

MULTIPLE FUNCTIONAL GRATING FILTER FOR INDOOR FLOOR WATER TRAPS

Field of the Invention

[0001] The present invention generally relates to indoor plumbing devices, and more particularly to a multiple functional grating filter that is capable of capturing over-sized objects, allowing free movement of used water into a floor trap pipe, preventing sewer gases from entering buildings and reducing noise caused by the falling water inside a trap pipe.

Background of the Invention

[0002] A typical plumbing system comprises a filter for capturing over-sized objects and a pipe for conducting used water after passing through the filter to a main water drain; the pipe usually has a trap for preventing sewer gases from the main water drain, and the trap can be U-, S-, or P-shaped. As shown in FIG 1, a typical P-trap plumbing system 1 comprises a grating filter 4 for preventing over-sized objects from entering and a P-trap pipe 6 for conducting used water from the grating filter 4 to a main water drain 8. Because of its shape, the P-trap pipe 6 retains a small amount of water at the lowest portion so that a water seal 12 is formed after the system's use; the water seal 12 prevents sewer gases passing from the main water drain back into the occupied space of a building. Essentially, all plumbing systems including sinks, bathtubs, showers, and toilets must be equipped with either an internal or external trap.

[0003] As shown in FIG 1, the P-trap pipe 6 has a flood rim 10 that is the minimum water level at which the used water begins to overflow into the main water drain. Of course, a plumbing system installed must allow smooth movement of used water from grating filters to main water drains through the traps.

[0004] In order for the water seal 12 to work properly, it must maintain a minimum water seal level 14 in a trap so as to prevent sewer gases from entering buildings. When a plumbing system is not routinely used, the water of the water seal will be evaporated; thus the water seal cannot function properly. In certain occasions, a trap primer may be

installed; these trap primers are devices that automatically recharge traps with water to maintain the water seals. However, plumbing systems in most public and private residential buildings are not equipped with such trap primer devices. In addition, the trap primers increase the cost of plumbing systems.

[0005] As shown in FIG 1, there is a vertical distance from the grating filter 4 at floor level 2 to the flood rim 10 of the P-trap. This vertical distance is denoted as H. Typically, the height H is about 500 mm. With this height H, the falling water from the grating filter to the flood rim causes a noise problem particularly in the middle of the night.

[0006] FIG 2 shows an available two layered grating filter that has an inner layer 20 which is a cylinder, and an outer layer 22 which is basically a filter. There is a bowl at bottom of the outer layer 22 which can keep a small amount of water to form a water seal 29 with a minimum water seal level 26 and thereby prevent sewer gases from entering buildings. The water can only flow 28a if the water level is higher than a flood rim 24. As shown in FIG 2, the water level kept in the bowl at bottom of the outer layer 22, must not be lower than the minimum water seal level 26; otherwise, the filter fails to prevent sewer gases from entering buildings. In addition, it has the same noise problem as shown in FIG 1.

[0007] FIG 3 shows another grating filter that has a filter 30 for preventing large objects from dropping into the trap, a ball holder 32 and a floating ball 36. The grating filter utilizes the floating ball 36 to seal the opening 38 at bottom of the ball holder 32 so as to prevent sewer gases from entering buildings when no water flows. The floating ball 36 is supposed to float when water flows so as to allow free water movement. However, due to wrong calculation, at times, the water 34 inside the ball holder 32 can press a high pressure on the floating ball 36. As a result, the ball 36 seals the opening 38 to stop water from flowing.

[0008] FIG 4A shows another grating filter that has a filter 40, a water tub 42, and a lid 46 rotating around an axle 44. When water flows through the filter, the water will open the lid to allow the water flow; when no water is flowing, the lid will automatically close the opening due to gravity. However, the grating filter shown in FIG 4A still has some limitations. For example, the axle 44 and its support are weak in this design, and therefore the structure is not durable. In addition, the metal materials are not suitable. High quality plastic material must be used to increase its durability, which increases the total cost. To

cut material cost, as a result, the height of the device is very small. It does not have enough space for the user to put the washing machine drainage pipeline into the device. Furthermore, dust and small particles accumulated adjacent to the edges of the lid can reduce the device's effectiveness of preventing sewer gases from entering buildings. Finally, it is unable to reduce the noise caused by falling water, as can be seen from FIG 4B. The falling water **28b** simply pours into the water seal in the P-trap and therefore generates water-falling noise.

Summary of the Invention

[0009] One embodiment of the present invention provides a multiple functional grating filter that comprises a cylindrical filter for filtering a liquid, having one end with filtering slots; a multiple functional guider having a cylinder shaped floating ring guider and a liquid flowing guider; where the cylinder shaped floating ring guider and liquid flowing guider are coupled to form a liquid container with openings for allowing the liquid to pass through, and where the cylinder shaped floating ring guider is configured in such a way that the one end with filtering slots of the cylindrical filter is received; thereby the liquid passing through the cylindrical filter flows to the liquid container; and a floating ring being positioned outside the cylindrical surface of said multiple functional guider so that said floating ring can move upwards or downwards smoothly along the cylinder shaped floating ring guider; whereby when no liquid exists in said liquid container, said floating ring seals the openings to prevent sewer gases from entering buildings; when there is liquid inside said liquid container, said floating ring rises and the openings are open, thus the liquid can flow away through the openings.

[0010] In another embodiment of the multiple functional grating filter, said cylinder shaped floating ring guider has guiding ridges; thereby the guiding ridges guide the floating ring's vertical movement. In a further embodiment of the multiple functional grating filter, the guiding ridges have triangular shaped configuration.

[0011] In another embodiment of the multiple functional grating filter, said liquid flowing guider is bell-shaped. In a further embodiment of the multiple functional grating filter, the bell shaped liquid flowing guider comprises an inner portion that is protruded upwardly for reducing the falling distance of the liquid and guiding the liquid to the liquid

container; thereby the noise caused by the falling liquid from the filter is reduced. In another further embodiment of the multiple functional grating filter, the bell shaped liquid flowing guider comprises an outer portion that is extended to near the inner surface of a trap pipe; thereby the noise caused by the liquid flowing to the trap pipe is reduced.

[0012] In another embodiment of the multiple functional grating filter, said floating ring has a hollow configuration. In a further embodiment of the multiple functional grating filter, said floating ring is made from plastic material.

[0013] In another embodiment of the multiple functional grating filter, said cylinder shaped floating ring guider and said liquid flowing guider are coupled by two pillars.

[0014] In another embodiment of the multiple functional grating filter, said multiple-functional guider has two symmetrical cuts made at outer edge of said liquid flowing guider. In a further embodiment of the multiple functional grating filter, said multiple-functional guider further has fenders at positions of the two symmetrical cuts for forcing liquid to flow to other position that is nearer to the internal wall of a trap pipe, resulting in minimized liquid falling noise.

[0015] Another embodiment of the present invention provides a plumbing system that comprises a trap pipe for providing a water seal within the pipe; wherein the trap pipe has a first end and a second end; and wherein the first end is coupled to a main drain; and a multiple functional grating filter being coupled to the second end of the trap pipe; thereby water can flow from the grating filter to the main drain via the trap pipe; wherein the multiple functional grating filter comprises: a cylindrical filter for filtering a liquid, having one end with filtering slots; a multiple functional guider having a cylinder shaped floating ring guider and a liquid flowing guider; where the cylinder shaped floating ring guider and liquid flowing guider are coupled to form a liquid container with openings for allowing the liquid to pass through, and where the cylinder shaped floating ring guider is configured in such a way that the one end with filtering slots of the cylindrical filter is received; thereby the liquid passing through the cylindrical filter flows to the liquid container; and a floating ring being positioned outside the cylindrical surface of said multiple functional guider so that said floating ring can move upwards or downwards smoothly along the cylinder shaped floating ring guider; whereby when no liquid exists in said liquid container, said floating ring seals the openings to prevent sewer gases from entering buildings; when there

is liquid inside said liquid container, said floating ring rises and the openings are open, thus the liquid can flow away through the openings.

[0016] In another embodiment of the plumbing system, said cylinder shaped floating ring guider has guiding ridges; thereby the guiding ridges guide the floating ring's vertical movement. In a further embodiment of the plumbing system, the guiding ridges have triangular shaped configuration.

[0017] In another embodiment of the plumbing system, said liquid flowing guider is bell-shaped. In a further embodiment of the plumbing system, the bell shaped liquid flowing guider comprises an inner portion that is protruded upwardly for reducing the falling distance of the liquid and guiding the liquid to the liquid container; thereby the noise caused by the falling liquid from the filter is reduced. In another further embodiment of the plumbing system, the bell shaped liquid flowing guider comprises an outer portion that is extended to near the inner surface of a trap pipe; thereby the noise caused by the liquid flowing to the trap pipe is reduced.

[0018] In another embodiment of the plumbing system, said floating ring has a hollow configuration. In a further embodiment of the plumbing system, said floating ring is made from plastic material.

[0019] In another embodiment of the plumbing system, said cylinder shaped floating ring guider and said liquid flowing guider are coupled by two pillars.

[0020] In another embodiment of the plumbing system, said multiple-functional guider has two symmetrical cuts made at outer edge of said liquid flowing guider. In a further embodiment of the plumbing system, said multiple-functional guider further has fenders at positions of the two symmetrical cuts for forcing liquid to flow to other position that is nearer to the internal wall of the trap pipe, resulting in minimized liquid falling noise.

[0021] In another embodiment of the plumbing system, the trap pipe has a P, U, or S shaped water seal.

[0022] The objectives and advantages of the invention will become apparent from the following detailed description of preferred embodiments thereof in connection with the accompanying drawings.

Brief Description of the Drawings

[0023] Preferred embodiments according to the present invention will now be described with reference to the Figures, in which like reference numerals denote like elements.

[0024] FIG 1 shows a typical P-trap plumbing system known in the art.

[0025] FIG 2 shows a two layered grating filter known in the art.

[0026] FIG 3 shows a grating filter with a floating ball known in the art.

[0027] FIG 4A and FIG 4B show a grating filter with a lid known in the art.

[0028] FIG 5A is an exploded view of the multiple functional grating filter in accordance with one embodiment of the present invention.

[0029] FIG 5B is a sectional view of the assembled multiple- functional grating filter device 50 shown in FIG 5A.

[0030] FIG 6 shows a more detailed illustration of the working principles of the multiple functional grating filter in accordance with one embodiment of the present invention.

[0031] FIG 7 shows an diagrammatic illustration of the installed multiple functional grating filter in accordance with one embodiment of the present invention.

[0032] FIGS 8A and 8B illustrates the installation of the multiple functional grating filter in accordance with one embodiment of the present invention.

[0033] FIGS 9A, 9B, 9C and 9D show more details of the multiple-functional guider of the multiple functional filter in accordance with one embodiment of the present invention.

Detailed Description of the Invention

[0034] The present invention may be understood more readily by reference to the following detailed description of certain embodiments of the invention.

[0035] Throughout this application, where publications are referenced, the disclosures of these publications are hereby incorporated by reference, in their entireties,

into this application in order to more fully describe the state of art to which this invention pertains.

[0036] The present invention provides a multiple functional grating filter that allows water to flow into a trap pipe with a trap, filters oversized objects so as to prevent these objects from falling into the trap, seals the openings of the filter to prevent sewer gases from entering buildings when no water flows, and eliminates or at least minimizes water-falling noise. Briefly, the multiple-functional grating filter comprises a cylindrical filter, a multiple-functional guider and a floating ring. The cylindrical filter provides filtering slots. The floating ring is floatable and positioned outside the cylindrical surface of the multiple-functional guider, where the multiple-functional guider comprises a cylinder shaped floating ring guider and a water flowing guider.

[0037] Referring to FIG 5A, there is provided an exploded view of the multiple functional grating filter in accordance with one embodiment of the present invention. The multiple-functional grating filter 50 comprises a cylindrical filter 52 with slots 57 for filtering purpose, a floating ring 54 and a multiple functional guider 56. As also shown in FIG 5A, the filter is assembled as follows: a) the floating ring 54 is positioned along outer cylindrical surface of the multiple-functional guider 56, and b) then, the multiple functional guider 56 is fixed to the cylindrical filter 52. FIG 5B provides a sectional view of the assembled multiple- functional grating filter device 50 shown in FIG 5A.

[0038] Now referring to FIG 6, there is provided a more detailed illustration of the working principles of the multiple functional grating filter in accordance with one embodiment of the present invention. As shown in FIG 6, the multiple-functional guider 56 comprises a cylinder shaped floating ring guider 56a with openings 58 at the bottom and a water flowing guider 56c, where the two guiders 56a, 56c are configured to form a water container 56b when the openings 58 are closed by the floating ring 54. When the floating ring 54 is lifted up by the water pressure from the water container 56b, the water from the water container can flow into the trap pipe through the openings 58.

[0039] The floating ring 54 is floatable and positioned along the outer cylindrical surface of the multiple- functional guider 56. The cylindrical floating ring guider 56a guides the floating ring 54 to move upwards or downwards along the cylindrical floating ring guider 56a. There is a gap, denoted as ΔR , between the floating ring guider 56a and the floating ring 54. The value of ΔR should be large enough that allows free movement of

the floating ring **54**; however, if ΔR is too large, the floating ring may not be guided to an accurate sealing position. A preferable value for ΔR is from 0.30 to 0.35 mm.

[0040] Still referring to FIG 6, when no water exists in the water container **56b** the floating ring **54** seals the openings **58** from the start point **66** to the end point **68** due to the gravity force F_g , so that the device can prevent sewer gases from entering buildings. When there is water in the water container **56b**, the floating ring **54** rises due to its buoyancy force F_b ; thus the water can flow away through the openings **58** into the trap pipe (see water flows **28d**).

[0041] The floating ring **54** may be made from plastic material; it may have a hollow configuration, therefore the gravity force F_g is less than the buoyancy force, F_b , if there is water **64** in the container **56b**. Thus the water in the water container **56b** is able to generate a buoyancy force to raise the floating ring **54** upwards, resulting in the water flowing away from the device into the P-trap. In addition to the buoyancy force F_b , the water **64** in the container **56b** also generates a horizontal force F_h , as shown in FIG 6. However, the horizontal force component F_h does not have any effect on the floating ring's movement, because F_h is balanced by an opposite horizontal force (not shown in FIG 6) due to symmetrical structure of the water container **56b** and the floating ring **54**.

[0042] Still referring to FIG 6, the water flowing guider **56c** is the bell-shaped. The water flowing guider **56c** can be divided into two functional portions: an inner portion **56c-1**, and an outer portion **56c-2**. The outer portion **56c-2** can guide the water **28d** to flow along the internal wall of the P trap pipe due to the water's adhesiveness, rather than directly falling into the seal water kept in the P-trap, so that water falling noise is significantly reduced, if not eliminated. When there is water flowing into the water container **56b**, the inner portion **56c-1** guides the water **28c** to flow towards the circled bottom of the floating ring **54**, which generates the water flowing force acting at the bottom of the floating ring **54**. The water in the water container **56b** generates the floating force, or buoyancy force that is proportional to the height of the water level **64** in the water container **56b**. As a result, the floating ring **54** rises due to its buoyancy force, F_b , and water flowing force (not shown in FIG 6). Thus the water can flow away from the filter.

[0043] Now referring to FIG 7, there is provided an diagrammatic illustration of the installed multiple functional grating filter in accordance with one embodiment of the present invention. The multiple-functional grating filter **50** is installed into a P-trap pipe

70 at its inlet 71. It is noted that the inlet 71 is provided by the standard grating 4 shown in FIG 1. The used water flows into the filter 50. The water flow 28e is guided by the inner portion 56c-1 of the water flow guider 56c. Thus the water flows towards bottom of the water container 56b. The buoyancy force and water flowing force raises the floating ring 54 to allow the water to flow away through the openings 58 of the water container 50b. It is noted that before leaving the filter, the water is guided by the outer portion 56c-2 so that the water flows along the internal wall of the P-trap pipe due to water's adhesiveness, thus the water falling noise is minimized.

[0044] In order to efficiently minimize the water falling noise, the edge of the outer-water- flowing-guider 56c-2 shall be near to the internal wall of the P-trap pipe, and the gap between them is about 3~4 mm. This design results in that the diameter of the outer portion 56c-2 is larger than the inner diameter of the standard inlet 71, which makes it impossible to install the device into the P-trap through the standard inlet. To overcome this problem, the outer portion 56c-2 has two symmetrical cuts 82 made at outer edge of the water guider shown in FIG. 8, so that it is feasible to mount the device into the gratings 4. FIG 8A shows the installation procedure. Firstly, the device is positioned with an inclination angle β , where β is about 10~15 degrees, and then one side of the outer portion 56c-2 is inserted through the inlet 71 to the internal wall of the P-trap pipe, thereafter the entire device is able to move downwards and mounted onto the inlet 71, as shown in FIG 8B. A reverse procedure is enough when taking the filter out from the P-trap inlet 71.

[0045] Now referring to FIGS 9A, 9B, 9C and 9D, there are provided more details of the multiple-functional guider of the multiple functional filter in accordance with one embodiment of the present invention. FIG 9A shows a cross-sectional view of the multiple-functional guider 56; the positions of further cross-sections are shown.

[0046] FIG 9B is a cross-section view of the multiple functional guider 56 shown in FIG 9A, taken along line A-A of FIG 9A. FIG 9B shows the two symmetrical cuts 82 made at outer edge ring of the outer portion 56c-2. These two cuts make it feasible to mount the device into the inlet 71 as described previously. FIG 9B also shows guiding ridges 92 that guide the floating ring's movement. This design reduces possible resistance caused by any dust and small objects accumulated between the floating ring 54 and the cylindrical floating ring guider 56a. FIG 9C is a cross-section view of the multiple functional guider 56 shown in FIG 9A, taken along line B-B of FIG 9A. As can be seen

from FIG 9C, the cylindrical floating guider **56a** is connected to the water guider **56c** by two pillars **94**. FIG 9D is a cross-section view of the multiple functional guider **56** shown in FIG 9C, taken along line C-C of FIG 9C. FIG 9D shows that there are two fenders **96** at positions of two symmetrical cuts **82** made at outer edge of the bell-shaped water guider. These two fenders stop water falling at this position, and forces water to flow to the position that is nearer to the internal wall of the P-trap pipe, such that water falling noise is minimized.

[0047] The present invention also provides a plumbing system that can be installed in any suitable locations such as bathrooms, showers, and sinks. The plumbing system comprises a multiple functional grating filter as described above and a trap pipe. The trap pipe has a P, U, or S water seal so that when the trap pipe is coupled to a main drain, the water seal can prevent the sewer gases from entering buildings. The trap pipe is also receptive for the multiple functional grating filter so that the multiple functional grating filter can reduce the noise and provide another mechanism for preventing the sewer gases from entering the buildings; therefore, the plumbing system has dual mechanisms for preventing the sewer gases from entering buildings.

[0048] While the present invention has been described with reference to particular embodiments, it will be understood that the embodiments are illustrative and that the invention scope is not so limited. Alternative embodiments of the present invention will become apparent to those having ordinary skill in the art to which the present invention pertains. Such alternate embodiments are considered to be encompassed within the spirit and scope of the present invention. Accordingly, the scope of the present invention is described by the appended claims and is supported by the foregoing description.

CLAIMS

What is claimed is:

1. A multiple functional grating filter, comprising:
 - a cylindrical filter for filtering a liquid, having one end with filtering slots;
 - a multiple functional guider having a cylinder shaped floating ring guider and a liquid flowing guider; where the cylinder shaped floating ring guider and liquid flowing guider are coupled to form a liquid container with openings for allowing the liquid to pass through, and where the cylinder shaped floating ring guider is configured in such a way that the one end with filtering slots of the cylindrical filter is received; thereby the liquid passing through the cylindrical filter flows to the liquid container; and
 - a floating ring being positioned outside the cylindrical surface of said multiple functional guider so that said floating ring can move upwards or downwards smoothly along the cylinder shaped floating ring guider;
 - whereby when no liquid exists in said liquid container, said floating ring seals the openings to prevent sewer gases from entering buildings; when there is liquid inside said liquid container, said floating ring rises and the openings are open, thus the liquid can flow away through the openings.
2. The multiple functional grating filter of claim 1, wherein said cylinder shaped floating ring guider has guiding ridges; thereby the guiding ridges guide the floating ring's vertical movement.
3. The multiple functional grating filter of claim 2, wherein the guiding ridges have triangular shaped configuration.
4. The multiple functional grating filter of claim 1, wherein said liquid flowing guider is bell-shaped.
5. The multiple functional grating filter of claim 4, wherein the bell shaped liquid flowing guider comprises an inner portion that is protruded upwardly for reducing the

falling distance of the liquid and guiding the liquid to the liquid container; thereby the noise caused by the falling liquid from the filter is reduced.

6. The multiple functional grating filter of claim 4, wherein the bell shaped liquid flowing guider comprises an outer portion that is extended to near the inner surface of a trap pipe; thereby the noise caused by the liquid flowing to the trap pipe is reduced.

7. The multiple functional grating filter of claim 1, wherein said floating ring has a hollow configuration.

8. The multiple functional grating filter of claim 7, wherein said floating ring is made from plastic material.

9. The multiple functional grating filter of claim 1, wherein said cylinder shaped floating ring guider and said liquid flowing guider are coupled by two pillars.

10. The multiple functional grating filter of claim 1, wherein said multiple-functional guider has two symmetrical cuts made at outer edge of said liquid flowing guider.

11. The multiple functional grating filter of claim 10, wherein said multiple-functional guider further has fenders at positions of the two symmetrical cuts for forcing liquid to flow to other position that is nearer to the internal wall of a trap pipe, resulting in minimized liquid falling noise.

12. A plumbing system comprising:

a trap pipe for providing a water seal within the pipe; wherein the trap pipe has a first end and a second end; and wherein the first end is coupled to a main drain; and

a multiple functional grating filter being coupled to the second end of the trap pipe; thereby water can flow from the grating filter to the main drain via the trap pipe;

wherein the multiple functional grating filter comprises:

a cylindrical filter for filtering a liquid, having one end with filtering slots;

a multiple functional guider having a cylinder shaped floating ring guider and a liquid flowing guider; where the cylinder shaped floating ring guider and liquid flowing guider are coupled to form a liquid container with openings for allowing the liquid to pass through, and where the cylinder shaped floating ring guider is configured in such a way that the one end with filtering slots of the cylindrical filter is received; thereby the liquid passing through the cylindrical filter flows to the liquid container; and

a floating ring being positioned outside the cylindrical surface of said multiple functional guider so that said floating ring can move upwards or downwards smoothly along the cylinder shaped floating ring guider;

whereby when no liquid exists in said liquid container, said floating ring seals the openings to prevent sewer gases from entering buildings; when there is liquid inside said liquid container, said floating ring rises and the openings are open, thus the liquid can flow away through the openings.

13. The plumbing system of claim 12, wherein said cylinder shaped floating ring guider has guiding ridges; thereby the guiding ridges guide the floating ring's vertical movement.

14. The plumbing system of claim 13, wherein the guiding ridges have triangular shaped configuration.

15. The plumbing system of claim 12, wherein said liquid flowing guider is bell-shaped.

16. The plumbing system of claim 15, wherein the bell shaped liquid flowing guider comprises an inner portion that is protruded upwardly for reducing the falling distance of the liquid and guiding the liquid to the liquid container; thereby the noise caused by the falling liquid from the filter is reduced.

17. The plumbing system of claim 15, wherein the bell shaped liquid flowing guider comprises an outer portion that is extended to near the inner surface of a trap pipe; thereby the noise caused by the liquid flowing to the trap pipe is reduced.

18. The plumbing system of claim 12, wherein said floating ring has a hollow configuration.
19. The plumbing system of claim 18, wherein said floating ring is made from plastic material.
20. The plumbing system of claim 12, wherein said cylinder shaped floating ring guider and said liquid flowing guider are coupled by two pillars.
21. The plumbing system of claim 12, wherein said multiple-functional guider has two symmetrical cuts made at outer edge of said liquid flowing guider.
22. The plumbing system of claim 21, wherein said multiple-functional guider further has fenders at positions of the two symmetrical cuts for forcing liquid to flow to other position that is nearer to the internal wall of the trap pipe, resulting in minimized liquid falling noise.
23. The plumbing system of claim 12, wherein the trap pipe has a P, U, or S shaped water seal.