(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
13 March 2014 (13.03.2014)

WIPO | PCT

(10) International Publication Number
WO 2014/037958 A1

(51) International Patent Classification:
A01G 9/18 (2006.01) *A01G 9/24* (2006.01)

(21) International Application Number:
PCT/IN2012/000830

(22) International Filing Date:
19 December 2012 (19.12.2012)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
2779/DEL/2012 6 September 2012 (06.09.2012) IN

(72) Inventor; and
(71) Applicant : **GUPTA, Sat Parkash** [IN/IN]; 182/63, Industrial Area, Phase-I, Chandigarh 160002 (IN).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

WO 2014/037958 A1

(54) **Title**: IMPROVEMENT IN AND RELATING TO ENVIRONMENT CONTROLLED STRUCTURED GREEN HOUSES FOR COST EFFECTIVE FOOD PRODUCTION

(57) **Abstract**: The present invention relates to the environment controlled multibay structured greenhouses provisioning modules Z1 to Z7 and plurality of sensors. Z1 provisioning compressor, tanks T1, T2, Ta, capture manifold, release manifold, Z2 provisioning cost effective material earth tube heat exchanger for very cost effective heating of premises in cold / freezing cold locations, drastically reducing crude (fossil fuel) demand, Z3 maintains greenhouse relative humidity defined precise set point, Z4 generates geo-thermal energy, Z5 ameliorates global warming by abhorting greenhouse carbon dioxide release into atmospheres, Z6 uses activated fertilizers, nutrients solutions reducing input cost, ~50% drip dozing, ~75% foliar dozing, Z7 offers greenhouse roof and sides' polyethylene film fixed and automated roll on/ off thermal screen cum shading curtains 0-100% convertible and cost effective means or methods eliminating gutters, increasing light energy into greenhouse, Z7 Z3, and Z5 offer best integrated pest management obviating toxic crop protection agents' use.

IMPROVEMENT IN AND RELATING TO ENVIRONMENT CONTROLLED STRUCTURED GREEN HOUSES FOR COST EFFECTIVE FOOD PRODUCTION

TECHNICAL FIELD OF THE INVENTION

The present invention in particular relates to the Improvement in and relating to environment controlled greenhouses using compressor and in general to the numerous applications and needs structures and installations.

BACKGROUND OF THE INVENTION

Even the latest prior art greenhouses are suffering numerous problems of which so far no cost effective tangible solutions exist and as such cost effective food production cannot be realized in prior art greenhouses.

Few basic problems of prior art greenhouse are mentioned herein below:

It is almost impossible to maintain in greenhouse air relative humidity defined precise set points. Water molecules evaporate into air till equilibrium, if temperature increases at a certain air relative humidity air expands and can hold more water and relative humidity reduces. Also, at a certain air relative humidity if temperature decreases, greenhouse air contracts and can hold less water. As long as water doesn't condense out of air greenhouse air relative humidity increases with any further temperature decrease, concentration of water in air rises above saturation point and condenses (dew point) forming large drops of water on greenhouse cover films' and gutters' interior surfaces which drip on to plants'.

Several foliar diseases are directly related to high relative humidity especially botrytis and powdery mildew. Powdery mildew spores germinate best at 95% relative humidity or higher condensation also reduces light transmission.

Another problem is mist, a very fine continuous layer of moisture on greenhouse cover film and gutters' interior surfaces during cold early morning hours when temperature decreases and relative humidity saturates or dense fog in greenhouse which also reduces light transmission into greenhouse.

Also, there is utmost difficulty in maintaining greenhouse air temperature defined precise set point in hot locations wherein there is no option of using fan /pad or foggers evaporative cooling which increases relative humidity. The greenhouse air temperature defined precise set point can't be controlled and maintained because more the greenhouse air relative humidity, less effective is the evaporative cooling. Furthermore, supplementary cooling cost in hot locations is very high.

Very heavy cost of greenhouse supplementary heating mostly by burning fossil fuel which also emits very substantial air pollutants, most of which also aggravate global warming

During dark hours, plants exhale carbon dioxide and are in dire need of oxygen rich environment to Respirate and rejuvenate Plants' health vigor and strong immune system maximizing plants' tolerance to disease etc.

Due to dark hours plants' exhaled carbon dioxide and or due to residual carbon dioxide after sunlight hours fertilization events and thereafter till solar radiation into greenhouse is more than defined events greenhouse carbon dioxide ppm much higher than atmosphere carbon dioxide ppm, greenhouse carbon dioxide is released into atmosphere aggravating global warming and heavy cost of carbon credits.

Another problem is that in greenhouse air relative humidity air temperature and carbon dioxide ppm vary due to horizontal and vertical gradients (non-uniformity) and hot or cold pockets which are further augmented by plants' own moisture production (transpiration) driven by leaf temperature and VPD.

In prior art greenhouse during winter, horizontal air fans are provisioned to run continuously to improve greenhouse relative humidity and temperature uniformity and to abhort hot or cold pockets, but cost benefit ratio is minimal.

Also, intensity of solar radiation worldover at ground level is unevenly distributed because of variables such as solar altitude, which is associated with latitude, season, atmosphere conditions (cloud coverage), degree of pollution and elevation above sea level.

Climatic conditions are characterized by low and high atmosphere temperature during winter and summer, the absolute minimum during winter is ~ (-) 40°F and the absolute maximum during summer is ~ 115°F.

In prior art greenhouse thermal screen is installed at gutters' interior level to retain heat at night to reduce heat loss from greenhouse and thermal energy cost. But the problem is to maintain greenhouse thermal screen air tight to reduce heat loss from below thermal screen to above thermal screen. Furthermore, during snow storms, thermal screen is triggered-off to allow below thermal screen heat to reach ceiling to melt snow. The sudden exposure of plants enjoying cozy environment to colder environment is detrimental to plants' health. Furthermore this method of melting snow is not adequate.

In prior art greenhouse, double layer inflated polyethylene is used to reduce heating cost. However, there is utmost difficulty to maintain optimal insulation between two layers of inflated polyethylene which is critical for increased

heating efficiency to minimize heat loss and thermal energy cost in cold locations. Another problem is isolating leaking holes.

Furthermore, in hot locations separate shading curtains are used during hot summer sunlight hours to reduce needless heat gain to reduce supplementary cooling cost.

So for no cost effective tangible solution exists to control daily light photoperiod, which is vital factor Influencing plants' growth. Plants grown in conditions of varying daily light photoperiod pattern can't settle in regular life cycle and grow poorly.

Another problem is gutter-connected multibay greenhouses. It is absolutely unviable to install gutters of adequate volume to handle very heavy down pour of water in multibay greenhouses.

As such heavy down pour of water overflows on multibay greenhouses roofs and along sides' and enters into greenhouse, damaging crop and gutters related other problems viz. blocking incoming sunlight energy into greenhouse, condensation or mist on gutters' interior surfaces and snow accumulation in gutters.

Another problem is snow accumulation on greenhouse roof cover film exterior surfaces.

Yet another problem is dust / dirt accumulation on greenhouse cover film exterior surfaces. Dust / dirt etc. causes substantial reduction in transmitted solar radiation into greenhouse. Within few weeks after installation dust / dirt can render greenhouse cover film almost opaque rather than transparent and hence reduces light transmission very substantially. Dust / dirt accumulation on greenhouse cover film and in gutters also promotes growth of fungi and algae wherein dust / dirt are serving as soil and mineral elements.

Another problem is fire hazards, because of highly inflammable greenhouse cover polyethylene film, insect nettings and screens etc.

Yet another grave problem is food production in greenhouse in freezing cold locations, wherein, life exists but sunlight energy is very deficient.

Another problem is very heavy capital cost and labour intensive complicated equipments for:

(i) Warm water drip irrigation

(ii) Fertilizers, nutrients, pH adjustment chemicals. crop protection treatment drip dozing

(iii) Fertilizers, nutrients crop treatment foliar dozing

(iv) Greenhouse evaporative cooling

(v) Greenhouse, humidification in hot locations.

(vi) Dust dirt wash off from cover film exterior surfaces

(vii) Fire fighting

(viii) Greenhouse pressurized water manifold for hand mist gun.

Also, as of now for roll on/off curtains' and screens, very high cost large wall thickness C-class large diameter galvanized iron pipes are used to keep them weighted down to retain them tightly in place and prevent them from blowing out by wind. However, these means are very expensive.

Basic needs to overcome the problems of prior art greenhouse are:

1. Substantial reduction in operating cost.

2. Maintaining greenhouse relative humidity and temperature defined precise set points.

3. Abhorting dark hours carbon dioxide release into Atmosphere which aggravate global warming and heavy cost of carbon credits.

4. Provisioning plants oxygen rich environment during dark hours to respirate and rejuvenate Plants' health vigor and strong immune system maximizing plants' tolerance to disease etc.

5. Reducing use and cost of fertilizers, nutrients, chemicals, crop protection agents etc.

6. Minimizing greenhouse supplementary heating and supplementary cooling cost in respective cold and hot locations.

7. Sourcing some cost effective material to serve thermal screen cum shading material for "AN ALL IN ONE SOLUTION IN SEASONAL OR MOST SEASONS MOSTLY HOT AND MOSTLY COLD OR FREEZING COLD LOCATIONS."

8. Increasing sunlight energy into greenhouses.

9. Stopping heavy down pour of water overflowing on multibay greenhouses' roofs and along sides, entering into greenhouse and damaging crop.

10. Reducing dust / dirt accumulation on greenhouse cover film exterior surfaces which will lead to increase in light transmission.

11. Efficient method to combat fire hazards which may occur due to highly inflammable greenhouse cover polyethylene film, insect netting, screens etc.

12. Facilitating melting snow accumulation on greenhouse roof cover film and in gutters.

13. Provisioning growing media crop root zone aeration, maintaining crop root zone temperature defined set point and drained off leachate automated collection.

14. Provisioning cost effective integrated pest management and obviating toxic crop protection agents use.

15. Obviating ventilation need during rain and snow when prior art greenhouse is closed.

16. Facilitating Food production in greenhouse in cold or freezing cold locations wherein, life exists but sunlight energy is very deficient and wherein so for food production has not been realized.

17. Reducing cost of galvanized iron pipes for roll on/off curtains' and screens for weighting down to retain them tightly in place and to prevent them from blowing out by wind.

OBJECTS OF THE INVENTION

Background

EARTH TUBE HEAT EXCHANGER **FUNDA**
SOIL STATA BETWEEN 2 - 3 MTR DEPTH
TEMP REGIME IS CONSTANT (THERMAL CONSTANT)
TEMP IN THIS STATA DISPLAYS NO DIURNAL FLUCTUATION
IT DOES DISPLAY ANNUAL FLUCTUATION BUT AMPLITUDE IS SMALL
AT AHEMDABAD (INDIA) 23. 03 N Lat
AVERAGE THERMAL CONSTANT 27° C

(SHARAN & JHADAV: 2002)

Deeper the STATA, higher the average thermal constant temperature. As such in seasonal or most seasons mostly cold or freezing cold locations, STATA depth can be measured wherein the defined average thermal constant temperature ~68°F or higher can be realized.

Since last few decades basic problem has been and which is still persisting is very high and ever rising prices of crude dictated by crude producers which is solely responsible for worldover inflation and economic instability, very substantial portion of global total area (excluding oceans etc.) comprises of seasonal or most seasons mostly cold or freezing cold locations wherein for heating of the premises very substantial crude (fossil fuel) is burnt which also emits very substantial atmosphere pollutants most of which also aggravate global warming. If heating of the premises can be provisioned by some other cost effective means, crude (fossil fuel) demand would be drastically reduced and in place of the crude producers it would be the purchaser dictating crude prices and crude producers would be forced to offer much lower realistic prices.

For heating of premises the best means is earth tube heat exchanger which offers very cost effective heating of premises in cold or freezing cold locations saving substantial fossil fuels.

Another cost effective means is geo-thermal energy which involves low investment cost over other renewable energy sources and emits only a small percentage of atmosphere air pollutants than emitted by burning fossil fuels, no fuel expense and it does not depend upon energy markets. By provisioning geothermal energy generating neat and clean automated equipments.

1st Objective

To drastically reduce crude demand by provisioning heating of the premises by earth tube heat exchanger which maintains premises temperature equal to average thermal constant temperature of the location at ~68°F or higher with or without geo-thermal energy generating module.

Background

Due to dark hours plants' exhaled carbon dioxide or due to residual carbon dioxide after sunlight hours carbon dioxide (1000-1500 ppm) fertilization events and thereafter till solar radiation into greenhouse is more than defined greenhouse carbon dioxide ppm much higher than atmosphere carbon dioxide ppm, greenhouse carbon dioxide is traditionally released into atmosphere aggravating global warming.

Similarly industrial co-produced carbon dioxide escapes into atmosphere.

2nd Objective

To offer tangible method to ameliorate global warming by Abhorting Greenhouse carbon dioxide traditional release into atmosphere and instead capturing, compressing, storing and utilizing this carbon dioxide for sunlight hours fertilization to optimize yield for very low cost food production And also abhorting industrial co-produced carbon dioxide traditional escape into atmosphere and instead capturing with Compressors' manifolds' inlets positioned around carbon dioxide co-producing sources.

Compressors' delivery in very deep water bore which after installation of compressors' delivery pipes is tightly filled with soil maintaining dissolved carbon dioxide which in due course would convert into hydro carbons.

Background

Land on earth planet is limited, population is growing very fast. In a world with a burgeoning population, fight against hunger cannot be over emphasized.

Apart from food security another much more grave problem is cost of food production which is rising very fast due to very high and ever rising input costs So that in coming decades even if food is available, most of the world population in general and population in undeveloped and developing countries in particular would not be able to afford cost of food and would have to starve and die of hunger.

As such it is essential to harness tangible means for cost effective food production.
As of now best means is using activated solutions of fertilizer and nutrients reducing their input cost by ~50% in drip dozing and by ~75% in foliar dozing, spraying activated solutions of fertilizers and nutrients is the best method which enhances their use efficiency and eliminates their leaching cost and water table pollution only Diammonium Phosphate activated solution basal dozing to be dozed together with seed drilling or transplanting and obviating toxic

crop protection agents' use saving their and spraying labours' substantial cost, labours' health hazards and non-toxic food production.

It is also essential to harness means to facilitate food production in most seasons mostly cold or freezing cold locations wherein life exits but sunlight energy is very deficient.

3rd Objective

To offer cost effective tangible methods for cost effective food production by using activated solutions of fertilizers and nutrients and obviating toxic crop protection agents' use, saving their and spraying labours' substantial cost, labours' health hazards and non-toxic food production and to facilitate food production in cold or freezing cold locations by increasing deficient sunlight energy together with artificial lighting energy, using earth tube heat exchanger together with Geo-thermal energy generating module.

4th Objective

To offer environment friendly extremely efficient greenhouse for very low cost food production

5th Objective

To offer cost effective tangible methods of the numerous problems which prior art greenhouses are suffering so that cost effective food production can also be realized in existing greenhouse.

SUMMARY OF THE INVENTION:

The first aspect of the present invention is summarized as a greenhouse equipped with a solar radiation sensor, a temperature sensor, a relative humidity sensor and a carbon dioxide sensor.

The second aspect of the present invention is summarized as a greenhouse equipped with a basic module Z1 which comprises of a compressor, a tank T1, a tank T2, a tank Ta, a capture manifold and a release manifold, wherein the capture manifold captures dark hours carbon dioxide rich greenhouse air or sunlight hours oxygen rich greenhouse air which is compressed and stored in operating T1 or T2. Ta stores atmosphere compressed air.

The third aspect of the present invention is summarized as a cost effective method to measure average thermal constant temperature of a location by stepwise placement of thermistor probes in bores of various depths below ground level to realize most suitable average thermal constant temperature.

The fourth aspect of the present invention is summarized as a greenhouse equipped with a cost effective material earth tube heat exchanger to condition greenhouse relatively cooler air to relatively warmer in cold locations and to condition relatively warmer greenhouse air to relatively cooler in hot locations.

The fifth aspect of the present invention is summarized as a greenhouse equipped with a module Z3 comprising of greenhouse air relative humidity sensor together with relevant provisions of Z1 and Z2 to maintain greenhouse relative humidity at defined precise set point.

The sixth aspect of the present invention is summarized as a greenhouse provisioned with a geo-thermal module Z4 comprising of geo-thermal neat and clean automated module to generate thermal energy for greenhouse supplementary heating and for numerous other needs.

The seventh aspect of the present invention is summarized as a system to abhort dark hour's plants exhaled carbon dioxide and residual carbon dioxide after sunlight hours carbon dioxide (1000-1500 ppm) fertilization events, traditional release into atmosphere and instead capturing compressing storing and utilizing this carbon dioxide during sunlight hours fertilization to optimize yield and to ameliorate global warming.

The eighth aspect of the present invention is summarized as a cost effective tangible method to reduce input cost of fertilizers by using their activated solutions and obviating toxic crop protection agents' use, saving their and spraying labours' substantial cost, labours' health hazards and non-toxic food production.

The ninth aspect of the present invention is summarized as a tangible method to maintain greenhouse cover film exterior surfaces free of dust / dirt by provisioning two roof sprinkler manifolds, two gable sides' sprinkler manifolds and two long sides' sprinkler manifolds.

The tenth aspect of the present invention is summarized as efficient fire fighting system to combat fire hazards which may occur due to highly inflammable greenhouse cover film, insect netting and screens etc.

The eleventh aspect of the present invention is summarized as a system using growing media beds provisioned to abhort crop root zone contact with soil wherein harmful pests exist which may harm crops. By using growing media

beds, yield is almost double and all benefits of bags can be realized much better at much lower cost. Furthermore growing media beds' serves other needs as well viz. crop root zone aeration, maintaining crop root zone temperature set point and drained off leachate automated collection which bags don't offer and also saving substantial cost of growing media bags.

The twelfth aspect of the present invention is summarized as a system provisioning greenhouse roof covers films' and gutters' interior surfaces heating manifold to melt snow which slides off.

The thirteenth aspect of the present invention is summarized as a cost effective tangible method to reduce greenhouse supplementary heating cost in cold locations and greenhouse supplementary cooling cost in hot locations by using a thermal screen cum shading material roof external curtains and four sides internal curtains which are 0-100% convertible and which also serve as most efficient photoperiod control.

The fourteenth aspect of the present invention is summarized as a cost effective tangible method in locations of artificial lighting energy being capital and operating cost intensive, module Z7 equipped with cost effective tangible means and/or by tangible methods by installing deficient of artificial lighting energy which after increase would be optimum into greenhouse saving substantial capital and operating cost of artificial lighting energy.

Z7 is provisioned with cost effective tangible means and/or by tangible methods for increasing deficient sunlight energy into greenhouse to be optimum for food production in locations wherein sunlight energy is not deficient but is reduced due to dust / dirt accumulation on greenhouse cover film exterior surfaces and/or due to condensation or mist formation on greenhouse cover films' interior surfaces.

The fifteenth aspect of the present invention is summarized as a method for cost effective food production in very cold or freezing cold locations wherein life exists but sunlight energy is very deficient, the cost effective food production is realized by increasing deficient sunlight energy together with artificial lighting energy by provisioning greenhouse with mirrors, aluminium foils etc using earth tube heat exchanger together with geo-thermal energy generating automated equipment.

The sixteenth aspect of the present invention is summarized as a system provisioning integrated pest management by maintaining green house relative humidity at ~80% which abhorts pressure of disease, bacteria, pathogens, fungus, virus etc.

The seventeenth aspect of the present invention is summarized as a greenhouse wherein gutters together with all gutters' related problems are eliminated

The eighteenth aspect of the present invention is summarized as a tangible method to maintain optimal insulation between two layers of inflated double layer polythene greenhouse cover film and isolating leaking holes.

The nineteenth aspect of the present invention is summarized as a system in which smaller wall thickness and smaller diameter, cheaper galvanized iron pipes filled with sand (ends sealed to ensure no escape of sand) are used in place of costly large wall thickness C-class and large diameter galvanized iron pipes which serves same need and saving their considerable cost.

DETAILED DESCRIPTION OF THE INVENTION:

According to the first embodiment of the present invention, greenhouse is provisioned with a plurality of sensors viz. a solar radiation sensor, a temperature sensor, a relative humidity sensor and a carbon dioxide sensor.

Atmosphere weather station provisioned with an atmosphere solar radiation sensor, an atmosphere air relative humidity sensor, an atmosphere air temperature sensor, a wind speed sensor and a rain detector.

When wind speed exceeds normal weather station wind, speed sensor triggers-off roof automated roll on/off thermal screen cum shading material external curtains. And when high speed wind is not
materializing or is over after defined delay, roof automated roll on/off thermal screen cum shading material external curtains return to the previous position (home).

And when weather station rain detector detects rain, atmosphere rain detector trigger-off roof automated roll on/off thermal screen cum shading material external curtains and when rain is not materializing or is over, roof automated roll on/off thermal screen cum shading material external curtains return to the previous position (home).

And when atmosphere temperature is approaching 0°C, weather station temperature sensor triggers-off roof automated roll on/off thermal screen cum shading material external curtains and when snow is not materializing or is over after defined delay till no snow remains on greenhouse roof (home).

And at sunset or after defined Photoperiod hours , atmosphere solar radiation sensor triggers-on roof automated roll on/off thermal screen cum shading material external curtains and four sides' internal curtains.

According to the second embodiment of the present invention, the greenhouse provisions a basic module Z1 which comprises of a compressor, a tank T1 a tank T2, a tank Ta, a capture manifold and a release manifold, wherein the compressor compresses carbon dioxide rich greenhouse air of dark hours and oxygen rich greenhouse air of sunlight hours which is captured by capture manifold. The dark hours carbon dioxide rich greenhouse air or sunlight hours oxygen rich greenhouse air is compressed and stored in operating T1 or T2 which also serves to dehumidify stored compressed greenhouse air.

The greenhouse relative humidity sensor triggers-on operating T1 or T2 moisture drain off valve to drain off moisture content for optimal dehumidification maintaining greenhouse air relative humidity at ~set point in operating T1 or T2 or drains off total moisture content to maintain almost dry air in operating T1 or T2.

Release manifold simultaneously releases into greenhouse, carbon dioxide rich dehumidified conditioned greenhouse air already stored in Ec during sunlight hours and oxygen rich dehumidified conditioned greenhouse air already stored in Eo during dark hours.

The events of capture manifold and release manifold are provisioned concurrent.

The tank Ta stores atmosphere compressed air and also serves to dehumidify stored atmosphere compressed air, greenhouse relative humidity sensor maintains greenhouse air relative humidity at ~set point in Ta which is used for release into greenhouse for maintaining carbon dioxide and oxygen balance and also for auxiliary equipments operations

When capture manifold is not operating, compressor is provisioned to compress atmosphere air to maintain optimal atmosphere compressed air stock in Ta.

During morning defined sunlight hours, atmosphere solar radiation sensor trigger-on compressor capture manifold and release manifold events. Capture manifold to capture oxygen rich greenhouse air which is compressed and stored in operating T1 or T2; and release manifold to simultaneously release into greenhouse dehumidified conditioned carbon dioxide rich greenhouse air already stored in 1st compartment Ec thus utilizing during sunlight hours (dark hours plants exhales carbon dioxide or residual carbon dioxide after carbon dioxide fertilization events) to optimize yield for very cost effective food production and to substantially ameliorate global warming.

According to the third embodiment of the present invention, a cost effective method to measure average thermal constant temperature of a location by placement of thermistor probes in bores made by rotary borer of diameter ~ 2 centimeter more than thermistors' probe dimensions and a steel rod, bottom end of which is welded with ~ 5 centimeters thick steel plate of diameter 2 centimeter less than the bore diameter pushes the thermistors' probe to place it at bottom end of the bore of 2.5 meter depths below ground level. After placement of thermistors' probe, bore is tightly filled with soil to maintain optimal insulation between thermistors' probe and the atmosphere.

Thermistors probe output temperature is recorded continuously till temperature stabilizes and remains constant for few days. This constant temperature is average thermal constant temperature of the location, similar treatments of other bores ~ 20 square meters apart with stepwise depth increments of 0.5 meter or more or less in each subsequent bores based upon average thermal constant temperature at 2.5 meter depth and thermistors probe placement till most suitable average thermal constant temperature is realized (~ 68°F or higher).

According to the fourth embodiment of the present invention, a module Z2 comprising of a cost effective material earth tube heat exchanger is provisioned together with relevant provisions of Z1 to condition relatively cooler greenhouse air to relatively warmer in cold locations and to condition relatively warmer greenhouse air to relatively cooler in hot locations.

The cost effective earth tube heat exchanger comprises of four separate compartments. 1st compartment Ec stores operating T1 or T2 (carbon dioxide rich dehumidified) greenhouse air, 2nd compartment Eo stores operating T1 or T2 (oxygen rich dehumidified) greenhouse air, 3rd compartment Ecd stores operating T1 or T2 (carbon dioxide rich almost dry) greenhouse air and 4th compartment Eod stores operating T1 or T2 (oxygen rich almost dry) greenhouse air.

When greenhouse air temperature is more than or less than average thermal constant temperature (defined), greenhouse temperature sensor trigger-on earth tube heat exchanger, compressor, capture manifold and release manifold events.

When greenhouse air temperature equals earth tube heat exchanger average thermal constant temperature (defined), greenhouse air temperature sensor triggers-off earth tube heat exchanger, compressor, capture manifold and release manifold events.

In Cold Locations

Greenhouse temperature sensor triggers-on compressor, capture manifold and release manifold events capture manifold to capture dark hours carbon dioxide rich or sunlight hours oxygen rich greenhouse air which is compressed and stored in operating T1 or T2, greenhouse relative humidity sensor maintains greenhouse air relative humidity at ~set point in operating T1 or T2, operating T1 or T2 (carbon dioxide rich dehumidified) greenhouse air is stored in 1st compartment Ec and operating T1 or T2 (oxygen rich dehumidified) greenhouse air is stored in 2nd compartment Eo.

Release manifold to simultaneously release into greenhouse hot air and when greenhouse air temperature equals greenhouse air temperature defined precise set point then greenhouse air temperature sensor trigger-off release manifold hot air release, compressor, and capture manifold events.

Hunting Rising Trend (-) 2.5%, Lowering Trend (+) 2.5%

In Hot Locations

Greenhouse temperature sensor triggers-on evaporative cooling with concurrent compressor, capture manifold and release manifold events, capture manifold to capture dark hours carbon dioxide rich or sunlight hours oxygen rich greenhouse air which is compressed and stored in operating T1 or T2. Greenhouse air relative humidity sensor maintains almost dry greenhouse air in operating T1 or T2, operating T1 or T2 (carbon dioxide rich almost dry) greenhouse air is stored in 3rd compartment Ecd and operating T1 or T2 (oxygen rich almost dry) greenhouse air is stored in 4th compartment Eod.

Release manifold to simultaneously release into greenhouse 3rd compartment Ecd already stored almost dry conditioned carbon dioxide rich greenhouse air during sunlight hours and 4th compartment Eod already stored almost dry conditioned oxygen rich greenhouse air during dark hours for optimal evaporative cooling to maintain greenhouse air temperature at defined precise set point.

When greenhouse air temperature equals greenhouse air temperature defined precise set point, greenhouse air temperature sensor trigger-off evaporative cooling, compressor, capture manifold and release manifold events.

Hunting Rising Trend (-) 2.5%, Lowering Trend (+) 2.5%

As such, it is very easy to adjust greenhouse temperature at defined precise set point which helps in improving timing of crops significantly especially of flowers.

Z2 substantially reduces greenhouse supplementary heating cost in cold locations and greenhouse supplementary cooling cost in hot locations by maintaining greenhouse air temperature equal to earth tube heat exchanger average thermal constant temperature.

In the environment controlled or non environment controlled structures and installations for numerous applications and needs, cold storages multiplexes, hotels, malls, commercial and residential complexes, museums', zoological parks', stud forms, cows and buffalos sheds etc (premises'), wherein Z2 offers very cost effective conditioning of premises' with relatively cooler air to relatively warmer in cold locations and conditioning premises with relatively warmer air to relatively cooler in hot locations. Marinating (Premises') temperature equals to average thermal constant temperature of the location.

Furthermore Z2 is most cost effective and most potent tool to condition colder air to warmer in seasonal or all seasons' mostly cold or freezing cold locations saving very substantial cost of conventional thermal energy.

According to the fifth embodiment of the present invention, the module Z3 is provisioned with greenhouse air relative humidity sensor together with relevant provisions of Z1 and Z2. Z3 events are greenhouse air relative humidity driven to maintain greenhouse air relative humidity at defined precise set point. When, greenhouse air relative humidity is more than greenhouse relative humidity defined precise set point, then greenhouse relative humidity sensor triggers-on compressor, capture manifold and release manifold events. Capture manifold to capture dark hours carbon dioxide rich or sunlight hours oxygen rich humid greenhouse air which is compressed and stored in operating T1 or T2. Greenhouse air relative humidity sensor maintains almost dry air in operating T1 or T2, operating T1 or T2 (carbon dioxide rich almost dry) greenhouse air is stored in 3rd compartment Ecd and operating T1 or T2 (oxygen rich almost dry) greenhouse air is stored in 4th compartment Eod.

Release manifold to simultaneously release into greenhouse 3rd compartment Ecd, already stored almost dry conditioned carbon dioxide rich greenhouse air during sunlight hours and 4th compartment Eod, already stored almost dry conditioned oxygen rich greenhouse air during dark hours to maintain greenhouse relative humidity at defined precise set point (~80% or lower or higher). When greenhouse relative humidity equals greenhouse air relative humidity defined precise set point, then greenhouse air relative humidity sensor triggers-off compressor, capture manifold and release manifold events.

Hunting Rising Trend (-) 2.5%, Lowering Trend (+) 2.5%

In hot locations when greenhouse air relative humidity is less than greenhouse air relative humidity defined precise set point, then greenhouse relative humidity sensor triggers-on evaporative cooling and when greenhouse air relative humidity equals greenhouse air relative humidity defined precise set point, then greenhouse air relative humidity sensor triggers-off evaporative cooling. Z3 offers much higher crop density, yield, quality, crop uniformity and earlier harvest.

Hunting Rising Trend (-) 2.5%, Lowering Trend (+) 2.5%

During sunlight hours

Release manifold releases into greenhouse

(a) Earth tube heat exchanger 1st compartment Ec already stored (carbon dioxide rich dehumidified) conditioned greenhouse air.

(b) Earth tube heat exchanger 3rd compartment Ecd already stored almost dry conditioned carbon dioxide rich greenhouse air to maintain in greenhouse air relative humidity defined precise set point or for optimal evaporative cooling to maintain greenhouse air temperature defined precise set point in hot locations

(c) Ta stored atmosphere compressed air to maintain carbon dioxide and oxygen balance in greenhouse.

(d) Hot air in cold locations.

(e) Additional carbon dioxide for fertilizing for optimal photosynthesis to optimize yield.

During dark hours

Release manifold releases into greenhouse

(a) Earth tube heat exchanger 2nd compartment Eo already stored (oxygen rich dehumidified) conditioned greenhouse air.

(b) Earth tube heat exchanger 4th compartment Eod, already stored almost dry conditioned oxygen rich greenhouse air to maintain in greenhouse air relative humidity defined precise set point or for optimal evaporative cooling to maintain greenhouse air temperature defined precise set point in hot locations.

(c) Ta stored atmosphere compressed air to maintain carbon dioxide and oxygen balance in greenhouse.

(d) Hot air in cold locations.

Release manifold released air

(a) Pushes up greenhouse stale air from cultivation level to above plants.

(b) Creates multiple combinations of horizontal and vertical flows and circulation cycles around plants for uniform mixing of release manifold released air with greenhouse existing air.

(c) Controls and maintains in greenhouse in all vertical and horizontal locations;

(i) Relative humidity defined precise uniform set point.
(ii) Temperature defined precise uniform set point.
(iii) Carbon dioxide ppm defined precise uniform set point.

(d) Optimal air circulation minimizing fungus problems. No hot or cold pockets. No need of horizontal air fans, saving their considerable capital and operating cost.

(e) Also pollinates plants for optimal pollination during pollination hours, release pressure is increased.

According to the sixth embodiment of the present invention, a geo-thermal neat and clean automated module Z4 is provisioned together with relevant provisions of Z1 and Z6. Z4 comprises of two identical geo-thermal energy generating tanks 1st fresh dozing tank and 2nd spent dozing tank, a hot air tank and a carbon dioxide tank.

The primary function of Z4 is to generate geo-thermal energy for

(i) Greenhouse supplementary heating
(ii) Irrigation water warming,

(iii) Drip dozing solution warming
(iv) Foliar dozing solutions warming
(v) Growing media beds crop root zone warming
(vi) Greenhouse roof cover film and gutter interior surfaces heating
Snow melts and slides off.

The secondary function of Z4 is to offer almost free of cost carbon dioxide for fertilization for optimal photosynthesis and also almost free of cost high quality sterilized growing media cum compost.

A module Z4 needs ~ 7 square meter space at greenhouse floor area in cold or freezing cold locations. Both geo-thermal fresh dozing tank and spent dozing tank are positioned at greenhouse floor area till spent dozing tank cooling mode temperature equals greenhouse air temperature. When spent dozing tank outer surfaces temperature equals greenhouse air temperature spent dozing tank thermistor trigger-on alarms defined duration and intervals.

Added benefit is that hot surfaces of fresh dozing, spent dozing tank, hot air tank and carbon dioxide tank radiate heat to maintain greenhouse warm.

More than one individual Z4 is positioned scattered on greenhouse floor area ensuring uniform greenhouse air temperature.

Therefore in the environment controlled or non environment controlled structures and installations for numerous applications and needs, cold storages multiplexes, hotels, malls, commercial and residential complexes, museums', zoological parks', stud forms, cows and buffalos sheds etc (premises') Z4 offers very cost effective heating of premises in cold or freezing cold locations saving very substantial conventional thermal energy and its cost.

According to the seventh embodiment of the present invention, a module Z5 provisioned with greenhouse carbon dioxide sensor together with relevant provisions of Z1 and Z2 to abhort greenhouse carbon dioxide traditional release into atmosphere.

Z5 events are driven by greenhouse carbon dioxide ppm when greenhouse carbon dioxide ppm are more than atmosphere carbon dioxide ppm (~350 ppm) (except during sunlight hours carbon dioxide fertilization events and thereafter till solar radiation into greenhouse is more than defined) due to dark hours plants exhaled carbon dioxide or due to residual carbon dioxide after sunlight hours carbon dioxide (1000-1500 ppm) fertilization events.

Greenhouse carbon dioxide sensor triggers-on compressor, capture manifold and release manifold events Capture manifold to capture carbon dioxide rich greenhouse air which is compressed and stored in operating T1 or T2.

Greenhouse relative humidity sensor maintains greenhouse air relative humidity at ~set point in operating T1 or T2, operating T1 or T2 carbon dioxide rich dehumidified greenhouse air is stored in 1st compartment Ec.

Release manifold to simultaneously release into greenhouse 2nd compartment Eo, already stored (oxygen rich dehumidified) conditioned greenhouse air when greenhouse carbon dioxide ppm equals atmosphere carbon dioxide ppm, greenhouse carbon dioxide sensor triggers-off compressor, capture manifold and release manifold events.

During dark hours, greenhouse carbon dioxide sensor trigger-on compressor, capture manifold and release manifold events release manifold to release into greenhouse, oxygen rich dehumidified conditioned greenhouse air already stored in 2nd compartment Eo, to serve plants' dire need for oxygen rich environment during dark hours to respirate and rejuvenate plants health vigor and strong immune system maximizing plants' tolerance to disease, organisms, bacteria, pathogens, fungi, viral infection, harmful insect, pests and capture manifold to simultaneously to capture dark hours carbon dioxide rich greenhouse air which is compressed and stored in operating T1 or T2 greenhouse air relative humidity sensor maintains greenhouse air relative humidity at ~ set point in operating T1 or T2. Operating T1 or T2 dehumidified carbon dioxide rich greenhouse air is stored in 1st compartment Ec.

As such in the environment controlled multibay structured greenhouse instead of high cost carbon credits purchase, substantial revenue is generated by selling carbon credits, furthermore present innovative greenhouse being just like air conditioned premises leading to much higher energy efficiency, reduced operating cost and wherein there are no horizontal or vertical gradients (non uniformity), no hot or cold pockets, crops in greenhouse at all locations enjoy uniform relative humidity, temperature and carbon dioxide ppm defined precise set points, and there is no need of horizontal air fans saving their substantial capital and operating cost and wherein all benefits of very tall greenhouse can be realized in much less tall greenhouse saving substantial greenhouse capital and operating cost.

According to the eighth embodiment of the present invention, the module Z6 comprising of activated fertilizer, nutrient and crop treatment dosing system and a drip dozing irrigation system in which there are four operating HDPE tanks viz. a WT, a IRWT, a TNDT, and a TNFT, a reserve water tank WTR, a high pressure pump HP, a water transfer pump PT, a sediment transfer pump PS, a drip manifold DM and a foggers manifold FM two sediment collection tanks and a leachate collection tank. Using activated fertilizers and nutrients', solutions, reduces their use and cost by ~50% in drip dozing and by ~75% in foliar dozing.

Tank WT stores water for supply to high pressure pump, HP and via water transfer pump PT to tanks IRWT, TNDT, TNFT, etc. WT inlet is connected to water supply line. Tank WTR stores reserve water for, supply to WT during water supply line failure. WTR inlet connected to water supply line. Tank IRWT stores water for irrigation and for defined duration irrigation before and after each fertilizing drip dozing event.

In Tank TNDT, fertilizer, nutrients, pH adjustment, crop root zone treatment, solution mixing, activating and drip dozing is done. After TNDT manual fresh dozing event (weight or volume) push button signal. All subsequent operations are provisioned fully automated till TNDT sediment drain out into sediment collection tank event is over.

In tank TNFT, crop treatment, fertilizers and nutrients foliar dozing, solution mixing activating and foliar dozing is done. After TNFT manual fresh dozing event (weight or volume), push button signal. All subsequent operations are provisioned fully automated till TNFT sediment drains out into sediment collection tank event is over.

Tank DFFNSCT stores fertilizer, nutrients drip and foliar dozing solution sediment and Tank FTDTSCT stores crop treatment foliar and drip dozing solution sediment.

According to the ninth embodiment of the present invention, module Z6, comprising of two roof sprinkler manifolds, two gable sides' sprinkler manifolds and two long sides' sprinkler manifolds are provisioned to maintain greenhouse cover film exterior surfaces free of dust / dirt. Roofs', gable sides' and long sides' sprinkler manifolds inlets connected to high pressure pump outlet.

During defined sunlight hours duration and interval (based upon location dust / dirt status)
Atmosphere solar radiation sensor trigger-off roof automated roll on/off thermal screen cum shading material external curtains and when said curtains are actually fully off, atmosphere solar radiation sensor trigger-on roof gable sides and long sides sprinkler manifolds to throw pressurized water onto greenhouse roofs', both gable sides' and both long sides' cover film exterior surfaces to wash off all dust / dirt.

According to the tenth embodiment of the present invention, greenhouse is provisioned with smoke detectors for efficient fire fighting to combat fire hazards, because of highly inflammable greenhouse cover polyethylene film, insect netting and screens etc.

Smoke detection trigger-off all ongoing events and triggers-on all six sprinkler manifolds to throw pressurized water onto greenhouse roof, both gable sides' and both long sides' to extinguish fire at the earliest. The main benefit is minimal damage of greenhouse cover film and crop inside greenhouse.

According to the eleventh embodiment of the present invention, module Z6 is provisioned with a plurality of growing media beds' treatments, wherein thermal screen cum shading material fixed at growing media beds' bottom ends at ~60 centimeter depth and ~60 centimeter along four interior vertical sides with 15 centimeter overlap on four horizontal exterior sides' surfaces bottom end provisioned with another layer of polythene film and in between the two layers is provisioned pipes for growing media crop root zone aeration, for maintaining crop root zone temperature at defined set point and for drained off leachate collection and thereafter top ends is tightly covered with thermal screen cum shading material with 15 centimeter overlap along four interior vertical sides.

Thereafter growing media beds crop root zone is heated to temperature defined set point. Holes for seeding or transplanting after crop emergence covered all around with thermal screen cum shading material which not only helps in maintaining growing media crop root zone temperature, but it also abhorts germination of weed seeds.

Greenhouse air temperature is mostly cooler than growing media crop root zone temperature.
Thermal screen cum shading material exterior and interior surfaces being solid barriers between soil underneath bottom layer growing media crop root zone and greenhouse air temperature environments, absorbs and retains soil underneath bottom layer or crop root zone and greenhouse air temperature hot or cold air trying to enter into growing media crop root zone and crop root zone hot air trying to escape into greenhouse air.

Growing media beds' treatment manifold
There are four treatments.

1st Treatment

Pressurized air injections into growing media beds' treatment manifold 1st inlet for growing media beds' aeration after each irrigation event or after defined duration Irrigation each event.

2nd Treatment

Pressurized water injections into growing media beds' treatment manifold 2nd inlet each evening at defined hours and duration.

3rd treatment

Pressurized air 2nd injections into growing media beds' treatment manifold 1st inlet defined duration.

4th treatment

Pressurized hot air injections into growing media beds' treatment manifold 3rd inlet.

When growing media beds' crop root zone temperature is less than temperature defined set point, then growing media beds' crop root zone thermistors, trigger-on pressurized hot air injections into growing media beds' treatment manifold 3rd inlet. When growing media beds' crop root zone temperature equals crop root zone temperature defined set point crop root zone, thermistors' trigger-off pressurized hot air injections. When growing media beds crop root zone temperature is again less than crop root zone defined set point, then crop root zone thermistors' again trigger-on pressurized hot air injections into Growing media beds' treatment manifold 3rd inlet and so on and off.

Hunting Rising Trend (-) 2.5%, Lowering Trend (+) 2.5%

After respective 1st, 2nd, 3rd, 4th treatment, drained off leachate collecting in leachate collection manifold is transferred into a leachate storing tank LCT.

According to the twelfth embodiment of the present invention, a greenhouse roof covers film and gutters interior surfaces heating manifold is provisioned. When atmosphere air temperature is approaching 0°C, weather station atmosphere temperature sensor triggers-on pressurized hot air injections into heating manifold to heat greenhouse roof cover film and gutters interior surfaces. The snow melts and slides off.

According to the thirteenth embodiment of the present invention the module Z7 offers a thermal screen cum shading material interior and exteriors surfaces areas of which are solid barriers between greenhouse interior temperature environment and atmosphere temperature environment. It absorbs and retains greenhouse hot or cold air trying to escape into atmosphere and also absorbs and retains atmosphere cold and/or hot air trying to enter into greenhouse.

Heat energy accumulation on roof and four sides thermal screen cum shading material curtains interior surfaces saves substantial heating cost and helps keep greenhouse air from cooling down during winter, cold evenings, nights and mornings, greenhouse remains warm. There is no chance of moisture condensation or mist formation on greenhouse cover film and gutters' interior surfaces.

Thus reducing greenhouse supplementary heating cost in cold locations and greenhouse supplementary cooling cost in hot locations. AN ALL IN ONE SOLUTION IN SEASONAL OR MOSTLY ALL SEASONS MOSTLY HOT AND MOSTLY COLD OR FREEZING COLD LOCATIONS.

Greenhouse roof polyethylene film fixed and roof automated roll on/off thermal screen cum shading material external curtains are provisioned 0-100% convertible and greenhouse four sides polyethylene film fixed and four sides thermal screen cum shading material internal curtains are also provisioned 0-100% convertible.

In cold or freezing cold locations during sunlight hours and also during daylight over cast sky hours, sunset hours as and when solar radiation is less than defined (~1200 foot candles) greenhouse solar radiation sensor triggers-off greenhouse roof and four sides automated roll on/off thermal screen cum shading curtains to maximize heat gain (sensible and latent).

According to the fourteenth embodiment of the present invention, Artificial lighting energy being capital and operating cost intensive, Z7 equipped with cost effective tangible means and/or methods for increasing deficient artificial lighting which after increase would be optimum reducing very substantially capital and operating cost of artificial lighting energy by installing much less quantum or artificial lighting.

Module Z7 being equipped with cost effective tangible means for increasing very deficient sunlight energy together with artificial lighting in very cold and freezing cold locations wherein life exists but sunlight energy is very deficient, deficient sunlight energy together with artificial lighting energy is increased to be optimum into greenhouse for food production.

Artificial lighting comprising of compact fluorescent lamps at ~10 square meter centers hanging from truss bottom ~15 centimeter above plants' tops are provisioned to be raised as plants' grow in height and Fluorescent tubes installed staggered at ~20 square meter centers around growing media beds' horizontal width centre and are provisioned alternately red, blue and white.

module Z7 being equipped with cost effective tangible means and/or by tangible methods for increasing deficient sunlight energy into greenhouse to be optimum for food production in locations wherein sunlight energy is not deficient but is reduced due to dust / dirt accumulation on greenhouse cover film exterior surfaces and/or due to condensation or mist formation on greenhouse cover films' interior surfaces.

Sunlight energy and heat energy being concurrent in hot locations during sunlight hours, greenhouse solar radiation sensor triggers-on optimal shading by adjusting positions of greenhouse roof and four sides automated roll on/off thermal screen cum shading curtains to admit into greenhouse only defined deficient solar radiation which after

increase would be optimum into greenhouse for food production to minimize needless heat gain to minimize supplementary cooling cost.

The sunlight is increased by provisioning greenhouse with mirrors and aluminium foils at 5 square meters centers. Incoming sunlight energy striking any mirror or aluminium foil is reflected to other mirrors and aluminum foils and is increased by repeated light reflecting cycles to be optimum. Mirrors and aluminum foils also spread light more uniformly.

According to the fifteenth embodiment of the present invention, food production is facilitated in cold or freezing cold locations by increasing deficient sunlight energy together with artificial lighting energy, using earth tube heat exchanger together with Geo-thermal energy generating module.

According to the sixteenth embodiment of the present invention, Z7 offers Preventive treatment of growing media beds before each crop seeding or transplanting by a cost effective non toxic material and/or by a cost effective tangible method to destroy all growing media pests is performed. At defined intervals green house standing crops are provisioned with preventive treatment by a cost effective non toxic material and/or by a cost effective method to destroy all disease bacteria, pathogens, harmful insect and pests.

Module Z3 offers best integrated pest management by maintaining green house relative humidity at ~80%. No condensation or mist on greenhouse covers film and gutters' interior surfaces. no water drops dripping on to plants, no plants injury, no dense fog in greenhouse, minimal pressure of disease, organisms bacteria pathogens, fungi, viral infection, harmful insect, pests no reduction in light transmission into greenhouse and obviating use of toxic crop protection agents saving their and spraying labours' substantial cost and labours' health hazards and non toxic food production.

During dark hours, Z5 greenhouse carbon dioxide sensor trigger-on release manifold to release into greenhouse, oxygen rich dehumidified conditioned greenhouse air already stored in 2nd compartment Eo, to serve plants' dire need for oxygen rich environment to respirate and rejuvenate plants health vigor and strong immune system maximizing plants' tolerance to disease, organisms, bacteria, pathogens, fungi, viral infection, harmful insect pests.

Present innovative greenhouse being just like air conditioned premises leading, efficiently preventing ingress of pests and pathogens into greenhouse much more efficient biological control.

According to the seventeenth embodiment of the present invention, Z7 being equipped with cost effective tangible means and/or by cost effective tangible methods to eliminate gutters' together with all gutters' related problems in a

multibay greenhouse leading to no blocking of incoming sunlight energy into greenhouse, no condensation, no mist on gutters interior surfaces, no water drop dripping, on to plants, no plant injury, no snow accumulation in gutters, no very heavy down pour of water, overflowing on greenhouse roofs and along sides, no entry of rain water into greenhouse, no damage to crops inside, no dust/dirt accumulation in gutters, no algae, fungi growth in gutters.

Similarly in multibay structures and installations for numerous applications and needs, there is no very heavy down pour of water overflowing on structures roofs and along sides, no entry of rain water into structures, no damage to materials inside, no snow accumulation in structures' gutters'.

According to the eighteenth embodiment of the present invention, Z7 equipped with cost effective tangible method to maintain optimal insulation between two layers of inflated double layer polyethylene greenhouse cover film which is critical for increased thermal efficiency and to reduce heat loss and thermal energy cost. Double layer polyethylene greenhouse cover film total area is divided into horizontal and vertical segments of ~2 square meters and ~3 mm wide thermal sealing is done after each segment is inflated to ensure that each segment is fully insulated from all other segments. Leaking segment can be visually identified and easily repaired.

According to the nineteenth embodiment of the present invention, Z7 equipped with cost effective tangible means and/or by a cost effective tangible method to use smaller wall thickness and smaller diameter, cheaper galvanized iron pipes filled with sand (ends sealed to ensure no escape of sand) in place of costly large wall thickness C-class and large diameter galvanized iron pipes. They both serve same objective. So, by using smaller wall thickness and smaller diameter, cheaper galvanized iron pipes filled with sand, considerable cost is saved.

The above description is to understand the invention and in no way to limit the scope of invention which is amendable to various modifications and improvements within the scope of present invention which will be evident to those skilled in the art.

I Claim:

1. An environment controlled multibay structured greenhouse comprising of basic module Z1 and modules Z2, Z3, Z4, Z5, Z6, Z7, and a plurality of sensors;

wherein said basic module Z1 comprises of a compressor, a tank T1, a tank T2, a tank Ta, a capture manifold and a release manifold;

said module Z2 comprises of a cost effective material earth tube heat exchanger and greenhouse air temperature sensor together with relevant provisions of Z1;

said module Z3 comprises of a greenhouse relative humidity sensor together with relevant provisions of Z1 and Z2 to maintain greenhouse relative humidity at defined precise set point;

said module Z4 comprises of a geothermal energy generating neat and clean automated module together with relevant provisions of Z1 and Z6;

said module Z5 comprises of a greenhouse carbon dioxide sensor to ameliorate global warming by abhorting greenhouse carbon dioxide traditional release into atmosphere together with relevant provisions of Z1 and Z2;

said module Z6 comprises of a fertilizers, nutrients, crop treatment drip or foliar dozing system, a drip dozing irrigation system, a foggers' manifold, a plurality of sprinkler manifolds, smoke detectors, and a plurality of growing media beds' treatments together with relevant provisions of Z1 and Z4;

and said module Z7 offers greenhouse roof and four sides polythene film fixed and automated roll on/off thermal screen cum shading curtains 0-100% convertible and also cost effective tangible means to eliminate gutters, to increase sunlight energy into greenhouse and for cost effective integrated pest management.

2. The environment controlled multibay structured greenhouse as claimed in claim 1, wherein said atmosphere weather station is equipped with a plurality of sensors comprising, a solar radiation sensor, a temperature sensor, a relative humidity sensor, a wind speed sensor, and a rain detector, the said weather station sensors triggers-off roof automated roll on/off thermal screen cum shading material external curtains when said weather station wind speed

sensor senses wind speed exceeding normal or when said weather station rain detector detects rain or when said weather station temperature sensor senses atmosphere air temperature approaching 0°C.

3. The environment controlled multibay structured greenhouse as claimed in claim 1, wherein the events of said capture manifold and said release manifold are provisioned concurrent.

4. The environment controlled multibay structured greenhouse as claimed in claim 1, wherein the said module Z1 comprises of said tank Ta for storing atmosphere compressed air, said greenhouse relative humidity sensor trigger-on Ta moisture drain off valve to drain off moisture content for optimal dehumidification maintaining greenhouse relative humidity at ~set point in Ta, Ta stored atmosphere compressed air is released into greenhouse to maintain carbon dioxide and oxygen balance in greenhouse and also used for auxiliary equipment operations

5. The environment controlled multibay structured greenhouse as claimed in claim 1, wherein the said compressor of said module Z1 compresses capture manifold captured carbon dioxide rich greenhouse air of dark hours and oxygen rich air of sunlight hours, the compressed dark hours carbon dioxide rich greenhouse air or sunlight hours oxygen rich greenhouse air is compressed and stored in operating T1 or T2, greenhouse relative humidity sensor triggers-on operating T1 or T2 moisture drain off valve to drain off moisture content for optimal dehumidification maintaining greenhouse relative humidity at ~ set point in operating T1 or T2 or drains off total moisture content maintaining almost dry air in operating T1 or T2.

6. The environment controlled multibay structured greenhouse as claimed in claim 1, wherein the said module Z2 is equipped with said cost effective material earth tube heat exchanger having 4 separate compartments, 1st compartment Ec stores operating T1 or T2 (carbon dioxide rich dehumidified) greenhouse air, 2nd compartment Eo stores operating T1 or T2 (oxygen rich dehumidified) greenhouse air, 3rd compartment Ecd stores operating T1 or T2 (carbon dioxide rich almost dry) greenhouse air and 4th compartment Eod stores operating T1 or T2 (oxygen rich almost dry) greenhouse air.

7. The environment controlled multibay structured greenhouse as claimed in claim 1, wherein during morning defined sunlight hours, said atmosphere solar radiation sensor trigger-on compressor, capture manifold and release manifold events, said capture manifold to capture oxygen rich greenhouse air which is compressed and stored in operating T1 or T2, greenhouse relative humidity sensor maintains greenhouse relative humidity at ~set point in operating T1 or T2, operating T1 or T2 oxygen rich dehumidified greenhouse air is stored in 2nd compartment Eo; and said release manifold to simultaneously release into greenhouse, dehumidified conditioned carbon dioxide rich greenhouse air already stored in 1st compartment Ec thus utilization during sunlight hours (dark hours plants exhaled carbon dioxide

or residual carbon dioxide after carbon dioxide fertilization events) to optimize yield for very cost effective food production and to substantially ameliorate global warming.

8. The environment controlled multibay structured greenhouse as claimed in claim 1, wherein average thermal constant temperature of a location is measured by placement of a thermistor probes in bores of various depths, below ground level commencing at 2.5 meter depth with increment of ~0.5 meter or more or less based upon average thermal constant temperature at 2.5 meter depth similar treatment of all subsequent bores till most suitable average thermal constant temperature is realized (~68°F or higher).

9. The environment controlled multibay structured greenhouse as claimed in claim 1, wherein the said module Z2 events are driven by greenhouse air temperature, and when greenhouse air temperature is more than or less than average thermal constant temperature (defined), said greenhouse air temperature sensor trigger-on earth tube heat exchanger, compressor, capture manifold and release manifold events.

10. The environment controlled multibay structured greenhouse as claimed in claim 1, wherein when greenhouse air temperature equals earth tube heat exchanger average thermal constant temperature (defined), said greenhouse air temperature sensor trigger-off earth tube heat exchanger, compressor, capture manifold, and release manifold events.

11. The environment controlled multibay structured greenhouse as claimed in claim 1, wherein in cold locations, said greenhouse air temperature sensor triggers-on compressor, capture manifold and release manifold events, said capture manifold to capture dark hours carbon dioxide rich or sunlight hours oxygen rich greenhouse air which is compressed and stored in operating T1 or T2, greenhouse relative humidity sensor maintains greenhouse relative humidity at ~set point in operating T1 or T2, operating T1 or T2 carbon dioxide rich dehumidified greenhouse air is stored in 1st compartment Ec and operating T1 or T2 oxygen rich dehumidified greenhouse air is stored in 2nd compartment Eo, said release manifold to simultaneously release into greenhouse, hot air; when greenhouse air temperature equals greenhouse air temperature defined precise set point then said greenhouse air temperature sensor trigger-off hot air release, compressor and capture manifold events.

12. The environment controlled multibay structured greenhouse as claimed in claim 1, wherein in hot locations, the said greenhouse air temperature sensor trigger-on evaporative cooling with concurrent compressor, capture manifold and release manifold events, said capture manifold to capture dark hours carbon dioxide rich or sunlight hours oxygen rich greenhouse air which is compressed and stored in operating T1 or T2, said greenhouse relative humidity sensor maintains almost dry air in operating T1 or T2, operating T1 or T2 carbon dioxide rich almost dry air is stored

in 3rd compartment Ecd and operating T1 or T2 oxygen rich almost dry air is stored in 4th compartment Eod; said release manifold to simultaneously release into greenhouse, 3rd compartment Ecd already stored almost dry conditioned carbon dioxide rich greenhouse air during sunlight hours and 4th compartment Eod already stored almost dry conditioned oxygen rich greenhouse air during dark hours for optimal evaporative cooling to maintain greenhouse air temperature at defined precise set point; when greenhouse air temperature equals greenhouse air temperature defined precise set point then said greenhouse air temperature sensor trigger-off compressor, capture manifold and release manifold events.

13. The environment controlled multibay structured greenhouse as claimed in claim 1, wherein it is very easy to adjust greenhouse air temperature at defined precise set point which helps in improving timing of crops significantly especially of flowers.

14. The environment controlled multibay structured greenhouse as claimed in claim 1, wherein said module Z2 substantially reduces greenhouse supplementary heating cost in cold locations and greenhouse supplementary cooling cost in hot locations by maintaining greenhouse air temperature equal to earth tube heat exchanger average thermal constant temperature of the location.

15. An environment controlled or non environment controlled structures and installations for numerous applications and needs, cold storages multiplexes, hotels, malls, commercial and residential complexes, zoological parks', stud farms cows or buffalos sheds etc (premises), wherein Z2 offers very cost effective conditioning of premises' relatively cooler air to relatively warmer in cold locations and conditioning of premises' relatively warmer air to relatively cooler in hot locations, marinating (premises) air temperature equals to defined average thermal constant temperature of the location, saving very substantial cost of conventional thermal energy burning fossil fuel which also emits very substantial atmosphere pollutants most of which also aggravate global warming.

16. The environment controlled multibay structured greenhouse as claimed in claim 1, wherein said module Z2 is most cost effective and most potent tool to condition colder air to warmer in seasonal or all seasons' mostly cold or freezing cold locations saving very substantial cost of conventional thermal energy.

17. The environment controlled multibay structured greenhouse as claimed in claim 1, wherein said module Z3 events are driven by greenhouse air relative humidity, when greenhouse air relative humidity is more than greenhouse air relative humidity defined precise set point, greenhouse air relative humidity sensor trigger-on compressor, capture manifold and release manifold events; capture manifold to capture dark hours carbon dioxide rich or sunlight hours oxygen rich greenhouse air which is compressed and stored in operating T1 or T2, the said

greenhouse air relative humidity sensor maintains almost dry air in operating T1 or T2, operating T1 or T2 carbon dioxide rich almost dry air is stored in 3rd compartment Ecd and operating T1 or T2 oxygen rich almost dry air is stored in 4th compartment Eod, release manifold to simultaneously release into greenhouse, 3rd compartment Ecd already stored almost dry conditioned carbon dioxide rich greenhouse air during sunlight hours and 4th compartment Eod already stored almost dry conditioned oxygen rich greenhouse air during dark hours to maintain greenhouse air relative humidity at defined precise set point (at ~80% or lower or higher), when greenhouse air relative humidity equals greenhouse air relative humidity defined precise set point greenhouse air relative humidity sensor trigger-off compressor, capture manifold and release manifold events.

18. The environment controlled multibay structured greenhouse as claimed in claim 1, wherein there is much higher crop density, yield, quality, crop uniformity and earlier harvest and no condensation or mist on greenhouse cover film and gutters interior surfaces, no water drops dripping on to plants, no plants injury, no dense fog in greenhouse, no reduction in light transmission and minimal pressure of disease, organisms bacteria, pathogens, fungi, viral infection, harmful insect, pests, obviating toxic crop protection agents use, saving their and spraying labours' substantial cost and labours' health hazards and non toxic food production.

19. The environment controlled multibay structured greenhouse as claimed in claim 1, wherein the said module Z4 comprises of automated geo-thermal energy harnessing module comprising of two identical geo-thermal tanks, 1st fresh dozing tank and 2nd spent dozing tank, a hot air tank, a carbon dioxide tank; module Z4 offering very cost effective greenhouse supplementary heating in seasonal or all seasons mostly cold or freezing cold locations, saving very substantial cost of conventional thermal energy burning fossil fuel which also emits very substantial atmosphere pollutants most of which also aggravate global warming; Z4 geo-thermal heat energy almost free of cost providing almost free of cost carbon dioxide for sunlight hours fertilization to optimize yield for very cost effective food production and high quality sterilized growing media cum compost.

20. The environment controlled or non environment controlled structures as claimed in claim 15 wherein the said module Z4 offers very cost effective heating of premises in cold or freezing cold locations saving very substantial cost of conventional thermal energy.

21. The environment controlled multibay structured greenhouse as claimed in claim 2, wherein when the said weather station atmosphere temperature sensor senses atmosphere air temperature approaching 0°C, triggers-on hot air injections into greenhouse cover film and gutters' interior surfaces heating manifold, melting snow which slides off.

22. The environment controlled multibay structured greenhouse as claimed in claim 1, wherein the said module Z5 events are greenhouse carbon dioxide ppm driven (except during sunlight hours carbon dioxide fertilization events and after fertilization events till atmosphere solar radiation into greenhouse is more than defined), when greenhouse carbon dioxide ppm is more than atmosphere carbon dioxide ppm due to dark hours plants exhaled carbon dioxide or due to residual carbon dioxide after carbon dioxide (1000-1500 ppm) fertilization events, instead of carbon dioxide traditional release into atmosphere which aggravates global warming, said greenhouse carbon dioxide sensor trigger-on compressor, captures manifold and release manifolds events, capture manifold to capture carbon dioxide rich greenhouse air which is compressed and stored in operating T1 or T2, greenhouse relative humidity sensor maintains greenhouse relative humidity at ~set point in operating T1 or T2, operating T1 or T2 carbon dioxide rich dehumidified greenhouse air is stored in 1st compartment Ec; release manifold to simultaneously release into greenhouse dehumidified conditioned oxygen rich greenhouse air already stored in 2nd compartment Eo.

23. The environment controlled multibay structured greenhouse as claimed in claim 1, wherein during dark hours, the said Z5 greenhouse carbon dioxide sensor trigger-on release manifold to release into greenhouse, oxygen rich dehumidified conditioned greenhouse air already stored in 2nd compartment Eo, to serve plants' dire need for oxygen rich environment to respirate and rejuvenate plants health vigor and strong immune system maximizing plants' tolerance to disease, organisms, bacteria, pathogens, fungi, viral infection, harmful insect, pests; capture manifold simultaneously to capture dark hours carbon dioxide rich greenhouse air which is compressed and stored in operating T1 or T2 greenhouse relative humidity sensor maintains greenhouse relative humidity at ~ set point in operating T1 or T2, operating T1 or T2 carbon dioxide rich dehumidified greenhouse air is stored in 1st compartment Ec.

24. The environment controlled multibay structured greenhouse as claimed in claim 1, wherein there are no horizontal or vertical gradients (non uniformity) no hot or cold pockets, crops in greenhouse all locations enjoy uniform relative humidity, temperature and carbon dioxide ppm defined precise set points, and there is no need of horizontal air fans saving their substantial capital and operating cost and wherein all benefits of very tall greenhouse can be realized in much less tall greenhouse saving substantial greenhouse capital and operating cost.

25. The environment controlled multibay structured greenhouse as claimed in claim 1, wherein the said module Z6 uses activated fertilizers' and nutrients', solutions, reducing their use and cost by ~50% in drip dozing and by ~75% in foliar dozing.

26. The environment controlled multibay structured greenhouse as claimed in claim 1, wherein the said module Z6 comprises of drip manifold and a tank TNDT wherein fertilizers, nutrients and crop treatment solutions mixing,

activating and drip dozing is done and wherein after manual fresh dozing event (weight or volume) and push button signal, module Z6 offers all subsequent operations fully automated uptill sediment drain out into sediment collection tank event is over.

27. The environment controlled multibay structured greenhouse as claimed in claim 1, wherein the said module Z6 comprises of foggers manifold and a Tank TNFT wherein fertilizers, nutrients and crop treatment solutions mixing, activating and foliar dozing is done and wherein after manual fresh dozing event (weight or volume) and push button signal, module Z6 offers all subsequent operations fully automated uptill sediment drain out into sediment collection tank event is over.

28. The environment controlled multibay structured greenhouse as claimed in claim 1, wherein the said module Z6 uses growing media beds' in place of traditional growing media bags leading to almost double the yield and wherein all benefits of bags are realized much better at much lower cost and also wherein other needs viz. crop root zone aeration, maintaining crop root zone temperature at defined set point and drained off leachate automated collection is realized which bags don't offer and also saving substantial cost of growing media bags.

29. The environment controlled multibay structured greenhouse as claimed in claim 1, wherein during defined sunlight hours duration and intervals, the said atmosphere solar radiation sensor trigger-off, roof automated roll on/off thermal screen and shading material external curtains and when the said curtains are actually fully off, atmosphere solar radiation sensor triggers-on roof, gables and long sides sprinkler manifolds to throw pressurized water on to greenhouse cover films' all exterior surfaces to wash off all dust / dirt leading to no reduction in light transmission.

30. The environment controlled multibay structured greenhouse as claimed in claim 1, wherein the said module Z6 offers efficient fire fighting to combat fire hazards which may occur because of highly inflammable greenhouse polyethylene cover films', insect nettings and screens etc, smoke detection triggers-off all ongoing events and simultaneously triggers-on roof, gables and long sides sprinkler manifolds to throw pressurized water on to greenhouse roof and four sides to extinguish fire at the earliest.

31. The environment controlled multibay structured greenhouse as claimed in claim 1, wherein the said module Z7 offers thermal screen cum shading material, of which interior and exteriors surfaces are solid barriers between greenhouse interior temperature environment and atmosphere temperature environment and which absorbs and retains greenhouse hot or cold air trying to escape into atmosphere and also absorbs and retains atmosphere hot or cold air trying to enter into greenhouse, which is an all in one solution in seasonal or mostly all seasons mostly hot and mostly cold and freezing cold locations.

32. The environment controlled multibay structured greenhouse as claimed in claim 1, wherein the said module Z7 offers greenhouse roof and four sides' polyethylene cover film fixed and greenhouse roof and four sides automated roll on/off thermal screen cum shading material curtains 0-100% convertible.

33. The environment controlled multibay structured greenhouse as claimed in claim 1, artificial lighting energy being capital and operating cost intensive, the said module Z7 is equipped with cost effective tangible means and/or by tangible methods by installing deficient artificial lighting so that deficient artificial light energy after increase would be optimum into greenhouse, saving substantial capital and operating cost of artificial lighting energy.

34. The environment controlled multibay structured greenhouse as claimed in claim 1, in seasonal or mostly all seasons mostly cold or freezing cold locations, wherein life exists but sunlight energy is very deficient, the said module Z7 being equipped with cost effective tangible means and/or by a tangible method for increasing very deficient sunlight energy together with artificial lighting energy. To be optimum into greenhouse for food production.

35. The environment controlled multibay structured greenhouse as claimed in claims 33 and 34, wherein artificial lighting comprising of compact fluorescent lamps at ~10 square meter centers hanging from truss bottom ~15 centimeter above plants' tops and are provisioned to be raised as plants' grow in height and fluorescent tubes installed staggered at ~20 square meter centers around growing media beds' horizontal width centers and are provisioned alternately red, blue and white.

36. The environment controlled multibay structured greenhouse as claimed in claim 1, in locations wherein sunlight energy is not deficient but sunlight transmission into greenhouse is reduced due to dust / dirt accumulation on greenhouse cover film exterior surfaces and/or due to condensation or mist formation on greenhouse cover films' interior surfaces or due to fog in greenhouse equipped with cost effective tangible means and/or by tangible methods for increasing deficient sunlight energy to be optimum into greenhouse for food production.

37. The environment controlled multibay structured greenhouse as claimed in claim 1, sunlight energy and heat energy being concurrent the said module Z7 is equipped with cost effective tangible means and/or methods in hot locations by admitting into greenhouse defined deficient sunlight energy which after increase would be optimum into greenhouse, saving substantial cost of greenhouse supplementary cooling.

38. The environment controlled multibay structured greenhouse as claimed in claims 33, 34, 36 and 37 wherein the light energy is increased by provisioning greenhouse with mirrors and aluminium foils at 5 square meters centers,

incoming deficient sunlight energy and/or artificial lighting energy striking any mirror or aluminium foil is reflected to other mirrors and/or aluminum foils and is increased by repeated light reflecting cycles to be optimum and more uniform into greenhouse.

39. The environment controlled multibay structured greenhouse as claimed in claim 1 in cold or freezing cold locations wherein life exists but sunlight energy is very deficient food production is facilitated by increasing deficient sunlight energy together with artificial lighting energy, using earth tube heat exchanger together with Geo-thermal energy generating module.

40. The environment controlled multibay structured greenhouse as claimed in claim 1, wherein the said module Z7 offers preventive treatment of growing media beds before each crop seeding or transplanting by a cost effective non-toxic material and/or by cost effective tangible methods, to destroy all growing media pests, Z7 offering preventive treatment of greenhouse standing crops by a cost effective non-toxic material, and/or by cost effective tangible methods to destroy all disease, bacteria, pathogens, harmful insect, pests at defined intervals, obviating toxic crop protection agents use, saving their and spraying labours' substantial cost and labours' health hazards and non toxic food production.

41. The environment controlled multibay structured greenhouse as claimed in claim 1, wherein the said module Z3 offers integrated pest management by maintaining greenhouse relative humidity precise set point at ~80%, or lower or higher leading to no condensation, no water drops dripping on to plants, no plants injury, no mist and no fog in greenhouse.

42. The environment controlled multibay structured greenhouse as claimed in claim 1, wherein the said module Z7 offers most efficient photoperiod control by greenhouse roof and 4 sides automated roll on/off thermal screen cum shading material curtains leading to very healthy plants' growth and strong immune system, maximizing plants' tolerance to disease etc.

43. The environment controlled multibay structured greenhouse as claimed in claim 1, wherein present innovative greenhouse being just like air conditioned premises, efficiently preventing ingress of pests and pathogens into greenhouse and having much more efficient biological control.

44. The environment controlled multibay structured greenhouse as claimed in claim 1, wherein the said module Z7 being equipped with cost effective tangible means and/or by tangible methods to eliminate gutters together with all gutters' related problems leading to no blocking of incoming sunlight energy into greenhouse, no condensation, no

mist on gutters interior surfaces, no snow accumulation in gutters, no heavy down pour of water overflowing greenhouses roofs and along sides, no entry of rain water into greenhouse, no damage to crop inside, no dust/dirt accumulation in gutters and no algae and fungi growth in gutters.

45. The environment controlled or non environment controlled structures and installations as claimed in claim 15, wherein the said module Z7 being equipped with cost effective tangible means and/or by tangible methods to eliminate gutters together with all gutters' related problems leading to no snow accumulation in gutters', no heavy down pour of water overflowing the structures' roofs and along sides, no entry of water into the structures, no damaging materials inside the structures.

46. The environment controlled multibay structured greenhouse as claimed in claim 1, wherein the said module Z7 being equipped with cost effective tangible means to use smaller wall thickness and smaller diameter, cheaper galvanized iron pipes filled with sand (ends sealed to ensure no escape of sand) in place of costly large wall thickness C-class and large diameter galvanized iron pipes, saving considerable cost.

47. The environment controlled multibay structured greenhouse as claimed in claim 1, wherein the said module Z7 is equipped with cost effective tangible means and/or by tangible methods to maintain optimal insulation between two layers of inflated double polyethylene greenhouse covering which is critical for increased thermal efficiency and to reduce heat loss and thermal energy cost and also offers to facilitate isolating leaking holes in double layer inflated polyethylene greenhouse cover film.

INTERNATIONAL SEARCH REPORT

International application No
PCT/IN2012/000830

A. CLASSIFICATION OF SUBJECT MATTER
INV. A01G9/18 A01G9/24
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A01G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	AU 2006 202 086 A1 (JOHN NORWOOD) 7 December 2006 (2006-12-07) the whole document -----	1-47
A	DE 25 15 363 A1 (HOELTER HEINZ) 28 October 1976 (1976-10-28) the whole document -----	1

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
26 April 2013	07/05/2013

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Dagnelies, Joëlle

1

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IN2012/000830

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☒ Claims Nos.: 1(partially)
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
see FURTHER INFORMATION sheet PCT/ISA/210

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IN2012/000830

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
AU 2006202086 A1	07-12-2006	NONE	
DE 2515363 A1	28-10-1976	NONE	

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box II.2

Claims Nos.: 1(partially)

The drafting of the claims with vague and enigmatic expressions (such as "provisions", "provisioned"), with expressions that attempts to define the subject-matter in terms of the result to be achieved instead of providing the technical features necessary for achieving this result (such as "cost effective tangible means to eliminate gutters"), with unconsistent terminology between the claims, with dubious grammatical structure, makes it impossible to determine fully and unambiguously the subject-matter for which protection is sought. Since it is impossible to determine fully and unambiguously the subject-matter for which protection is sought, the search was restricted to the understandable technical features of claim 1 only.

The applicant's attention is drawn to the fact that claims relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure. If the application proceeds into the regional phase before the EPO, the applicant is reminded that a search may be carried out during examination before the EPO (see EPO Guidelines C-IV, 7.2), should the problems which led to the Article 17(2) declaration be overcome.