Introduction

We are designing an autonomous aquarium controller capable of performing rudimentary tasks. This aquarium controller will be ideal for aquariums in offices and for people who do not wish to spend much time taking care of their aquariums. The tasks that our system is capable of performing are the following:

1) The system we are developing is capable of monitoring the pH and change the water to purify the water.

2) The system is capable of controlling the temperature of the aquarium.

3) The system is capable of simulating daylight over user input intervals.

4) The system is capable of feeding fish in the aquarium over user input intervals.

5) The system allows users to modify the aquarium parameters remotely over the internet.

We will achieve the first objective by changing the water in the tank. Biological waste in the water results in an alteration of the pH of the water. By monitoring the pH of the water we can determine when the waste in the water has reached a critical level. When this level is reached, water will be removed from the aquarium and replaced with clean water. As a result the pH of the water will return to a level that is appropriate for the fish.

We will achieve the second objective by monitoring the temperature of the aquarium and when necessary activating a user provided heater.

We will achieve the third objective by activating user provided lights at a time schedule that the user desires.

We will achieve the fourth objective by activating a motor connected to a barrel with a hole in it. The barrel contains the food and will initially be held with the hole facing up so no food falls through. The barrel will spin and food will fall in to the tank as a result of the circular motion of the motor.

The fifth will be achieved by having an Ethernet port on our device capable of communicating across the internet.

Results of Patent Search

We found two companies in the market that at one time developed aquarium controllers to do many of the same things listed above. The first is the Aqua Controller line by Neptune Systems and the other is Octopus and the AquaNode products by Aquadyne Computer Corporations.

The AquaController line from Neptune Systems is capable of monitoring pH, temperature, simulating daylight, and allows internet access to aquarium.

Although these aquarium controllers can be obtained in the market, we could not find patents pertaining to aquarium controllers specifically. Both Neptune Systems and Aquadyne Corporation develop products that perform objective 1,2 and 3 above. None of the products that were examined from these companies integrated objective 3 and 4 into their controller.

We examined other patents for other devices that incorporated any of the objectives listed above, because it is possible that we may be infringing on these patents as well.

The following patents were some of the patents found for each of the categories.

Functionality	Title -- Patent Number
Water Purification	Water Purification System and Apparatus 4,966,096
	Fish Pond Methods and Systems 6,041,738
Maintaining Water Temperature	Heater apparatus for an aquarium 6,140,615
Simulating Daylight	Control apparatus for electrical devices 3,949,241
Feeding the fish	Fish feeding device 6,467,431
Internet control of Operations	This functionality is performed by any server. In our case, we check and modify values on the controller—which is the functionality that most servers perform anyways. No patent search was conducted for this.

Patent Comparison and Analysis

1) Water Purification

4,966,096
Ecological Systems Technology, L.P.
October 30, 1990

Water purification system and apparatus

Abstract

The present invention provides a water purification system that creates an integrated, small-scale marine or fresh water ecosystem that is particularly useful as a home, school, office, or laboratory ***aquarium***. In operation, water from the ***aquarium*** tank is routed to an algal turf scrubber screen or equivalent algal-growing surface placed in a moveable, substantially flat, horizontally positioned, tray-shaped receptacle. An algal turf, comprising preferably a dense colony of microalgae, resides on the screen. As the receptacle fills with water, the center of gravity of the receptacle moves across the axis of the pivots upon which the receptacle is mounted. At this time, the substantially filled receptacle rotates on its pivots and the desired surge effect across the scrubber by the exiting water is achieved. The surge, light energy provided by lights above the receptacle, and algal photosynthesis promote metabolic cellular-ambient water exchange to remove carbon dioxide, dissolved nutrients and organic compounds, and other pollutants. Oxygen is also released into the water. The substantially emptied receptacle returns to its horizontal position and the purified and oxygenated water is then returned to the tank. In addition, other appropriate components of the ecosystems may be included, such as tide creators, high intensity, broad spectrum artificial lights over the tank, salinity controllers, ***pH*** controllers, sediment removers, temperature controllers, automatic feeders, timers and the like.

Analysis

This system purifies water through the mechanical motion of water passing over a "scrubber" of "algal turf" that seems to filter the water and clean it before it is returned back to the water. This design is unlike ours where we replace the water in the tank when too much biological waste accumulates.

6,041,738
Fun Fishing LLC.
March 28, 2000

Fish pond methods and systems

Abstract

This invention pertains to a ***fish*** pond system for use as a ***fish*** pond amusement park. The ***fish*** pond system includes a ***fish*** pond having at least one ***fish*** container in a deeper, typically a central region, and a pond liner extending outwardly from the ***fish*** container, preferably inclined at a generally upward angle, preferably less than 10 degrees. The pond has a shallower zone having a depth of at least about 7 inches at the juncture of the central region and the shallower zone. The ***fish*** container has greater depth than the shallower zone such that ***fish*** congregate in the ***fish*** container. The ***fish*** pond system preferably includes a water recirculation system receiving water from the bottom of the ***fish*** container, passing the water through a settling container, typically a settling pond, and returning the water to the ***fish*** pond. ***Fish*** waste solids settle to the bottom of the settling pond, and are removed to a decomposition pond within the ***fish*** pond system, where the ***fish*** wastes are biologically decomposed by plants. The ***fish*** pond system preferably includes an aerator controlling oxygen in the water, and water plants removing nitrates and phosphates from the water. An optional biofilter supports bacteria that convert ammonia in the water to nitrite and then to nitrate. Thus the ***fish*** pond system generates substantially no waste for off-site transport for disposal or treatment away from the area of the ***fish*** pond system.

Analysis
This system purifies water through the mechanical motion of water passing through different areas in the pool/pond where the waste in the water is allowed to settle. The water is then returned back to the original pool. This design is unlike ours where we actually replace the water in the tank when too much biological waste accumulates. The waste should be carried away from the tank through the process of water removal.

2) Maintaining Water Temperature

6,140,615
October 31, 2000
Sanki Consys Co., Ltd.

Heater apparatus for an aquarium

Abstract

A heater apparatus includes a flat-shaped heater portion attachable to a vessel such as a water tank, and a controller for controlling the heater portion. The heater portion includes a flat heater, a first temperature sensor for detecting temperature of the flat heater, and a second temperature sensor for detecting temperature of what is contained in the vessel or water tank. The controller keeps the temperature constant inside the vessel in accordance with the temperature detected by the second temperature sensor. If the rate of rise in temperature detected by the first temperature sensor is faster than is deemed normal, the controller stops current flowing to the flat heater.

Analysis
This system is performing the same functionality we are in much of the same way. We will be using only one temperature probe and a controller will activate the heater based on this one sensor probe.

3) Simulating Daylight

3,949,241
Maute; Charles J.
April 6, 1976

Control apparatus for electrical devices

Abstract

The apparatus has a potentiometer electrically interpositioned between an inlet and an outlet for attenuating and increasing the level of electrical power conducted therebetween. The potentiometer has a depending control knob which is cyclically and repeatedly engaged by motor driven sectors. Accordingly, in a given time frame one sector turns the control knob gradually to provide progressively increasing electrical power. This sequence is followed by a quiescent period in which the increased power remains available. Next, another sector turns the control knob gradually to diminish and finally to cut off power. This diminution of power, too, occurs over a given time frame,

and is followed by a quiescent period in which power remains cut off. Subsequently, and automatically, the gradual, power-increasing period follows. The apparatus has an especial utility for use with an ***aquarium,*** albeit not limited to such an application, for simulating the occurrence of sunrise and nightfall.

Analysis

This system is controlled by a motor connected to a potentiometer that seems to step gradually and in the process either dims or brighten the lights to simulate daylight. We, on the other hand, ask the user to input a daylight schedule they wish to implement. We use a microprocessor to control when the light turns on and off. The microprocessor signals a relay to allow power to turn the lights on completely or turns the lights off completely. There is no dimming or brightening in our case.

4) Feeding the Fish

6,467,431
Stietzel; Andrew M
October 22, 2002

Fish feeding device

Abstract

A ***fish*** feeding device for automatically feeding ***fish*** at predetermined intervals. The ***fish*** feeding device includes a housing adapted for mounting to a side of a ***fish*** tank towards an upper rim thereof. A feeding wheel is rotatably mounted to the housing adapted for dispensing food into the ***fish*** tank. A timer is mounted to the housing and in communication with the motor. The motor rotates the feeding wheel at a predetermined ***time*** or ***interval*** indicated by the timer.

Analysis
This system is controlled by a timer which activates a motor. The motor rotates a feeding wheel that dispenses food. This is very similar to our implementation where we use the real-time clock on the microprocessor (a timer) to determine when the food should be dispensed.

Analysis of Patent Liability
Literal Infringement

We seem to be infringing the patent 6,467,431 – Fish feeding device given above. The real-time clock on the microprocessor we will be using is nothing more than a timer. The mechanical mechanism that we will be implementing also seems to be in literal infringement of the device.

Infringement Under Doctrine of Equivalence

We seem to infringe the patent 6,097,007 -- Heater apparatus for an aquarium. The device containing a controller activates a heater based on temperature readings from a probe located in the water. There is some doubt though due to the fact that we are using only one probe as opposed to two probes. The user will be providing the heater which will be plugged in to a power module controlled by relays by a microcontroller. The heater may not be exactly the "flat heater" referred to in the patent claim.

Actions Recommended

We need to obtain either the patents or license for the above designs in order to incorporate the above. The date of issue for the Fish feeding device (6,467,431) is October 22, 2002. This means that it will be the year 2022 before it expires. It is wise to acquire the patent to market our product.

We also need to obtain either the patents or license for the -- Heater apparatus for an aquarium (6,140,615). The patent will expire in 2020 which is a long time to wait.

References

1) http://www.uspto.gov
2) http://www.aquadyne.com
3) http://www.neptunesys.com
4) No web page available for Sanki Consys Co., Ltd.
5) The patent for the fish feeding device is owned by Stietzel; Andrew M (No website available)