

MOSQUITO SORTER

FIELD OF THE INVENTION

5 The present invention relates to a mosquito sorter. In particular, the present invention relates to a mosquito sorter and a method of sorting mosquitoes using the same.

BACKGROUND

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Only female mosquitoes require blood meals and bite animals. Stimuli that influence biting or blood feeding of female mosquitos include a combination of carbon dioxide, temperature, moisture, smell, colour and movement. Male mosquitoes do not bite, but feed on nectar of flowers or other suitable sugar
15 source. Acquiring a blood meal as a source of protein is essential for egg production of a female mosquito, although male and female mosquitoes are nectar feeders for their nutrition. In some species of mosquitos, female mosquitos feed on humans and are therefore vectors for a number of infectious diseases affecting millions of people every year. Past attempts are made to eradicate female
20 mosquito population through genetic modification or using chemicals. Some of these chemicals are harmful to the environment as well as human beings.

It is therefore desirable to provide an apparatus and a method that seeks to address at least one of the problems described hereinabove, or at least to provide
25 an alternative.

SUMMARY OF INVENTION

In accordance with one aspect of this invention, a mosquito sorter for segregating
30 mosquitoes is provided. The mosquito sorter comprises at least one separator unit, the separator unit comprises an input channel having a wall forming the input channel, a first end and a second end, wherein the wall having at least one air vent with a plurality of openings to allow air flow into and out of the input channel; a first release channel extending from the second end of the input channel; a second

release channel extending from the second end of the input channel; wherein the input channel, the first release channel and the second release channel are configured to form a three-way pathway; at least one separation valve coupled to the three-way pathway; a detector coupled proximate to the first end of the input channel for detecting one or more characteristics of mosquito passing by the detector; and at least one trap door valve arranged within the input channel and positioned before the detector or between the detector and the second end of the input channel, proximate the detector; wherein the at least one trap door valve is operable between an open position and a closed position for directing mosquito through the input channel towards the at least one separation valve; and wherein the at least one separation valve is configured to operate between an open position and a closed position to permit and restrict passageway between the input channel and the first release channel or between the input channel and the second release channel for sorting mosquito according to the characteristics of the mosquito.

In one embodiment, the separator unit comprises one separation valve, the separation valve comprises a plate pivotally coupled to a junction of the three-way pathway, wherein the plate is configured to pivotally operate between a first position wherein the plate is inclined at an angle relative to the vertical axis of the plate to provide a passageway between the input channel and the first release channel, and a second position wherein the plate is inclined at an angle relative to the vertical axis of the plate to provide a passageway between the input channel and the second release channel.

In one embodiment, the separator unit comprises one separation valve, the separation valve comprises a plate pivotally coupled to a point joining the first release channel and the second release channel, wherein the plate is configured to pivotally operate between a first position wherein the plate restricts a passageway between the input channel and the second release channel to provide a passageway between the input channel and the first release channel, and a second position wherein the plate restricts the passageway between the input channel and the first release channel to provide the passageway between the input channel and the second release channel.

In one embodiment, the separator unit comprises at least two separation valves, each of the separation valves comprises a plate pivotally coupled to the first release channel and the second release channel, wherein each plate is operable
5 between an open position and a closed position to permit and restrict passageway between the input channel and the first release channel, and between the input channel and the second release channel

In one embodiment, the mosquito sorter comprises a container for receiving water
10 containing pupae and/or a plurality of mosquitoes, wherein the container is removably attached to the first end of the input channel. In this embodiment, the container comprises at least one inlet for receiving air or water from outside the container. The container further comprises an inlet fan positioned at one of the inlets for directing air into the container to encourage movements of mosquitoes
15 towards the first end of the input channel.

In one embodiment, the mosquito sorter further comprises a first release container removably attached to the first release channel for receiving mosquitoes of a first type; and a second release container removably attached to the second release
20 channel for receiving mosquitoes of a second type.

In one embodiment, the second release container comprises an air flow control valve operative to controllably release air from within the mosquito sorter to create negative pressure within the mosquito sorter to direct mosquito into the second
25 release container.

In one embodiment, the mosquito sorter is configured for sorting mosquitoes based on gender.

30 In accordance with a second aspect of this invention, an apparatus for segregating mosquitoes is provided. The apparatus comprises a plurality of separator units in accordance with embodiments of the present invention, a container removably attached to the plurality of separator units; a plurality of first release containers, each of the plurality of first release containers removably attached to the first

release channel of each of the plurality of separator units for receiving mosquitoes of a first type; and a second release container having a plurality of inlets in air communication with the second release channel of each of the plurality of separator units for receiving mosquitoes of a second type from each of the separator units.

In accordance with a third aspect of this invention, a method of sorting mosquitoes is provided. The method comprises providing a mosquito sorter in accordance with embodiments of the present invention; attaching a container containing water and pupae and/or mosquitoes to the first end of the input channel; operating an inlet fan to direct one or more mosquitoes within the container towards the input channel; identifying by a detector one or more characteristics of the mosquito passing by the detector one at a time; transmitting to a control unit a signal on the one or more characteristics of the mosquito identified by the detector; controlling the at least one trap door valve in response to the signal received by the control unit to direct the mosquito to the separation valve; and controlling the separation valve to direct the mosquito into the first or second release channel in response to the one or more characteristics of the mosquito determined by the detector.

In one embodiment, the method further comprises releasing air within the second release container to create a negative pressure within the second release container to direct the mosquito of the second type into the second release container

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying figures (Figs.) illustrate embodiments and serves to explain principles of the disclosed embodiments. It is to be understood, however, that the figure is presented for purposes of illustration only, and not for defining limits of relevant inventions. Particularly,

Fig. 1 is a cross-sectional view of a mosquito sorter according to an embodiment of the present invention.

Fig. 2 is a cross-sectional view of a mosquito sorter according to another embodiment of the present invention.

Fig. 3 is a cross-sectional view of a separator unit of the mosquito sorter of Fig. 2,
5 according to an embodiment of the present invention.

Fig 4 is a cross-sectional view of an apparatus for segregating mosquitoes including multiple separator units according to some embodiments of the present invention.

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DETAILED DESCRIPTION

The present invention aims to provide a useful mosquito sorter for segregating mosquitoes into mosquitoes of a first type and mosquitoes of a second type in
15 accordance with one or more characteristics of the mosquitoes. In one embodiment, the present invention aims to provide a useful mosquito sorter for segregating mosquitoes into female mosquitoes and male mosquitoes. Exemplary, non-limiting embodiments of the present application will now be described with references to the above-mentioned figure.

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Figs. 1, 2 and 4 illustrate various embodiments of the mosquito sorter of the present invention. The mosquito sorter comprises a separator unit 104, a container 102, a first release container 106 and a second release container 108.

25 Fig. 3 illustrates the separator unit 104 of the mosquito sorter of the present invention. The separator unit 104 comprises an input channel 112, a first release channel 114 and a second release channel 116. The input channel 112 has a wall forming the input channel, a first end 134 and a second end 136. In one embodiment, the wall comprises at least one air vent 113 with plurality of openings
30 (not shown) to allow air flow into and out of the input channel. In another embodiment, the air vent 113 comprises an air permeable vent material having perforations forming the plurality of openings of the air vent. Any suitable type of air permeable vent materials could be used without departing from the scope of the present invention. In yet another embodiment, the air vent comprises a plurality of

openings and an air permeable vent material spanning the plurality of openings. In the various embodiments, the plurality of openings should have a size sufficient for air to flow through and sufficient to restrict the mosquitoes from flying out of the input channel. In one embodiment, the plurality of openings has a size of less than 2 mm in diameter. In various embodiments, more than one air vent is provided. The air vents may be arranged on the wall of the input channel in any suitable manner without departing from the scope of the invention.

The first release channel 114 and the second release channel 116 each extends from the second end 136 of the input channel. The first release channel and the second release channel each has a distal end disposed away from the second end of the input channel. The input channel, the first release channel and the second release channel are configured to form a three-way pathway. The three-way pathway can be arranged in any suitable matter. In an exemplary embodiment, the first release channel 114 and the second release channel 116 are arranged substantially perpendicular to the input channel 112. In another exemplary embodiment, the first release channel 114 and the second release channel 116 are arranged in a substantially L-shaped configuration, with the first release channel being arranged in the same axis as the input channel.

The input channel 112 is a cylindrical tube. The mid-section of the input channel is substantially straight and has an inner diameter narrow enough for one mosquito to pass through. Preferably, the mid-section of the input channel has a cross-sectional inner diameter between 5 mm and 200 mm, more preferably 10 mm. In various embodiments, the input channel has an input funnel 128 extending from the first end of the input channel. The length of the input channel 112 spanning from the end of the input funnel 128 to the second end of the input channel is between 50 and 1,000 mm, preferably about 70 mm.

The first release channel 114 and the second release channel 116 are cylindrical tubes. The first and second release channels 114, 116 could be formed as a single integral unit or as separate units. The cross-sectional inner diameter of the first and second release channels 114, 116 is between 5 and 200 mm, preferably about 50 mm. In the embodiment illustrated in Fig. 1, the length between the distal end of

the first release channel 114 and the distal end of the second release channel 116 is between 150 and 2,000 mm. In one embodiment, the distal end of the first release channel and the distal end of the second release channel each has screw thread around the outer periphery of the distal ends of the two release channels 114, 116.

The input channel 112, the first release channel 114 and the second release channel 116 are made of transparent material. Suitable transparent material includes, but not limited to, acrylic and glass. Preferably, the input channel 112, the first release channel 114 and the second release channel are made of acrylic.

The separator unit 104 further comprises a detector 110 coupled to outer surface of the input channel and positioned proximate the first end 134 of the input channel. The detector 110 is provided to detect one or more characteristics of a mosquito passing by the detector within the input channel. The input channel is made of transparent material and this provides the detector with a view of the mosquito as it passes by the detector. In one embodiment, the detector is an opto-bio signature detector for capturing images of the mosquitoes. In another embodiment, the detector is an audio sensor for detecting audio frequencies of the mosquitoes as the mosquitoes fly by the detector. The detector 110 is communicatively wired to and controlled by a control unit (not shown). The control unit comprises a processor, a memory storage and other input and output peripherals which provide the communication means to the detector.

The separator unit 104 further includes at least one trap door valve 130 arranged within the input channel 112. In one embodiment of the present invention, the at least one trap door valve 130 is positioned between the detector 110 and the second end of the input channel, proximate the detector. In another embodiment, the separator unit comprises at least two trap door valves 130, 132 arranged in a spaced-apart manner in the input channel, as shown in Fig. 1. The space between the two trap door valves 130, 132 defines an isolation chamber for isolating one mosquito within the isolation chamber. In various embodiments, the at least one trap door valve 130 is positioned before the detector (as shown in Fig. 2).

The trap door valves 130, 132 are operable between a closed position and an open position. The trap door valves consist of a valve trapdoor 138 transversely positioned across the diameter of the input channel 112 in the closed position. Each of the valve trapdoors 138 is pivotal at a point on inner wall surface of the input channel 112. In one embodiment, when the trap door valves 130, 132 are in the closed position, the valve trapdoors 138 restrict movement of the mosquito within the input channel. When the trap door valves 130, 132 are in the open position, the valve trapdoors 138 swing open to a position to provide a passage for the mosquito to pass through and move towards the second end of the input channel. In the embodiment illustrated in Fig. 1, the trap door valves 130, 132 are perforated to provide a passage for air to pass through to the second end of the input channel when the valves are in the closed position.

The separator unit 104 further comprises at least one separation valve 140. The separation valve 140 is coupled to the three-way passage. The separation valve is configured to operate between an open position and a closed position to permit and restrict passageway between the input channel and the first release channel or between the input channel and the second release channel for sorting mosquito according to the characteristics of the mosquito. The separation valve 140 directs the mosquito to either the first release channel 114 or the second release channel 116 based on the one or more characteristics of the mosquito determined by the detector.

In the embodiment illustrated in Fig. 1, the separator unit comprises one separation valve 140. The separation valve consists of a pivotal plate. The pivotal plate is mounted on inner wall surface proximate the second end of the input channel. The plate is coupled to a junction of the three-way pathway. The pivotal point of the plate can be anywhere along the vertical axis of the plate. In one embodiment, the pivotal point is at centre of the plate. The plate is configured to pivotally operate between a first position wherein the plate is inclined at an angle relative to the vertical axis of the plate to provide a passageway between the second end of the input channel and the first release channel, and a second position wherein the plate is inclined at an angle relative to the vertical axis of the plate to provide a passageway between the second end of the input channel and the second release

channel.

In the embodiment illustrated in Fig. 2, the separator unit comprises one separation valve 140. The separation valve consists of a plate pivotally coupled to
5 a point 117 joining the first release channel 114 and the second release channel 116. The plate is configured to pivotally operate between a first position wherein the plate restricts a passageway between the input channel and the second release channel to provide a passageway between the input channel and the first
10 release channel, and a second position wherein the plate restricts the passageway between the input channel and the first release channel to provide the passageway between the input channel and the second release channel.

In a further embodiment, at least two separation valves 140 are provided. Each of the separation valves comprises a plate pivotally coupled to the first release
15 channel 114 and the second release channel 116, respectively, wherein each plate is operable between an open position and a closed position to permit and restrict passageway between the input channel and the first release channel, and between the input channel and the second release channel, respectively.

The trap door valves 130, 132 or valve trapdoors 138 and the separation valve 140
20 are communicatively wired to and controlled by a control unit (not shown). The control unit is configured to enable control of the valves trapdoors 138 and the separation valve 140 between an open position and a closed position for directing the mosquito through the input channel towards the separation valve to be sorted
25 according to the characteristics of the mosquito determined by the detector.

Referring back to Fig. 3, the separator unit 104 may further comprise a vibration
device 137 positioned at outer wall of the input channel for providing periodical
vibrations to the input channel 112. The vibration device 137 is activated as and
30 when needed, for example, when there are mosquitoes clinging onto the inner wall of the input channel. The vibrations help to shake the mosquitoes off the inner wall of the input channel.

The separator unit 104 may also include a mosquito counter 139. The mosquito counter 139 is for counting mosquitoes entering the first release container 106. Any suitable mosquito counter may be used. The mosquito counter 139 may be positioned anywhere between the separation valve 140 and the first release container 106, on the outer wall of the first release channel. In an exemplary embodiment shown in Fig. 3, the mosquito counter 139 is positioned proximate and downstream from the separation valve 140.

The separator unit 104 may further include a gate actuation unit 141. The gate actuation unit 141 is positioned on outer wall of the first release channel, proximate the distal end of the first release channel. The gate actuation unit 141 allows gate 145 of the first release container to be closed once sufficient quantity of mosquitoes enter the first release container 106. When this occurs, the first release container 106 will be replaced with a new first release container for collection of a further batch of mosquitoes.

The mosquito sorter 100 further comprises a container 102 removably attached to the first end of input channel 112. In various embodiments, the container 102 is removably attached to the funnel end 128 of the input channel. The container 102 can be removably attached to the funnel end of the input channel by any suitable fastening means. In an exemplary embodiment, the container 102 consists of four vertical sides, a top side and a bottom side. The top side has an air **outlet 122** providing a channel for outflow of air together with the mosquitoes from within the container 102 into the input channel 112. The air outlet 122 has a circular attachment neck with a spiral ridge circumscribing the outer surface. The spiral ridge circumscribing the circular attachment neck provides a secure fastening of the container 102 to the funnel end 128 of the input channel. The funnel end 128 has a corresponding spiral groove circumscribing an inner rim surface that matches the spiral ridge of the circular attachment neck of the container 102. The spiral ridge provides a type that requires a push-in and twist before the input channel is released from the attachment neck of the air outlet 122. The cross-sectional outer diameter of the rim of the container is more than 50 mm and this is slightly wider than the cross-sectional inner diameter of the circular attachment neck which is about 50 mm. The container 102 is for receiving water containing

mosquito pupae, and/or adult mosquitoes, including male and female mosquitoes. The container 102 is a transparent container made of suitable material. In one embodiment, the container 102 is made of material such as acrylic. The transparent container provides a visual observation of flying mosquitoes 80 and pupae 82 in stagnant water when the mosquitoes and pupae are in the container 102.

The container 102 further includes an air inlet 118. The air inlet 118 is disposed on one side of the container. The air inlet 118 provides a passage for inflow of air from outside the container 102 into the container 102. The air inlet 118 may also provide a passage for outflow of air from inside the container 102 to outside the container. The air inlet 118 can be positioned at any of the four vertical sides of the container 102.

At the air inlet 118, there is provided an air inlet fan 124 at an access. The air inlet fan 124 provides a propelling air into the container 102 to encourage movements of the mosquitoes towards the first end of the input channel 134. The propulsion by the air inlet fan 124 causes air in the container 102 to move towards the air outlet 122 at the top side of the container, forcing the mosquitoes in the container to travel towards the air outlet 122. The air inlet fan 124 can be powered by any suitable means. In one embodiment, the air inlet fan 124 is electrically powered. The air inlet fan 124 is connected to a direct current (DC) electrical source. The direct current electrical source is derived from an electrical main, step down and converted. In another embodiment, the air inlet fan 124 is powered by a dry cell, for example 9 volts DC battery or by a plurality of solar cell connected to a nickel cadmium rechargeable battery and to the air inlet fan 124.

The container 102 further includes a mesh filter 126 disposed at the air inlet 118 where the inlet fan 124 is placed. The mesh filter 126 is for preventing unwanted suspended debris in the air from entering the container 102. The mesh filter 126 also prevents the mosquitoes from travelling out of the container 102.

The container 102 further includes a water inlet 120 disposed on one side of the container 102. In various embodiments, the water inlet 120 is disposed on opposite

side as the air inlet 118. The water inlet 120 provides a channel for receiving water and pupae into the container 102. Any suitable means may be employed to introduce water and pupae into the container. For example, the water and pupae may be introduced into the container using a funnel and a hose attached to the water inlet 120. Alternatively, the introduction of the water and the pupae can be from another container (not shown). A water inlet valve (not shown) may be installed before the water inlet 120 to regulate the flow of water into the container. The height of the water inlet 120 from the bottom side is dependent on the volume of water and concentration of pupae to be contained in the container. In one embodiment, the water inlet 120 is positioned about 1 to 50 mm, preferably about 40 mm from the bottom side of the container 102. The water inlet 120 can also be a passage for introducing adult mosquitoes into the container 102 when required.

The mosquito sorter 100 further comprises a first release container 106 removably attached to the distal end of the first release channel 114 for receiving mosquitoes of a first type, and a second release container 108 removably attached to the distal end of the second release channel 116 for receiving mosquitoes of a second type. The first release container 106 and the second release container 108 can be attached to the respective release channel of the separator unit by any suitable means. In an exemplary embodiment, the first and the second release containers 106, 108 are each removably attached to the respective release channel 114, 116 via screw thread.

The first release container 106 comprises a release inlet 144 arranged on one side wall of the first release container. The release inlet 144 can be of any suitable configuration. In an exemplary embodiment, the release inlet 144 is circular with a screw thread circumscribing along inner periphery of the release inlet. The inner diameter of the release inlet 144 is between 5 to 200 mm, preferably about 10 mm. The release inlet 144 comprises a hinged hatch that is biased by a coiled spring. The hinged hatch is operable between an open position and a closed position. The hinged hatch is normally closed to seal the first release container 106. In the embodiment shown in Fig. 1, the hinged hatch is pushed opened when the distal end of the first release channel 114 is removably secured into the release inlet

144, providing a passageway for mosquitoes to travel from the first release channel 114 into the first release container 106.

In another embodiment, the first release container 106 further comprises an aperture 143 in air communication with the first release channel 114 and a gate 145 pivotally mounted to the aperture 143. The gate 145 is operable between a closed position to seal the first release container 106 and an open position to provide a passageway for air flow and mosquitoes into the first release container 106.

The first release container 106 further comprises a release barrier 142 configured to operate between an open position and a closed position. In one embodiment, the release barrier 142 is located on top side of the first release container 106. The release barrier 142 has tiny perforations to allow air to enter into the first release container 106. The release barrier 142 provides an exit for the mosquitoes of the first type when the release barrier 142 is lifted by a human operator. The release barrier 142 can be of any suitable shape and size, without departing from the scope of the invention. The release barrier 142 has a handle to provide hand grip for lifting the release barrier to release the mosquitoes within the first release container and for transporting the first release container to desired place to release the mosquitoes into the environment. The first release container 106 houses mosquitoes of the first type.

The first release container 106 may be made of any suitable material. Preferably, the first release container 106 is made of transparent material, for example acrylic. The transparent chamber provides a visual observation of the mosquitoes in the first release container. The first release container 106 can be of any suitable shape and size. In an exemplary embodiment shown in Fig. 1, the first release container 106 is rectangular. The length is between 20 and 200 mm, preferably about 120 mm and the width is between 20 and 200 mm, preferably about 120 mm. The first release container has a height between 20 and 200 mm, preferably about 150 mm.

The second release container 108 comprises an inlet 148 arranged on one side wall of the second release container. The inlet 148 is in air communication with the

second release channel 116. The second release container 108 is removably secured to the distal end of the second release channel via the inlet 148, providing a passageway for mosquitoes to travel from the second release channel 116 into the second release container 108. The second release container 108 can be
5 removably secured to the second release channel 116 by any suitable means. In one embodiment, the inlet 148 is circular with a screw thread circumscribing along inner periphery of the inlet 148. The screw thread engages with the screw thread of the distal end of the second release channel to removably secure the second release container 108 to the second release channel 116.

10 The inlet 148 is provided with a gate 149 pivotally mounted at the inlet 148. The gate 149 is operable between a closed position to seal the second release container 108 and an open position to provide the passageway for air flow and mosquitoes into the second release container 108. The second release container
15 108 is provided to house mosquitoes of the second type. In an exemplary embodiment, the second release container 108 is for housing mosquitoes that do not match the requirements. The requirements are determined by at least an algorithm in the control unit. The second release container 108 comprises an exterminator 146 arranged within the second release container. The exterminator
20 146 comprises a rotating fan blade that when in operation, rotates and kills the unwanted mosquitoes in the second release container. The exterminator is electrically powered. The exterminator is connected to and controlled by the control unit. The detachability of the second release container 108 from the separator unit allows easy disposal of the exterminated mosquitoes in the second
25 release container.

The second release container further comprises an air flow control valve 147 operative to controllably release air from within the mosquito sorter to create a negative pressure 150 within the mosquito sorter to direct mosquito into the
30 second release container.

The second release container 108 may be made of any suitable material. Preferably, the second release container 108 is made of transparent material, for example acrylic. The transparent chamber provides a visual observation of the

mosquitoes in the second release container. The second release container can be of any suitable shape and size. In an exemplary embodiment shown in Fig. 1, the second release container 106 is rectangular. The length is between 20 and 200 mm, preferably about 120 mm. The width is between 20 to 200 mm, preferably about 120 mm. The second release container has a height between 20 and 200 mm, preferably about 150 mm.

In one embodiment, the mosquito sorter of the present invention is configured for sorting mosquitoes based on gender. In particular, the mosquito sorter is configured to sort and group male mosquitoes into one group and female mosquitoes into another group into two separate containers. The unwanted mosquitoes which may include male mosquitoes and female mosquitoes that do not meet the requirements are grouped with the female mosquitoes. In an exemplary embodiment, the detector 110 obtains the characteristics of the mosquito, for example, an image of a mosquito, provides an input signal and transmits the input signal to the control unit. The control unit in turn controls the valves 130,132, the separation valve 140 and the air inlet fan 124 based on the captured image to direct the mosquito to the rightful release container. The first release container houses mosquitoes that meet the predetermined requirements, for example male mosquitoes, and the second release container houses mosquitoes that do not meet the predetermined requirements, for example female mosquitoes and/or unwanted mosquitoes. The mosquitoes in the first release container are to be released into the environment whilst the mosquitoes in the second release container may be exterminated in the second release container.

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In accordance with a second aspect of the invention, an apparatus for segregating mosquitoes is provided. The apparatus comprises a plurality of separator units, each of the plurality of separator units comprises an input channel having a wall forming the input channel, a first end and a second end, wherein the wall having at least one air vent with a plurality of openings to allow air flow into and out of the input channel; a first release channel extending from the second end of the input channel; a second release channel extending from the second end of the input channel. The input channel, the first release channel and the second release channel are configured to form a three-way pathway. Each of the separator units

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further comprises at least one separation valve coupled to the three-way pathway; and a detector coupled proximate to the first end of the input channel for detecting one or more characteristics of mosquito passing by the detector. The at least one trap door valve is operable between an open position and a closed position for directing mosquito through the input channel towards the at least one separation valve; and wherein the at least one separation valve is configured to operate between an open position and a closed position to permit and restrict passageway between the input channel and the first release channel or between the input channel and the second release channel for sorting mosquito according to the characteristics of the mosquito.

The apparatus further comprises a container removably attached to the plurality of separator units via the first end of the input channel of each of the plurality of the separator units for receiving water containing pupae and/or a plurality of mosquitoes; a plurality of first release containers, each of the plurality of first release containers removably attached to the first release channel of each of the plurality of separator units for receiving mosquitoes of a first type; and a second release container having a plurality of inlets in air communication with the second release channel of each of the plurality of separator units for receiving mosquitoes of a second type from each of the separator units.

The second release container further comprises a plurality of gates, each of the gates is pivotally mounted to a respective inlet of the second release channel, wherein each of the gates is operable between a closed positioned to seal the respective inlet and an open position to provide a passageway for air flow and mosquitoes into the second release container from the respective separator unit.

The second release container further comprises an air flow control valve operative to controllably release air from within the apparatus to create a negative pressure within the apparatus to direct mosquito into the second release container.

In one embodiment, the mosquito sorter of the present invention is assembled by attaching the container 102 to the input channel 112 of the separator unit 104; attaching the first release container to the distal end of the first release channel

and attaching the second release container to the distal end of the second release channel.

5 In accordance with a third aspect of the invention, a method for sorting mosquitoes according to one or more characteristics of the mosquitoes is provided. In one embodiment, the method involves detecting and determining the gender of one or more mosquitoes.

The method comprises providing a mosquito sorter comprising a separator unit.
10 The separator unit comprises an input channel having a wall forming the input channel, a first end and a second end, wherein the wall having at least one air vent with a plurality of openings to allow air flow into and out of the input channel; a first release channel extending from the second end of the input channel; a second release channel extending from the second end of the input channel; wherein the
15 input channel, the first release channel and the second release channel are configured to form a three-way pathway, at least one separation valve coupled to the three-way pathway; a detector coupled proximate to the first end of the input channel for detecting one or more characteristics of mosquito passing by the detector; and at least one trap door valve arranged within the input channel and
20 positioned before the detector or between the detector and the second end of the input channel, proximate the detector; wherein the at least one trap door valve is operable between an open position and a closed position for directing mosquito through the input channel towards the at least one separation valve; and wherein the at least one separation valve is configured to operate between an open position
25 and a closed position to permit and restrict passageway between the input channel and the first release channel or between the input channel and the second release channel for sorting mosquito according to the characteristics of the mosquito.

The mosquito sorter further comprises a first release container removably attached
30 to the first release channel for receiving mosquitoes of a first type; and a second release container removably attached to the second release channel for receiving mosquitoes of a second type.

The method further comprises attaching a container containing water and pupae

and/or mosquitoes to the first end of the input channel. The pupae in the water are allowed to hatch into adult mosquitoes.

5 An inlet fan attached to the container is activated to direct one or more mosquitoes within the container towards the input channel. The inflow air from outside the container into the container through the inlet fan propels the mosquitoes to the first end of the input channel. The input channel has a width to allow only one mosquito to pass through. As the mosquito passes by the first end of the input channel, the mosquito is detected by the detector positioned proximate the first end of the input
10 channel. The method further comprises identifying by a detector one or more characteristics of the mosquito passing by the detector one at a time. The detected characteristics or signals are then transmitted to a control unit. The control unit controls the at least one trap door valve in response to the signals received by the control unit to direct the mosquito to the separation valve. This involves
15 transmitting the signal to the at least one trap door valve to cause the trap door valve to move to an open position to allow the mosquito to travel through the input channel. The control unit sends signal to the separation valve for it to either move to an open position or a closed position in response to the signal sent by the control unit to direct the mosquito into the first release channel or the second
20 release channel in response to the one or more characteristics of the mosquito determined by the detector.

In one embodiment, when a mosquito of a second type is determined by the detector, the signal is transmitted to the control unit and the control unit will direct
25 the trap door valve 138 to close. The separation valve will be directed to close the passageway between the input channel and the first release channel. This in turns causes the passageway between the input channel and the second release channel to open. The air flow control valve at the second release container is then operated to release the air within the second release container. The negative
30 pressure created within the second release container causes the one or more mosquitoes within the input channel to be sucked out from the input channel and into the second release container. The air vents on the wall of the input channel facilitate and allow air to flow within the input channel and the second release channel.

The detector and the control unit operate in a manner such that if the captured optical signal matches the predetermined optical signatures stored in the control unit, the control unit will make an assessment whether it is the mosquito of the predetermined type. If the mosquito is the predetermined type, the control unit will actuate the trap door valve(s) 138 and the separation valve 140 sequentially to guide the mosquito into the first release channel 106 and into the first release container 106. If the capture optical signal does not match the predetermined optical signatures stored in the control unit, the control unit will consider the mosquito to be an unsure type, which will be treated as unwanted type. The control unit will then actuate the trap door valve(s) 138 and the separation valve 140 sequentially to guide the mosquito into the second release channel 116 and into the second release container 108.

In one embodiment, the captured optical signal is further analysed by the control unit through extracting the bio signatures, in particular, frequency harmonics of the mosquitoes. The optical signal is modulated by the male and female mosquitoes when flying, the male and female mosquitoes modulating the optical signals at different frequencies. Male and female mosquitoes emit different audio frequencies when flying. In this case, the detection of the audio frequency is analysed by the control unit, by identifying certain frequency harmonics and comparing the frequency harmonics with the stored signatures to ascertain the gender of the mosquito. In another embodiment, an audio sensor is used as the detector to detect audio frequency created by flying mosquitoes.

Exploiting and mimicking the natural ability to pick up audio frequencies by the antennal flagellum. The same principle is adopted in the alternative detection of male and female mosquitoes. In nature, male mosquitoes use flagellum to help locate female mosquitos by the (very) quiet buzzing sounds they emit. The sound waves trigger the flagellum to move. This movement is then carried through to Johnston's organ, which identifies the speed of other mosquitoes' beating wings and distinguishes between males and females mosquitoes as well as other mosquito species.

The present invention uses propelled air to drive mosquitoes from the container 102 into the separator unit 104. In an alternative embodiment, an audio speaker is used to attract the specific gender of the mosquitoes. The audio speaker can be installed anywhere along the input channel 112. The audio frequency produced
5 by the audio speaker attracts the mosquitoes to travel into the separator unit 104. Different audio frequencies can be used to attract specific gender of the mosquitoes.

The apparatus and method of the present invention provide a more effective and
10 environmentally friendly means to sort mosquitoes into different types and to reduce the mosquito population in order to prevent wide spread of infection diseases.

In the application, unless specified otherwise, the terms "comprising", "comprise",
15 and grammatical variants thereof, intended to represent "open" or "inclusive" language such that they include recited elements but also permit inclusion of additional, non- explicitly recited elements.

As used herein, the term "about", in the context of concentrations of components of
20 the formulations, typically means +/- 5% of the stated value, more typically +/- 4% of the stated value, more typically +/- 3% of the stated value, more typically, +/- 2% of the stated value, even more typically +/- 1% of the stated value, and even more typically +/- 0.5% of the stated value.

25 Throughout this disclosure, certain embodiments may be disclosed in a range format. The description in range format is merely for convenience and brevity and should not be construed as an inflexible limitation on the scope of the disclosed ranges. Accordingly, the description of a range should be considered to have specifically disclosed all the possible sub-ranges as well as individual numerical
30 values within that range. For example, description of a range such as from 1 to 6 should be considered to have specifically disclosed sub-ranges such as from 1 to 3, from 1 to 4, from 1 to 5, from 2 to 4, from 2 to 6, from 3 to 6 etc., as well as individual numbers within that range, for example, 1, 2, 3, 4, 5, and 6. This applies regardless of the breadth of the range.

It will be apparent that various other modifications and adaptations of the application will be apparent to the person skilled in the art after reading the foregoing disclosure without departing from the spirit and scope of the application
5 and it is intended that all such modifications and adaptations come within the scope of the appended claims.

Reference Numerals

	80	mosquitoes (male and female)
	82	pupae (male and female)
5	84	male mosquitoes
	86	unwanted mosquitoes or female mosquitoes
	100	mosquito sorter
	102	container
	104	separator unit
10	106	first release container
	108	second release container
	110	detector
	112	input channel
	113	air vent
15	114	first release channel
	116	second release channel
	117	point
	118	air inlet
	120	water inlet
20	122	air outlet
	124	air inlet fan
	126	mesh filter
	128	input funnel
	130	first trap door valve
25	132	second trap door valve
	134	first end of the input channel
	136	second end of the input channel
	137	vibration device
	138	valve trap door
30	139	mosquito counter
	140	separation valve
	141	gate actuation unit
	142	release barrier
	143	aperture

- 144 release inlet
- 145 gate of first release container
- 146 exterminator
- 147 air flow control valve
- 5 148 inlet of second release container
- 149 gate of second release container
- 150 negative pressure

Claims

1. A mosquito sorter for segregating mosquitoes, the sorter comprising:
at least one separator unit, the separator unit comprises:

5 an input channel having a wall forming the input channel, a first end and a second end, wherein the wall having at least one air vent with a plurality of openings to allow air flow into the input channel when a negative pressure is created within the mosquito sorter;

10 a first release channel extending from the second end of the input channel;

 a second release channel extending from the second end of the input channel; wherein the input channel, the first release channel and the second release channel are configured to form a three-way pathway;

15

 at least one separation valve coupled to the three-way pathway;

 a detector coupled proximate to the first end of the input channel for detecting one or more characteristics of mosquito passing by the detector; and

20

 at least one trap door valve arranged within the input channel and positioned before the detector or between the detector and the second end of the input channel, proximate the detector;

 wherein the at least one trap door valve is operable between an open position and a closed position for directing mosquito through the input channel towards the at least one separation valve; and

25

 wherein the at least one separation valve is configured to operate between an open position and a closed position to permit and restrict passageway between the input channel and the first release channel or between the input channel and the second release channel for sorting mosquito according to the characteristics of the mosquito; and

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a first release container removably attached to the first release channel for receiving mosquitoes of a first type; and

a second release container removably attached to the second release channel for receiving mosquitoes of a second type, wherein the second release container comprises:

an inlet in air communication with the second release channel;

a gate pivotally mounted to the inlet, wherein the gate is operable between a closed position to seal the second release container and an open position to provide a passageway for air flow and mosquitoes into the second release container; and

an air flow control valve operative to controllably release air from within the mosquito sorter to create negative pressure within the mosquito sorter to direct mosquito into the second release container.

2. The mosquito sorter according to claim 1, wherein the separator unit comprises two trap door valves arranged in a space-apart manner between the detector and the second end of the input channel, wherein the two trap door valves are being configured to operate between a closed position and an open position independently or in combination for releasing one mosquito at a time.

3. The mosquito sorter according to claim 2, wherein the space between the two valves defines an isolation chamber for isolating one mosquito within the isolation chamber.

4. The mosquito sorter according to claim 1, wherein the separator unit comprises one separation valve, the separation valve comprises a plate pivotally coupled to a junction of the three-way pathway, wherein the plate is configured to pivotally operate between a first position wherein the plate is inclined at an angle relative to the vertical axis of the plate to provide a passageway between the input channel and the first release channel, and a second position wherein the plate is inclined at an angle relative to the vertical axis of the plate to provide a passageway between the input channel and the second release channel.

5. The mosquito sorter according to claim 1, wherein the separator unit comprises one separation valve, the separation valve comprises a plate pivotally coupled to a point joining the first release channel and the second release channel, wherein the plate is configured to pivotally operate between a first position wherein the plate restricts a passageway between the input channel and the second release channel to provide a passageway between the input channel and the first release channel, and a second position wherein the plate restricts the passageway between the input channel and the first release channel to provide the passageway between the input channel and the second release channel.

6. The mosquito sorter according to claim 1, wherein the separator unit comprises at least two separation valves, each of the separation valves comprises a plate pivotally coupled to the first release channel and the second release channel, wherein each plate is operable between an open position and a closed position to permit and restrict passageway between the input channel and the first release channel, and between the input channel and the second release channel.

7. The mosquito sorter according to claim 4, wherein the first release channel and the second release channel are arranged substantially perpendicular to the input channel.

8. The mosquito sorter according to claim 5 or 6, wherein the first release channel and the second release channel are arranged in a substantially L-shaped configuration with the first release channel being arranged in the same axis as the input channel.

9. The mosquito sorter according to claim 1, wherein the plurality of openings of the air vent having a size of less than 2 mm.

10. The mosquito sorter according to claim 9, wherein the air vent comprises an air permeable vent material providing the plurality of openings for the air vent.

11. The mosquito sorter according to claim 1, wherein the air vent comprises an air permeable vent material having perforations of a size of less than 2mm spanning the plurality of openings.

5 12. The mosquito sorter according to claim 1, wherein the separator unit further comprises:

a vibration device positioned at outer wall of the input channel for providing periodical vibrations to the input channel.

10 13. The mosquito sorter according to claim 1, wherein the separator unit further comprises:

a mosquito counter positioned on outer wall of the first release channel, proximate the separation valve.

15 14. The mosquito sorter according to claim 1, wherein the separator unit further comprises:

a gate actuation unit positioned on outer wall of the first release channel, proximate a distal end of the first release channel.

20 15. The mosquito sorter according to claim 1, 7 or 8, wherein the first end of the input channel extends outwardly to form a funnel shape.

16. The mosquito sorter according to claim 1, wherein the detector is an opto-bio signature detector for capturing images of mosquito passing by the detector.

25

17. The mosquito sorter according to claim 1, wherein the detector is an audio sensor for detection of audio frequencies of mosquito passing by the detector.

18. The mosquito sorter according to claim 1, wherein the input channel has an
30 internal diameter narrow enough for one mosquito to pass through.

19. The mosquito sorter according to anyone of the preceding claims, further comprising:

a container for receiving water containing pupae and/or a plurality of mosquitoes, wherein the container is removably attached to the first end of the input channel.

5 20. The mosquito sorter according to claim 19, wherein the container comprises at least one inlet for receiving air or water from outside the container.

21. The mosquito sorter according to claim 19, wherein the container further comprises an inlet fan positioned at one of the inlets for directing air into the
10 container to encourage movements of mosquitoes towards the first end of the input channel.

22. The mosquito sorter according to claim 21, wherein the container further comprises a filter disposed at the inlet where the inlet fan is positioned, for
15 preventing escape of mosquito from within the container.

23. The mosquito sorter according to claim 1, 19 or 22, wherein the first release container comprises a release inlet arranged on one side of the first release container, wherein the release inlet comprises a hinged hatch operable between
20 an open position for allowing mosquitoes to travel into the first release container and a closed position for sealing the first release container.

24. The mosquito sorter according to claim 23, wherein the first release container comprises a release barrier configured to operate between an open
25 position and a closed position.

25. The mosquito sorter according to claim 23, wherein the first release container is removably attached to the first release channel via the release inlet.

30 26. The mosquito sorter according to claim 1, 19, 22 or 24, wherein the first release container further comprises an aperture in air communication with the first release channel and a gate pivotally mounted to the aperture, wherein the gate is operable between a closed position to seal the first release container and an open

position to provide a passageway for air flow and mosquitoes into the first release container.

27. The mosquito sorter according to claim 1, wherein the second release
5 container comprises an exterminator arranged within the second release container.

28. The mosquito sorter according to claim 1, wherein the second release container comprises a plurality of inlets.

10 29. The mosquito sorter according to claim 28, wherein the mosquito sorter further comprises a second separator unit in air communication with a second first release container and the container, wherein the second separator unit is removably attached to one of the plurality of inlets of the second release channel.

15 30. The mosquito sorter according to anyone of the preceding claims, wherein the mosquito sorter is made of transparent material.

31. The mosquito sorter according to anyone of the preceding claims, wherein the sorter is configured for sorting mosquitoes based on gender.

20

32. An apparatus for segregating mosquitoes, the apparatus comprising:
a plurality of separator units, each of the plurality of separator units comprises:

25 an input channel having a wall forming the input channel, a first end and a second end, wherein the wall having at least one air vent with a plurality of openings to allow air flow into the input channel when a negative pressure is created within the apparatus;

a first release channel extending from the second end of the input channel;

30 a second release channel extending from the second end of the input channel; wherein the input channel, the first release channel and the second release channel are configured to form a three-way pathway;

at least one separation valve coupled to the three-way pathway;

a detector coupled proximate to the first end of the input channel for detecting one or more characteristics of mosquito passing by the detector; and

at least one trap door valve arranged within the input channel and positioned before the detector or between the detector and the second end of the input channel, proximate the detector;

wherein the at least one trap door valve is operable between an open position and a closed position for directing mosquito through the input channel towards the at least one separation valve; and

wherein the at least one separation valve is configured to operate between an open position and a closed position to permit and restrict passageway between the input channel and the first release channel or between the input channel and the second release channel for sorting mosquito according to the characteristics of the mosquito;

a container removably attached to the plurality of separator units via the first end of the input channel of each of the plurality of the separator units for receiving water containing pupae and/or a plurality of mosquitoes;

a plurality of first release containers, each of the plurality of first release containers removably attached to the first release channel of each of the plurality of separator units for receiving mosquitoes of a first type; and

a second release container having a plurality of inlets in air communication with the second release channel of each of the plurality of separator units for receiving mosquitoes of a second type from each of the separator units, wherein the second release container further comprises:

a plurality of gates, each of the gates is pivotally mounted to a respective inlet of the second release channel, wherein each of the gates is operable between a closed positioned to seal the respective inlet and an open position to provide a passageway for air flow and mosquitoes into the second release container from the respective separator unit; and

an air flow control valve operative to controllably release air from within the apparatus to create negative pressure within the apparatus to direct mosquito into the second release container.

33. A method of sorting mosquitoes, the method comprising:

providing a mosquito sorter comprising:

a separator unit, the separator unit comprises:

5 an input channel having a wall forming the input channel, a first end and a second end, wherein the wall having at least one air vent with a plurality of openings to allow air flow into the input channel when a negative pressure is created within the mosquito sorter;

10 a first release channel extending from the second end of the input channel;

 a second release channel extending from the second end of the input channel; wherein the input channel, the first release channel and the second release channel are configured to form a three-way pathway,

 at least one separation valve coupled to the three-way pathway;

15 a detector coupled proximate to the first end of the input channel for detecting one or more characteristics of mosquito passing by the detector; and

20 at least one trap door valve arranged within the input channel and positioned before the detector or between the detector and the second end of the input channel, proximate the detector;

 wherein the at least one trap door valve is operable between an open position and a closed position for directing mosquito through the input channel towards the at least one separation valve; and

25 wherein the at least one separation valve is configured to operate between an open position and a closed position to permit and restrict passageway between the input channel and the first release channel or between the input channel and the second release channel for sorting mosquito according to the characteristics of the mosquito;

30 a first release container removably attached to the first release channel for receiving mosquitoes of a first type; and

 a second release container removably attached to the second release channel for receiving mosquitoes of a second type, wherein the second release container comprises:

an inlet in air communication with the second release channel;

a gate pivotally mounted to the inlet, wherein the gate is operable between a closed position to seal the second release container and an open position to provide a passageway for air flow and mosquitoes into the second release container; and

an air flow control valve operative to controllably release air from within the mosquito sorter to create negative pressure within the mosquito sorter to direct mosquito into the second release container;

attaching a container containing water and pupae and/or mosquitoes to the first end of the input channel;

operating an inlet fan to direct one or more mosquitoes within the container towards the input channel;

identifying by a detector one or more characteristics of the mosquito passing by the detector one at a time;

transmitting to a control unit a signal on the one or more characteristics of the mosquito identified by the detector;

controlling the at least one trap door valve in response to the signal received by the control unit to direct the mosquito to the separation valve;

controlling the separation valve to direct the mosquito into the first or second release channel in response to the one or more characteristics of the mosquito determined by the detector.

34. The method according to claim 33, further comprising:

releasing air within the second release container using the air flow control valve to create negative pressure within the second release container to direct the mosquito of the second type into the second release container.

35. The method according to claim 33, wherein the step of identification comprises:

capturing an image of the mosquito and transmitting the image to the control unit;

comparing the image with a list of predetermined images stored in the control unit; and

allowing the control unit to direct the separation valve to open to the first release channel or the second release channel in accordance to a match between
5 the captured image and the stored images.

36. The method according to claim 33, wherein the step of identification comprises:

capturing an image of the mosquito and transmitting the image to the
10 control unit;

measuring the width of the antennal flagellum from the captured image; and

allowing the control unit to direct the separation valve to open to the first release channel or the second release channel in accordance to the width of the antennal flagellum.

15

37. The method according to claim 33, wherein the step of identification comprises:

capturing the audio frequencies and transmitting the captured frequencies to the control unit;

20 comparing the captured audio frequencies with a list of audio signatures stored in the control unit; and

allowing the control unit to direct the separation valve to open to the first release channel or the second release channel in accordance to a match between the captured audio frequencies and audio signatures stored in the control unit.

25

38. The method according to claim 33, when a mosquito of a second type is determined, the method comprises:

closing the trap door valve;

directing the separation valve to close a passageway between the input
30 channel and the first release channel, causing a passageway between the input channel and the second release channel to open; and

releasing air within the second release container using the air flow control valve to create negative pressure within the second release container to direct the mosquito of the second type into the second release container.