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(54) **DEVICES FOR TRAPPING INSECTS**

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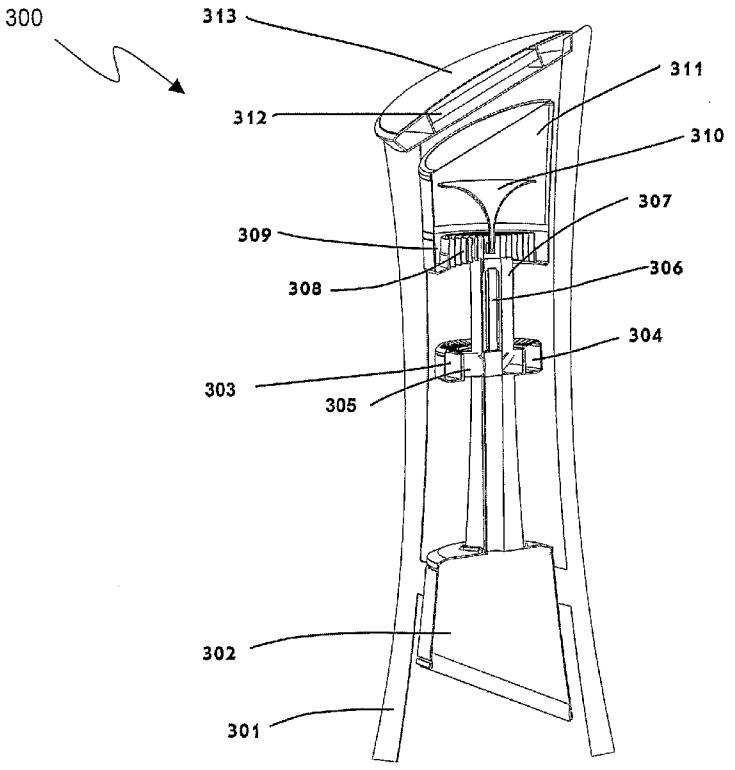
(57) **ABSTRACT**

The present invention discloses trapping devices for biting (e.g. mosquitoes, sand flies, black flies, and biting midges) and nuisance flies (e.g. houseflies, filth flies, and fruit flies). The outdoor solution for biting flies includes a solar panel, a housing, a bag, and a ventilator located in the housing. The ventilator creates a capture zone having an airflow toward the bag. A CO2 generator, chemical attractants, a heat source, and a UV light attract mosquitoes to the capture zone. The chemical attractants are released continuously, the CO2 is released in pulses, and the ventilator and UV are operated in independent programmable intervals. The device is efficient in energy consumption and CO2 production. Other trapping devices are disclosed having a combination of insect-attracting mechanisms including a ventilator. Novel insect zappers including a ventilator are disclosed as well. Indoor and outdoor solutions for insects including biting and nuisance flies.

Insect SolarTrap



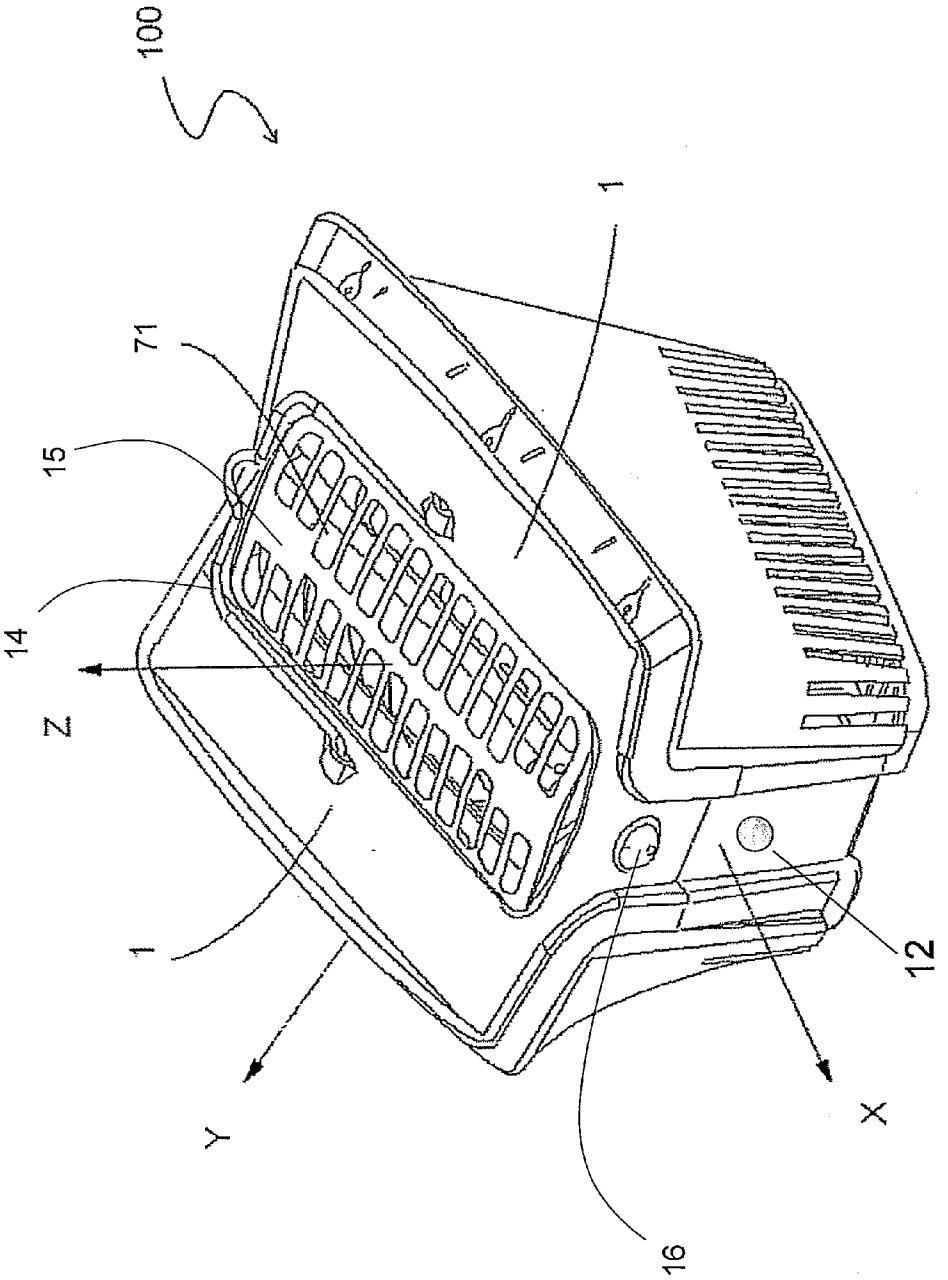


Figure 1

Insect ComboTrap

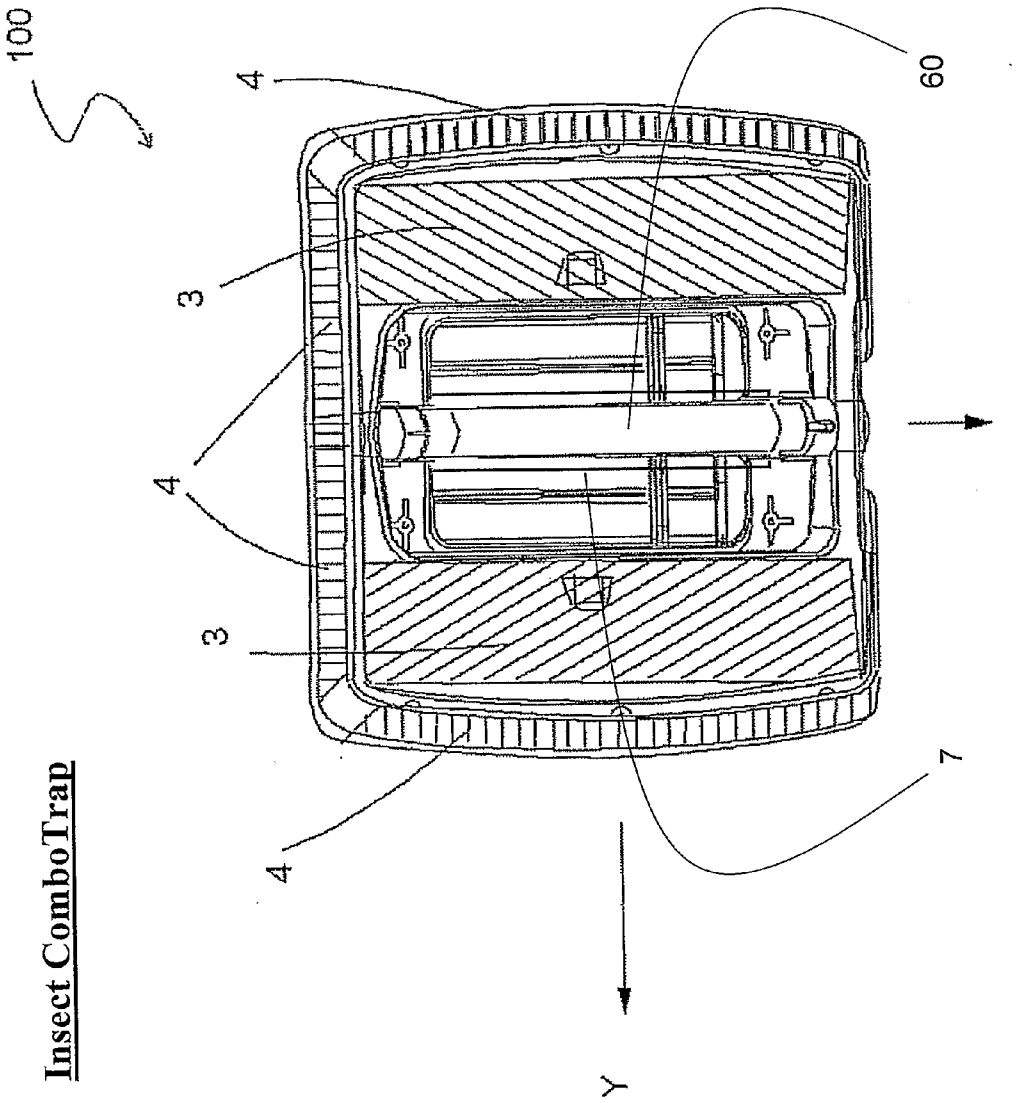


Figure 2

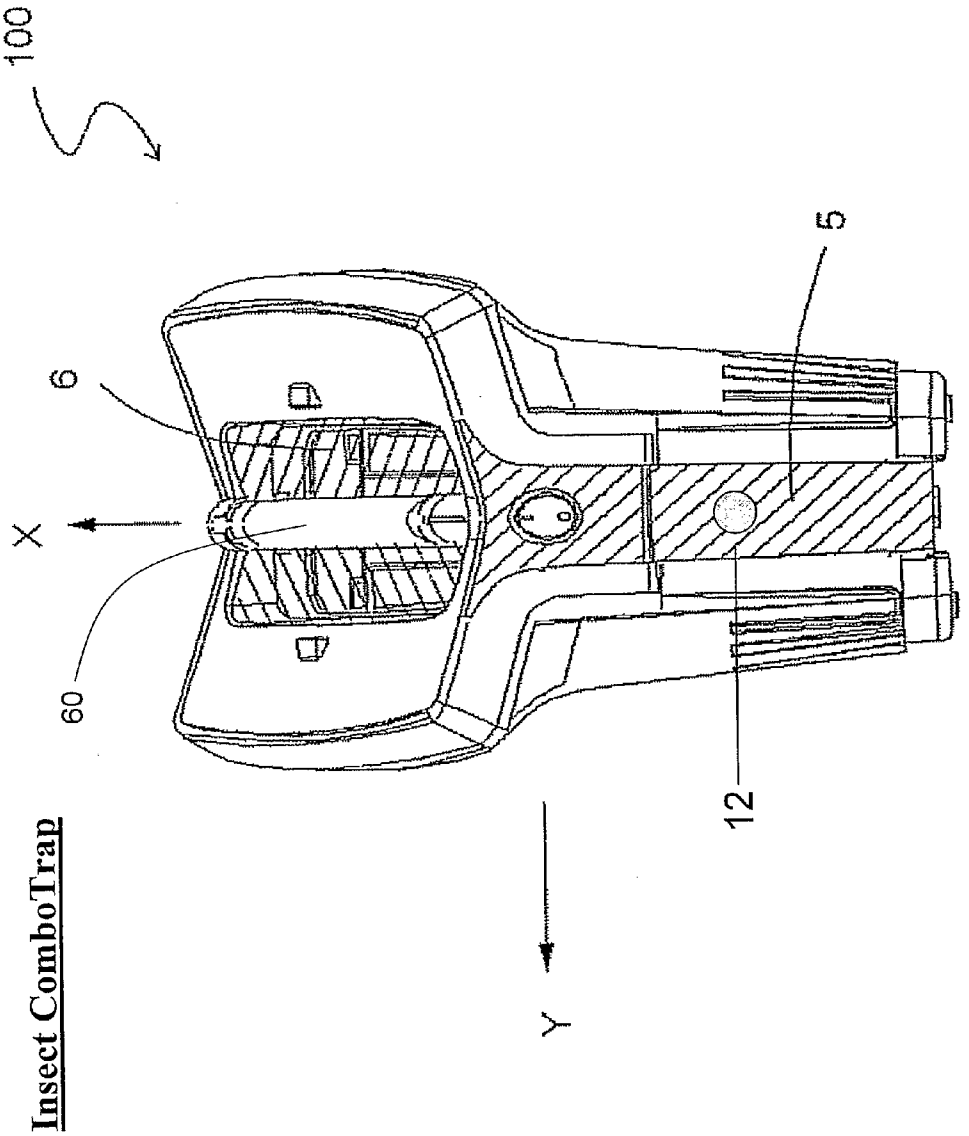


Figure 3

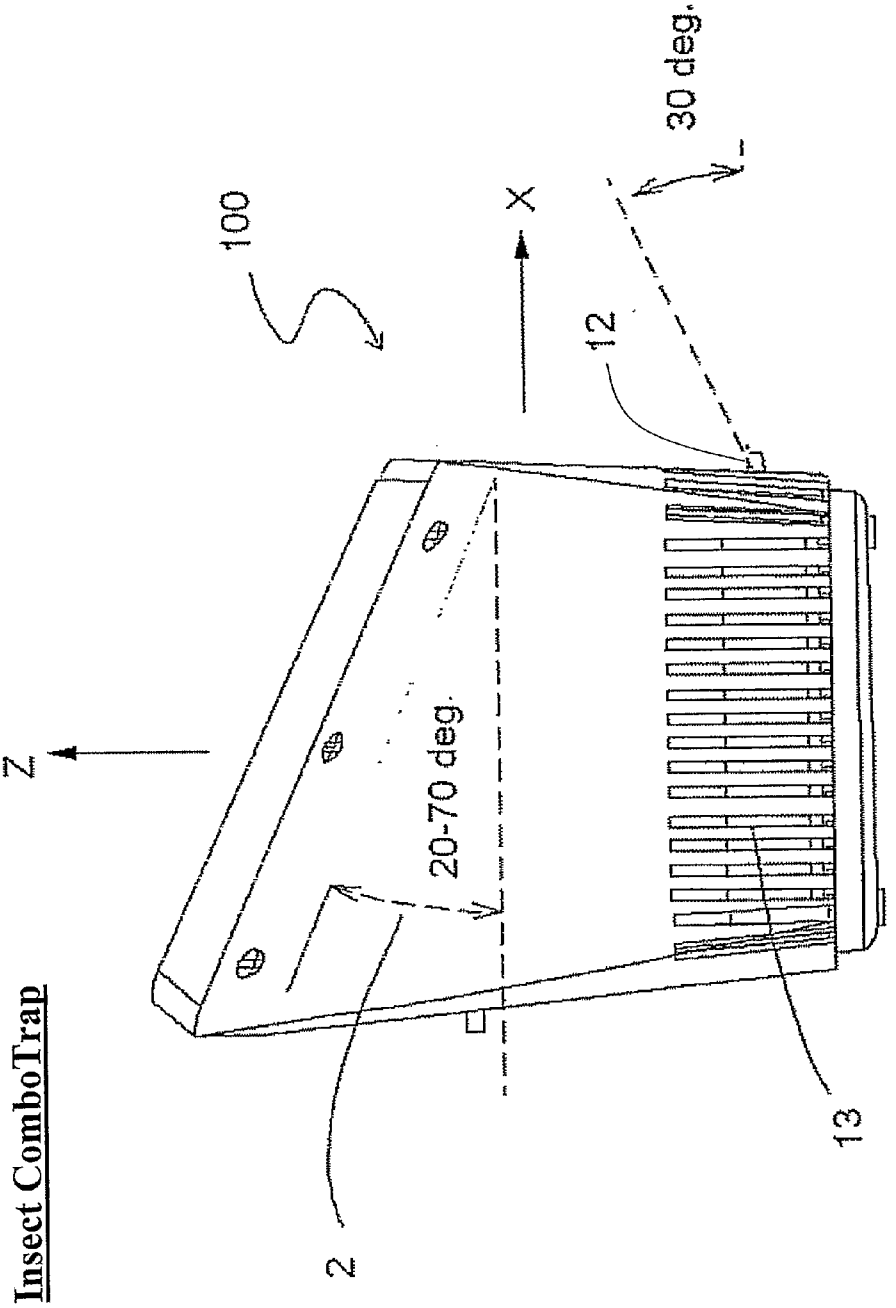


Figure 4

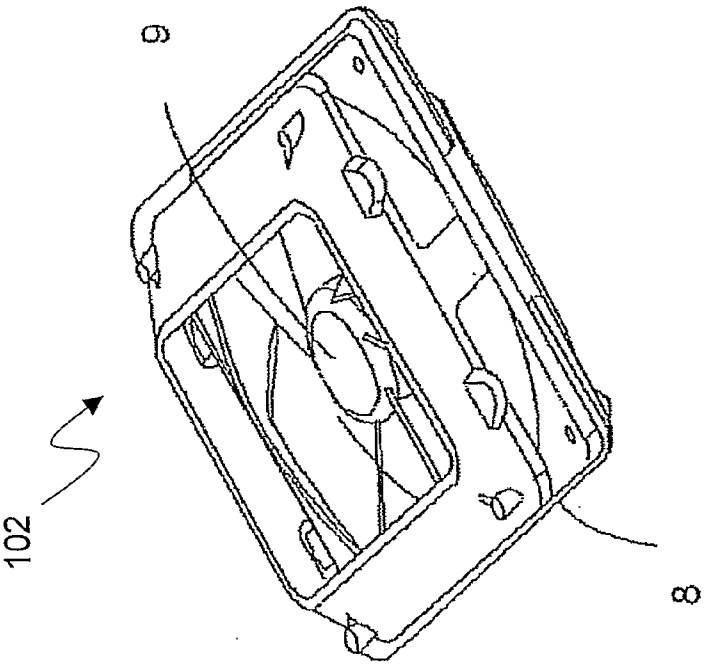


Figure 5B

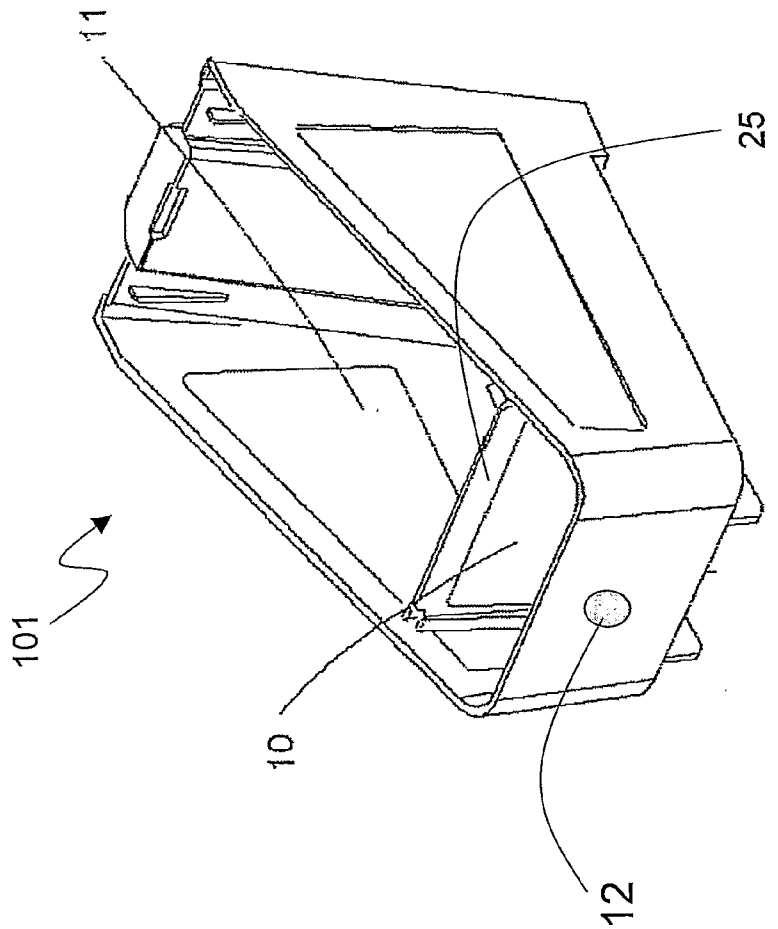


Figure 5A

Insect ComboTrap

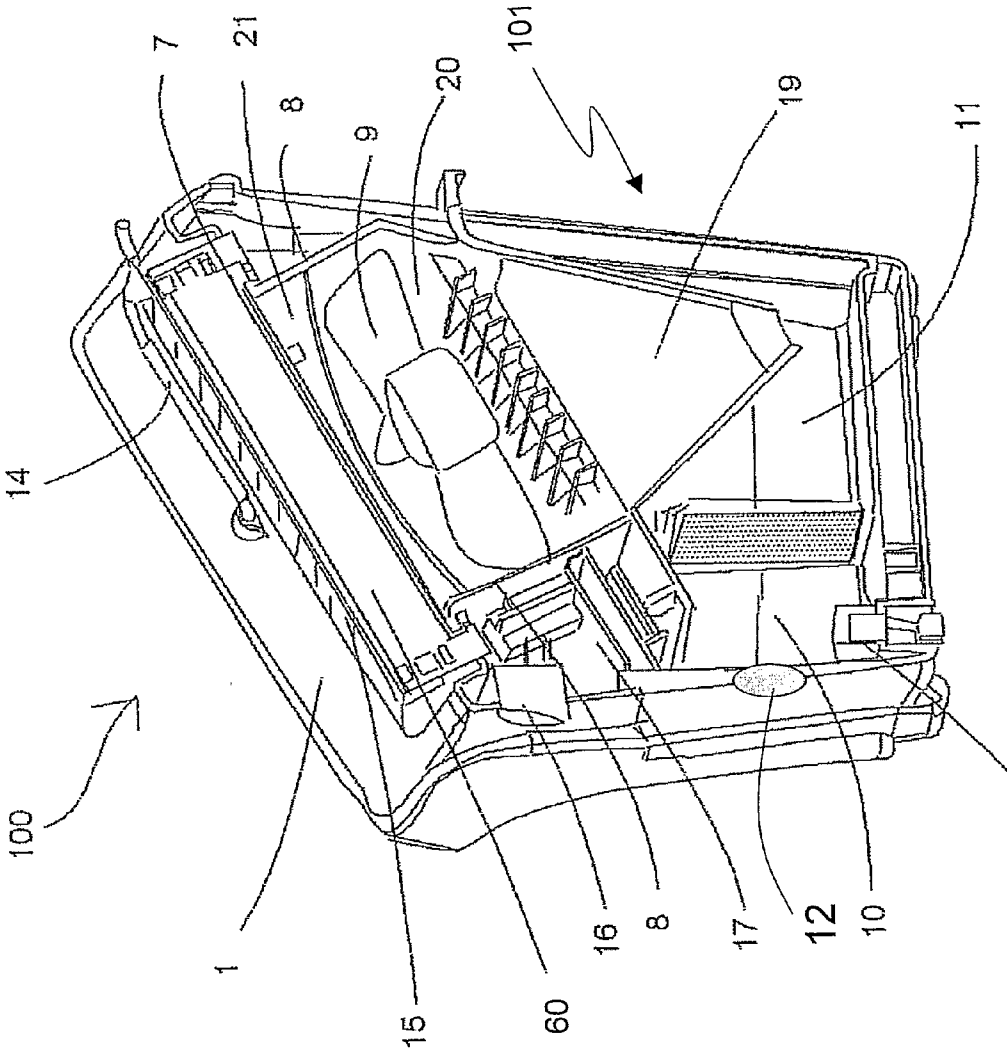

Insect ComboTrap
100
14
7
21
8
9
20
101
19
11
1
15
60
16
8
17
12
10
18

Figure 6

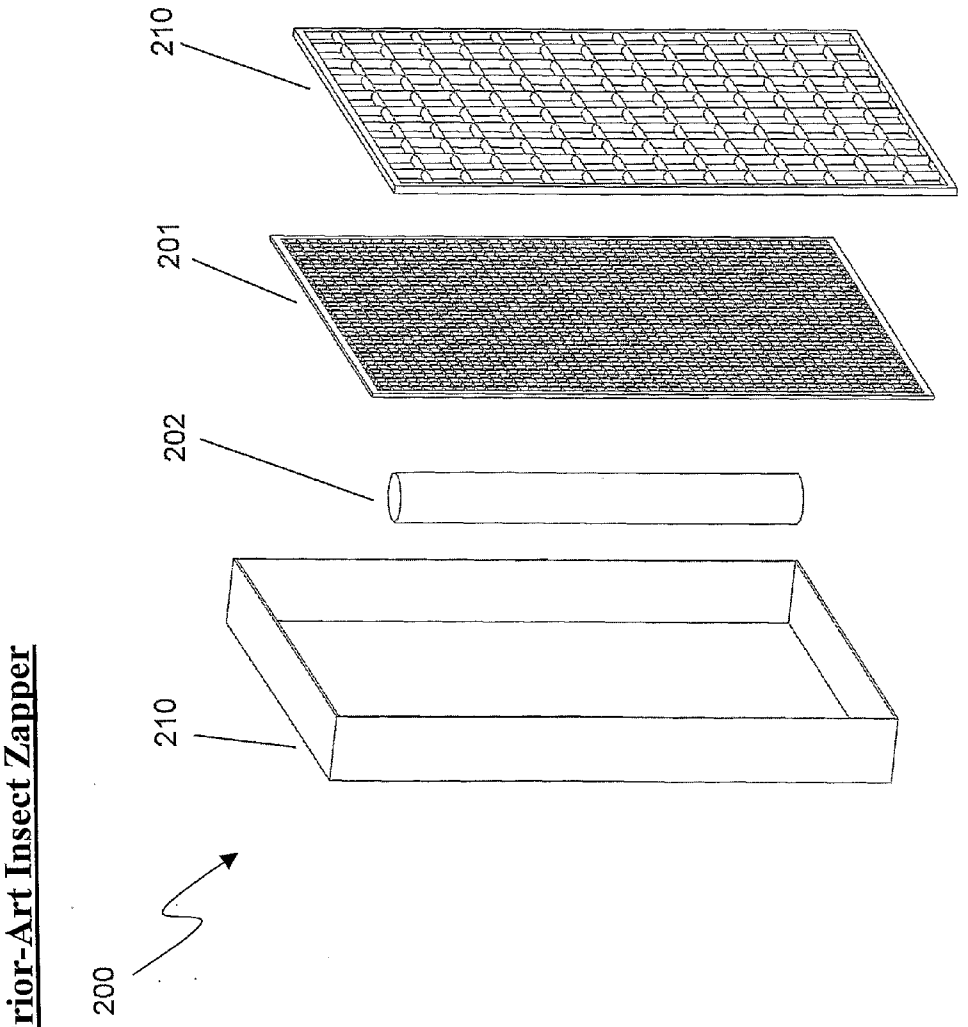


Figure 7

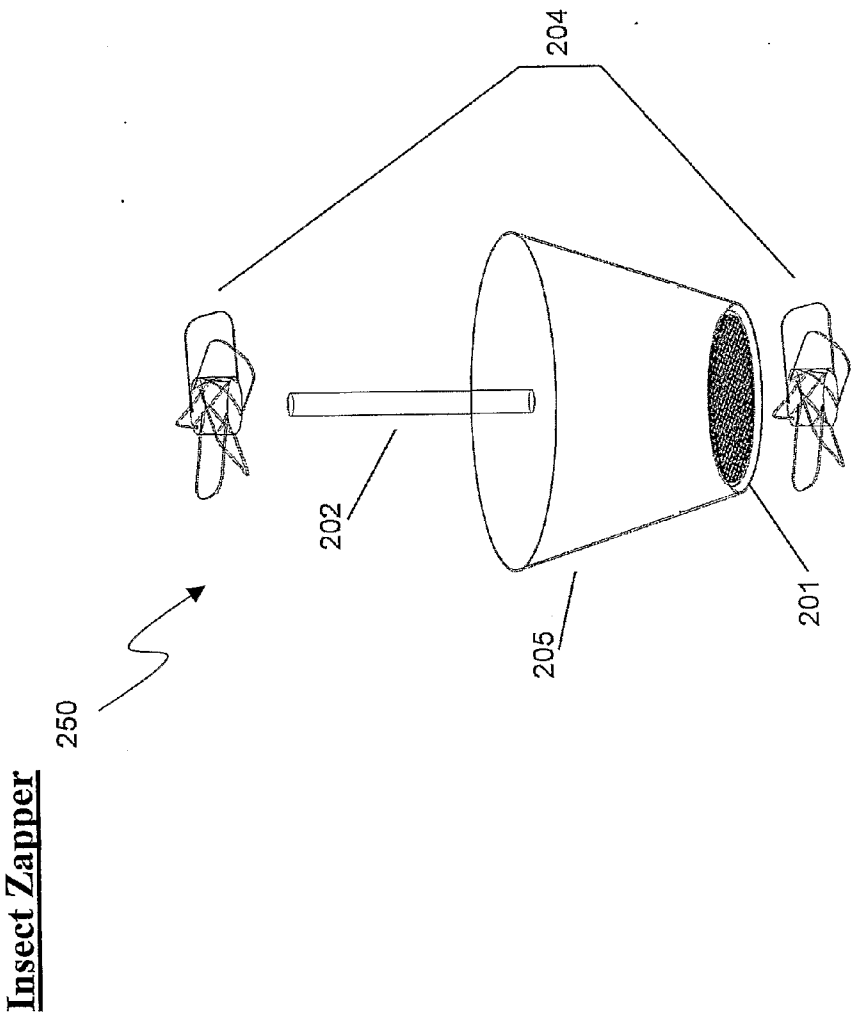


Figure 8

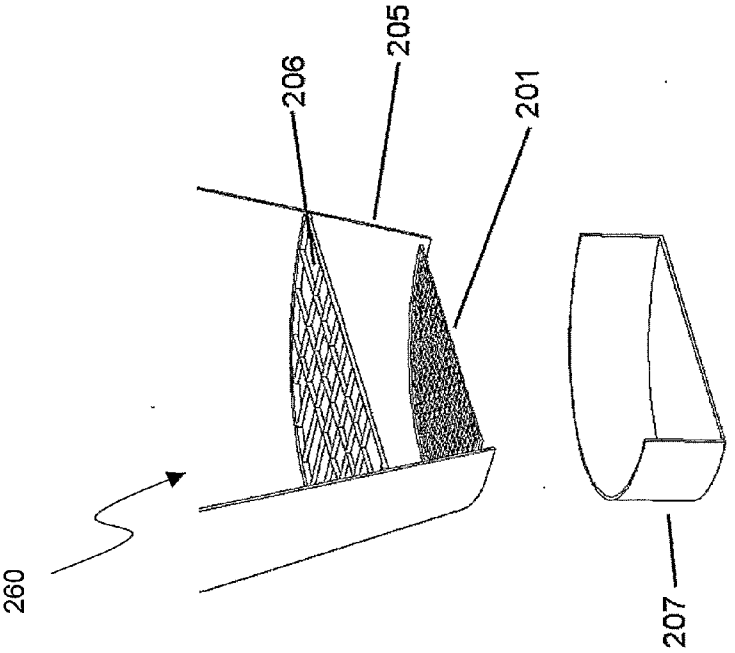


Figure 9B

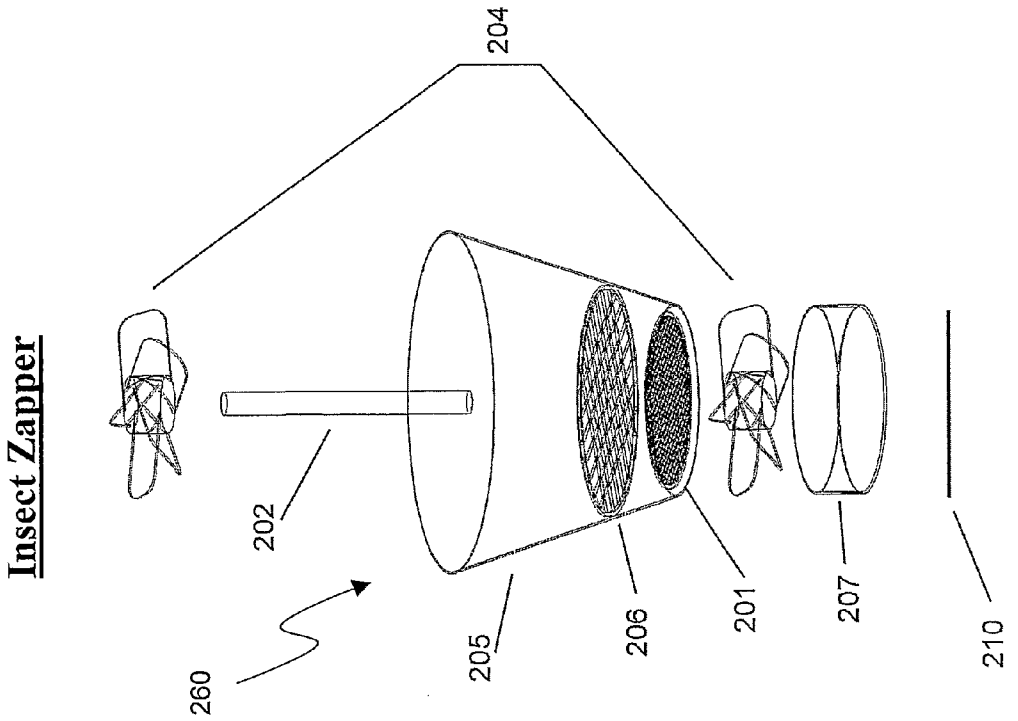


Figure 9A

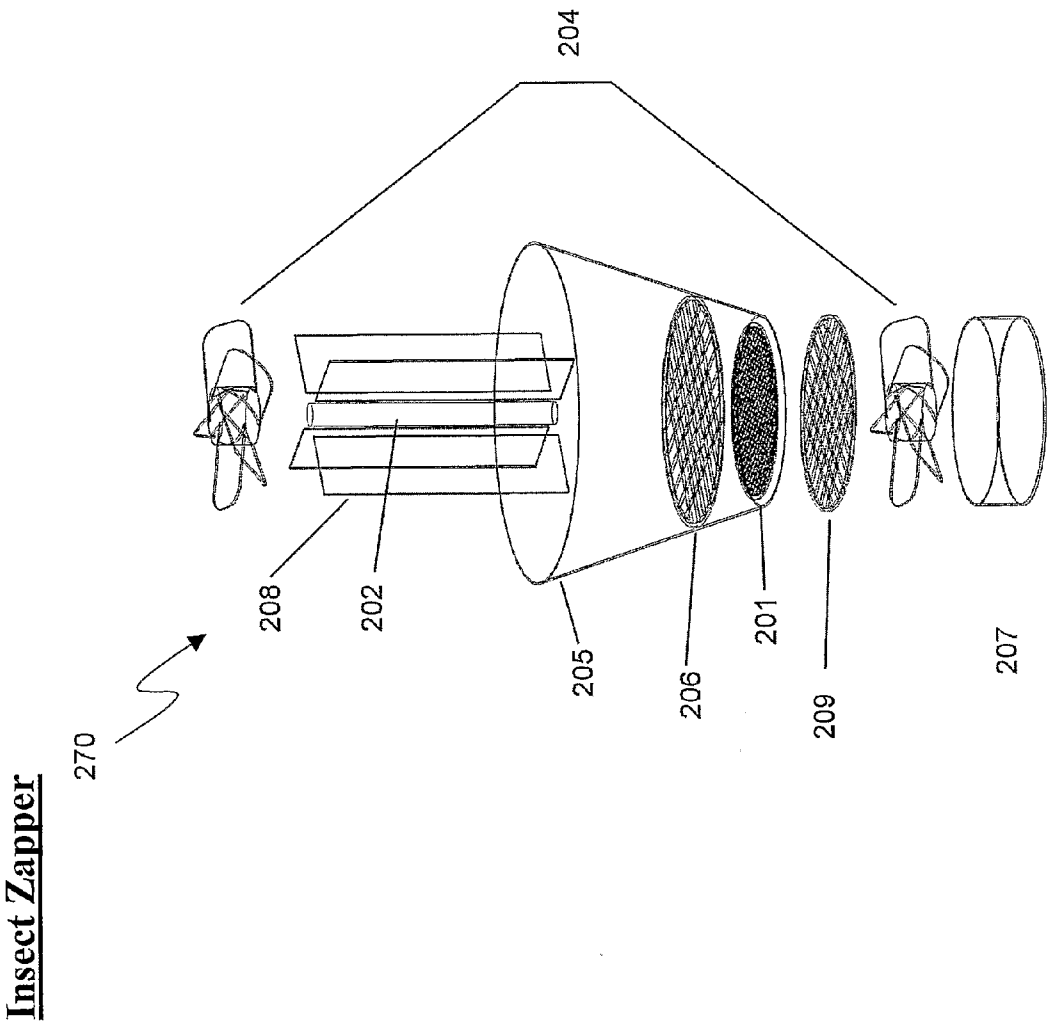


Figure 10

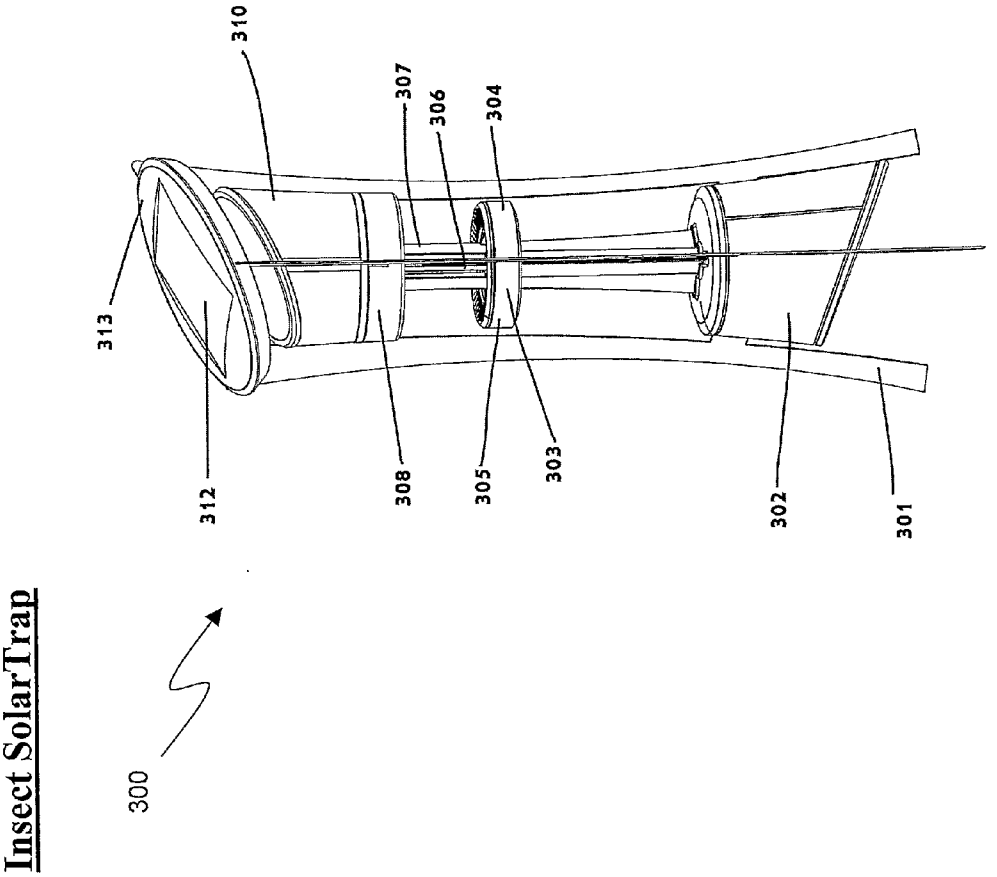
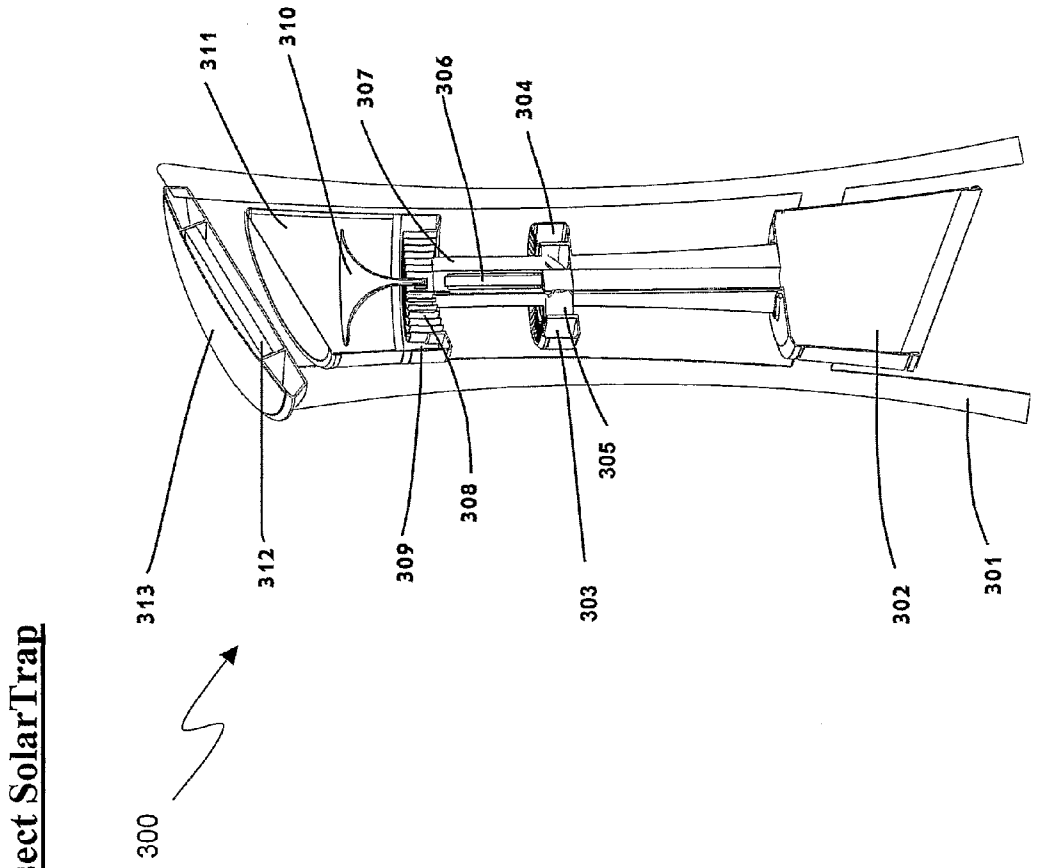

Insect SolarTrap
300
310
307
306
304
313
312
308
305
303
302
301

Figure 11


Insect SolarTrap
300
313
312
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308
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301
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310
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306
304

Figure 12

DEVICES FOR TRAPPING INSECTS

FIELD AND BACKGROUND OF THE INVENTION

[0001] The present invention relates to insect-trapping devices for attracting and trapping biting flies (e.g. mosquitoes, sand flies, and biting midges) and nuisance flies (e.g. house flies, filth flies, and fruit flies).

[0002] Biting flies and nuisance flies are major pests because of their troublesome biting behavior, and the general irritation they cause. Furthermore, some species are carriers of various human and animal diseases. Current control methods for these flies include: source reduction by removal and/or modification of breeding habitats, the use of pesticides to reduce larval and adult populations, and removing adults by trapping devices and toxic bait stations.

[0003] There are numerous specialized traps in the prior art available to attract and kill all kind of insects; nevertheless, no trap in the prior art has been shown to be equally good at eliminating biting flies and nuisance flies. Typically, traps have a combination of attracting features (e.g. optical parameters, heat, CO_2, and chemical odors) and catching/killing features (e.g. suction, sticky paper, electric grids, and pesticides). Apart from some simple sticky traps, all insect traps depend on external energy sources. Small existing traps using solar power have not proven to be effective at catching and controlling mosquitoes. Energy for the various components of conventional traps (e.g. light sources, suction, and heat) is either provided by batteries, an electrical-outlet connection, or combustion.

[0004] The most important long-distance attracting feature is CO_2, produced in conventional traps by combustion, release of CO_2 from bottles, chemical reactions, and/or catalytic processes. Some of the major problems in the designs of prior-art traps, especially large outdoor traps, include the energy source, the airflow, the air turbulence, and the availability of CO_2. Specifically, the problems, associated with existing traps based on conventional features, include the following:

[0005] (1) electric cords create potential obstacles that can lead to accidents (e.g. tripping, cutting, and disconnecting) besides the energy costs associated with continuous usage;

[0006] (2) batteries need to be frequently recharged or changed, adding to the indirect costs (e.g. replacement costs, environmental disposal costs, and service time);

[0007] (3) combustion sources (as a source of CO_2) pose a potential fire and explosion hazard, and need to be frequently changed, adding to the indirect costs (e.g. replacement costs, environmental disposal costs, CO_2 release, and service time);

[0008] (4) chemical reactions (as a source of CO_2) need to be frequently replenished, adding to the indirect costs (e.g. replacement costs, chemical containment/spill prevention, environmental disposal costs, and service time); and

[0009] (5) catalytic processes (as a source of CO_2) are limited to producing only small amounts of CO_2 using state-of-the-art titanium technology.

[0010] Traps dependent on propane tanks, carbon dioxide tanks, or electricity make the trap more difficult to install and use. Furthermore, carbon dioxide tanks are not readily available to the average consumer.

[0011] Most small and large indoor and outdoor mosquito traps operate using a source of suction (e.g. a ventilator). The resulting air turbulence often repels small insects, especially blood-sucking flies. So-called bug zappers are effective at killing large fast-flying insects, but small slow-flying insects (e.g. biting flies and most nuisance flies) are repelled by the fields generated by the electric grid.

[0012] Examples of trapping methods are: EP1477061 discloses an apparatus having a body carrying an insect-collecting bag impregnated with an insecticide and connected to a suction inlet, the suction action being effected through the inside of the apparatus by means of a motor-driven unit, the body of the apparatus supporting at the top a dome carrying a series of high-luminosity LEDs and a chemical-action attraction support, capable of attracting the insects toward the entrance inlet subjected to the suction action for their collection in the inner bag with insecticidal effect. FR2851721 discloses a portable device for destruction of biting/flying insects that uses a battery-powered electric motor with a flexible cutter line attached to a rotor.

[0013] It would be desirable to have more effective insect-trapping devices for attracting and trapping mosquitoes and other blood-sucking flying insects.

SUMMARY OF THE INVENTION

[0014] It is the purpose of the present invention to provide insect-trapping devices for attracting and trapping mosquitoes and other blood-sucking flying insects that improve on the prior art. Specifically, insect-trapping devices utilizing: shape and color patterns as a visual target; heat, CO_2, and chemical attractants to attract biting and nuisance flies toward the device; UV light to knock out the flies' orientation; and improved suction and shielded electric grids to eliminate the flies from the vicinity.

[0015] The present invention discloses insect-trapping devices having several configurations. Some preferred embodiments of the present invention include an item of electrical/electronic equipment for eliminating, by means of attraction and suction, any type of insect, especially dipterous insects (e.g. flies and mosquitoes). Preferred embodiments of the present invention include an apparatus for outdoor use and an apparatus for indoor use. Such indoor use includes homes, hotels, hospitals, food outlets, and more generally the interior and exterior of any space where it is desired to remove insects in the space. To attract the insects, two or more complementary senses (e.g. smell, sight, and taste) are used.

[0016] According to the present invention there is provided a system for attracting and catching insects, especially biting flies and nuisance flies. The system features improved attracting and catching capability, and attractant dissipation. The combination of the features mentioned is important as there are numerous known parameters which are synergistic in attracting and catching biting flies and nuisance flies.

[0017] Therefore, according to the present invention, there is provided for the first time an insect-trapping device for catching biting and nuisance flies, the device including: (a) at least two heat-emitting elements for attracting insects; (b) a light-emitting element, positioned below the heat-emitting element in the trap, for disorienting sensory perceptions of the insects; (c) a transparent grill for covering the light-emitting element; (d) an attractant-emitting element configured to emit at least one attractant in a vicinity of the trap, the attractant-emitting element positioned below the heat-emitting element in the device; (e) a collection compartment, positioned below

the ventilator, for desiccating and storing trapped insects; (f) a ventilator, positioned below the light-emitting element in the device, configured: (i) to create an airflow through the device; (ii) to disperse at least one attractant; and (iii) to draw in attracted insects into the collection compartment; and (g) a device housing for housing at least two heat-emitting elements, the light-emitting element, the transparent grill, the attractant-emitting element, the collection compartment, and the ventilator; wherein at least two heat-emitting elements, the light-emitting element, the transparent grill, the attractant-emitting element, and the ventilator are operative to synergistically effect an attraction of the insects into the device.

[0018] Preferably, the housing is configured to be a visual attractant for the insects using alternating dark and light color-patterns on a three-dimensional shape.

[0019] Preferably, at least two heat-emitting elements includes a heating film, configured to produce a heating pattern having at least two separated parallel strips, covered by a dark sheath.

[0020] Preferably, at least two heat-emitting elements are configured to be combined to form a concave surface that is tilted in an angle of 20-70° toward a base of the device, the surface having at least one center-portion slit through which the insects are drawn into the trap.

[0021] Preferably, the attractant-emitting element is configured to store and emit different types of at least one attractant, wherein the types are at least one type selected from the group consisting of: a liquid form, a dry solid form, a moist solid form, an embedded form, a cartridge form, a slow-release form, and wherein the attractant-emitting element is configured to have an adjustable airflow regulator adapted to select a release rate and a dispersion rate of at least one attractant.

[0022] Preferably, the light-emitting element includes an ultraviolet light source, having an emission wavelength of 280-320 nm, wherein the light source is centered in a gap between at least two heat-emitting elements.

[0023] Preferably, the transparent grill is transparent to UV light, and is configured to allow the light to be directed toward at least two heat-emitting elements.

[0024] According to the present invention, there is provided for the first time an insect-zapping device for catching biting and nuisance flies, the device including: (a) a light-emitting element for attracting and disorienting insects; (b) a zapper base for supporting the light-emitting element; and (c) an electric grid for zapping the insects, the electric grid oriented parallel to the zapper base and positioned below the light-emitting element.

[0025] Preferably, the device further includes: (d) a ventilator for drawing in attracted insects toward the electric grid.

[0026] Preferably, the electric grid is configured to be powered when the ventilator is being powered.

[0027] More preferably, the device further includes: (e) a funnel for causing the attracted insects to fall toward the electric grid.

[0028] More preferably, the device further includes: (e) a metal mesh for shielding electric and magnetic fields generated by the electric grid.

[0029] More preferably, the device further includes: (e) a collection compartment for storing zapped insects.

[0030] Most preferably, the device further includes: (f) a metal mesh for shielding electric and magnetic fields generated by the electric grid, and for preventing human contact with the electric grid.

[0031] More preferably, the device further includes: (e) at least one panel for causing the attracted insects to fall toward the electric grid.

[0032] Most preferably, at least one panel is configured to be heated and to have a dark color.

[0033] According to the present invention, there is provided for the first time an insect-trapping device for catching biting flies, the device including: (a) a cover having an integrated solar panel and control unit; (b) a collection compartment, positioned below the cover, for storing trapped insects; (c) a light-emitting element, positioned below the collection compartment, for disorienting sensory perceptions of attracted insects by emitting light; (d) a ventilator, having apertures on top and bottom, configured: (i) to create an airflow through the device; (ii) to push the attracted insects from above toward the collection compartment; and (iii) to pull the attracted insects from below toward the collection compartment; and (e) an emitter ring, having an attractant chamber and a CO_2 generator, positioned in close contact to the ventilator, the emitter ring for releasing CO_2 and at least one attractant into a vicinity of the device; (f) a heat-emitting element, positioned in close contact to the emitter ring, for heating the CO_2.

[0034] Preferably, the cover is configured to be tilted in to a desired angle for optimizing utilization of sunlight.

[0035] Preferably, the cover has a bottom alignment rim for diverting about 80% of the airflow, coming from the ventilator and attractant chamber, towards an upper portion of the device.

[0036] Preferably, the control unit has different pre-programmed operational modes including at least one mode selected from the group consisting of: an energy-saving mode, regular mode, short-term mode, long-term mode, a high-performance mode, a day mode, a night mode, and a day/night mode.

[0037] Preferably, the collection compartment includes an air baffle, having an internal labyrinth/valve system, for enabling the attracted insects to enter the collection compartment while the ventilator is operational, and for preventing the trapped insects from emerging from the collection compartment while the ventilator is not operational.

[0038] Preferably, the device further includes: (g) an airflow director for directing the airflow into the collection compartment.

[0039] Preferably, the light-emitting element is configured to produce light having an emission wavelength of 280-320 nm.

[0040] Preferably, the light-emitting element is shielded by a reflector for redirecting light from the light-emitting element toward a lower portion of the device in order to reduce an attraction of non-target insects.

[0041] Preferably, the light-emitting element, the heat-emitting element, the ventilator, the CO_2 generator, and the attractant chamber are each configured to synchronously operate according to independent on/off duty cycles.

[0042] These and further embodiments will be apparent from the detailed description and examples that follow.

BRIEF DESCRIPTION OF THE DRAWINGS

[0043] The present invention is herein described, by way of example only, with reference to the accompanying drawings, wherein:

[0044] FIG. **1** shows an isometric view of an insect ComboTrap for catching insects, in particular mosquitoes and houseflies, according to preferred embodiments of the present invention;

[0045] FIG. **2** shows a top view of the ComboTrap of FIG. **1**;

[0046] FIG. **3** shows a front view of the ComboTrap of FIG. **1**;

[0047] FIG. **4** shows a side view of the ComboTrap of FIG. **1**;

[0048] FIG. **5**A shows an isometric view of the collection compartment of the ComboTrap of FIG. **1**;

[0049] FIG. **5**B shows an isometric view of the ventilator compartment of the ComboTrap of FIG. **1**;

[0050] FIG. **6** shows a longitudinal cross-sectional view of the ComboTrap of FIG. **1**;

[0051] FIG. **7** is a simplified schematic diagram of an electric-grid insect zapper, according to the prior art;

[0052] FIG. **8** is a simplified schematic diagram of a first improved insect zapper, according to a preferred embodiment of the present invention;

[0053] FIG. **9**A is a simplified schematic diagram of a second improved insect zapper, according to another preferred embodiment of the present invention;

[0054] FIG. **9**B shows an expanded view of the insect zapper of FIG. **9**A;

[0055] FIG. **10** is a simplified schematic diagram of a third improved insect zapper, according to another preferred embodiment of the present invention;

[0056] FIG. **11** shows a side view of a solar-powered insect trap for catching biting flies, according to preferred embodiments of the present invention;

[0057] FIG. **12** shows a cross-sectional view of the SolarTrap of FIG. **11**.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0058] The present invention relates to insect-trapping devices utilizing: shape and color patterns as a visual target; heat, CO_2, and chemical attractants to attract biting and nuisance flies toward the device; UV light to knock out the flies' orientation; and improved suction and shielded electric grids to eliminate the flies from the vicinity. The principles and operation for such insect-trapping devices, according to the present invention, may be better understood with reference to the accompanying description and the drawings.

Insect ComboTrap

[0059] Referring now to the drawings, FIG. **1** shows an isometric view of an insect trap for catching insects, in particular mosquitoes and houseflies, according to preferred embodiments of the present invention. An insect ComboTrap **100** having a heated surface **1** (preferably a concave dark-colored heated surface) is shown. Heated surface **1** may have various shapes (e.g. elliptical or square). Heated surface **1** is heated by a heating film (or wire) that transfers the energy to the external environment.

[0060] The heating arrangement of heated surface **1** includes multiple strips of heating film with about 1-4 cm between each strip, making sure to have sufficient heat, as well as a unique, fluctuating heating pattern with a temperature gradient from 42° C. to ambient room temperatures. The maximum temperature on the surface of ComboTrap **100** is about 42° C.

[0061] The requirements for such a controlled and patterned heating arrangement comes from the need to imitate the body-heat pattern of warm-blooded prey for biting flies (e.g. about 37-44° C.), as well as the heating patterns emitted by rotting organic matter (e.g. several degrees above ambient temperature) for house and filth flies. An attractant-dispersant outlet **12**, shown in FIG. **1**, is used to attract insects by dispersing optional attractants in the vicinity of the ComboTrap **100**.

[0062] In FIG. **1**, a protective transparent grill **15** provides a safety feature to keep children's fingers away, and to keep large non-target insects (e.g. moth, beetles) out of ComboTrap **100**. Grill **15** is transparent in order not to block light emitted from the interior of ComboTrap **100**. Grill **15** includes a plurality of apertures **71** that are preferably positioned in at least one row along the longitudinal surface of grill **15**. Through apertures **71**, insects are sucked into ComboTrap **100**, and light is transmitted as well, serving to attract the insects. The convex grill **15** and the double row of apertures are additionally reflecting the ultraviolet light towards the heated surface **1**. A hanging handle **14** enables ComboTrap **100** to hang on a tree or post, for example. A power switch **16** is also shown in FIG. **1**.

[0063] FIG. **2** shows a top view of the ComboTrap of FIG. **1**. A dark sheath **3** is used to cover heated surface **1**. It is important that sheath **3** is dark, relative to the rest of the body of ComboTrap **100**, in order to enhance the attraction of insects to heated surface **1**. To enhance the color-pattern and heating-pattern effect, heated surface **1** is surrounded by a dark unheated top stripe **4** of about 1-4 cm width along the rim of heated surface **1**.

[0064] FIG. **2** also shows an ultraviolet light source **60** positioned in the center of ComboTrap **100**. An emission reflector **7**, positioned under light source **60**, is configured to yield a maximum reflection of UV light from light source **60**, while not hindering the airflow of the suction mechanism positioned further inside ComboTrap **100**, and not increasing the noise level caused by the suction mechanism. These aims are achieved due to the small convex profile of emission reflector **7**. Emission reflector **7** has the same width as the light source **60**, allowing for adequate passage of airflow. Furthermore, the convex profile of emission reflector **7** provides better airflow by acting as an aerodynamic airfoil.

[0065] FIG. **3** shows a front view of the ComboTrap of FIG. **1**. A dark unheated front stripe **5** is shown on the front of ComboTrap **100**, forming a unique three-dimensional pattern and a visual target in conjunction with dark, heated surface **1** and surrounding top stripe **4**. Biting flies are mainly attracted by the heated areas, while nuisance flies are attracted by the unheated areas. Suction slits **6** are positioned underneath emission reflector **7**. Preferably, there is one central UV light source **60**. Preferably, there are at least two lateral suction slits **6**, having a width of between 8 mm to 3 cm.

[0066] FIG. **4** shows a side view of the ComboTrap of FIG. **1**. Note that the dotted lines marking certain areas of FIG. **4** are meant to define the elements as numbered in the description, and do not specify sections. The upper portion of ComboTrap **100** has a tilt angle **2** of between 20° to 70° in the x-z plane. Tilt angle **2** creates a slanted plane for heated surface **1** (not shown in FIG. **4**) that attracts biting and nuisance flies as well. Ventilation slits **13** allows a special arrangement for

exhaust of the airflow such that ventilated air is dispersed in a way that approaching insects are not repelled by the speed or turbulences of the airflow. Additionally, ventilation slits **13** provide a measure of safety, preventing hands from being able to contact the moving parts inside ComboTrap **100**. It is noted that the dispersing angle of attractant-dispersant outlet **12** is limited to a maximum of about 30° relative to the x-z plane in order to prevent the attractant from being entrained into the inlet portion (i.e. apertures **71**) of ComboTrap **100**.

[0067] FIGS. **5**A and **5**B show the inner portions of ComboTrap **100**. FIG. **5**A shows an isometric view of the collection compartment of the ComboTrap of FIG. **1**. A collection compartment **101** houses a collecting portion **11** in which the insects are trapped until being disposed, while an attractant cell **10**, separated from collecting portion **11** by a divider **25**, contains attractants which are ventilated and transferred outside ComboTrap **100** via attractant-dispersant outlet **12**. The side panels of collection compartment **101** have meshed openings. Attractant cell **10** may contain different cartridges of attractant combinations. Attractant cell **10** may be in liquid or solid form (either moist or dry). Changeable airflow regulators (i.e. an adjustable meshed region in divider **25**) determine the ventilation of the attractants, and by this regulate the release rate of the attractants.

[0068] Examples of attractants include lactic acid, octenol, flowers extracts, and fruit extracts. Even water will enhance the attraction of mosquitoes due to the presence of moisture. The unique configuration of ComboTrap **100** allows the attractants emitted by the trapped insects to blend with attractants contained in the attractant cell **10**. Some trapped insect species, especially house flies before and even after their death, emit attractants through their body. Furthermore, attractant cell **10** serves to isolate trapped insects from the attractants (especially liquid attractants) in order to avoid possible rotting of the trapped insects (and by this to avoid producing a foul odor).

[0069] FIG. **5**B shows an isometric view of the ventilator compartment of the ComboTrap of FIG. **1**. A ventilator compartment **102**, having a funnel-shaped suction channel **8**, is shown. As mentioned above, ventilation is critical in such an insect trap as the airflow has to be maximized, while the power consumption and the noise have to be minimized. In ventilator compartment **102**, the cross-section that the airflow passes through will always be larger than cross-section of a ventilator **9** (going from inlet to outlet side of the airflow path). The maximum strength of the airflow is at the inlet as a result of a venturi-tube shape to the lower portion of ventilator compartment **102** (shown in FIG. **6**). So, insects are sucked in by an airflow path in a continuous stream from the inlet to the outlet. Ventilator compartment **102** is positioned beneath light source **60**, and is arranged to ensure a low noise level along with an optimum suction level.

[0070] FIG. **6** shows a longitudinal cross-sectional view of the ComboTrap of FIG. **1**. The airflow arrangement at the bottom of ComboTrap **100** is created by collection compartment **101**, ventilation slits **13**, ventilator compartment **102**, and the internal and external shape of ComboTrap **100**. Air flows out of the meshed side panels of collection compartment **101** and ventilation slits **13**. The ventilated air is dispersed in a way that approaching insects are not repelled by the speed or turbulences of the airflow.

[0071] ComboTrap **100** includes an electronic board **17** for controlling all electrical functionality of ComboTrap **100** including current regulation and temperature control, and a power socket **18**. A collection-compartment cover **19**, having a mesh cone, enables insects to enter collecting portion **11**, but gives the insects only a very small aperture (e.g. 8-15 mm) to leave (e.g. "fish basket" principle). Collection-compartment cover **19** keeps trapped insects inside ComboTrap **100**, and makes sure that the airflow forces the insects into collecting portion **11**. A lower airflow director **20** and an upper airflow director **21** are two sleeves which direct the airflow, and keep the airflow in one flow path. A grid, located on lower airflow director **20**, prevents fingers from contacting ventilator **9** even when collection compartment **101** is exposed.

[0072] The trap according to the present invention includes an attractant which may be suitable for all kinds of insects, especially for mosquitoes. An attractant "cocktail" can be yielded from fermentation processes with different types of yeast. Among these attractants, the most potent ones are lactic acid, acetone, 3-methylbutanol, glutamic acid, tyrosine, lysine, and phenylalanine. These attractants (as well as others not specified here) are collected from the fermentation process (by collecting the emitted gases), and are enriched and embedded in ethanol, aqua dist., or other suitable carriers including all kinds of slow-release substances. The attractants, with the carrier, can be packed in a variety of cartridges to ensure easy handling and long shelf-life. The attractants that are based on food products and processes are also FDA-exempt.

[0073] The attractants are either released in the main airstream, or released through attractant-dispersant outlet **12** towards the front of ComboTrap **100** with the help of a specially-diverted partial air-stream, or by passive diffusion only. Attractant-dispersant outlet **12** diffuses the air at an angle of approximately 30° relative to the x-z plane, as shown in FIG. **4**. The measurements and angles shown in the drawings are meant to serve strictly as examples, and are in no way limiting.

Insect Zapper

[0074] FIG. **7** is a simplified schematic diagram of an electric-grid insect zapper, according to the prior art. An insect zapper **200** having a zapper base **210** and an electric grid **201**, positioned in front of an "attracting" UV light source **202**, is shown in FIG. **7**. Electric grid **201** is typically oriented perpendicular to zapper base **210**. Insect zapper **200** produces poor results with regard to mosquitoes. Insect zappers such as insect zapper **200** act as a repellant toward mosquitoes due to the magnetic and electric fields created by electric grid **201**.

[0075] Such magnetic and electric fields act as a repellant toward other insects as well; however, because such insects are flying at such high speeds, the insects to not have enough time to redirect their course. Thus, the insects collide into the electric grid, and are zapped. In contrast, mosquitoes tend to have a hovering and swarming flight pattern as they assess their prey. Thus, when the mosquitoes feel the presence of the fields, they are repelled, and redirect their course before colliding into the electric grid.

[0076] FIG. **8** is a simplified schematic diagram of a first improved insect zapper, according to a preferred embodiment of the present invention. An insect zapper **250**, which is operative to zap other insects as well, has electric grid **201** positioned below UV light source **202**, thereby reducing the repelling effect caused by electric grid **201**, especially when electric grid **201** is oriented parallel to zapper base **210**, according to preferred embodiments of the present invention. To draw insects and mosquitoes toward electric grid **201**, a

ventilator **204** is positioned below or above electric grid **201**. In another preferred embodiment of the present invention, a funnel **205** is included to enhance the performance of ventilator **204** with electric grid **201**. Funnel **205** causes the insects and mosquitoes to be fall down toward electric grid **201** after the insects and mosquitoes collide with interior surface of funnel **205**.

[0077] FIG. **9**A is a simplified schematic diagram of a second improved insect zapper, according to another preferred embodiment of the present invention. An insect zapper **260** having a metal mesh **206** is shown in FIG. **9**A. Metal mesh **206** serves to further reduce the repelling effect caused by electric grid **201** by shielding the electric and magnetic fields created in the vicinity of electric grid **201**. Mosquito zapper **260** also has a collection compartment **207**. FIG. **9**B shows an expanded view of the insect zapper of FIG. **9**A.

[0078] FIG. **10** is a simplified schematic diagram of a third improved insect zapper, according to another preferred embodiment of the present invention. An insect zapper **270** having a plurality of heated panels **208**, which serve as an attractant for blood-sucking flies (e.g. mosquitoes), is shown in FIG. **10**. Panels **208** are heated in the range of about 35-42° C., and are shown oriented perpendicular to zapper base **210**. Panels **208** are preferably dark-colored. Such a vertical arrangement for panels **208** serves to divert mosquitoes, which are circling around light source **202**, towards ventilator **204** by hitting panels **208** and falling down toward ventilator **204** and electric grid **201**. The performance of insect zapper **270** is further improved if panels **208** have a dark color. FIG. **10** also shows an optional protective screen **209**. In another preferred embodiment of the present invention, electric grid **201** is switched on and off, in coordination with ventilator **204**, in order to temporarily remove the electro-magnetic field completely.

Insect SolarTrap

[0079] FIG. **11** shows a side view of a solar-powered insect trap for catching biting flies, according to preferred embodiments of the present invention. An insect SolarTrap **300**, having legs **301**, is shown in FIG. **11**. The profile of SolarTrap **300**, exposed to an approaching biting fly, is reduced to a minimum in order to guide the insects towards the center of SolarTrap **300**, which is the visual target and the capture zone. A battery compartment and electronic control center **302** contains the batteries (that enable 48-hour operation without sunlight) and the electronic parts. Control center **302** sets the time for operation, sets the connecting conditions that ensure maximum charging efficiency, and defines the operating conditions when available power is low (e.g. low ampere\hour usage). Control center **302** allows for different, pre-programmed operational modes (e.g. energy-saving mode, regular mode, short-term mode, long-term mode, high-performance mode, day mode, night mode, and day/night mode).

[0080] A better view of the internal components of SolarTrap **300** can be seen in FIG. **12**. FIG. **12** shows a cross-sectional view of the SolarTrap of FIG. **11**. An attractant/CO_2 emitter ring **303** has an attractant chamber and CO_2 generator, both located in the center portion of emitter ring **303**. Half of emitter ring **303** houses the CO_2 generator (e.g. concentrating CO_2 from the air, and releasing the CO_2 by magnetic field), and the other half of emitter ring **303** houses the attractant chamber (e.g. Westham's attractant and octenol). The attractant is released through numerous apertures in emitter ring **303**. The position of the two attractants (i.e. the CO_2 generator and the attractant chamber) is selected such that the attractants diffuse into the middle of the capture zone.

[0081] Heating element **304** is a small, circular component that heats emitter ring **303** (e.g. 39-44° C.) by surrounding the release valve of the CO_2 generator of emitter ring **303** to attract biting flies into the capture zone of SolarTrap **300**. A ventilator **305** is used to "push/pull" the mosquitoes. Ventilator **305** works in pulses of about 5-10 sec. on, followed by about 15-60 sec. off. The use of such pulses increases the efficiency of SolarTrap **300** as mosquitoes are disturbed by strong air streams and air turbulences, as well as noises. Emitter ring **303** is situated in close contact with ventilator **305**.

[0082] A UV light source **306** (e.g. 280-320 nanometer emission wavelength) enhances the performance of SolarTrap **300** by disorienting attracted insects. A reflector **307** is used to intensify and direct the UV light emitted from light source **306**. UV light from light source **306** is shielded by protruding, concave reflector **307**, and redirected toward the ground to reduce the attraction of non-target species that might otherwise be attracted from a far distance to the ultraviolet light emanating from SolarTrap **300**. The emitted UV light shines downward in a conical shape toward the ground.

[0083] So, while the mosquitoes approach the released CO_2 and attractant, hovering around the capture zone of SolarTrap **300**, the UV knocks out their orientation, the air pulses take the mosquitoes by surprise and force the mosquitoes into a collection compartment **308**. The push/pull function is used to account for the fact that mosquitoes, located above and below ventilator **305**, are affected by the air pulses, and pushed/pulled into collection compartment **308**. By nature of the configuration and push/pull operation, the "capture area" is doubled compared to conventional suction traps which only "pull" mosquitoes into the collecting section. Collection compartment **308** makes sure that the airflow will not crumble the trapped and desiccated (i.e. fragile) mosquitoes. Attractant cartridges (e.g. octenol and/or lactic acid) can be hung on a hook below ventilator **305**.

[0084] Synchronization of heat, light, airflow, CO_2, and attractant release occurs as follows: heating element **304** is continuously operational, the UV light and airflow are pulse-programmed, the CO_2 is released in short pulses every 5 to 10 seconds, and the attractant is evenly and continuously released.

[0085] An exemplary program cycle is provided here for illustrative purposes. Light source **306** is programmed to operate in pulses of about 5-10 sec., followed about 1-2 sec. later by ventilator **305** operating for about 5-10 sec., followed by an interval of about 10-60 sec. without any airflow or light. The length of the intervals depends on the various modes that can be selected. CO_2 is only emitted while there is no airflow. The pulsed features significantly increase the performance of SolarTrap **300** to catch mosquitoes because biting flies are disturbed considerably by airflow and noise (from ventilator **305**). The off-duty intervals (of ventilator **305** and light source **306**) allow the attractants and CO_2 to form highly-attractive plumes in the vicinity of SolarTrap **300**. Furthermore, the off-duty intervals allow mosquitoes to approach such plumes undisturbed. After which, the UV light knocks out the mosquitoes orientation, making it easy for ventilator **305** to push/pull them toward collection compartment **308**.

[0086] An air baffle **309**, forming an internal labyrinth/valve system, is integrated into collection compartment **308**. The labyrinth/valve-system structure enables mosquitoes to

enter, but ensures that the mosquitoes cannot emerge from air baffle **309**. An airflow director **310** (resembling downward-pointing funnel) forces the air above into collection compartment **308**. A wire mesh **311** lines the walls of collection compartment **308**, and enables maximum air to flow through SolarTrap **300**. A solar panel **312** is used to energize heating elements **304**, ventilator **305**, light source **306**, the magnetic field used for the CO_2 generator, and the rechargeable batteries over time.

[0087] A transparent protective cover **313** can be opened in order to access control center **302**. Cover **313** can be tilted to a desired angle (depending on the latitude SolarTrap **300** is deployed at) in order to ensure an optimal utilization of sunlight, and proper alignment of the bottom of cover **313** to divert about 80% of the airflow coming from emitter ring **304** and ventilator **305**) toward the top of SolarTrap **300**.

[0088] While the invention has been described with respect to a limited number of embodiments, it will be appreciated that many variations, modifications, and other applications of the invention may be made.

What is claimed is:

1. An insect-trapping device for catching biting and nuisance flies, the device comprising:

(a) at least two heat-emitting elements for attracting insects;

(b) a light-emitting element, positioned below said heat-emitting element in the trap, for disorienting sensory perceptions of said insects;

(c) a transparent grill for covering said light-emitting element;

(d) an attractant-emitting element configured to emit at least one attractant in a vicinity of the trap, said attractant-emitting element positioned below said heat-emitting element in the device;

(e) a collection compartment, positioned below said ventilator, for desiccating and storing trapped insects;

(f) a ventilator, positioned below said light-emitting element in the device, configured:

(i) to create an airflow through the device;

(ii) to disperse said at least one attractant; and

(iii) to draw in attracted insects into said collection compartment; and

(g) a device housing for housing said at least two heat-emitting elements, said light-emitting element, said transparent grill, said attractant-emitting element, said collection compartment, and said ventilator;

wherein said at least two heat-emitting elements, said light-emitting element, said transparent grill, said attractant-emitting element, and said ventilator are operative to synergistically effect an attraction of said insects into the device.

2. The device of claim **1**, wherein said housing is configured to be a visual attractant for said insects using alternating dark and light color-patterns on a three-dimensional shape.

3. The device of claim **1**, wherein said at least two heat-emitting elements includes a heating film, configured to produce a heating pattern having at least two separated parallel strips, covered by a dark sheath.

4. The device of claim **1**, wherein said at least two heat-emitting elements are configured to be combined to form a concave surface that is tilted in an angle of 20-70° toward a base of the device, said surface having at least one center-portion slit through which said insects are drawn into the trap.

5. The device of claim **1**, wherein said attractant-emitting element is configured to store and emit different types of said at least one attractant, wherein said types are at least one type selected from the group consisting of: a liquid form, a dry solid form, a moist solid form, an embedded form, a cartridge form, a slow-release form, and wherein said attractant-emitting element is configured to have an adjustable airflow regulator adapted to select a release rate and a dispersion rate of said at least one attractant.

6. The device of claim **1**, wherein said light-emitting element includes an ultraviolet light source, having an emission wavelength of 280-320 nm, wherein said light source is centered in a gap between said at least two heat-emitting elements.

7. The device of claim **1**, wherein said transparent grill is transparent to UV light, and is configured to allow said light to be directed toward at least two heat-emitting elements.

8. An insect-zapping device for catching biting and nuisance flies, the device comprising:

(a) a light-emitting element for attracting and disorienting insects;

(b) a zapper base for supporting said light-emitting element; and

(c) an electric grid for zapping said insects, said electric grid oriented parallel to said zapper base and positioned below said light-emitting element.

9. The device of claim **8**, the device further comprising:

(d) a ventilator for drawing in attracted insects toward said electric grid.

10. The device of claim **9**, wherein said electric grid is configured to be powered when said ventilator is being powered.

11. The device of claim **9**, the device further comprising:

(e) a funnel for causing said attracted insects to fall toward said electric grid.

12. The device of claim **9**, the device further comprising:

(e) a metal mesh for shielding electric and magnetic fields generated by said electric grid.

13. The device of claim **9**, the device further comprising:

(e) a collection compartment for storing zapped insects.

14. The device of claim **11**, the device further comprising:

(f) a metal mesh for shielding electric and magnetic fields generated by said electric grid, and for preventing human contact with said electric grid.

15. The device of claim **9**, the device further comprising:

(e) at least one panel for causing said attracted insects to fall toward said electric grid.

16. The device of claim **14**, wherein said at least one panel is configured to be heated and to have a dark color.

17. An insect-trapping device for catching biting flies, the device comprising:

(a) a cover having an integrated solar panel and control unit;

(b) a collection compartment, positioned below said cover, for storing trapped insects;

(c) a light-emitting element, positioned below said collection compartment, for disorienting sensory perceptions of attracted insects by emitting light;

(d) a ventilator, having apertures on top and bottom, configured:

(i) to create an airflow through the device;

(ii) to push said attracted insects from above toward said collection compartment; and

(iii) to pull said attracted insects from below toward said collection compartment; and

(e) an emitter ring, having an attractant chamber and a CO_2 generator, positioned in close contact to said ventilator, said emitter ring for releasing CO_2 and at least one attractant into a vicinity of the device;

(f) a heat-emitting element, positioned in close contact to said emitter ring, for heating said CO_2.

18. The device of claim **17**, wherein said cover is configured to be tilted in to a desired angle for optimizing utilization of sunlight.

19. The device of claim **17**, wherein said cover has a bottom alignment rim for diverting about 80% of said airflow, coming from said ventilator and attractant chamber, towards an upper portion of the device.

20. The device of claim **17**, wherein said control unit has different pre-programmed operational modes including at least one mode selected from the group consisting of: an energy-saving mode, regular mode, short-term mode, long-term mode, a high-performance mode, a day mode, a night mode, and a day/night mode.

21. The device of claim **17**, wherein said collection compartment includes an air baffle, having an internal labyrinth/valve system, for enabling said attracted insects to enter said collection compartment while said ventilator is operational, and for preventing said trapped insects from emerging from said collection compartment while said ventilator is not operational.

22. The device of claim **17**, the device further comprising:

(g) an airflow director for directing said airflow into said collection compartment.

23. The device of claim **17**, wherein said light-emitting element is configured to produce light having an emission wavelength of 280-320 nm.

24. The device of claim **17**, wherein said light-emitting element is shielded by a reflector for redirecting light from said light-emitting element toward a lower portion of the device in order to reduce an attraction of non-target insects.

25. The device of claim **17**, wherein said light-emitting element, said heat-emitting element, said ventilator, said CO_2 generator, and said attractant chamber are each configured to synchronously operate according to independent on/off duty cycles.

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