

1 **"Insect Trapping Device"**

2

3 The present invention relates to a device for
4 attracting and/or trapping insects. More
5 specifically, the invention provides a device for
6 attracting, capturing and killing haematophagous
7 flying insects.

8

9 **Background to the Invention**

10 Bloodsucking (haematophagous) flying insects are
11 commonly attracted to a potential living blood
12 source such as a human through the detection of a
13 mixture of carbon dioxide, air and water vapour
14 present in exhaled breath. Thus the insects are
15 attracted towards a specific concentration of gases
16 released at a specific temperature.

17

18 Insects are also known to be attracted to traps by
19 the use of lights or attractants such as sugar-based
20 solutions or chemical attractants. Once in the
21 vicinity of the trap various means are commonly used
22 to contain or kill the insects. Such means include

1 drowning or use of insecticides. Further insect
2 traps, such as those typically designed for the
3 trapping of mosquitoes, are also known in the field.
4 In these traps carbon dioxide gas and/or chemical
5 attractants such as octenol are released into the
6 vicinity of the trap. This carbon dioxide and
7 attractant mixture attracts insects along
8 a concentration gradient towards the trap. Once in
9 the vicinity of the trap a suction mechanism is used
10 to draw the mosquitoes into the trap, where they are
11 retained until they die or are disposed of.

12
13 International PCT Patent Publication No WO99/37145
14 describes one such device. Hydrocarbon gas fuel is
15 burnt to produce a gaseous mixture of carbon dioxide
16 and water vapour. The gases are then released
17 downwardly. Insects attracted towards the device
18 are drawn into the device by suction and are thus
19 trapped.

20
21 However, the release of the carbon dioxide and
22 attractant from such prior art traps causes their
23 rapid dissipation into the surrounding atmosphere,
24 particularly in exposed or windy conditions. The
25 dissipation of the attractants into the atmosphere
26 results in their becoming too diluted to provide an
27 effective concentration gradient which can attract
28 the mosquitoes towards the trap. As such, they
29 become ineffective for insect attraction.

30
31 A further disadvantage to the presence of peripheral
32 air currents is the dissipation of heat from the

1 carbon dioxide and attractant mixture. Mosquitoes
2 are commonly attracted to heated gaseous mixtures
3 and thus where the gas emitted is not maintained at
4 optimal temperature, the efficiency of insect
5 capture is much reduced.

6
7 The generation of carbon dioxide and attractant such
8 that it is expelled about the periphery of a trap is
9 an important step in the function of insect traps.
10 However, the dissipation of the attractant-
11 containing gases results in the traps losing
12 trapping efficiency and also being less energy
13 efficient as more carbon dioxide needs to be
14 produced to provide an emission level which can be
15 detected by insects.

16

17 **Summary of the Invention**

18 According to a first aspect of the present
19 invention, there is provided an insect trapping
20 apparatus including:

21 a source of carbon dioxide;

22 an exhaust means from which the carbon dioxide
23 is exhausted;

24 a suction means for drawing air into the
25 apparatus and being adequate to allow the ingress of
26 insects contained within the air, the insects being
27 drawn into the apparatus at an area proximal to
28 where the gas is exhausted from the apparatus;

29 means for retaining the insects which are drawn
30 into the apparatus; and

31 at least one anti-dispersal means for reducing
32 dissipation of gas exhausted from the apparatus.

1 Preferably the exhaust means is adapted to direct
2 the exhausted carbon dioxide substantially towards
3 the anti-dispersal means.

4

5 Preferably the exhaust means includes an exit port
6 through which the carbon dioxide is exhausted.

7

8 **Anti-Dispersal Means**

9 Preferably the anti-dispersal means is positioned in
10 spaced arrangement with the exit port. More
11 preferably the anti-dispersal means is located above
12 the exit port. More preferably still the anti-
13 dispersal means is concentric with the exit port.
14 For example, in a preferred embodiment the centre of
15 the anti-dispersal means may be located several
16 centimetres above the centre of the exit port such
17 that the anti-dispersal means provides equal cover
18 on all sides of the exit port.

19

20 The anti-dispersal means can be composed of at least
21 one carbon dioxide retaining plate member extending
22 around the exit port and thus defining a carbon
23 dioxide retaining area. The carbon dioxide
24 retaining area is preferably located around the
25 exhaust means, more preferably around the exit port.

26

27 The anti-dispersal means serves to shelter the plume
28 of exhausted gases from peripheral air currents and
29 their cooling effect, thus preventing the
30 dissipation of the attractant gases into the
31 atmosphere. The exhausted attractant mixture is
32 therefore concentrated around the device, generally

1 in the region of the carbon dioxide retaining area.
2 The concentration gradient that the insect follows
3 is thus increased and insects are more effectively
4 attracted to the device where they can be trapped.

5

6 The at least one carbon dioxide retaining plate
7 member may be any shape suitable to define the
8 carbon dioxide retaining area. The member may
9 typically be planar, arcuate or a combination of
10 both.

11

12 In a preferred embodiment, the anti-dispersal means
13 is of a generally inverted dish shape i.e. is
14 concave towards the exit port. Thus the carbon
15 dioxide retaining plate member may curve downwardly
16 towards the exit port at its peripheral edge(s).

17

18 Preferably the at least one carbon dioxide retaining
19 member is a series of flanges projecting outwardly
20 from the apparatus. Each flange preferably extends
21 outwardly from a side of a central planar hexagonal
22 plate at an angle such that a carbon dioxide
23 retaining area is defined around the exit port
24 through which the gases are exhausted.

25

26 The hexagonal plate may be positioned in any
27 position suitable for retaining carbon dioxide in
28 the vicinity of the exit port. For example, the
29 hexagonal plate may preferably be positioned above
30 the exit port.

31

1 A further advantage of the anti-dispersal means is
2 that it prevents the escape of attracted insects
3 such that they are more easily trapped.

4
5 The anti-dispersal means also serves as a weather
6 cover. Precipitation is thus prevented from
7 entering the system and the carbon dioxide exhausted
8 is kept within the local vicinity of the device.

9
10 **Carbon Dioxide Source**

11 The carbon dioxide source may be any suitable source
12 of carbon dioxide. For example, the carbon dioxide
13 source may be a pressurised canister of carbon
14 dioxide. Alternatively, the carbon dioxide can
15 evaporate from a source of dry ice. Preferably the
16 carbon dioxide is produced by the combustion of a
17 mixture of gas and air, most preferably in the
18 presence of a catalyst.

19
20 Preferably the gas is a hydrocarbon gas such as
21 propane, butane or a suitable mixture thereof.
22 Alternatively, the gas is Patio GasTM, a
23 propane/butane mixture supplied by Calor UK.

24
25 The gas is preferably stored within a container and
26 discharged via a 37mb pressure regulator. The gas
27 container is preferably stored within the device in
28 a self-contained housing. The gas preferably enters
29 the combustion chamber through a nozzle which
30 controls gas flow and pressure.

31

1 The skilled reader will be aware that the regulated
2 pressure of gas supplied from containers may vary in
3 different countries and therefore modifications to
4 the nozzle may be required to obtain effective
5 functioning of the apparatus. Such modifications
6 will be obvious to the skilled man. For example,
7 with a regulated pressure of 37mb, a nozzle size of
8 0.3mm is suitable to allow sufficient gas to feed
9 into the combustion chamber for a power requirement
10 of 0.25kW.

11
12 Typically, the nozzle housing has at least one hole
13 to permit the flow of gas to draw the required
14 amount of air into the system to allow complete
15 combustion. Complete combustion means that no
16 hydrocarbons are included in the gas which is
17 exhausted from the apparatus.

18
19 Preferably the carbon dioxide is mixed with air
20 prior to being exhausted from the apparatus. The
21 apparatus preferably further includes a second
22 suction means for drawing air into the apparatus.

23
24 The air to be mixed with the carbon dioxide is
25 typically drawn into the device via the second
26 suction means. Typically when the carbon dioxide is
27 produced from the combustion of a mixture of gas and
28 air, the carbon dioxide is exhausted as a mixture of
29 carbon dioxide, air and water vapour. Combustion
30 typically takes place within a combustion chamber,
31 which is preferably manufactured from cast
32 aluminium.

1
2 Preferably the second suction means, for the suction
3 of air, is provided by a venturi arrangement. For
4 the purposes of the present invention a venturi
5 arrangement is defined as an opening which narrows,
6 causing a build-up of pressure sufficient to draw
7 air into the apparatus of the invention.

8

9 **Catalyst**

10 The catalyst is preferably one which allows the
11 combustion of gas and air without a flame and which,
12 when operating at full working temperature, results
13 in the release of carbon dioxide. The catalyst is
14 preferably in the form of a monolith block.

15

16 Preferably the catalyst is a substrate coated with
17 at least 200m²/g platinum. The greater the surface
18 area of the catalyst, the better the performance of
19 the catalyst at comparable precious metal content.

20

21 Pelleted catalysts have a lower surface area (<
22 100m²/g) than coated substrates (>200m²/g) as the
23 pellets are packed together reducing the available
24 surface area. Coated substrates such as that of the
25 present invention have a greater resistance to
26 higher temperatures and against contaminants. They
27 also contain oxygen storage compounds making the
28 combustion process easier to initiate than beaded
29 catalysts. For example, ignition within the present
30 apparatus typically requires only one spark.

31

1 The catalyst has the advantage that it has better
2 resistance against high temperatures. The catalyst
3 typically burns in the region of 500°C to 1500°C.
4 The ability to withstand high combustion
5 temperatures means that contaminants such as carbon
6 monoxide are not produced so that carbon deposits
7 from the hydrocarbon gas source do not build up on
8 and detrimentally affect the functioning of the
9 catalyst.

10

11 A wide range of catalysts are known in the art and a
12 suitable catalyst will be known to the skilled man.

13

14 The catalyst is typically housed in a chamber.

15

16 Carbon Dioxide Exhaust

17 Preferably the carbon dioxide concentration
18 immediately following combustion is between 6000 to
19 12000 ppm at a temperature which is preferably in
20 the region of between 160°C to 210°C. More
21 preferably the carbon dioxide is exhausted at a
22 concentration of between 8000 to 10000 ppm carbon
23 dioxide at a temperature of 190°C.

24

25 In one embodiment of the present invention, the
26 carbon dioxide mixture is exhausted from the
27 apparatus at a concentration of between 500 to 10000
28 ppm, more preferably between 600 to 7000. Most
29 preferably the carbon dioxide mixture is exhausted
30 at a concentration of approximately 4600 ppm.

31

1 The temperature of the carbon dioxide mixture on
2 exhaustion from the apparatus may be at a
3 temperature of between 22 and 45 °C, preferably
4 between 24 and 42°C. Most preferably the
5 temperature of the carbon dioxide mixture is
6 maintained at between 10 to 15 °C above ambient
7 temperature (i.e. above the temperature of the
8 surrounding atmosphere).

9
10 Preferably the carbon dioxide mixture is exhausted
11 from an exhaust pipe, or similar outlet means,
12 through the exit port.

13
14 Preferably the outward flow of the exhausted carbon
15 dioxide is effected by at least one fan. The fan
16 may suitably be a 40mm fan.

17
18 The exterior end of the exhaust pipe may be oriented
19 in any direction suitable for the attraction of
20 insects. Preferably the exterior end of the exhaust
21 pipe is oriented in an upwards direction. The
22 gaseous attractant mixture is therefore preferably
23 exhausted upwardly.

24
25 An output of approximately 4600 parts per million
26 (ppm) carbon dioxide at a temperature 10 - 20 °C
27 above ambient temperature is preferred. An output
28 velocity of between 3 to 3.5 km/h or 1.5 to 2 mph is
29 also preferred. This level of output ensures that
30 the denser carbon dioxide does not sink immediately
31 upon exhaustion.

32

1 Preferably an insect attractant is added to the
2 carbon dioxide prior to it being exhausted.
3 Alternatively, a cartridge containing the insect
4 attractant is located near to the exterior exit port
5 of the exhaust means.

6
7 Preferably the attractant is an insect sex
8 attractant pheromone. More preferably the
9 attractant is octenol (1-octen-3-ol).
10 Alternatively, the attractant is octanol, octonal,
11 1-heptanol, 3-octanol or the like.

12 13 **Insect Trapping**

14 Preferably the first suction means is provided by at
15 least one fan, more preferably two fans. The at
16 least one fan may suitably be a 92mm fan. A suction
17 rate of 4.5 to 5.5 km/h or 2 to 3.5 mph is
18 preferred.

19
20 The at least one fan is preferably driven by
21 thermoelectric generation. Preferably at least two
22 thermoelectric generators are connected in series
23 and are further connected in series to the at least
24 one fan, forming an electrical circuit. More
25 preferably four thermoelectric generators are used.

26
27 Thermoelectric generators suitable for use with the
28 invention will be known to the skilled man.
29 Suitable thermoelectric generators can be obtained
30 from suppliers such as Melcor, FerroTec and
31 Supercool AB. Such thermoelectric generators can be
32 manufactured to the specification required for use

1 with the apparatus. A single thermoelectric
2 generator assembly can be used to power the
3 apparatus at 12 volts and 0.5 amps. Preferably four
4 thermoelectric generators connected in series are
5 used.

6
7 The exterior end of the first suction means can be
8 oriented in any direction suitable for the drawing
9 in of insects. Preferably the exterior end of the
10 first suction means is oriented in an upwards
11 direction. Insects are preferably drawn into the
12 apparatus through a suction pipe.

13
14 The exterior ends of both the suction and exhaust
15 pipes are most preferably oriented in an upwards
16 direction.

17
18 Further, the entrance port of the suction pipe and
19 the exit port of the exhaust pipe are preferably
20 located proximal to each other.

21
22 The portion of the suction pipe that extends
23 exterior to the apparatus preferably envelops the
24 exterior portion of the exhaust pipe. This portion
25 of the suction pipe may optionally take the form of
26 a funnel shape where it envelops the exhaust pipe.

27
28 The interior end of the suction pipe is preferably
29 enclosed in the retaining means.

30
31 Preferably the retaining means is a capture bag or
32 the like. The capture bag is preferably disposable.

1
2 A further advantage of the present apparatus is that
3 heat from the gas combustion is retained within the
4 apparatus such that trapped insects are killed and
5 become desiccated. The temperature in the vicinity
6 of the insect retaining means is generally 10°C
7 above ambient temperature when the apparatus is in
8 operation. Killed and desiccated insects can thus
9 be removed easily and hygienically from the
10 apparatus, eliminating the possibility that the
11 insects may escape and/or inflict further bites.

12
13 The insects trapped by the apparatus are any
14 haematophagous insects. According to one embodiment
15 of the invention, the insects are from the family
16 *Ceratopogonidae*, preferably midges. According to an
17 alternative embodiment of the invention, the insects
18 are mosquitoes.

19
20 **Additional Features**

21 Preferably the trapping apparatus can further
22 include a safety mechanism which maintains a safe
23 operating temperature.

24
25 The safety mechanism preferably includes a safety
26 valve, a safety valve button, a thermocouple and a
27 bimetallic switch. The safety valve, safety valve
28 button, thermocouple and bimetallic switch are
29 preferably connected in a circuit.

30
31 The safety valve controls the flow of gas into the
32 combustion chamber. The thermocouple is preferably

1 located such that it detects the temperature of the
2 combustion chamber and the temperature of the
3 chamber housing the catalyst. When the temperature
4 differential between the two chambers is
5 sufficiently high, a voltage flows along the
6 thermocouple to maintain the safety valve in its
7 open position. If the temperature in the combustion
8 chamber drops or the catalyst malfunctions, the
9 valve closes, thus preventing gas entering the
10 combustion chamber.

11

12 The bimetallic switch is preferably located on the
13 outer wall of the combustion chamber and is
14 connected in circuit with the safety valve such that
15 if the trapping apparatus overheats the safety valve
16 closes. The trapping apparatus is deemed to have
17 overheated when the temperature of the outer wall of
18 the combustion chamber exceeds 120°C.

19

20 The apparatus may further include a multispark
21 igniter. This is an electronic battery operated
22 device. On depression it provides a continuous
23 spark to the combustion chamber so as to ignite the
24 gas/air fuel mixture.

25

26 The apparatus may also include a voltmeter or other
27 voltage indicator to provide a visual reading of the
28 power generated by the thermoelectric generators.
29 For example, a red colour on a power indicator may
30 show that the apparatus is warming up whilst a green
31 colour could indicate that the apparatus is fully
32 operational.

1

2 At least one exhaust vent may be provided in the
3 walls of the combustion chamber so as to allow for
4 free movement of the air drawn in by the fans. This
5 aids the suction of air and facilitates maintenance
6 of a continuous air speed, for example approximately
7 11 km/h. Such an air speed helps prevent the
8 entrance of insects into the combustion mechanism.

9

10 The apparatus may also be used merely for attracting
11 insects.

12

13 According to a second aspect of the present
14 invention, there is provided an insect trapping
15 apparatus including:

16 a source of carbon dioxide;

17 an exhaust means from which the carbon dioxide
18 is exhausted in an upward direction;

19 a suction means for drawing air into the
20 apparatus and being adequate to allow the ingress of
21 insects contained within the air, the insects being
22 drawn into the apparatus at an area proximal to the
23 area from which gas is exhausted;

24 means for retaining the insects which are drawn
25 into the apparatus; and

26 a top shield for reducing dissipation of gas
27 exhausted from the apparatus, wherein the top shield
28 is positioned in spaced relationship above the
29 exhaust means.

30

1 Preferred features of each aspect of the invention
2 are as for each other aspect, *mutatis mutandis*
3 unless the context demands otherwise.
4

5 **Figures**

6 An embodiment of the invention will now be
7 described, by way of example only, with reference to
8 the following drawings which are not intended to be
9 construed as being limiting on the present
10 invention, wherein:

11 Figure 1 shows a side view of the upper part of
12 the trapping apparatus;

13 Figure 2 shows a perspective top view of the
14 trapping apparatus;

15 Figure 3 shows a front view of the combustion
16 chamber and heat sink of the trapping apparatus;

17 Figure 4 shows a cross section of the front
18 view of the combustion chamber and heat sink along
19 line A-A in the direction shown in Figure 3;

20 Figure 5 shows a schematic of the upper part of
21 the apparatus of the invention (A) and a table of
22 measurements (B) of carbon dioxide concentrations
23 and temperatures taken at six specific areas shown
24 on the schematic; and

25 Figure 6 shows a schematic (A) of the
26 combustion chamber and the exhaust and suction
27 pipes, with an enlarged view (B) of the components
28 of the combustion chamber.
29

30 The trapping apparatus 10 has a combustion chamber
31 12 housing a chamber 14 which contains a catalyst
32 54. A thermocouple 16 is located inside the

1 combustion chamber 12 and is in contact with the
2 catalyst chamber 14. A spark igniter 18 is also
3 located inside the combustion chamber 12. The base
4 of the combustion chamber 12 is mounted on a venturi
5 arrangement housed within a nozzle housing 20. A
6 jet carrier 24 is located at the base of the nozzle
7 housing 20. A gas nozzle 22 is also provided at the
8 base of the combustion chamber 12. A sintered disc
9 (not shown) is located between the gas nozzle 22 and
10 the combustion chamber 12.

11

12 An exhaust chimney 26 houses an inner exhaust pipe
13 28. The thermoelectric generators 30 are arranged
14 between the outer wall of the combustion chamber 12
15 and a heat sink 32. A heat plate 56 is used in
16 conjunction with heat transfer pins 58 to assist in
17 thermal conductivity of the heat generated from
18 combustion to the hot side 48 of the thermoelectric
19 generators 30. The heat pins 58 are provided above
20 and below the catalyst 54 to ensure effective heat
21 transfer through to the heat plate 56 and thus to
22 the thermoelectric generators 30. The high thermal
23 conductivity of the cast aluminium combustion
24 chamber 12 further assists in heat transfer to the
25 thermoelectric generators 30.

26

27 The heat plate 56 is generally made of aluminium but
28 may be made from copper. It is generally
29 approximately 3mm thick.

30

31 The combustion chamber 12, thermoelectric generators
32 30 and heat sink 32 are housed in a first outer

1 housing 34. A capture chamber (not shown) is
2 located inside the first outer housing 34. An outer
3 suction pipe 36 extends from the top of the first
4 outer housing 34 into the capture chamber and
5 envelops the exhaust chimney 26. The portion of the
6 suction pipe 36 which extends exterior to the
7 apparatus 10 forms a funnel shape 36A. A vapour
8 shield (anti-dispersal means/top shield) 38 is
9 mounted above the inner exhaust pipe 28.

10

11 A door 40 leading to the capture chamber is provided
12 on the first outer housing 34. A service panel 42
13 is also provided on the first outer housing 34. A
14 multi-spark ignition switch 44 is situated on the
15 service panel 42. An air vent 66 is also located in
16 the first outer housing 34. The first outer housing
17 34 is mounted on a second outer housing 46, which
18 houses a gas cylinder (not shown).

19

20 The trapping apparatus 10 as shown in Figures 1 and
21 2 is mounted on wheels 50.

22

23 In use, a gas cylinder (not shown) is housed within
24 the second outer housing 46. A safety valve button
25 60 is activated to draw gas from the gas cylinder
26 through the nozzle 22 and sintered disc into the
27 combustion chamber 12. The venturi arrangement
28 simultaneously draws air into the combustion chamber
29 12. The ignition switch 44 is depressed, activating
30 the spark igniter 18 and causing the gas and air
31 mixture to ignite. A temperature differential thus
32 builds up between the combustion chamber 12 and the

1 heat sink 32. The gas mixture burns until the
2 oxygen in the air is used up and the catalyst 54
3 reaches its working temperature of 350 °C (measured
4 on the top surface of the active catalyst; the
5 temperature of the inside of the catalyst can reach
6 up to 800°C). The gas is now burnt completely by
7 catalytic conversion producing steam and 8000 -
8 10000 ppm carbon dioxide at 190 °C (i.e. at the
9 exhaust chimney 26, directly above the combustion
10 chamber 12). A power indicator 68 indicates that
11 the apparatus has reached this stage.

12

13 When the temperature differential between the
14 combustion chamber 12 and the catalyst chamber 14 is
15 sufficiently high, the thermocouple 16 produces a
16 voltage which holds the safety valve open. The
17 temperature differential is sufficient when a
18 voltage of 5 millivolts is generated. The safety
19 valve button 60 may then be deactivated.

20

21 The heat from the operational catalyst 54 is
22 transferred via the heat pins 58 and plates 56
23 through the walls of the combustion chamber 12 to
24 the thermo-electric generators 30, which are
25 connected to an electrical output and which convert
26 the temperature differential between the combustion
27 chamber 12 and the heat sink 32 into a voltage which
28 is used to drive the inlet and outlet fans 62,64.
29 The voltage required to activate the fans is
30 approximately 3 volts. The inlet fan 62 helps
31 maintain the temperature differential between the
32 combustion chamber 12 and the heat sink 32.

1
2 The outlet fan 64 mixes the carbon dioxide produced
3 from combustion and the air drawn in through the
4 second suction means, and forces the mixture up the
5 inner exhaust pipe 28 and out through the exhaust
6 chimney 26. The carbon dioxide/water vapour/air
7 mixture leaves the exhaust chimney 26 at a
8 concentration of 800 to 5000 ppm carbon dioxide and
9 at a temperature in the region of 10 to 15 °C above
10 ambient temperature, ambient temperature being
11 between 15 to 25 °C, for example 20 to 22 °C.

12
13 A cartridge 52 containing an insect attractant, such
14 as octenol, is placed at the exit of the inner
15 exhaust pipe 28. When octenol evaporates from the
16 cartridge 52, it mixes with the carbon dioxide/water
17 vapour/air mixture, forming an insect-attracting
18 vapour.

19
20 The warmth of the carbon dioxide mixture causes the
21 gaseous mixture to rise up from the exit port of the
22 exhaust pipe 28. As described *supra*, such plumes of
23 attractant are vulnerable to dissipation caused by
24 air currents such that insects are not optimally
25 attracted.

26
27 However, the vapour shield 38 of the present
28 invention inhibits the attractant vapour from
29 dissipating from the local vicinity of the trapping
30 apparatus 10. The downwardly curved peripheral
31 edges and the location of the vapour shield 38 above
32 the exit port help protect the carbon dioxide

1 attractant mixture from surrounding air currents.
2 The concentration and temperature of the carbon
3 dioxide mixture are thus reliably maintained at
4 known and relatively constant levels, and insect
5 trapping is optimised.

6
7 The attracted insects are drawn in by the inlet fan
8 62 through the outer suction pipe 36 into the
9 capture bag (not shown). Once the capture bag is
10 sufficiently full, the bag may be detached from the
11 interior end of the suction pipe 36, sealed and
12 disposed of. The capture bag is generally
13 sufficiently full when it is half to three quarters
14 full of insects.

15
16 Figure 5 shows the results of a test conducted to
17 determine the efficacy of the vapour shield 38 and
18 apparatus design in retaining the mixture of carbon
19 dioxide, water vapour and air in the local vicinity
20 of the suction means. Measurements of temperature
21 and carbon dioxide concentration were taken. The
22 ambient carbon dioxide concentration was measured as
23 600 parts per million (ppm), and the ambient
24 temperature as 22 °C. Measurement 1 was taken 100mm
25 above the attractant container 52.

26
27 The output velocity from the exhaust pipe 28 was
28 measured at point (i) in Figure 5 as 1.9 miles per
29 hour (mph) (3.2 kilometres per hour (km/h)), and the
30 suction velocity of the suction pipe 36 was measured
31 at point (ii) in Figure 5 as 3.3 mph (4.8 km/h).

32

1 As can be seen from the results shown in the table
2 in B of Figure 5, the vapour shield 38 was effective
3 at retaining advantageous carbon dioxide
4 concentrations and temperatures in the local
5 vicinity of the suction pipe 36. These carbon
6 dioxide concentrations and temperatures are thought
7 to be optimal for insect attraction and thus the
8 efficiency of the apparatus is improved.

9
10 It will be understood by one skilled in the art that
11 various modifications and variations may be made to
12 the invention as herein described without departing
13 from the scope of the invention. Although the
14 invention has been described in connection with
15 specific examples, it should be understood that the
16 invention as claimed should not be unduly limited to
17 such examples. For example, the chemical attractant
18 may be replaced by any chemical attractant commonly
19 known in the field. The capture bags may optionally
20 contain an insecticide.

1 **Claims**

2

3 1. An insect trapping apparatus including:
4 a source of carbon dioxide;
5 an exhaust means from which the carbon
6 dioxide is exhausted;
7 a suction means for drawing air into the
8 apparatus and being adequate to allow the
9 ingress of insects contained within the air,
10 the insects being drawn into the apparatus at
11 an area proximal to where the gas is exhausted
12 from the apparatus;
13 means for retaining insects which are
14 drawn into the apparatus; and
15 at least one anti-dispersal means for
16 reducing dissipation of gas exhausted from the
17 apparatus.

18

19 2. An apparatus as claimed in claim 1 wherein the
20 exhaust means is adapted to direct the
21 exhausted carbon dioxide towards the anti-
22 dispersal means.

23

24 3. An apparatus as claimed in claim 1 or claim 2
25 wherein the exhaust means includes an exit port
26 through which the carbon dioxide is exhausted.

27

28 4. An apparatus as claimed in claim 1 to claim 3
29 wherein the anti-dispersal means is in spaced
30 arrangement with the exit port.

31

- 1 5. An apparatus as claimed in any of claims 1 to 4
2 wherein the anti-dispersal means is located
3 above the exit port.
4
- 5 6. An apparatus as claimed claim 4 or 5 wherein
6 the anti-dispersal means is concentric with the
7 exit port.
8
- 9 7. An apparatus as claimed in any preceding claim
10 wherein the anti-dispersal means is concave
11 towards the exit port.
12
- 13 8. An apparatus as claimed in any preceding claim
14 wherein the anti-dispersal means is composed of
15 at least one carbon dioxide retaining member
16 extending around the exit port and thus
17 defining a carbon dioxide retaining area.
18
- 19 9. An apparatus as claimed in claim 8 wherein the
20 carbon dioxide retaining member is a series of
21 flanges projecting outwardly from the
22 apparatus.
23
- 24 10. An apparatus as claimed in claim 9 wherein each
25 flange projects outwardly from a side of a
26 planar hexagonal plate at an angle such that
27 the carbon dioxide retaining area is defined
28 around the exit port.
29
- 30 11. An apparatus as claimed in any preceding claim
31 wherein the source of carbon dioxide is

- 1 combustion of a mixture of gas and air.
2
- 3 12. An apparatus as claimed in claim 11 wherein the
4 combustion takes place in the presence of a
5 catalyst.
6
- 7 13. An apparatus as claimed in claim 12 wherein the
8 catalyst is a platinum-coated monolith block.
9
- 10 14. An apparatus as claimed in any of claims 11 to
11 13 wherein the gas is propane, butane or a
12 suitable mixture thereof.
13
- 14 15. An apparatus as claimed in any preceding claim
15 wherein the carbon dioxide is mixed with air
16 prior to being exhausted through the exit port.
17
- 18 16. An apparatus as claimed in claim 15 wherein the
19 air which is mixed with the carbon dioxide is
20 drawn in by a further suction means.
21
- 22 17. An apparatus as claimed in any preceding claim
23 wherein the carbon dioxide is exhausted as a
24 mixture of carbon dioxide, air and water
25 vapour.
26
- 27 18. An apparatus as claimed in any preceding claim
28 wherein an insect attractant is added to the
29 carbon dioxide prior to its exhaustion.
30
- 31 19. An apparatus as claimed in any preceding claim
32 wherein the carbon dioxide is exhausted at a

- 1 concentration of between 500 to 10000 ppm.
2
- 3 20. An apparatus as claimed in claims 1 to 18
4 wherein the carbon dioxide is exhausted at
5 approximately 4600 ppm.
6
- 7 21. An apparatus as claimed in any preceding claim
8 wherein the carbon dioxide is exhausted at
9 between 22 °C to 45 °C.
10
- 11 22. An apparatus as claimed in claims 1 to 20
12 wherein the carbon dioxide is exhausted at
13 between 24 °C to 42 °C.
14
- 15 23. An apparatus as claimed in any preceding claim
16 wherein the carbon dioxide is exhausted at a
17 velocity of between 3 to 3.5 km/h.
18
- 19 24. An apparatus as claimed in any preceding claim
20 wherein the carbon dioxide is exhausted from an
21 exhaust pipe.
22
- 23 25. An apparatus as claimed in claim 24 wherein the
24 exterior end of the exhaust pipe is oriented in
25 an upward direction.
26
- 27 26. An apparatus as claimed in claim 24 wherein the
28 exterior end of the exhaust pipe is adapted to
29 be directed towards the anti-dispersal means.
30
- 31 27. An apparatus as claimed in any preceding claim
32 wherein the suction means includes at least one

- 1 fan and a suction pipe.
- 2
- 3 28. An apparatus as claimed in claim 27 wherein the
- 4 exterior portion of the suction pipe is located
- 5 proximal to the area where gas is exhausted
- 6 from the exhaust means.
- 7
- 8 29. An apparatus as claimed in claim 27 or 28
- 9 wherein the portion of the suction pipe
- 10 exterior to the apparatus envelops the exterior
- 11 portion of the exit port through which carbon
- 12 dioxide is exhausted.
- 13
- 14 30. An apparatus as claimed in claim 29 wherein the
- 15 exterior enveloping portion of the suction pipe
- 16 is substantially funnel-shaped.
- 17
- 18 31. An apparatus as claimed in any one of claims 27
- 19 to 30 wherein the interior end of the suction
- 20 pipe is connected to the retaining means.
- 21
- 22 32. An apparatus as claimed in any preceding claim
- 23 wherein the suction rate of the suction means
- 24 is between 4.5 to 5.5 km/h.
- 25
- 26 33. An apparatus as claimed in any preceding claim
- 27 wherein at least one air vent is provided in
- 28 the walls of the apparatus.
- 29
- 30 34. An insect trapping device including:
- 31 a source of carbon dioxide;
- 32 an exhaust means from which the carbon

1 dioxide is exhausted in an upward direction;
2 a suction means for drawing air into the
3 apparatus and being adequate to allow the
4 ingress of insects contained within the air,
5 the insects being drawn into the apparatus at
6 an area proximal to the area from which gas is
7 exhausted;
8 means for retaining insects drawn into the
9 apparatus; and
10 a top shield for reducing dissipation of
11 gas exhausted from the apparatus, wherein the
12 top shield is positioned in spaced relationship
13 above the exhaust means.