June 26, 1962 R. L. MANN ETAL 3,040,980

METHOD AND APPARATUS FOR COUNTING MOBILE AQUATIC CREATURES

Filed Feb. 19, 1957 3 Sheets-Sheet 1

FIG. 1

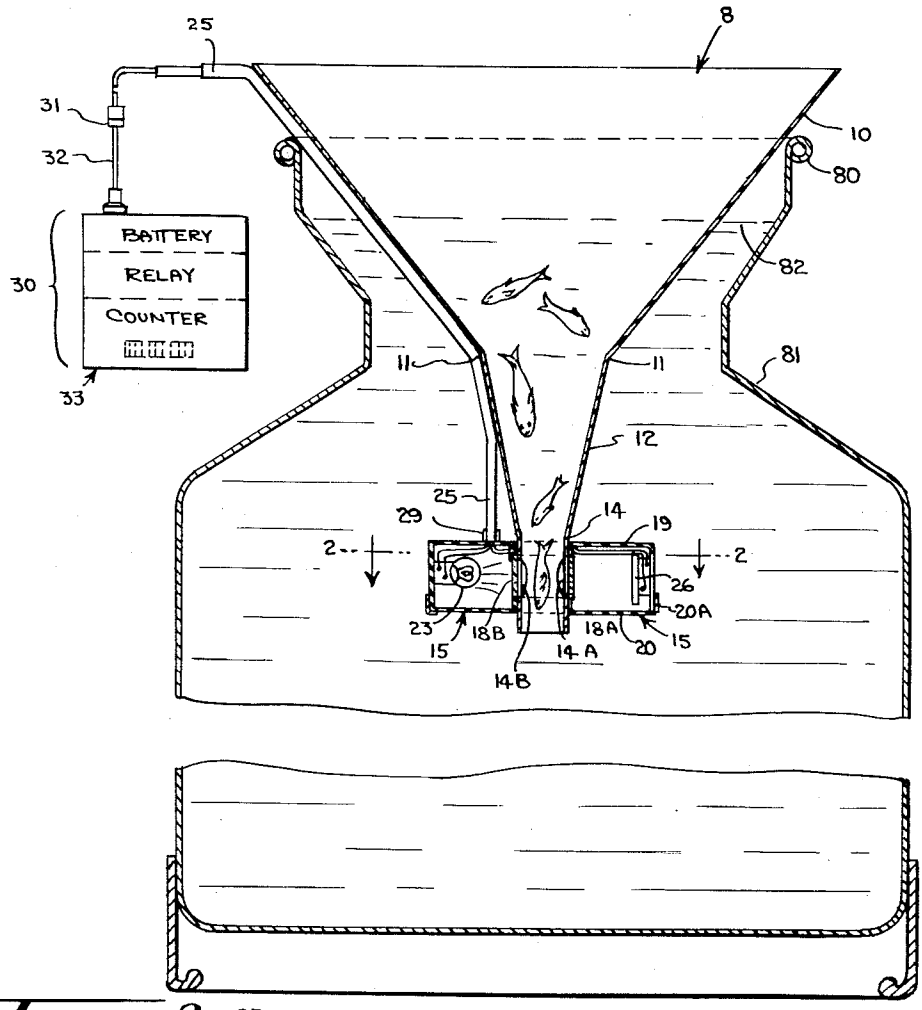
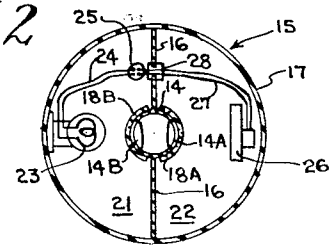


FIG. 2



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METHOD AND APPARATUS FOR COUNTING MOBILE AQUATIC CREATURES

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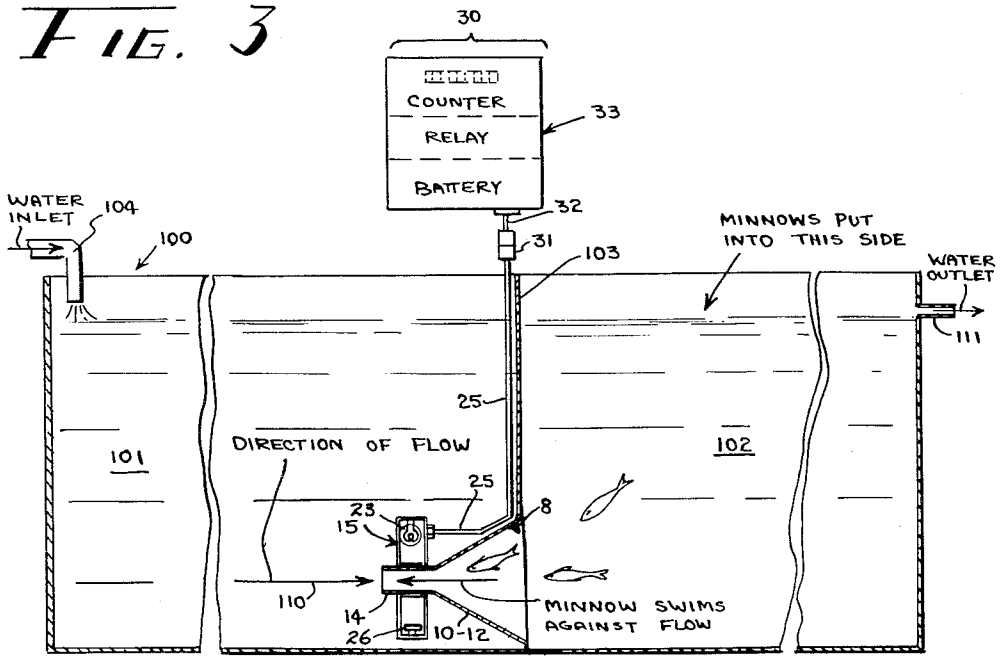
FIG. 3



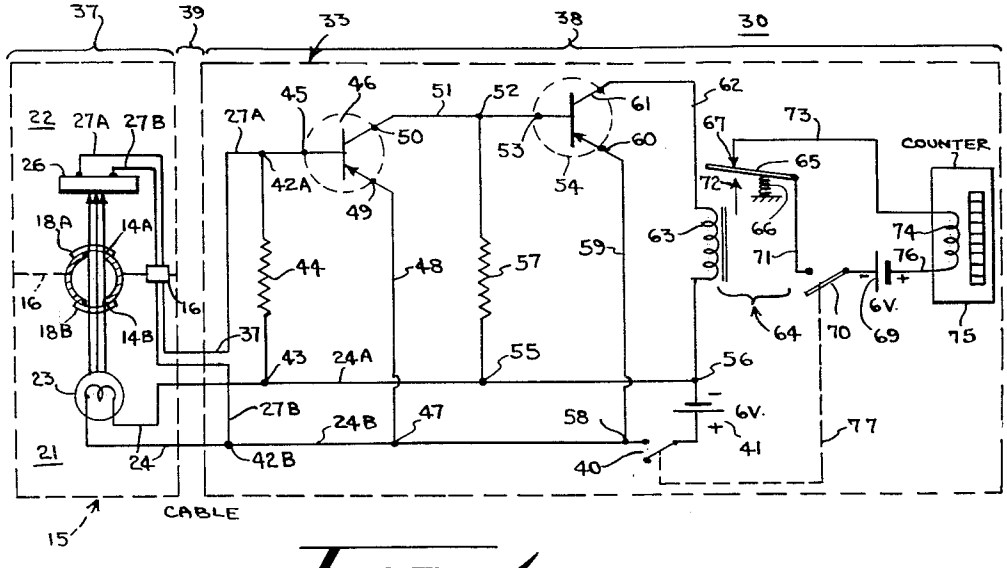


FIG. 4

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FIG. 5

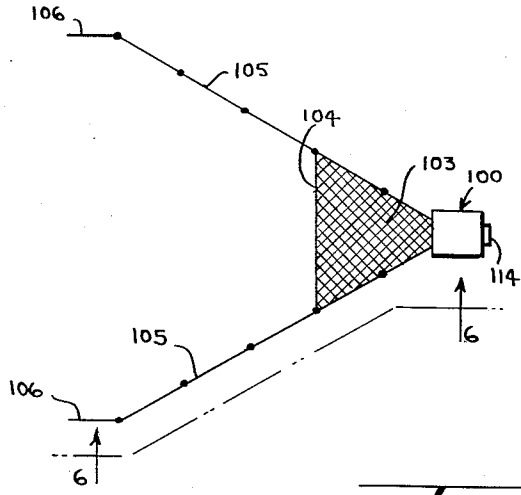


FIG. 6

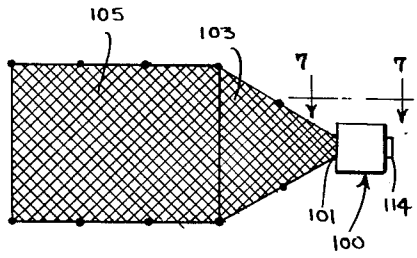
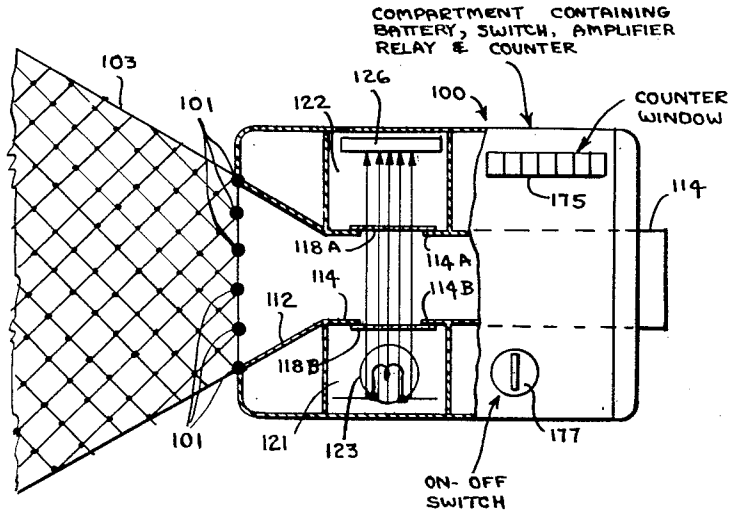


FIG. 7



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METHOD AND APPARATUS FOR COUNTING MOBILE AQUATIC CREATURES

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4 Claims. (Cl. 235—98)

This invention relates to method and apparatus for counting individual, mobile, aquatic creatures and particularly to method and apparatus for counting fish. One principal field of usefulness of the invention is in the live bait business, and more especially, the minnow business. Heretofore there has not been available any device for counting of live minnows at both the wholesale and retail levels. Minnows are sold on the basis of count, and a large amount of time is used for such counting operations essential for invoicing the merchandise. For the counting of live minnows it has heretofore been the practice to use two or more persons. The minnows are moved from one container to another a few at a time by dip-netting and one of the persons involved in counting the operation keeps count of the number of minnows as for example the number in each netfull. A great many errors are present in such an operation and more frequently than not, the count is grossly erroneous.

Another field of usefulness of the invention is in connection with census operations, as of migratory fishes and spot checking in lake fish census based upon sectional seining operations.

It is an object of the present invention to provide a method and apparatus for counting individual mobile aquatic creatures such as minnows, fishes, crayfish, shrimp and the like. It is an especial object of the invention to provide a device which may be used wherever minnows and the like aquatic creatures are handled and sold. It is another object of the invention to provide a method and apparatus for counting minnows, fishes and the like aquatic creatures without appreciable handling or disturbance of such creatures or injury thereto. It is another object of the invention to provide a method and apparatus for counting aquatic creatures on a basis far more accurate and much less costly than any previously available, and to provide such methods and apparatus capable of being used by relatively unskilled personnel. Another object of the invention is to provide a counting apparatus of low initial and operating cost and maximum portability.

It is a further object of the invention to provide a counting apparatus for minnows and such live bait which can be installed in tanks or ponds wherein such minnows, fish or live bait are reared, maintained or transported or used in connection with fixed or mobile seins and fish traps for counting.

Other and further objects of the invention are those inherent in the apparatus illustrated, described and claimed.

To the accomplishment of the foregoing and related ends, this invention then comprises the features hereinafter fully described and particularly pointed out in the claims, the following description setting forth in detail certain illustrative embodiments of the invention, these being indicative, however, of but a few of the various ways in which the principles of the invention may be employed.

The invention is illustrated with reference to the drawings wherein: FIGURE 1 is a vertical sectional view illustrating one form of apparatus of the invention. FIGURE 2 is a transverse sectional view taken along the lines and in the direction of arrows 2—2 of FIGURE 1. FIGURE 3 is a vertical sectional view illustrating another form of the apparatus of the present invention and

illustrating an installation in which the invention is used. FIGURE 4 is a schematic wiring diagram of the electrical components of the invention. FIGURE 5 is a plan view of another form of the invention; FIGURE 6 is a vertical elevational view taken in the direction of arrows 6—6 of FIGURE 5 and FIGURE 7 and is an enlarged horizontal view, partly in section of the device, taken in the direction of arrows 7—7 of FIGURE 6.

Referring to FIGURE 1 the invention comprises first an enclosure generally designated **8** in which the minnows, fish or aquatic creatures, which it is desired to count, may be confined and guided at least temporarily in preparation for the counting operation. In the form shown in FIGURE 1, such enclosure is in the shape of a conical funnel having a wide angled mouth portion **10** which extends downwardly to the level **11—11**, where the angle of the cone decreases, forming portion **12**, which in turn leads into the section **14**, wherein the count takes place. The section **14** is a defined path or passage, through which the aquatic creatures are lead, and may conveniently be a short conduit or tube.

The tube **14** need not be of a specific cross-section and the size is determined by the size of the fishes desired to be counted. Each size will count accurately fishes or other creatures of a particular size range. For minnows, a round tube **14** of ¾" inside diameter will count minnows of a size range from about 1¼" (length) which are slender and tiny, to 4–6" (length) minnows, having a girth such that they will just slide through the tube. This illustrates range. Hence it is to be understood that the size of the passageway is determined by the size being counted.

The passage **14** has windows **14A** on one side and **14B** on the other side of the tube. These windows are aligned along an axis transverse to the axis of passage **14** so that light may pass from one window, thence across passage **14** and into the other window. The windows need not be of any particular shape but it is preferred that they should be circular or rectangular and they should be relatively large, compared with the passageway, so that there is little or no space in the passage which will be outside the light beam passing from window to window.

Around the tubular portion **10** of the enclosure there is positioned a box generally designated **15**, as shown in FIGURE 2, having a dividing wall **16—16** which extends inwardly from the outer wall **17** and reaches into contact with the tube **14**. Curved pieces of transparent material, **18A** and **18B** through which light may freely pass, are fitted over the windows **14A** and B and cemented or otherwise attached to tube **14** so as to make watertight closures over windows **14A** and **14B**. The box **15** is completed by means of the endwalls **19** and **20**, the latter being flanged at **20***a* so as to be capable of being removed. It is the objective that the box **15** should provide a watertight space having separate light-tight spaces **21** and another space **22**. In the space **21** there is located a light bulb **23** which is connected by the electric leads **24** to an electrical cable **25**, which (in this form of the invention) passes out of the apparatus and leads to a power source at a remote location, as shown in FIGURE 1. In the space **22** there is positioned on a line diametrically opposite the lamp **23**, a photo responsive unit **26**, which can be a photo electric tube, but preferably is a photo electric cell such as a selenium cell. This form of cell is sometimes known as a barrier layer cell and provides a relatively high signal for a given light change. The photo electric responsive device **26** is likewise provided with the requisite leads **27** which pass through a suitable insulator **28** in the wall **16** and join with the electric leads **24** to form the cable **25** leading to the remote location.

The various walls of the box **15** are made so as to form an entirely water tight container, for the protection of the electrical units therein contained and care is taken likewise that the cable **25** should be waterproof and that entrance nipple **29** is water tight, so that leakage into the box **15** does not occur in service. Likewise all of the walls of the container are closed tightly in respect to each other so that the wall **16** forms a light separation between the two spaces **21** and **22** so that no light passes between these spaces except for the light beam which is permitted to pass through windows **14A** and **14B**. The box **15** is thus made a part of tube **14** of the enclosure **8**.

Accordingly a light beam defined by window **14B** passes from light source **23** thence crosses the interior of tube **14** and substantially fills it, and then enters window **14A** and impinges upon photo responsive cell **26**. When a minnow, fish or the like aquatic creature passing through tube **14** intercepts all or part of the light cell **26** produces a signal, which is amplified and used to actuate the counter.

The cable **25** is fastened along the exterior surface of the enclosure **10** and extends to a separable connector **31** for readily disconnecting the cable **25** from the cable **32**. Cable **32** extends to instrument station **30** at which is located a power supply box generally designated **33**. The box **33** preferably contains a battery or other power source, amplifiers suited to the types of photo responsive devices used, a relay mechanism (where needed), and an electrically operated counter.

Referring to FIGURE 4, under the bracket **37** there is schematically illustrated the box **15** in which space **21** of which is located light bulb **23** which forms the light source. The light therefrom passes through the transparency **18B** and window **14B** and thence through the window **14A** and transparency **18A** into the compartment **22** in which there is located the photo responsive device **26**.

Under the bracket **38**, at the instrument station **30** there is located a box generally designated **33** in which the power source, amplifier, relay, and counter mechanisms are contained. The connection between the box **15** and the instrument box **33** at the remote location is indicated under the bracket **39** which denotes cable **25**, connector **31** and cable **32**. Thus the cable **25** contains the electrical leads **24** from the lamp **23** and the electrical leads **27** from the photo responsive device **26**. If desired a three conductor cable may be used although a four conductor cable is shown in this illustration. The cable **25—31** extends and enters the power supply, amplifier, relay and counter at box **33** at the remote location.

The power supply leads **24** extend through an Off-On switch **40** and to a battery or other power source **41** suited to the amplifier circuit used. The leads **27—27** from the photo electric device extend to the amplifier, which likewise may be of any type suited to the particular photo responsive device that is used. Merely by way of illustration there is shown a two-stage transistor amplifier. The photo cell leads **27A** and **27B** are connected at junctions **42A** and **42B**. Resistor **44** is connected from junction **42A** to junction **43**. Lead **27A** connects to the input terminal **45** of transistor **46**. Positive voltage is supplied to transistor **46** via junction **47** on line **24B**, thence via line **48** to terminal **49** of the transistor **46**. From the terminal **50** of the transistor **46**, which is the output, the line **51** extends through junction **52** to the input terminal **53** of the second stage transistor **54**, line **24A** extends from junction **43**, through junction **55** to negative battery terminal at **56**. A resistor **57** is connected between junction **52** on line **51** and junction **55** on line **24A**. From junction **58** on the positive battery supply line **24B** the line **59** connects to the terminal **60** of the second transistor **54**, and from the output terminal **61** of the second transistor **54**, an output circuit extends at **62** through the coil **63** of a relay generally designated **64**, the other terminal of such coil being connected to negative battery terminal **56**. The armature **65** of the relay is normally

biased by the spring **66** so as to be against the contact **67**. When the power switches **40** and **70** are closed, the relay armature **65** is drawn down to contact **72**, which is not used. This is the normal position of the armature **65** when there is no object interrupting the light beam in box **37**. However when coil **63** is de-energized the armature is sprung open, thereby completing a circuit from the battery **69** thence through a single pole control switch **70**, over line **71** to the armature **65** and thence through the contact **67** and via line **73** to the coil **74** of the magnetically operated counter mechanism **75**, and from the latter the circuit continues via line **76** to the positive terminal of the battery **69**. Accordingly every time the relay **64** is de-energized, the counter mechanism will be actuated through one count. The two switches **40** and **70** are connected together mechanically by operator **77** so that they can both be opened simultaneously or closed simultaneously. Separate power source **69** is used so that transient effects resulting in the circuit of coil **74** are isolated from the photo cell circuits.

Referring to FIGURES 1 and 2, enclosure **8** is placed on the top of a can such as milk can **81**. Since the ordinary milk can of commerce is frequently used for the handling and transportation of minnows, the enclosure **8** is preferably made of such a size that it will fit neatly upon the open neck **80** of the can **81**. The can **81** is filled with the environmental aquatic fluid in which the creatures are kept, usually water, fresh or sea water, with up to about the level **82** and this liquid of course rises within the funnel portions **14**, **12** and partly up through the portion **10** above the line **11—11**. The electrical circuits are then energized by operating the manual operator **77** to close switches **40** and **70**. When the switches **40** and **70** are closed, the circuits are energized and the lamp **23** is illuminated. It will be assumed of course that the two parts of the connector **31** are pushed together so that the connection of cable **25—32** is complete. The light source **23** is thus illuminated and the apparatus is ready to operate.

In using the device the operator need only ladle the minnows from the holding tank or from wherever they are contained and place them in the open mouth of the enclosure **8** and since this is funnel shaped the operation presents no difficulties. The minnows may be ladled using an ordinary hand type dipnet. Ordinarily they are handled by a dipnet and they will be spilled from the dipnet into the liquid which is standing in the open funnel **10** of the enclosure **8**.

It has been discovered in accordance with this invention that the minnows or little fishes, and even large fishes if the device is made of the size adapted for handling them, will proceed immediately to swim around in the liquid in the enclosure **10** and they immediately seek to find a lower level and very quickly will swim down through the portion **12** then through the tube **14** and out through the outlet of the tube **14** and into the can **81**. The swimming action has been discovered to be accentuated when the minnows are crowded in the funnel. As the minnows or other creatures being counted swim downwardly they move in an axial direction downwardly through the tube portion **14** and in so doing the minnow will interrupt the light source between the light **23** and the photo responsive device **26** and as a result a signal will be produced in the latter device which, when amplified, actuates the counter-mechanism **75** through one count. As more minnows are ladled into the enclosure **8** more will swim out of the bottom.

It has been found for example that the tubular portion **14** can be of size such that the largest minnows that are handled therethrough can just pass through. Such a size will also handle minnows that are very much smaller. Thus a tube **14** having an internal diameter of three-quarters of an inch will handle with a high degree of accuracy the counting of minnows ranging from the length of about one and a quarter inches up to the length of

four to six inches. The girth of the latter size minnows is frequently sufficient almost to fill the inside of a tube three-quarters of an inch in diameter, or at least there is not very much space around the minnow. Even so, the smaller minnows are counted accurately, thus an error of not more than one in one thousand in the counting is provided by the apparatus of the present invention. The device shown in FIGURE 1 when not in use can be disconnected from the counting mechanism by separating the connector **31**. If desired the counting mechanism housing **30** can be located at some fixed remote point and one or a plurality of "funnel" mechanisms can be used with it, one at a time by providing cabling of requisite length within electronic limitations.

While a funnel shape enclosure is illustrated and while the outlet tube **14** is illustrated as substantially vertical it will be understood that other shapes of enclosures may be utilized so long as the outlet therefrom is sufficiently closed so as to confine the minnows or fishes from jumping out. Thus a slideway provided for handling the minnows in a wet condition may be provided through which the minnows may swim or slide downwardly with provisions being made so that they are protected from flipping out due to their own activity.

Referring to FIGURE 3 there is illustrated another form of the invention in which the counting apparatus is separated into a tank which might be used for holding, or transporting minnows, or a tank such as one that might be used in a retail establishment where minnows are kept for sale. Thus there is provided a tank generally designated **100** having a left cell **101**, a right cell **102**, the two being defined by a dividing wall **103**. A water inlet is provided at **104** into cell **101** and outlet **111** is provided in the cell **102**, and the latter determines the water level of the entire tank.

The wall **103** is provided at a lower portion thereof with a device such as illustrated in FIGURE 1 namely a funnel member **8** having portions **10—12** leading into a tubular member **14**, on which there is located the light box photo cell container **15**. The cable **25** from container **15** can most conveniently be run up wall **103** and then through the connector **31** and the cable **32** to the remote location **30** at which there is located the box **33** containing the power source, amplifier, relay and counter mechanism. The wall **103** is thus a barrier between the cells **101** and **102**, and connection is made through the tube **14**. The flow of water from cell **101** is thus through the tube **14** to the cell **102**.

It has been found in accordance with this invention that the natural action of the minnows is to swim to a lower depth in a tank, here **102**, when the minnow is introduced into such tank and the minnow will then explore along the walls of the tank. The minnow desires to swim upstream in respect to a current of water and it will find unit **8**, through which such a flow emanates. The minnow then swims into the mouth **10** of the funnel **8** and then through the tube portion **14** and into the cell **101**. In so doing each of the minnows passing through the tube **14** interrupts the light passing from the lamp **23** to the photo electric responsive device **26** in the box **15** and causes a count to be registered on the counting mechanism **75**.

Minnows that have been raised in outdoor rearing pens under conditions of natural habitat, will be found to be exceedingly active when first placed into a tank and move very quickly from a tank such as cell **102** into an adjacent cell **101**, where a flow of water is provided as herein specified. Minnows which are more accustomed to being confined in a tank will behave more leisurely but will always find the current and move against the current from tank **102** to tank **101**. In this manner there is assurance that all minnows placed in a tank such as **102** will, due to their natural activity, move themselves to an adjacent tank and thereby be counted. The count will register all of the minnows entering the tank or cell **101** and the count upon which invoicing or inventory is made is thus assured.

In FIGURES 5, 6 and 7 there is illustrated another form of the invention which can be used for fish census, migration studies, and also for inventory counts where large bodies of water are used for rearing etc. In this form of the invention the entire photoelectric responsive devices, power source, relays, counters and switches are preferably placed in one sealed unit, such as unit **100**. This unit contains a funnel inlet end **112** leading to passageway tube **114**. In the tube **114** there are provided windows **114B** and **114A** which are aligned transversely across the tube and each window is covered with a transparency, as tranparencies **118A** and **118B** on windows **114A** and **114B**, respectively. The container **100** has a closed cell **121** for light source **123** and a closed cell **122** for photo responsive device **126**. The container also contains power sources **41** and **69**, amplifiers **46** and **54** (and their associated circuits), a relay **64** and a counter **75**, which can be connected as shown in FIGURE 4. The chamber **100** has a controller **177** which is a water-tight operator accessible from the exterior of the container **100** and the counter mechanism is so placed as to be visible from the exterior of the container, through window **175**.

At the entrance end of the container and around the mouth of funnel portion **112** are a plurality of eyelets **101** to which the small end of a funnel shaped net **103** of appropriate mesh size is attached. At the mouth **104** the funnel shaped net may, if desired, have extending wing nets **105—105**.

In use the support of the net depends upon whether the location is stationary or mobile. If mobile, two towing vessels are attached at **106** and buoys along the upper edge of the nets **105**, **103** and above the container **100** support it appropriately at required depth. If in a stationary location the support is by poles or stakes.

In either mode of use the fish enter between wings **105** (if used) or enter the mouth **104** of funnel net **103** and work down to funnel **112** and thence pass through passage **114** and are counted.

As many apparently widely differing embodiments of this invention may be made without departing from the spirit and scope thereof, it is to be understood that I do not specifically limit myself to the embodiment disclosed herein.

We claim as our invention:

1. A device for counting fish and the like mobile aquatic creatures comprising separate adjacent holding and receiving tanks, said holding and receiving tanks being constructed so as to provide space for said creatures to freely swim, a connection between the lower parts of said tanks for conducting a flow of water from the holding tank to the receiving tank, a water delivery supply positioned to deliver a flow of water to the holding tank, said flow continuing through said connection to the receiving tank, said receiving tank being provided with an overflow outlet above said connection for maintaining a prescribed depth of water therein, said connection being shaped so as to converge from a larger cross-sectional area adjacent the receiving tank to a counting passage of minimum cross-sectional area adjacent the holding tank, said counting pasage being constructed so as to provide a path transversely thereof along which a beam of light can be projected, a light source positioned externally in respect to said counting passage for projecting a light beam along said path and photo responsive means positioned externally in respect to said counting passage and located so that said light beam can impinge thereon so as to be activated thereby.

2. The device specified in claim 1 further characterized in that the tanks have a common wall and the connection is made with the large end thereof attached at an opening in said common wall near the bottom of the tanks.

3. The device of claim 1 further characterized in that the light source and photo responsive means are positioned in separate waterproof enclosures and waterproof electrical connections are provided therefrom to a remote instrument station.

4. The device of claim 1 further characterized in that at a remote station there is provided an electrically operated counting device and electrical means is provided connecting the photo responsive means and said counting device for operating said device through one counting operation for each interruption of the light beam.

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