vertical speed substantially similar to the sinking speed of the fodder particles in water exceeds a predetermined value.

6. A method as defined in claim 5, wherein the vertical speed of the objects is determined on the basis of a change of frequency caused by the speed of the objects relative to the hydrophone which receives the sound waves reflected by the objects in the water.

7. A method as defined in claim 6, wherein the vertical speed is measured only for objects located within a restricted area from the hydrophone.

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