

AUTOMATED GUTTER CONTROL SYSTEM

Field of the Invention

[0001] The present invention generally relates to a gutter control system, and in particular to an automated control system for rain gutter.

Background of the Invention

[0002] Roof top rain gutters are used for channeling rain water from roof to ground or rain harvesting systems. Problems arise when these gutters are often clogged with tree branches, leaves, debris, and birds' droppings. Once clogged, the rain water become stagnant and an ideal breeding ground for mosquitoes. In fact, rain gutters have been identified as one of the common breeding spots for mosquitoes.

[0003] Dengue fever and dengue hemorrhagic fever are one of the most serious mosquito-borne viral diseases in the world and are simply spread by the bites of Aedes mosquitoes. Aedes mosquitoes' breeding has been a health problem especially in urban area of tropical nations. Aedes mosquitoes are capable of breeding in still water anywhere. A search and destroy method is commonly used for controlling the mosquito population. Possible mosquito breeding grounds are searched for and insecticide is being sprayed to destroy the mosquito larvae. Fogging is also often done to kill adult mosquitoes.

[0004] There are several known ways of removing clog and prevent mosquitoes from breeding. Regular cleaning of roof top rain gutters is usually done to remove clogging. However, it tends to be labour intensive and costly, and may also be dangerous, especially if the cleaning person needs to climb up the house roof.

[0005] The use of top layer is useful in preventing tree branches, leaves, debris and birds' droppings from entering into the roof top rain gutters. Clogging is very rare in this case and what remains in the rain gutters are usually dead insects. US 5,099,620 discloses a rain gutter cover mounted adjacent to the bottom edge of a roof upon which

rain falls for preventing the entrance of leaves and other debris into the rain gutter, which may cause rain gutter clogging and the stoppage of rain flow into downspouts.

[0006] However, it does not solve the problem of mosquitoes' breeding. As it is impossible to channel 100% of the rain away from the rain gutters, some water puddles are left behind in the rain gutter. These will become ideal breeding grounds for mosquitoes, especially if there are irregularities in the joints of the rain gutters and connections to the downspout. The use of top layer for shielding the rain gutters also impedes evaporation of the remaining water in the gutters as the rain gutters are shielded from direct sunlight by the top layer. This subsequently leads to undesirable pockets of water ideal for mosquito breeding.

[0007] US 7,208,081 discloses an alternative use of foam-like material to cover the whole rain gutter. The foam material is open-pore polyether foam of 10-20 cells per square inch, which allows rainwater to travel through the filter while excluding leaves. However, this design poses another problem as the holes in the foam-like material for draining off water from the top into the rain gutter may also be trapped with small insects. As a result, stagnant water in the rain gutter is not removed totally.

[0008] Insecticides or mosquito dunks (Bti Briquets) are usually used in roof top rain gutters. There are typically two types of insecticide that could be placed in the rain gutters: liquid form and solid pellets. Liquid insecticide is easily washed away by rain. Solid insecticide pellets and solid mosquito dunks are having the same problem, unless they are fixed rigidly onto the rain gutters. In addition, these solid pellets would only be useful if they are in contact with water. As mosquitoes can breed in water area of about the size of a coin, these solid pellets would need to be fixed at regular spacing of a coin to fully ensure that all rain water puddles are in contact with at least one solid insecticide or mosquito dunk. Such a measure using many solid pellets is very expensive and labour costly. Solid pellets would also need to be replenished regularly.

[0009] Automatic rain gutter flushing system can also be used to flush away all tree branches, leaves, and debris. US 7,188,784 discloses an automatic rain gutter flushing system for automatically cleaning and flushing leaves and other debris from gutters and downspouts. Very strong water jets are usually needed and there is a possibility that long tree branches with unusual shapes and big debris may be jammed in

the downspouts. Moreover, a proper channel of directing the tree branches, eaves and debris to another place smoothly is needed.

Summary of the Invention

[0010] The following presents a simplified summary to provide a basic understanding of the present invention. This summary is not an extensive overview of the invention and is not intended to identify key features of the invention. Rather, it is to present some of the inventive concepts of this invention in a generalized form as a prelude to the detailed description that is to follow.

[0011] The present invention provides an automated control system for rain gutter. According to one aspect of the invention, there is provided an automated gutter control system comprises of a rain gutter, a top mesh layer, a set of dishes located along the rain gutter for collecting stagnant water, a set of nozzle placed beside or on top of each dish for dripping pesticide, a set of water jets for cleaning the rain gutter, a timing system for controlling the water jets, and a set of water sensors for detecting rain gutter system malfunction.

[0012] In one embodiment of the present invention, the set of water jets comprises high-pressure water jets for spraying high-pressure water to clean the rain gutter and flush away any clogging materials as well as stagnant water in the rain gutter.

[0013] In another embodiment of the present invention, the set of water jets further comprises water jets aimed at the set of dishes for removing stagnant water in the set of dishes.

[0014] In yet another embodiment of the present invention, the water sprayed from the water jets is mixed with pesticide.

[0015] In one embodiment of the present invention, the set of water sensors can be used for detecting several rain gutter system malfunction, such as to detect whether the pump speed of the water jets is in desired rate, to detect any power down issues in the rain gutter, to detect whether there is any blockage and further indicate the location of the blockage in the rain gutter.

[0016] In another embodiment of the present invention, the automated gutter control system further comprises a rain sensor such that water will not be sprayed from the water jets on rainy days.

[0017] In yet another embodiment of the of the present invention, the automated gutter control system further comprises a water filtering system for filtering used water and a water tank for storing the filtered water before reuse.

[0018] According to another aspect of the invention, there is provided an automated gutter control system comprises of a rain gutter and a top mesh layer; both made of heat conductive material, a set of dishes located along the rain gutter for collecting stagnant water, a set of nozzle placed beside or on top of each dish for dripping pesticide, a set of water jets for cleaning the rain gutter, a timing system for controlling the water jets, and a set of temperature sensors for monitoring the temperature of the rain gutter.

[0019] In one embodiment of the present invention, the gutter control system is set such that no water will be sprayed from the water jets if a minimum predetermined temperature is maintained for a minimum duration within a predetermined period of time.

[0020] In another embodiment of the present invention, the gutter control system can be set such that water will still be sprayed from the water jets during certain period of time, even if a minimum predetermined temperature is maintained for a minimum duration within a predetermined period of time.

[0021] The objectives and advantages of the present invention will become apparent from the following detailed description of embodiments thereof in connection with the accompanying drawings.

Brief Description of the Drawings

[0022] Preferred embodiments according to the present invention will now be described with reference to the figures accompanied herein, in which like reference numerals denote like elements;

[0023] FIG. 1 is an isometric view of a rain gutter according to one embodiment of the invention;

[0024] FIG. 2 is an isometric view of the rain gutter of FIG. 1 without a top layer showing water sensor arrangement according to one embodiment of the invention;

[0025] FIG. 3 is a perspective view of the rain gutter mounted on roof top together with a rain sensor and solar energy panels, according to one embodiment of the invention; and

[0026] FIG. 4 is a block diagram of automated gutter control system according to one embodiment of the present invention.

Detailed Description of the Invention

[0027] Description of certain embodiments of the present invention shall now be explained in detail, with reference to the attached drawings. It is to be understood that no limitation of the scope of the invention is thereby intended, such alterations and further modifications in the illustrated device, and such further applications of the principles of the invention as illustrated therein being contemplated as would normally occur to one skilled in the art to which the invention relates.

[0028] FIG. 1 shows an isometric view of a rain gutter according to one embodiment of the invention. The rain gutter **1** is designed with a black top mesh layer **2**, which slopes downwards away from the building. This top layer **2** allows water and smaller objects, such as birds' droppings to pass through but prevent larger objects from getting into the rain gutter **1**. The larger objects on the top layer **2** may be blown away by the wind, rolled down the sloping layer to the ground by gravity, or cleared by human regularly.

[0029] The rain gutter **1** is painted black for the purpose of attracting mosquitoes. There are several blocks of equally spaced small black dishes **3** placed along the bottom of the rain gutter **1**. These black dishes **3** serve the purpose of collecting stagnant water in order to provide an attractive breeding ground for mosquitoes. A nozzle **4** is placed beside or on top of each black dish **3** for dripping liquid Bti (*Bacillus thuringiensis* subspecies *israelensis*) into the black dishes **3** of stagnant water. Bti is an odourless

biopesticide and is only toxic to the larvae of mosquitoes and blackflies. It is biodegradable and it does not have any smell to repel adult mosquitoes.

[0030] While most types of mosquitoes lay eggs in stagnant water, *Aedes* mosquitoes lay eggs in moist area or near water. The use of black dishes **3** is to encourage mosquitoes to lay eggs directly on the water inside the dishes **3** or on the edge of the dishes **3** beside the water, or any place inside the rain gutter **1**. These mosquitoes will lay eggs singly or in floatable egg rafts, depending on their species.

[0031] High-pressure water jets **5** are fixed along the rain gutter **1**. Water mixed with liquid Bti, is sprayed at high pressure once a day automatically, during the day time, for a short duration of several minutes, to clean the rain gutter **1** and flush away any small clogging materials and stagnant water. There are also water jets **6** aimed at the small black dishes **3** to remove the stagnant water in the dishes **3**. As water in the gutter **1** is flushed everyday, mosquitoes' eggs laid and larvae hatched there would be washed away. Mosquito larvae are likely to die during this washing process as they would not be able to move up to the water surface to breathe in the running water. Furthermore, Bti would also kill the larvae. The strength of the running water would also help in disintegrating mosquito egg rafts into individual eggs, rendering these eggs unable to float on the surface of the water.

[0032] A timing system with a rain sensor **7** mounted on the roof top, is used to control the water jets **5**. On rainy days, water would not flow from the pipes **8**. On other days, the timing system would control the flow of water from the pipes **8**. Water from the pipes **8** may be pumped once a day, and each time for a duration of several minutes.

[0033] After this cleaning process, some amount of water would be left in the small black dishes. The nozzle **4** beside or on top of each black dish **3** would then be activated to drip extra amount of liquid Bti into each black dish **3**.

[0034] The water used is collected from the gutter **1** through the downspout **9** and is passed into a water filtering system **16**. Water is also spun to kill mosquito larvae by suffocation. It is then stored in a water tank **14** and recycled for use. This is an environmentally friendly design as Bti is non-toxic and yet effective against mosquito larvae. The use of running water everyday also helps to cool down the building.

[0035] Water sensors **15** can be placed at different height level and positions of the gutter **1**. FIG. 2 discloses a water sensor arrangement of the rain gutter according to one embodiment of the present invention. L denotes water sensors located on the left side or the beginning of the rain gutter **1**, while M and R denotes water sensors located in the middle of and on the right side or the end of the rain gutter **1** respectively. The number 1, 2 and 3 after the letter L, M or R, denote the height level of the water sensors, where 1 indicates the lowest level, 2 indicates the middle level and 3 indicates the highest level. All of these water sensors and timing information circuit are powered by rechargeable batteries and will serve as an automatic detector of rain gutter system malfunction. It will be apparent to those of ordinary skill in the art that various changes and modifications can be made to the above arrangement without departing from the fundamental principles and concepts.

[0036] Water is sprayed from left side to right side of the rain gutter **1**. Under normal working condition, L1 will be detecting water first followed by M1 and R1. At the end of the cleaning process, and after a pre-determined time, all L3, M3 and R3 should detect no water. The malfunction condition can then be detected by measuring the sensor inputs with timing information.

[0037] The timing information of the sensor can be used in several different ways. Firstly, it can be used to detect whether the pump speed of the water jets is in desired rate. If the time that water is detected at sensors L1, L3 is denoted as TL1, TL3 and the time that water is detected at sensors R1, R3 is denoted as TR1, TR3, the pump speed will then be considered not strong enough if $(TR1 - TL1)$ is larger than a predetermined threshold and $(TR3 - TL3)$ is also larger than a predetermined threshold.

[0038] It can also be used to tell whether the flushing system is in proper operation in all areas of the gutter. If any of the water sensor at sensors L1, M1 and R1, or L2, M2 and R2, or L3, M3 and R3 is not wet in the logical order, alert will be sent to the owners automatically, indicating the power down issues. The owners will also be alerted if there is any blockage in the rain gutter. Let the time that water is detected at sensors L1, L3 denoted as TL1, TL3 and the time that water is detected at sensors R1, R3 denoted as TR1, TR3. There might be blockages at lower part of the rain gutter, if $(TR1 - TL1)$ is larger than a predetermined threshold but $(TR3 - TL3)$ is not larger than a

predetermined threshold. On the other hand, the situation where (TR1-TL1) is not larger than a predetermined threshold but (TR3-TL3) is larger than a predetermined threshold, indicates that there might be blockages at upper part of the rain gutter.

[0039] In an alternative embodiment of the present invention, the rain gutter **1** and its cover **2** are made of light weight and heat conductive material, such as aluminum. This feature will allow the use of high temperature at roof top for raising the temperature of the rain gutter **1** and its cover **2**. The use of heat conductive materials will pass the high temperature heat from the sun to the water continuously whenever there is sun. Three temperature sensors **10**, **11** and **12** are fixed to the rain gutter **1**, two on each end and one in the middle. These sensors **10**, **11** and **12** will monitor the inner surface temperature of the rain gutter **1** to ensure that a minimum predetermined temperature is maintained for a minimum duration everyday or every two days, as required. The chosen temperature and duration should be high and long enough to prevent mosquito breeding. In summary, the use of heat conductive material such as aluminum for the rain gutter **1** and its cover **2** allows the use of the heat from the sun for helping the evaporation of the left over or stagnant water in the rain gutter **1**, such that the automatic flushing system with mal-function detector do not have to be activated when the temperature is high enough. If there is too much water in the rain gutter, the water temperature will then be raised to a temperature that is high enough that mosquito will not breed in it.

[0040] If the desired condition of high temperature within sufficient period of time cannot be maintained due to cloudy days or raining sessions, the automatic flushing system with mal-function detector will then be activated. Alternatively, both systems can be run in parallel for owners who prefer double assurance or a more robust system on alternate day.

[0041] In another embodiment of the present invention, solar energy panels **13** can be mounted on the roof top, as illustrated in FIG. 3. This is done to gather sunlight and convert it into electrical energy, which can be used to partially power the rain gutter cleaning system.

[0042] FIG. 4 illustrates a block diagram of automated gutter control system according to one embodiment of the present invention. The temperature sensors **10**, **11** and **12** will work together with the heat conductive material of the rain gutter **1** and its

cover **2**, such that the high temperature heat of the sun helps to accelerate the evaporation of the left over or stagnant water in the rain gutter **1**. If there is too much water inside the rain gutter **1**, which makes it too difficult to evaporate by the help of the heat from the sun alone, the high thermal conductivity of the rain gutter material will raise the water temperature such that it is too hot for the mosquito to breed. This system can be referred to as “clean-energy sub-system” as there is no pump involved.

[0043] The owners can choose on whether to activate the automatic flushing system only when the desired temperature of the rain gutter **1** cannot be maintained or to run the automatic flushing system parallel with the clean-energy sub-system. The automatic flushing system is equipped with a timing system and a rain sensor **7**, such that the water mixed with liquid Bti will be sprayed regularly using high pressure water jets **5**, except on rainy days, where rain water is used to clean the rain gutter **1** instead. The water used for spraying the rain gutter **1** is supplied from a water tank **14**, whereby the water is first mixed with liquid Bti.

[0044] The automatic flushing system is further equipped with several water sensors **15** that serve as malfunction detector of the rain gutter system. The timing information obtained from the sensor inputs is used to monitor the overall operation of the flushing system throughout the rain gutter **1** and automatically alert the owners whenever there is any blockage of the rain gutter **1**.

[0045] The nozzle **4** located beside or on top of each black dish **3** will then be activated to drip extra amount of liquid Bti into the black dishes **3** of stagnant water left after the cleaning process. The water used to clean the rain gutter will travel through the downspout **9** and pass the water filtering system **16**. The filtered water is then stored in the water tank **14** and mixed with liquid Bti, which can be reused for supplying the water for the high-pressure water jets **5**.

[0046] 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 skills in the art to which the present invention pertains. Such alternate embodiments are considered to be encompassed within the spirit

and the 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

1. An automated gutter control system, comprising:
 - a rain gutter;
 - a top mesh layer;
 - a set of dishes located along the rain gutter for collecting stagnant water;
 - a set of nozzle placed beside or on top of each dish for dripping pesticide;
 - a set of water jets for cleaning the rain gutter;
 - a timing system for controlling the water jets; and
 - a set of water sensors for detecting rain gutter system malfunction.
2. The automated gutter control system as claimed in claim 1, wherein said set of water jets comprises high pressure water jets for spraying high pressure water to clean the rain gutter and flush away any clogging materials as well as stagnant water in the rain gutter.
3. The automated gutter control system as claimed in claim 2, wherein said set of water jets further comprises water jets aimed at the set of dishes for removing stagnant water in the set of dishes.
4. The automated gutter control system as claimed in claim 1, wherein water sprayed from said water jets is mixed with pesticide.
5. The automated gutter control system as claimed in claim 1, wherein said set of water sensors can be used for detecting whether the pump speed of the water jets is in desired rate.
6. The automated gutter control system as claimed in claim 1, wherein said set of water sensors can be used for detecting any power down issues in the rain gutter.

7. The automated gutter control system as claimed in claim 1, wherein said set of water sensors can be used for detecting whether there is any blockage in the rain gutter.
8. The automated gutter control system as claimed in claim 6, wherein said set of water sensors can be used for further indicating the location of the blockage in the rain gutter.
9. The automated gutter control system as claimed in claim 1, and further comprising a rain sensor such that water will not be sprayed from the water jets on rainy days.
10. The automated gutter control system as claimed in claim 1, and further comprising a downspout for draining water from rain gutter.
11. The automated gutter control system as claimed in claim 1, and further comprising a water filtering system.
12. The automated gutter control system as claimed in claim 11, and further comprising a water tank for storing the filtered water before reuse.
13. The automated gutter control system as claimed in claim 1, and further comprising solar energy panels for converting solar energy into electrical energy.
14. An automated gutter control system, comprising:
 - a rain gutter made of heat conductive material;
 - a top mesh layer made of heat conductive material;
 - a set of dishes located along the rain gutter for collecting stagnant water;
 - a set of nozzle placed beside or on top of each dish for dripping pesticide;
 - a set of water jets for cleaning the rain gutter;
 - a timing system for controlling the water jets; and
 - a set of temperature sensors for monitoring the temperature of the rain gutter.

15. The automated gutter control system as claimed in claim 14, wherein said gutter control system is set such that no water will be sprayed from the water jets if a minimum predetermined temperature is maintained for a minimum duration within a predetermined period of time.
16. The automated gutter control system as claimed in claim 14, wherein said gutter control system can be set such that water will still be sprayed from the water jets during certain period of time, even if a minimum predetermined temperature is maintained for a minimum duration within a predetermined period of time.
17. The automated gutter control system as claimed in claim 14, wherein said set of water jets comprises high pressure water jets for spraying high pressure water to clean the rain gutter and flush away any clogging materials as well as stagnant water in the rain gutter.
18. The automated gutter control system as claimed in claim 17, wherein said set of water jets further comprises water jets aimed at the set of dishes for removing stagnant water in the set of dishes.
19. The automated gutter control system as claimed in claim 14, wherein water sprayed from said water jets is mixed with pesticide.
20. The automated gutter control system as claimed in claim 14, and further comprising a rain sensor such that water will not be sprayed from the water jets on rainy days.
21. The automated gutter control system as claimed in claim 14, and further comprising a downspout for draining water from rain gutter.

22. The automated gutter control system as claimed in claim 14, and further comprising a water filtering system.

23. The automated gutter control system as claimed in claim 22, and further comprising a water tank for storing the filtered water before reuse.

24. The automated gutter control system as claimed in claim 14, and further comprising solar energy panels for converting solar energy into electrical energy.