

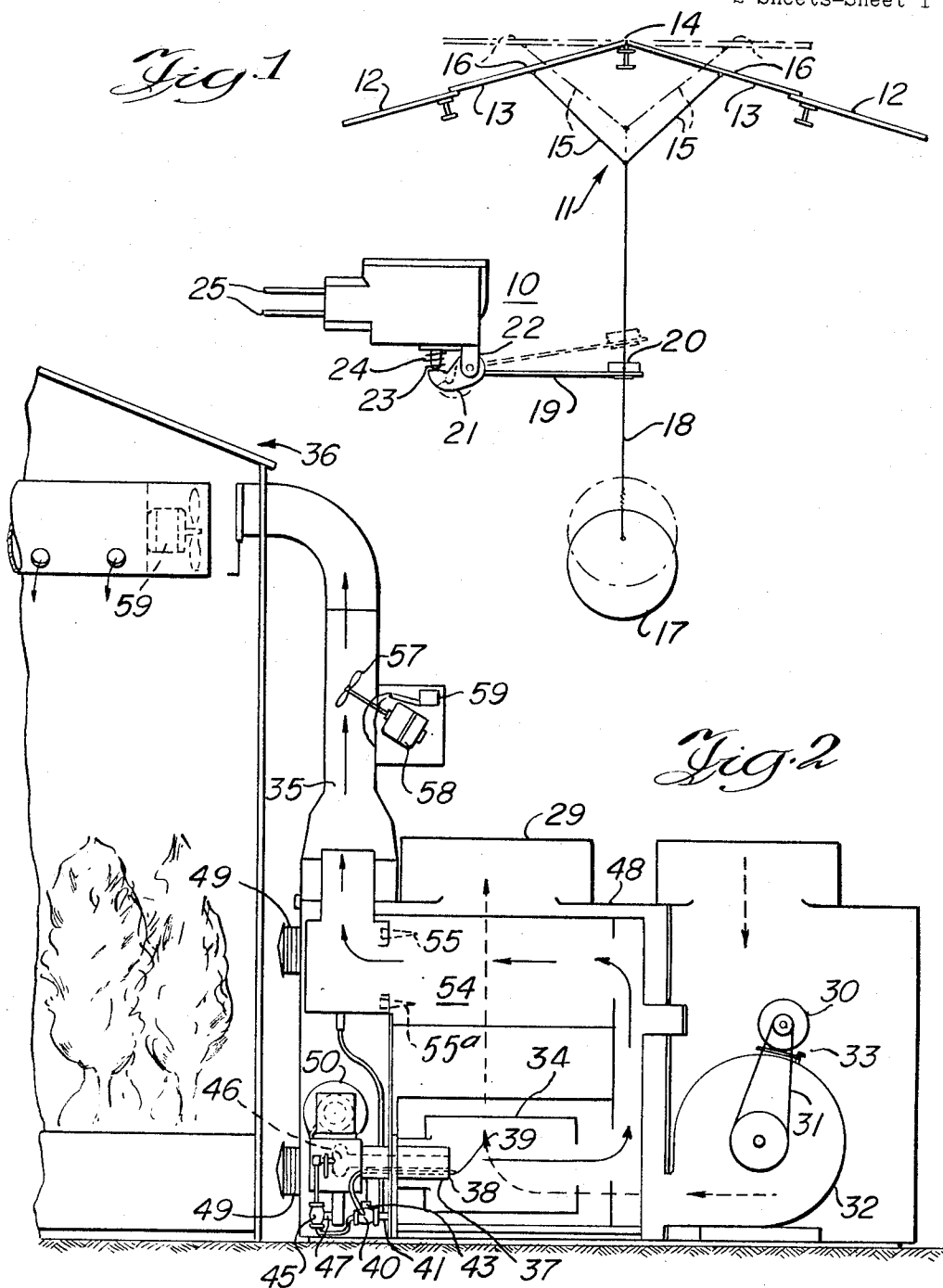
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W. I. TIBBITTS
ATMOSPHERE GENERATOR

3,383,179

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2 Sheets-Sheet 1



INVENTOR.

William I Tibbitts

By Hofgren, Wagner, Allen, Stillman & McCord

ATTORNEYS.

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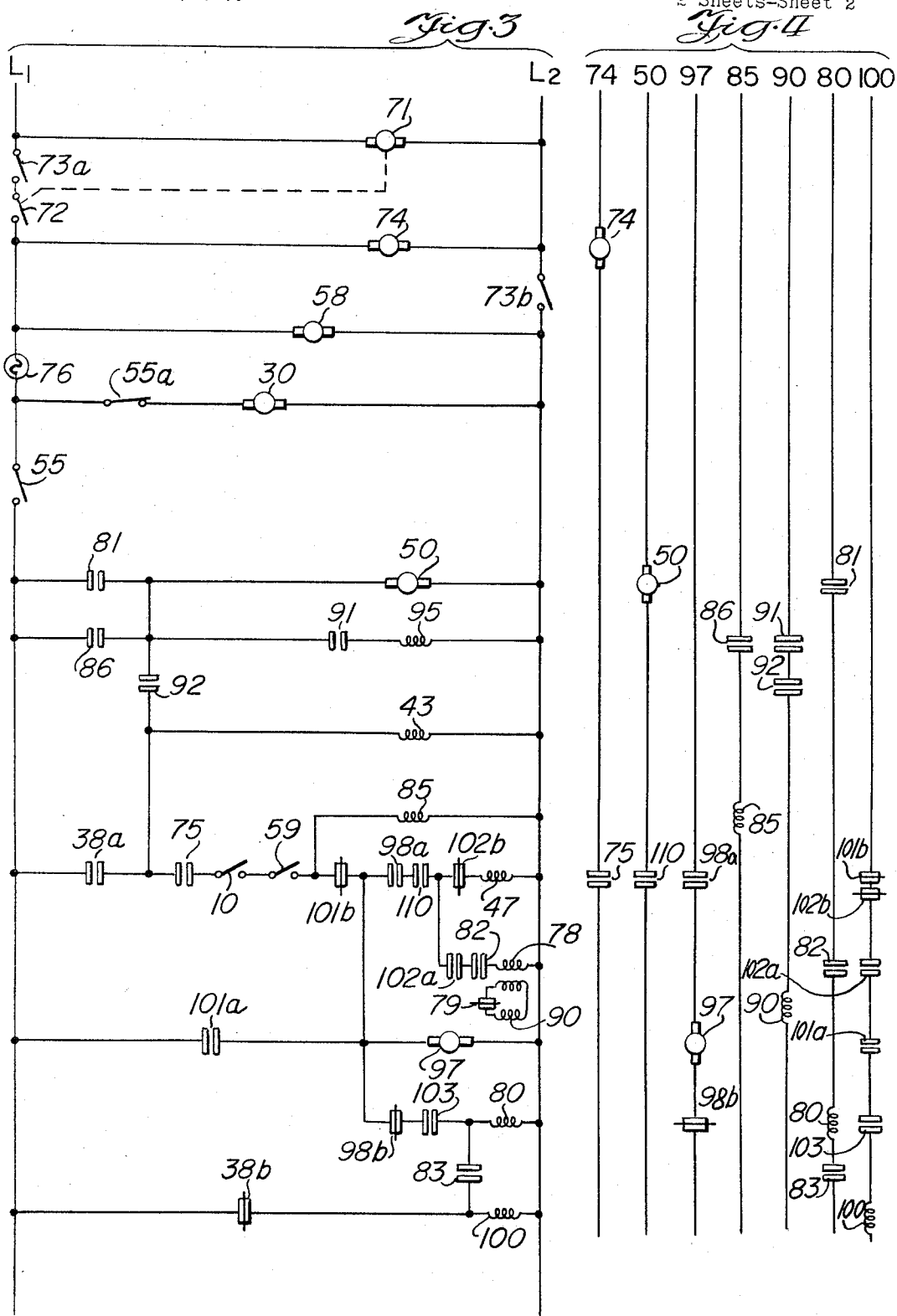
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3,383,179

ATMOSPHERE GENERATOR

William I. Tibbitts, St. Joseph, Mich., assignor to Whirlpool Corporation, a corporation of Delaware
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This invention relates to an atmosphere generator and control means therefor.

A feature of this invention is to provide an improved atmosphere generator control system in which plural timers are used in the system whereby the term of operation may be set by a first timing means to fall during a predetermined portion of a time period, for example, during the daylight hours of a 24-hour period, and where-
in a second timing means may be used to control generator operation, and thus atmosphere concentration, within the predetermined portion of the time period.

Another feature of the invention is the provision of means in the control system rendering the generator inoperable during such times as the structure, for example, a greenhouse, containing the generated atmosphere is vented to the outside atmosphere thereby precluding use-
less and wasteful operation of the generator.

More particularly, timing means are provided to insure that the burner chamber is purged of fuel before ignition of the pilot or burner thereby minimizing the possibility of an explosion and injury to persons in the area. Additionally, means are provided for precluding ignition before the burner air blower has attained a safe r.p.m. to protect the material subjected to the atmosphere from excessive heat. Means are also provided to terminate the operation should the atmosphere temperature exceed a preset level. Finally, means are provided for precluding generator operation if there is improper air movement in the duct conveying the atmosphere to the structure.

Further features and advantages will become apparent from the following description taken in connection with the accompanying drawings, in which:

FIGURE 1 is a detailed view of a vent operated switching means.

FIGURE 2 is a schematic illustration of the generator.

FIGURE 3 is a circuit diagram of the electrical portion of the system.

FIGURE 4 is a line diagram of the various control interrelations between elements of the electrical system.

The vent operated switch means of the present invention is shown in FIGURE 1. As its interrelation with the over-all system will be described in detail hereinafter, it is sufficient to say presently that it serves as an overriding control of the system to preclude operation of the latter when the vents of the atmosphere containing structure are open. The purpose of this feature is, of course, to prevent the generation of gases at a time when they will not be retained within the enclosing structure but will escape to the outside atmosphere, thus precluding wasteful operation of the device.

While the invention is susceptible to many divergent uses, as shown in FIGURE 1, the vent controlled switch is embodied in a greenhouse having a conventional roof 12 coming to a peak 14. Vents 13 are hinged (not shown) along the peak in any suitable manner. Suspended from the pair of vents 13 at 16 is a yoke 11, comprised of member 15, preferably of wire. Suspended in turn from the members is a wire or the like 18 which in turn supports a weight 17 to keep the wires taut. Preferably the length of each wire 15 is at least 1.5 times greater than the distance between roof peak 14 and the yoke connection 16 so as to minimize the force required to open and maintain the vents 13 in a desired position as well as the tension in the wires 15.

A switch 10 having an actuator 19 is adjustably secured

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by a collar and set screws arrangement 20 to the wire 18. By means of the adjustable connection any predetermined amount of vent opening may be selected to serve as the switch operating position. On the opposite end of the actuator 19 is mounted a lever 21 which is pivotally mounted to the switch 10 at 22. The switch 10 may be of conventional construction and is actuated by a shaft or pin operator 23 which is biased into engagement with lever 21 by a spring 24.

The vent switch 10 is connected into the control system (as will be shown later) by means of leads 25 and is arranged to be opened by upward movement of yoke 11 when the vents are opened to a predetermined degree. Thus fuel and electricity are conserved when the greenhouse is opened to the outside atmosphere.

FIGURE 2 shows the basic arrangement of the generator of the instant invention as used in the aforementioned exemplary greenhouse application. A conventional greenhouse structure is shown at 36. In accordance with this use of the invention, an atmosphere generator 29 communicates by duct 35 with a distribution duct 59 within the greenhouse 36 for delivery of the gases generated thereto.

The generator 29, which is of the type shown in Bose et al. application Ser. No. 382,148, filed July 13, 1964, and assigned to the same assignee as the present application, includes a blower unit for cooling air comprising a motor 30 driving by means of a belt 31 a blower 32. A conventional adjustable motor mount 33 is provided whereby the belt 31 can be drawn to the desired tautness.

The cooling air thus produced is introduced into generator housing 48 which includes a combustion chamber 34, preferably of stainless steel, for cooling the latter. Arranged in communication with the chamber 34 is a burner assembly comprising a pilot 37. A pilot sensor 38 and ignition device 39, such as a glow coil or a spark plug, are positioned in close proximity to the pilot 37 for sensing the presence or absence of the pilot flame and for igniting the pilot flame, respectively.

The flow of fuel to the pilot is controlled by a valve 40 in a gas main 41. The valve 40 is in turn controlled by a solenoid operator 43 which is supplied with electric current by leads in accordance with the dictates of the control system as will be seen hereinafter.

A main burner control valve 45 is placed in the gas main downstream of the pilot valve 40 and upstream of a gas orifice 46 is operated by a solenoid 47. As the burner construction is of conventional design, it is sufficient to note that combustion air is introduced through vents 49 and blower 50 to the gas stream where it is mixed and finally fed to the combustion chamber 34 where it is ignited and burned.

The products of combustion are then fed through a heat exchanger 54 to duct 35 to the greenhouse. It is to be noted that the combustion chamber 34 and duct 54 are arranged within the housing 48 such that the cooling air from blower 32 comes in intimate contact therewith to cool the products of combustion flowing therein, thereby preventing the excessive heat from being conducted into the greenhouse.

Within the duct 35 is arranged a blower 57 driven by a motor 58 which serves to aid the flow of gases in the duct. Also arranged within the duct is a sail switch 59 of conventional construction which, as will be described later, is arranged to preclude the main gas valve 45 from opening if there is improper air movement in the duct.

Additionally, a temperature responsive switch 55 is placed in the cooling air path adjacent heat exchanger 54 to terminate the operation of generator 29 should the temperature of the heat exchanger and/or the cooling air exceed a preset level. A second temperature responsive switch 55a is positioned in the cooling air path to de-

energize blower motor 50 at a preselected temperature of the cooling air. Should the temperature of the air increase sufficiently, switch 55a will operate to energize the blower motor 50.

Turning now to the detailed diagram of the control circuitry in FIGURE 3 and proceeding from top to bottom of that figure, there is seen two leads L₁ and L₂ for connection to the opposite polarities of an electric circuit. Connected across the two leads is a timer motor 71 for controlling by means of a cam or the like a switch 72 placed in lead L₁ in such a manner that motor 71 is independent of switch 72 while the remainder of the system receives current only when switch 72 is closed. Also placed between the timer switch 72 and the remainder of the system is a manually operable double pole switch 73 having contacts 73a, 73b. Thus, assuming that switch 73 is closed, the timer switch 72 controls the flow of current to the remainder of the system and can be set as desired to control the period during which the system may be energized and acts as a control for the system independently of the system.

A second motorized timer 74 is placed across leads L₁ and L₂ and controls the operation of switch 75 and ultimately determines during which portions of the time period during which timer controlled switch 72 is closed the atmosphere will be generated. Thus, once the system is energized by the first timer, the second timer controls the actual operation thereof in a manner described in greater detail below.

Also connected across leads L₁ and L₂ is the motor 58 for duct fan 57. Additionally placed in lead L₁ is a fuse 76. The motor 30 for the cooling air blower 32 is also connected in series with a normally closed thermostatic switch 55a across the leads L₁ and L₂. As a protective feature a normally closed thermally responsive switch 55 is placed in lead L₁. As mentioned previously, this switch 55 is placed in the cooling air path adjacent heat exchanger 54 and is arranged to open when a predetermined temperature is exceeded by air flowing over the heat exchanger, which, as will be seen, halts the atmosphere generating process.

Placed in series with the burner blower 50 across the leads L₁ and L₂ is a normally open relay switch 81 which may be energized to a closed position for starting the burner blower 50 by coil 80. Connected in parallel with relay switch 81 is a normally open relay switch 86 operated by coil 85. A normally open relay switch 91 controlled by coil 90 is placed in series with the primary of an ignition transformer 95, and both switch 91 and the transformer 95 are connected in parallel with blower motor 50. The secondary winding of the transformer 95 (not shown) is connected to the pilot igniting device 39 which, of course, is fired when the transformer is energized.

Also connected in parallel with blower 50 is the series circuit of a normally open relay switch 92, also operated by coil 90 and the pilot valve solenoid 43. Thus, when coil 90 is energized, and assuming either of switches 81 and 86 are closed, the pilot valve 43 is opened allowing gas to flow to the pilot and the igniting device is fired lighting the pilot.

At the junction of switch 92 and solenoid 43, and across lead L₁ is the first contact 38a of a conventional pilot heat sensor 38 of the SPDT variety. The sensor contact 38a is open when the sensor is in an unheated condition and will close when the pilot is lit. Connected to the same junction and across L₂ is the series circuit comprised of switch 75 operated by timer 74, vent switch 10, sail switch 59 and coil 85 which operates switch 86. By this arrangement, when pilot heat sensor is heated, thus contact 38a is closed, the pilot valve, and accordingly the flame, is independent of switch 92 thereby permitting ignition device to be de-energized to conserve power. By the same token, assuming timer switch 75, vent switch 10 and sail switch 59 dictate an "on" condition, coil 85 is

energized independently of switch 92 which closes switch 86 and permits the burner blower to operate independently of switch 81.

Connected to the junction of said switch 59 and coil 85 is the normally closed contact 101b of a SPDT relay switch 101 (operated by coil 100) which, in turn, is connected to L₂ through the normally open contact 98a of a SPDT timing switch 98 operated by purge timer motor 97; normally open centrifugal switch 110 which is closed when the burner air blower 50 has attained proper r.p.m.; the normally closed contact 102b of an SPDT relay switch 102, also operated by coil 100; and finally the main burner valve solenoid 47.

Connected to the junction between centrifugal switch 110 and contact 102b is a series circuit to lead L₂ comprised of the normally open contact 102a of SPDT relay switch 102, normally open relay switch 82 operated by coil 80 and the primary winding of a transformer 78. The secondary of transformer 78 is connected to the series circuit of a normally closed, manually resettable switch 99 and relay coil 90 which operates normally open switches 91 and 92, the arrangement being such as to close switches 91 and 92 when the transformer 78 is energized.

At the junction of contacts 101b and 98a, and across lead L₁ is connected the normally open contact 101a of the SPDT relay switch 101. Also connected to this same junction, and across L₂, is the purge timer motor 97. Also connected to this same junction, in series, is the normally closed contacts 98b of the SPDT switch 98 operated by purge timer 97, a normally open switch 103 (operated by coil 100) and relay coil 80.

At the junction of switch 103 and coil 80 is connected one pole of a normally open relay switch 83 operated by coil 80. The other pole is connected across relay coil 100 to lead L₂ and across the normally closed contact 38b of the SPDT pilot sensor switch 38. The contact 38b is arranged to be open when heated by the pilot.

OPERATION

Assuming manual DPST switch 73 (not shown) having contacts 73a, 73b has been closed, and timer motor 71 has closed timer switch 72, leads L₁ and L₂ supply the remainder of the system with current. Thus, the second timer 74, duct fan motor 58 and the cooling air blower 30 are energized and in operation. Similarly, current flows through the normally closed contact 38b of pilot sensor 38 to energize coil 100.

The energization of coil 100 simultaneously closes SPDT contacts 101a and 102a and switch 103 and opens SPDT contacts 101b and 102b. With the closing of contact 101a and switch 103, current flows to the purge timer 97 and to relay coil 80 which results in the closing of normally open switches 81, 82 and 83.

The closing of switch 81 energizes the burner air blower motor 50 while the closing of switch 83 makes relay coil 80 independent of the normally closed purge timer contact 98b when the latter opens upon completion of the purge interval. When the burner air blower is operating properly and for the period of time dictated by purge timer 97, purge timer switch contact 98a is closed while purge timer switch contact 98b is opened and burner air blower motor centrifugal switch 110 is closed. Relay coil 80 remains energized through sensor contact 38b and switch 83.

Since relay coils 100 and 80 have closed switch contact 102a and switch 82, respectively, current flows from L₁ through switch contacts 101a and 98a, centrifugal switch 110, switch contact 102a and switch 82 to energize transformer 78. By virtue of its connection to the secondary of transformer 78, relay coil 90 is energized thus closing switches 91 and 92 which energizes through those switches and switch 81, the pilot ignition transformer 95 and pilot valve solenoid 43. This energizes the pilot igni-

tion device 39 and permits gas to flow to the pilot 37 resulting in the lighting of the pilot 37.

When the pilot is lit, the sensor switch contact 38a is closed simultaneously with the opening of pilot sensor switch contact 38b. The closing of contact 38a makes the pilot ignition transformer 95 and the pilot valve solenoid independent of relay switch 81. The opening of contact 38b de-energizes relay coils 80 and 100.

This results in the opening of switches 81, 82 and 83 controlled by relay coil 80 which in turn shuts off the current to transformer 78. With the latter being de-energized, relay coil 90 no longer receives current resulting in the opening of switches 91 and 92 which de-energize the ignition transformer 95 and the burner air blower 50.

At this point the pilot 37 is lit, pilot valve solenoid 43 is receiving current through sensor contact 38a which is maintained closed by the pilot heat, and the system remains in a "standby" condition until the second timer 74, according to its present program closes timer switch 75.

Assuming at this point that the structure vents and thus vent switch 10 is closed, and duct fan 58 is operating properly so as to close said switch 59, when the timer switch 75 is closed, current is fed through sensor contact 38a, timer switch 75, vent switch 10 and sail switch 59 to relay coil 85 which, when energized, closes switch 85 thereby starting burner air blower 50. When the blower 50 has reached the requisite r.p.m., centrifugal switch 110 is closed. Since purge timer contact 98a has previously been closed when relay coil 100 was de-energized, current flows to main burner valve solenoid 47 which then permits the burner stream of fuel to flow into chamber 34 where it is ignited by the pilot 37. The gases thus generated, rich in carbon dioxide, are then directed to their point of application.

The system will remain in this condition until either (1) timer 74 opens switch 75, (2) the structure vents are opened thus opening switch 10, (3) the air passage in the ducts is improper resulting in the opening of switch 59, (4) the system is manually shut down by the opening of DPDT switch 73, (5) timer 71 opens switch 72, or (6) the thermally responsive switch 55 opens due to system malfunction.

In the first three cases, it is evident that the system merely reverts to its "standby" condition wherein the pilot 37 is lit, while in the latter three cases, all gas is shut off.

From the foregoing, it is evident that I have provided a reliable and safe control for atmosphere generators. From the economic standpoint, the advantages of the system are apparent, particularly that provided by my two-timer setup whereby not even pilot fuel is consumed when the main timer dictates an "off" condition.

Furthermore, it is apparent that by appropriately programming the second timer, the percent of carbon dioxide in the structure housing the material being treated, as well as the temperature thereof, can be controlled with some degree of fineness.

Having described my invention as related to the embodiment shown in the accompanying drawing, it is my intention that the invention be not limited by any of the details of description, unless otherwise specified, but rather be construed broadly within its spirit and scope as set out in the accompanying claims.

The embodiment of the invention in which an exclusive property or privilege is claimed is defined as follows:

1. An atmosphere generating system comprising: intermittently operable means for generating a gaseous atmosphere; control means, including an electric circuit,

operable when activated to cause said generating means to operate to generate a gaseous atmosphere; a first timing means including first electrical switch means closable during a predetermined time period; and an electrical second timing means connected in circuit with said switch means to be energized during said time period and deenergized at all other times and including second electrical switch means closable during at least one preset portion of said time period, said electrical circuit including said second switch means so as to be energized during said preset portion of said time period to activate said control means thereby causing said generating means to operate and generate said gaseous atmosphere, said generating means comprising a generator of the combustion type having a burner for receiving and consuming fuel and a pilot associated with said burner for igniting fuel received by said burner, said first timing means including means for activating said pilot during said time period and for deactivating said pilot at all other times, said control means including means for directing fuel to said burner and said second timing means comprising means for activating said directing means during said preset portion of said time period and for deactivating said directing means at all other times.

2. An atmosphere generating system that is particularly suited for providing at an atmosphere in a generally closed structure having means operable to vent said structure according to claim 1 further including means for overriding said second timing means to preclude activation of said directing means during said present portion of said time period when said vent means is venting said structure.

3. A gaseous atmosphere generator and control system, comprising: an electrical circuit; electrically operated control means in said circuit; electrically operated first timing means forming a part of said control means and in said circuit for selectively activating said circuit for preset time periods; electrically operated generating means in said circuit for generating said atmosphere; and electrically operated second timing means forming a part of said control means and in said circuit for selectively activating said generating means during at least one of said preset time periods when said circuit is activated by said first timing means.

4. The system of claim 3 wherein there are provided a chamber for receiving said atmosphere, duct means between said generating means and chamber for transferring said atmosphere to said chamber, selectively operable venting means in said chamber openable to a predetermined degree, and electrically operable means forming a part of said control means and in said electrical circuit for precluding operation of said generating means when said venting means are open to said predetermined degree.

5. The system of claim 3 wherein said control means includes safety means for sensing an abnormal unsafe condition in said system, and means in said circuit operated by said control means for precluding operation of said generating means during said condition.

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JAMES H. TAYMAN, JR., *Primary Examiner.*