AQUARIUM / POND FILTER

The present invention relates to a filter for an aquarium or pond, particularly (but not limited to) a filter for a marine aquarium.

BACKGROUND TO THE INVENTION

Keeping a marine aquarium successfully requires a large amount of equipment to keep the water clean and in the correct conditions for fish and invertebrates to thrive. A typical set-up involves a high-level display tank, and a sump, generally kept underneath the display tank, for example enclosed in a cupboard. Water is cycled between the display tank and the sump. The sump adds to the total water volume in the system, and also provides space for various pieces of water treatment equipment, for example, filters, protein skimmers, calcium reactors, and heaters.

Often, water is allowed to flow via pipes from the display tank to the sump by gravity, and is then pumped back up into the display tank.

The water in the system is usually constantly filtered to keep it clean, and in particular to prevent the accumulation of organics such as phosphates and nitrates. The usual means of providing filtration is to use a 'filter sock' in the flow path between the display tank and the sump. This is a simple and inexpensive device, but it becomes clogged typically after only one or two days, and must be replaced and cleaned out regularly.

To avoid the need for constant filter changes, automatic 'self-changing' filters have been developed. This type of filter includes a web of filtration material which is automatically advanced when dirty from a feed spool to a take-up spool. When the material is advanced, dirty filtration material is removed from the flow path and replaced with clean filtration material. The dirty filtration material is rolled up onto the take-up spool, and when the entire roll has been used the roll of dirty material can simply be removed and discarded, and replaced with a clean roll. Typically, the roll only has to be replaced once every few months.

However, a disadvantage of this type of filter is that it generally takes up a very large amount of space for a given filter capacity. This is due to the space taken up by the

advancement mechanism itself, and also the need to provide a sufficient surface area of filtration material to achieve a good flow rate.

A large filter, apart from taking up a large amount of space, can only be used with a high-volume aquarium because of the effect on water salinity when used in conjunction with an automatic top-up device. Large-sized filters have a large surface area of water within the filter, and so the normal difference in operating water level between a state when the filter web has just been advanced and a state just before the filter web advancement will be triggered again, although only a few mm in height, may be a significant volume of water due to the large surface area. As the water level in the filter (and therefore the volume of water in the filter) increases, the water is often replaced by reverse osmosis water from an automatic top-up device. This can produce an unacceptable drop in salinity. The use of filters of this kind is therefore limited to higher-volume aquaria, where the volume of water which can be held in the filter is not a significant portion of the overall water volume in the aquarium system.

In one known design, the filtration material is wrapped around the circumference of a drum to achieve a large surface area in a relatively small space. The drum is enclosed within a watertight container having an inlet. Water flows through the inlet into the space in the container which is outside the drum, through the filtration material into the drum, and then out through an outlet in the centre of the drum. This puts a relatively large area of filter material in the flow path. However, one problem with this arrangement is that larger particles of dertritus tend to drop out of suspension and fall to the bottom of the container, rather than being captured on the filter roll and disposed of. Although these large particles are being successfully filtered out of the display tank, they remain in the water system until cleaned out. Over time dirt particles can decay and release contaminants into the water, so it is desirable that all filtered detritus should be removed as soon as possible.

Another disadvantage of known automatic filters is that they are difficult to bypass when required. When feeding, it is desirable to suspend the filtration of water, to prevent the food being filtered out before the inhabitants have the opportunity to consume the food. However, it is important that water continues to circulate in order to ensure that it is sufficiently oxygenated. A filter sock (which needs to be changed regularly anyway) can

simply be removed for the time being. The roll of filtration material can be taken out of an automatic filter to suspend filtration, but this process is more fiddly, and it can be difficult to avoid wasting filtration material if the roll needs to be temporarily removed when it is only part used. The roll is generally installed by threading a loose end though a system of rollers, from the feed spool to the take-up spool. Therefore it is often necessary to cut the material to remove a part-used roll.

It is an object of the invention to reduce or substantially obviate the above mentioned problems.

STATEMENT OF INVENTION

According to a first aspect of the present invention, there is provided an aquarium or pond filter comprising:

a filter housing having a filter inlet and a filter outlet and a path for water to flow between the filter inlet and the filter outlet;

a web of filtration material, part of the web being disposed in a clean supply position, part of the web being disposed in a used waste position, and part of the web being disposed in an in-use position where it forms a porous barrier in the flow path between the filter inlet and the filter outlet;

at least one web guide for guiding the web, the web guide(s) defining the path of the in-use part of the web, and the path of the in-use part of the web changing direction where it passes the or each web guide;

the overall shape of the in-use part of the web being such that there is an inside space substantially enclosed by the web, the filter inlet being provided opening to the inside space;

web advancement means for advancing the web of filtration material to move at least some of the in-use part of the web to the waste position, and at least some of the supply part of the web to the in-use position;

~~characterised in that~~*in which* a bypass outlet is provided in the form of an aperture in the housing, on the inlet side of the porous barrier, for allowing at least some flow from the inlet to flow out of the bypass outlet without passing through the porous barrier, when the bypass outlet is open, the bypass outlet being at least partially closable to selectively reduce or prevent flow out of the bypass outlet.

Providing a bypass outlet allows the filter to be bypassed, for example when feeding. This makes it unnecessary to remove the filter web, which can be a fiddly process. Preferably, the bypass outlet is continuously adjustable, from a fully-open position in which substantially all of the flow through the inlet exits the housing through the bypass outlet, to a fully-closed position in which all of the flow passes through the porous barrier and exists the housing through the filter outlet. However, in some embodiments the bypass outlet may have a set of discrete positions, and/or may have a minimum flow rate through the bypass outlet even when maximally closed, so that there is always some flow through the bypass, and/or may have a maximum flow rate through the bypass outlet when maximally open which is less than the maximum flow rate through the filter as a whole, so that there is always some flow through the porous barrier.

It is thought that in some marine aquariums it is desirable to filter the water, but not too much. Water which is completely particle-free can be less desirable than water which is cleaned, but is allowed to retain a low level of desirable organic particles. The bypass may therefore be left partially-open all of the time, to facilitate this. Providing a bypass outlet which is continuously adjustable from fully-open to fully-closed gives the user the choice, and allows them to find the optimal bypass flow rate for their particular setup.

Preferably, the closable bypass outlet may comprise a movable closing plate provided over the bypass outlet to close the bypass outlet. The movable closing plate may be movably attached to the housing, for example on a pivot, runners, or a sliding guide, to allow the closing plate to slide against the wall of the housing, in a direction parallel to the wall of the housing, for moving between an open position and a closed position, or between any number of intermediate partially-closed positions.

The bypass outlet is preferably provided at a low point on the inlet side of the housing, so that water flows out of the bypass outlet even if the water level on the inlet side is low. The

water level will tend to build up as the in-use part of the filtration web becomes dirty, and in most embodiments a mechanism is provided for automatically advancing the filtration web when the water level rises beyond a set point. For example, a float switch or other trigger could be provided. Preferably, the closable bypass outlet is disposed below the level of the trigger, and an overflow outlet is disposed above the level of the trigger, in case the advancement mechanism fails for any reason.

In some embodiments, the filter outlet is provided below the inlet, so that water flows generally downwards from the inlet, through the filtration web, and to the filter outlet. ~~In this case, t~~The bypass outlet is preferably provided at a point as low as possible, but above the filtration web. In some embodiments, it may be necessary to leave a small space between the filtration web and the bypass outlet, so that the bypass outlet is slightly above the filtration web.

Ideally, both outputs are provided at a point which is below the water level ~~-~~of the sump in use, to eliminate noise from water flowing out of the filter.

~~In other embodiments, the filter outlet is provided above the inlet, so that water flows generally upwards from the inlet, through the filtration web, and to the filter outlet. In this case, the bypass outlet may be provided at any point on the housing below the filtration web, and as long as it can be opened to a sufficient extent it will divert all flow and prevent filtration altogether.~~

Preferably, the filter outlet is at least partially closable for controlling the rate of flow out of the filter outlet. By adjusting the filter outlet and bypass outlet in combination, the user can exercise very fine control over the flow rate in each path through the filter, to achieve the level of separation appropriate to the marine environment. The filter outlet may be closable by means of a sliding or pivoting plate which moves against the filter housing, or by any other means.

DESCRIPTION OF THE DRAWINGS

For a better understanding of the present invention, and to show more clearly how it may be carried into effect, preferred embodiments will now be described with reference to the accompanying drawings, in which:

Figure 1 is a view from in front of a first embodiment of an aquarium filter ~~according to the first aspect of~~ , not according to the invention;

Figure 2 is a view from one side of parts of the aquarium filter of Figure 1, showing the flow path through the filter;

Figure 3 is a view from behind of the aquarium filter of Figure 1;

Figure 4 is a view from in front of a second embodiment of an aquarium filter according to the first aspect of the invention;

Figure 5 is a view from in front of parts of the aquarium filter of Figure 4, showing the flow path through the filter;

Figure 6 is a cross-sectional view of a motorised take-up spool, which forms part of the aquarium filter of Figure 1 and also the aquarium filter of Figure 4.

DESCRIPTION OF THE EMBODIMENTS

Referring firstly to Figure 1, an aquarium filter is generally indicated at 10. The filter has a filter housing 12 which is generally in the form of an open-ended container having a base 14, a side wall 16, and an open top end 18. A flange 20 surrounds the open top end 18, providing a support surface for various components.

The flow path through the filter is illustrated in Figure 2. Water enters the filter through an inlet 20 in the base 14 of the filter, and flows generally upwards, as indicated by the arrows in Figure 2. The water passes through a flow deflector 22. The flow deflector is substantially in the form of a cylinder having a closed cap 24 and a plurality of apertures 26 around a side wall. The apertures 26 are, for example, around 8mm in diameter. The flow deflector serves to direct flow across the bottom of the filter and up the sides, keeping particles in suspension and constantly sweeping across any particles which may have settled on the bottom, to return them to a suspended state. It also reduces turbulence close to the filter web, which increases the effectiveness with which particles are caught in the web.

Because the inlet is provided in the base, water around the base of the filter will generally be flowing in an upwards direction. Although there are likely to be eddies and complex

flows, with the inlet in the base the water near the base will not be still. This prevents dirt particles from falling out of suspension in the water and settling in the filter housing, rather than being caught in the filter web.

As seen in Figure 2, the housing 12 includes an interior wall 30. The interior wall 30 divides the housing into an inlet side and an outlet side. An outlet 32 is disposed in the base 14 of the housing, on the outlet side of the interior wall 30. The inlet 20 is on the inlet side of the interior wall 30. Water flowing from the inlet 20 to the outlet 32 must therefore flow through the interior wall 30. The interior wall 30 is provided with a slot to allow water to flow through.

A web guide 28 is provided in the form of two substantially parallel apertured plates 34. The apertured plates are attached to each other, with their faces spaced apart from each other by rigid spacers 36. Between lower edges of the apertured plates 34, a curved endpiece 38 is provided. As seen best in Figure 2, the web guide 28 sits in the slot of the internal wall 30. Most of the web guide 28 is on the inlet side of the internal wall 30, but a small extent of the web guide 28 is on the outlet side of the wall. Water can flow from the inlet 20 to the outlet 32 by passing through the apertures in the apertured plates 34, into a region between the two apertured plates 34. The water can then flow through a gap between the two spaced apertured plates 34 (on the left hand side of the plates in Figure 2), through the slot in the internal wall 30 and then out of the outlet 32 in the base 14 of the filter housing 12.

As shown in Figure 1, a roll of filtration material 39 is provided on a feed spool 40. The filtration material passes through a system of rollers, and over the apertured plates 34 and curved endpiece 38 of the web guide 28. The filtration material 39 substantially covers both the apertured plates 34, and then feeds onto a take-up spool 42. The shape of the web guide enforces a change of direction on the filtration material 39, as it passes over the curved endpiece. This allows a relatively large surface area of filtration material 39 to be provided in a small space, since the filtration material is effectively folded over on itself.

The take-up spool is motorised as is described in more detail below. When the motorised take-up spool 42 is activated, filtration material is drawn from the feed spool 40 into the in-

use position (covering the web guide 28), and filtration material previously in the in-use position is rolled onto the take-up spool 42.

A float switch 44 is provided near the top of the filter housing 12. As water flows through the filter, detritus is caught in the filtration material and removed from the flow. As detritus builds up on the filtration material, the material will clog and the flow rate through the filter will reduce. This will result in water backing up on the inlet side of the internal wall 30. The water level will rise, and when it reaches the float switch the motorised take-up spool is activated to move previously in-use filtration material to the waste position (i.e. the take-up spool), and move new filtration material from the feed spool into the in-use position. In this way, clean filtration material will be supplied as and when required, using the filtration material in the most efficient way to ensure that filtration occurs effectively without wasting filtration material.

An overflow 46 is provided in the internal wall, above the level of the float switch 44. If the filter material advancement mechanism fails for any reason, or if the flow rate through the filter is simply too large even with clean filter web, then water will build up to the level of the overflow, and flow through the overflow to the outlet side of the internal wall 30, and out of the outlet 32.

A different trigger arrangement may be provided as an alternative to a float switch. Any suitable means of detecting water level to trigger filter roll advancement can be used.

The web guide 28 may be removed from the filter housing 14. Preferably, the web guide is slidable in substantially an upward direction as shown in Figure 1 (and as deployed in use). The web guide 28 can slide in the slot of the interior wall 30, to guide the web guide into its correct position, and to remove the web guide from the filter. Removing the web guide can be useful, because it allows the filtration roll to be removed when only part used, to allow the filter body to be cleaned. This can be done without cutting the filter web, by removing the web guide from the filter housing.

Preferably, a retaining screw is provided to fix the web guide 28 in position when in use. Alternatively, other retaining means may be used for this purpose.

A bypass 50 is provided in the base 14 of the filter housing, on the inlet side. Flow through the bypass is illustrated in Figure 2. The bypass is closable by means of a sliding cover, but when the bypass is open or partially open, at least some water will flow through the inlet 20 and diffuser 22, and then directly out of the bypass 50, without passing through the filtration material 39 and flowing out of the outlet. The bypass 50 may be opened, for example when feeding, to ensure that food is not filtered out before the inhabitants of the aquarium can eat it. In some aquaria, it may be preferred to keep the bypass 50 partially open at all times, to regulate the filtration of the water and ensure that it is not cleaned too much. Using the bypass will also serve to increase the maximum flow rate through the device. It will be appreciated that a bypass may be provided in other locations, in particular it may be advantageous in some designs to provide the bypass outlet on a front, back or side wall of the filter housing.

Referring now to Figure 3, the filter is shown from behind. A hook member 52 is provided for hanging the filter 10 on the side of a sump tank. The hook is adjustable up and down so that the filter can be hung at different heights to accommodate for the water level in the sump. This is achieved by mounting the hook 52 with two screws which run in slots. The hook 52 can move up and down when the screws are loose, the screws being allowed to move within the slots. When the screws are tightened, the hook is immobilised with respect to the filter housing.

Also visible in Figure 3 is a support arrangement for the feed spool 40 and motorised take-up spool 42. Both spools are mounted to a plate 53 which extends in a substantially vertical plane from the top of the housing 14. The plate 53 includes a lateral slot 55 which is used to adjustably mount the take-up spool 42. The take-up spool is mounted to the vertical plate of the housing by tightening a screw 54, which passes through the lateral slot 55 in the plate 53 and then into the take-up spool, to hold the take-up spool in position. Therefore, the take-up spool can be mounted in a range of lateral positions, dictated by the length of the lateral slot 55.

In some embodiments, the motor assembly includes a pin extending through the slot 55 in the plate 53. The pin prevents rotation of the motor assembly with respect to the plate 53,

even if the screw 54 is loose. As an alternative, a pin could be provided on the motor assembly in a location corresponding with an aperture or slot at any point on the plate 53.

The feed spool is mounted on a pivoting arm 57 which is pivotally connected at one end by means of a screw 58 to the vertical plate 53 of the filter housing. The feed spool is mounted to the other end of the pivoting arm 57. By loosening screw 58, pivoting the arm 57 and then re-tightening screw 58, the position of the feed spool 40 can be adjusted.

The adjustment to the height of the hook 52, and the positions of the take-up spool 42 and feed spool 40, allow the aquarium filter to be made to fit where there is very little space, by adjusting the positions of the parts to accommodate obstacles.

Referring to Figure 4, an ~~second~~ embodiment of a filter 110 according to the invention is shown. As for the ~~first embodiment~~filter 10, the filter 110 includes a filter housing 112 which has a base 114 and a sidewall 116. In this embodiment the housing 112 is substantially cuboidal, and so in fact has four sidewalls 116, but equally the housing could be substantially cylindrical with a single sidewall.

In this embodiment, as illustrated in Figure 5, water enters the filter through an inlet 120 in the rear sidewall of the housing 112. The inlet 120 is provided around a third to half way up the wall. An inlet tube 113 (shown in dotted outline in Figure 5) may be provided externally of the housing, to guide water from a more convenient point near the top of the filter to the inlet 120. Where water enters the filter housing 112 through the inlet 120, it is substantially surrounded on three sides by filter web 139. The filter web runs against apertured plates 134, guided by web roller guides 138, in substantially a 'U' shape. The inlet 120 is 'inside' the 'U', so that water flows generally sideways and downwards, as illustrated by the arrows in Figure 5, to pass from the inlet 120 through the filter web.

An outlet 132 is provided in the base of the housing, below the filter web 139.

A bypass outlet 150 is provided in the rear sidewall, below the inlet 120 but above the base of the 'U' shaped filtration web 139. The bypass outlet 150 may be opened or partially opened by moving a sliding gate, to allow water to flow out of the bypass outlet 150 from the inlet 120, without passing through the filtration web 139. A similar sliding gate may be

provided on the filter outlet 132, so that by adjusting both sliding gates the flow rate through the filter outlet 132 and bypass outlet 150 can be balanced and controlled.

The filtration web advancement mechanism with the feed spool 140, take-up spool 142 and float switch 144 works in exactly the same way as in the ~~first embodiment~~filter 10. As detritus builds up on the filtration web, the water level will rise inside the 'U'. When the water level reaches the float switch, the filtration web will advance to replace dirty filter material with clean filter material, to allow the water level to drop again.

Referring now to Figure 6, the motorised take-up spool 42 which is used in both ~~embodiments~~ filters 10, 110 will now be described in more detail. The motorised take-up spool 42 includes a motor assembly 210 and a spool assembly 212. The motor assembly includes an electric motor 214 and a gearbox 216, encased within a motor housing 218. The motor housing is substantially cylindrical. Fixing means in the form of a screw 220 are provided for rigidly (i.e. non-rotatably) attaching the motor housing 218 to the filter housing 12, 112 ~~in either embodiment~~.

A spindle 222 extends out of the motor housing 218, and when power is supplied to the motor 214 the spindle rotates slowly but with high torque, due to the high-ratio reduction gearbox 216. The spindle is connected to a cross-shaped rotational engagement means 224, which rotates with the spindle 222. The cross-shaped engagement means 224 engages with pins 226 on an interior surface of an end of the cylindrical spool assembly 212. Furthermore, the engagement means 224 is rigidly attached to the spool assembly 212 by means of a screw 228.

The spool assembly 212 substantially encloses the motor assembly, and when the motor is activated the spool assembly turns with respect to the static motor assembly. Roller bearings 230 are provided, rotatably attached to end faces of the motor assembly, to allow the spool assembly to rotate smoothly and centrally with respect to the motor assembly.

By substantially enclosing the motor assembly with the spool assembly, a highly compact motorised take-up spool is realised. This also increases the water resistance of the motor assembly and reduces motor noise. This can be used to make a compact aquarium filter which can fit in a limited space in a sump under an aquarium.

The embodiments shown are primarily aquarium filters. However, pond filters can be made to a similar design, increasing the size and capacity as necessary. For outdoor use, the housing may be made from, for example, ABS. For aquarium filters, clear acrylic is found to be a suitable material.

The embodiments described above are provided by way of example only, and various changes and modifications will be apparent to persons skilled in the art without departing from the scope of the present invention as defined by the appended claims.

CLAIMS

1. An aquarium or pond filter comprising:

a filter housing having a filter inlet and a filter outlet and a path for water to flow between the filter inlet and the filter outlet;

a web of filtration material, part of the web being disposed in a clean supply position, part of the web being disposed in a used waste position, and part of the web being disposed in an in-use position where it forms a porous barrier in the flow path between the filter inlet and the filter outlet;

at least one web guide for guiding the web, the web guide(s) defining the path of the in-use part of the web, and the path of the in-use part of the web changing direction where it passes the or each web guide;

the overall shape of the in-use part of the web being such that there is an inside space substantially enclosed by the web, the filter inlet being provided opening to the inside space;

web advancement means for advancing the web of filtration material to move at least some of the in-use part of the web to the waste position, and at least some of the supply part of the web to the in-use position;

~~characterised in that~~*in which* a bypass outlet is provided in the form of an aperture in the housing, on the inlet side of the porous barrier, for allowing at least some flow from the inlet to flow out of the bypass outlet without passing through the porous barrier, when the bypass outlet is open, the bypass outlet being at least partially closable to selectively reduce or prevent flow out of the bypass outlet.

2. An aquarium or pond filter as claimed in claim 1, in which the bypass outlet is continuously adjustable, from a fully-open position in which substantially all of the flow through the inlet exits the housing through the bypass outlet, to a fully-closed position in which all of the flow passes through the porous barrier and exits the housing through the filter outlet.

3. An aquarium or pond filter as claimed in claim 1, in which a movable closing plate is provided over the bypass outlet to close the bypass outlet.

4. An aquarium or pond filter as claimed in claim 3, in which the closing plate is attached to the housing via a pivot.

5. An aquarium or pond filter as claimed in any of the preceding claims, in which the filter outlet is at least partially closable for controlling the rate of flow out of the filter outlet.