water can be lost through evaporation.

It would be desirable if a means and method were available which addressed one or more of the above disadvantages associated with the production of foam and hydroponic growing of plants.

Summary of the Invention

The present invention thus provides in a first preferred aspect, a foam production unit comprising a chamber, inlet means to said chamber for oxygenated air and liquid, and means for controlling the flow of said air and liquid through or from said chamber to thereby create a liquid foam. By controlling the flow of air and liquid through or from the chamber, a back pressure is created resulting in aeration of the liquid and creation of the liquid foam.

In one form the chamber of the foam production unit comprises a mixing chamber in which liquid and air supplied to the chamber are mixed. The inlet means may comprise one or more inlets for air and one or more inlets for liquid.

The chamber may have one or more outlets and the means may be provided for controlling or restricting flow from the one or more inlets of air and liquid to or through the one or more outlets. The means for controlling flow may comprise means in the chamber which provide a controlled directional path for air and liquid from the air and liquid inlet means to the outlet. The means for controlling or restricting flow may comprise a plurality of discrete elements within the chamber. The discrete elements may comprise a plurality of spherical members or members of any other shape. The discrete elements may substantially fill the mixing chamber or may only partially fill the chamber. The discrete elements may be free for movement in the chamber so as to mix liquid and air in the chamber to enhance liquid foam production.

In another embodiment, the controlling means within the chamber may comprise an organic or other solid permeable material. The permeable material may comprise a solid foam. The solid foam may be a flexible open cell solid foam such as an organic or other foam. For example the foam may be a plastics foam or urethane foam. Alternatively the permeable material may be any other organic or inorganic material such as fibrous material which has similar flow controlling or restricting properties to foam.

The one or more outlets form the chamber may comprise one or more openings or slots in a wall of the chamber.

In another aspect, the outlet or outlets from the chamber may be limited such that air and liquid mixed in said chamber can exit from said chamber through the outlet as liquid foam.

Preferably the outlet or outlets is/are defined by or comprises a permeable material or member. The permeable material may comprise a solid foam. The foam may be a flexible open cell solid foam such as an organic or other foam. The permeable material may be selectively compressed to vary its permeability and thus the foam production. Alternatively the outlet or outlets may comprise a permeable member or wall for example a member or wall having a plurality of fine perforations.

In one preferred form, the mixing chamber may be defined by an outer elongated housing or tube. Preferably at least one air supply tube extends into the mixing chamber for supply of air thereto. Preferably the air supply comprises an oxygenated air supply. At least one liquid supply tube may also extend into the mixing chamber for supply of liquid thereto. The air supply tubes and liquid supply tubes may be formed so as to allow the directional flow of air and/or liquid. For example the tubes may have their side walls perforated.

Preferably the outer elongated housing or tube is covered by a layer of permeable material which restricts the passage of liquid and air and therefore enhances the production of foam.

The mixing chamber alternatively may be defined by the annular space between the air supply tube and outer housing or chamber and the solution is supplied to the annular space.

In a further embodiment, the foam production unit may comprise a nozzle. The nozzle may comprise a housing to which liquid and air may be supplied, the housing having an outlet which is restricted by a solid permeable material, typically in the form of a layer of such material. Alternatively the permeable material may comprise a perforated member.

The present invention in a further preferred aspect provides a method of growing plants using a growing medium which comprises a liquid foam. Preferably the liquid foam is formed by one or more of the above described methods and apparatus. Preferably, the foam comprises a foam which contains a plant nutrient or nutrients to promote the growth of plants.

The present invention in a further preferred aspect provides an apparatus for growing plants, said apparatus comprising a root chamber or compartment for

containing the roots of said plants and means for supplying a liquid foam to said root chamber. The liquid foam as referred to above suitably contains a plant nutrient or nutrients.

Preferably the liquid foam is formed in a foam production unit as referred to above from a solution of nutrients and a foaming agent. The foaming agent may comprise a soluble organic emulsifying concentrate.

Apparatus in accordance with the invention for growing plants may be in a number of different configurations.

In one aspect, the apparatus may comprise an elongated chamber typically in the form of a pipe or tube through which a foam production unit may extend or which alternatively may be supplied with liquid foam. The elongated chamber may be provided with a plurality of spaced openings in which plants to be grown may be located.

The elongated chamber may be oriented substantially horizontally or oriented substantially vertically. When in a vertical orientation, the elongated chamber may be defined by a plurality of separate compartments. The foam production unit may extend through and be located within the chamber or compartments. Alternatively, the foam production unit may be arranged externally with foam from the unit supplied to the respective compartments.

Elongated chambers of the above type may be mounted on a rotatable carousel to be rotatable about a vertical axis. Elongated chambers alternatively may be mounted on a frame for rotation about a horizontal axis.

In a further embodiment, the apparatus may comprise an open topped tray or compartment. A foam production unit may extend through the tray for supply of foam thereto. Alternatively the foam production unit may be provided in the base of the tray or compartment. Trays of the above type may be mounted on a rotatable frame for movement about a horizontal axis. Means such as pivot means may be provided to support the trays to maintain the trays in a substantially horizontal orientation when rotated.

According to a further aspect, the present invention provides an apparatus for growing plants, the apparatus comprising: an elongated chamber in the form of a pipe or tube; a foam production unit extending inside the elongated chamber; a plurality of spaced openings in the elongated chamber in which plants to be grown are located; and wherein the foam production unit provides a liquid foam from a

solution of nutrients and a foaming agent, wherein the liquid foam containing the nutrients is supplied to the plants to promote the growth of the plants.

The foam production unit may be located externally of the elongated chamber and the liquid foam may be fed inside the chamber by a feed tube extending inside the elongated chamber. The elongated chamber may be oriented substantially horizontally or oriented substantially vertically. When oriented substantially vertically, the elongated chamber may be defined by a plurality of separate compartments, and the foam production unit extends through and be located within the chamber or compartments. The foam production unit may be arranged externally with foam from the unit supplied to the respective compartments.

Preferably the elongated chambers may be mounted on a rotatable carousel to be rotatable about a vertical axis. The elongated chambers may be mounted on a frame for rotation about a horizontal axis.

According to a further aspect, the present invention provides an apparatus for growing plants according to any of the features of the above foam production unit wherein the elongated chamber may be formed in any shape which allows the growth of plants.

According to a still further aspect, the present invention provides an apparatus for growing plants comprising: an open topped tray or compartment; a foam production unit extending through the tray for supply of foam thereto for promoting the growth of plants.

Preferably, the trays may be mounted on a rotatable frame for movement about a horizontal axis, wherein a pivot means may be provided to support the trays to maintain the trays in a substantially horizontal orientation when rotated. The foam production unit may be provided in the base of the tray or compartment.

According to a further aspect, the present invention provides an apparatus for growing plants comprising: a foam producing unit having an axis, a peripheral wall extending about said axis and having axially spaced apart opposite ends, and end walls closing said peripheral wall at said opposite ends, said peripheral wall and said end walls providing said foam producing unit with an interior for receiving an oxygenated air and liquid; a plurality of shaped projections extending outwardly from the peripheral wall of the foam production unit; a root chamber comprising a top wall, a bottom wall and side walls enclosing the root chamber and spaced apart end walls, at least one end wall having a complimentary shaped projection to receive the

~~shaped projection extending from the peripheral wall of the foam production unit,~~ said top wall having an opening for receiving a plant; and a means for controlling the flow of said oxygenated air and liquid through or from said foam producing unit and into said root chamber to thereby create a liquid foam which contains a plant nutrient or nutrients to promote the growth of plants.

Preferably, the peripheral wall of said foam producing unit may be formed in the shape of a polygon or the peripheral wall of said foam producing unit may be formed in the shape of a cylinder.

Preferably, the shaped projections extending from the peripheral wall may be either in the shape of a polygon or a cylinder.

Preferably, the foam production unit may further comprise projections extending outwardly from said end walls to receive said oxygenated gas and liquid. Said projections may be used to mount said apparatus for growing plants in a vertical arrangement. Said projections may be mounted into a carousel for rotating the growing apparatus.

Preferably, the apparatus for growing plants may further comprise at least one reflector mounted to an edge of side of said growing apparatus to reflect light to promote the growth of the plants.

Preferably, the apparatus for growing plants may further comprise at least one light source to promote the growth of plants.

The foam production method and apparatus described above may also be used for producing foam for fire suppression applications or any other applications where liquid foam is required. The liquid for forming the foam may include or ~~comprise a fire suppressant liquid.~~

Brief Description of the Drawings

Reference will now be made to the accompanying drawings which illustrate preferred embodiments of the invention. The following embodiments are described in relation to the production of foam for growing of plants and a method and apparatus of growing plants in a liquid foam. It will be appreciated however that the described and illustrated foam production methods and apparatus may be used in any other application where liquid foam is required and thus the following description is not to be considered as limiting on the application of the invention or parts thereof. In the drawings:-

Fig. 1 illustrates in schematic sectional view, a foam production unit according to

Claims

1. A foam production unit comprising a chamber, inlet means to said chamber for oxygenated air and liquid, and means for controlling the flow of said oxygenated air and liquid through or from said chamber to thereby create a liquid foam.

2. A foam production unit as claimed in claim 1, wherein the chamber of the foam production unit comprises a mixing chamber in which liquid and oxygenated air supplied to the chamber are mixed.

3. A foam production unit as claimed in claim 1 or claim 2, wherein the inlet means comprises one or more inlets for oxygenated air and one or more inlets for liquid, and the chamber has one or more outlets and the means for controlling the flow is provided for controlling or restricting flow from the one or more inlets of oxygenated air and liquid to or through the one or more outlets.

4. A foam production unit as claimed in any one of claims 1 to 3, wherein the means for controlling flow comprises means in the chamber which provide a controlled directional path for oxygenated air and liquid from the oxygenated air and liquid inlet means to the outlet.

5. A foam production unit as claimed in any one of the preceding claims, wherein the means for controlling or restricting flow comprises a plurality of discrete elements within the chamber, wherein the discrete elements comprise a plurality of spherical members or members of any other shape, and the discrete elements substantially fill the mixing chamber.

6. A foam production unit as claimed in claim 5, wherein the discrete elements only partially fill the chamber, therefore the discrete elements are free for movement in the chamber so as to mix liquid and oxygenated air in the chamber to enhance liquid foam production.

7. A foam production unit as claimed in any one of the preceding claims, wherein the controlling means within the chamber comprises an organic or other solid permeable material, the permeable material comprises a solid foam, wherein the solid foam is a flexible open cell solid foam such as an organic or other foam.

8. A foam production unit as claimed in claim 7, wherein the permeable material is any other organic or inorganic material such as fibrous material which has similar flow controlling or restricting properties to foam.

9. A foam production unit as claimed in any one of claims 1 to 4, wherein the one or more outlets from the chamber comprise one or more openings or slots in a wall of the chamber, and are limited such that the oxygenated air and liquid mixed in said chamber can exit from said chamber through the outlet as liquid foam.

10. A foam production unit as claimed in claim 9, wherein the one or more outlets comprise a permeable material or member, wherein the permeable material may comprise a solid foam, and the foam is a flexible open cell solid foam such as an organic or other foam.

11. A foam production unit as claimed in 10, wherein the permeable material is selectively compressed to vary its permeability and thus the foam production.

12. A foam production unit as claimed in claim 10, wherein the one or more outlets comprise a permeable member or wall for example a member or wall having a plurality of fine perforations.

13. A foam production unit as claimed in any one of the preceding claims, wherein the mixing chamber is defined by an outer elongated housing or tube, and the at least one oxygenated air supply tube extends into the mixing

chamber for supply of oxygenated air thereto, and the at least one liquid supply tube extends into the mixing chamber for supply of liquid thereto.

14. A foam production unit as claimed in claim 13, wherein the oxygenated air supply tubes and liquid supply tubes are formed so as to allow the directional flow of oxygenated air and/or liquid, wherein the tubes have their side walls perforated.

15. A foam production unit as claimed in claim 13 or claim 14, wherein the outer elongated housing or tube is covered by a layer of permeable material which restricts the passage of liquid and oxygenated air and therefore enhances the production of foam.

16. A foam production unit as claimed in any one of the preceding claims, wherein the mixing chamber is defined by the annular space between the oxygenated air supply tube and outer housing or chamber and the solution is supplied to the annular space.

17. A foam production unit comprising a nozzle, wherein the nozzle comprises a housing to which liquid and oxygenated air are supplied, the housing having an outlet which is restricted by a solid permeable material, wherein the nozzle controls the flow of said oxygenated air and liquid through or from said foam production unit to thereby create a liquid foam.

18. A foam production unit as claimed in claim 17, wherein the solid permeable material is in the form of a layer of such material.

19 A foam production unit as claimed in claim 17 or claim 18 wherein the permeable material comprises a perforated member.

20. A foam production unit as claimed in any one of the preceding claims, wherein the foam comprises a foam which contains a plant nutrient or nutrients to promote the growth of plants.

21. An apparatus for growing plants comprising:

a foam producing unit having an axis, a peripheral wall extending about said axis and having axially spaced apart opposite ends, and end walls closing said peripheral wall at said opposite ends, said peripheral wall and said end walls providing said foam producing unit with an interior for receiving an oxygenated air and liquid;

a plurality of shaped projections extending outwardly from the peripheral wall of the foam production unit;

a root chamber comprising a top wall, a bottom wall and side walls enclosing the root chamber and spaced apart end walls, at least one end wall having a complimentary shaped projection to receive the shaped projection extending from the peripheral wall of the foam production unit, said top wall having an opening for receiving a plant; and

a means for controlling the flow of said oxygenated air and liquid through or from said foam producing unit and into said root chamber to thereby create a liquid foam which contains a plant nutrient or nutrients to promote the growth of plants.

22. An apparatus for growing plants as claimed in claim 21, wherein the peripheral wall of said foam producing unit is formed in the shape of a polygon.

23. An apparatus for growing plants as claimed in claim 21 or claim 22, wherein the peripheral wall of said foam producing unit is formed in the shape of a cylinder.

24. An apparatus for growing plants as claimed in any one of claims 21 to 23, wherein the shaped projections extending from the peripheral wall are either in the shape of a polygon or a cylinder.

25. An apparatus for growing plants as claimed in any one of claims 21 to 24, wherein the foam production unit further comprises projections extending outwardly from said end walls to receive said oxygenated gas and liquid, and said projections are used to mount said apparatus for growing plants in a vertical arrangement.

26. An apparatus for growing plants as claimed in claim 25, wherein said projections are mounted into a carousel for rotating the growing apparatus.

27. An apparatus for growing plants as claimed in any one of claims 21 to 26, further comprising at least one reflector mounted to an edge of side of said growing apparatus to reflect light to promote the growth of the plants, and at least one light source to promote the growth of plants.

28. A foam production and unit as claimed in any one of claims 1 to 27 also used for producing foam for fire suppression applications or any other applications where liquid foam is required.

29. A foam production unit as claimed in claim 28, wherein the liquid foam comprises a fire suppressant liquid.

30. An apparatus for growing plants as claimed in claim 27, wherein said apparatus comprises a root chamber or compartment for containing the roots of said plants and means for supplying a liquid foam to said root chamber, wherein the liquid foam contains a plant nutrient or nutrients.

31. An apparatus for growing plants as claimed in claim 30, further comprising a foam production unit for forming the liquid foam from a solution of nutrients and a foaming agent, the foaming agent comprises a soluble organic emulsifying concentrate.

32. An apparatus for growing plants, the apparatus comprising:

an elongated chamber in the form of a pipe or tube;

a foam production unit extending inside the elongated chamber;

a plurality of spaced openings in the elongated chamber in which plants to be grown are located; and

wherein the foam production unit provides a liquid foam from a solution of nutrients and a foaming agent, wherein the liquid foam containing the nutrients is supplied to the plants to promote the growth of the plants.

33. An apparatus for growing plants as claimed in claim 32, wherein the foam production unit is located externally of the elongated chamber and the liquid foam is fed inside the chamber by a feed tube extending inside the elongated chamber.

34. An apparatus for growing plants as claimed in claim 32 or claim 33, wherein the elongated chamber may be oriented substantially horizontally or oriented substantially vertically.

35. An apparatus for growing plants as claimed in claim 34 wherein when oriented substantially vertically, the elongated chamber may be defined by a plurality of separate compartments, and the foam production unit extends through and be located within the chamber or compartments, the foam production unit is arranged externally with foam from the unit supplied to the respective compartments.

36. An apparatus for growing plants as claimed in any one of claims 32 to 35, wherein the elongated chambers are mounted on a rotatable carousel to be rotatable about a vertical axis.

37. An apparatus for growing plants as claimed in any one of claims 32 to 34, wherein the elongated chambers are mounted on a frame for rotation about a horizontal axis.

38. An apparatus for growing plants as claimed in any one of claims 32 to 37, wherein the elongated chamber is formed in any shape which allows the growth of plants.

39. An apparatus for growing plants as claimed in claim 38 further comprising an open topped tray or compartment and a foam production unit extending through the tray for supply of foam thereto for promoting the growth of plants.

40. An apparatus for growing plants as claimed in claim 39, wherein the trays are mounted on a rotatable frame for movement about a horizontal axis, wherein a pivot means is provided to support the trays to maintain the trays in a substantially horizontal orientation when rotated.

41. An apparatus for growing plants as claimed in claim 40, wherein the foam production unit is provided in the base of the tray or compartment.

water can be lost through evaporation.

It would be desirable if a means and method were available which addressed one or more of the above disadvantages associated with the production of foam and hydroponic growing of plants.

Summary of the Invention

In accordance with a first aspect, the present invention provides a foam production unit comprising: a chamber with an inlet means to said chamber, the inlet means having an inlet for oxygenated air and an inlet for liquid, said chamber comprising: a coaxial pipe or tube assembly with an elongated inner pipe which is perforated along its length and an outer pipe which is coaxially arranged with the inner pipe and perforated along its length; a mixing chamber formed in an annular space located between the inner elongated pipe and the outer elongated pipe; and a means for controlling the flow of mixed air and liquid through or from the chamber to create a back pressure in the inner elongated pipe to thereby create a liquid foam.

Preferably, the inlet means may comprise one or more inlets for oxygenated air and one or more inlets for liquid, and the chamber has one or more outlets and the means for controlling the flow is provided for controlling or restricting flow from the one or more inlets of oxygenated air and liquid to or through the one or more outlets.

Preferably, the means for controlling the flow of mixed air and liquid through or from the chamber may comprise an air pervious layer extending along the length of the outer elongated pipe which restricts the passage of the mixed air and liquid exiting from the chamber to create the back pressure to thereby create the liquid foam.

Preferably, the air pervious layer may comprise a flexible open cell plastics foam or any other air pervious material. The air pervious layer may be wrapped spirally around the outer elongated pipe. Alternatively, the air pervious layer may be formed into a self-supporting sleeve which is located around the outer elongated pipe.

Preferably, the means for controlling the flow of mixed air and liquid through or from the chamber may comprise means in the chamber which provide a controlled directional path for oxygenated air and liquid from the oxygenated air and liquid inlet means to the outlet.

Preferably, the means for controlling or restricting flow comprises a plurality of discrete elements within the chamber, wherein the discrete elements comprise a plurality of spherical members or members of any other shape, and the discrete elements substantially fill the mixing chamber. Alternatively, the discrete elements

may only partially fill the chamber, therefore the discrete elements are free for movement in the chamber so as to mix liquid and oxygenated air in the chamber to enhance liquid foam production.

Preferably, the chamber may comprise a coaxial tube assembly with an elongated inner pipe with slots extending along its length and an elongated outer pipe which is coaxially arranged with the inner pipe and has slots extending along its length, and the means for controlling the flow is provided for controlling or restricting flow from the one or more inlets of oxygenated air and liquid to or through the coaxial tube assembly.

Preferably, the means for controlling the flow of mixed air and liquid through or from the chamber may comprise a permeable material or member formed in an annular space located between the inner elongated pipe and the outer elongated pipe, wherein the permeable material comprises a solid foam, and the foam is a flexible open cell solid foam such as an organic or other foam. The permeable material may be selectively compressed to vary its permeability and thus the foam production. For example the foam may be a plastics foam or urethane foam. Alternatively the permeable material may be any other organic or inorganic material such as fibrous material which has similar flow controlling or restricting properties to foam.

Preferably, the foam production unit may comprise a nozzle, wherein the nozzle comprises a housing to which liquid and oxygenated air are supplied, the housing having an outlet which is restricted by a solid permeable material, wherein the nozzle controls the flow of said oxygenated air and liquid through or from said foam production unit to thereby create a liquid foam, wherein the solid permeable material is in the form of a layer of such material.

Preferably, the permeable material may comprise a perforated member. The foam may contain a plant nutrient or nutrients to promote the growth of plants.

The one or more outlets form the chamber may comprise one or more openings or slots in a wall of the chamber. Alternatively, the outlet or outlets from the chamber may be limited such that air and liquid mixed in said chamber can exit from said chamber through the outlet as liquid foam.

Preferably the outlet or outlets is/are defined by or comprises a permeable material or member. The permeable material may comprise a solid foam. The foam may be a flexible open cell solid foam such as an organic or other foam. The permeable material may be selectively compressed to vary its permeability and thus

the foam production. Alternatively the outlet or outlets may comprise a permeable member or wall for example a member or wall having a plurality of fine perforations.

In one preferred form, the mixing chamber may be defined by an outer elongated housing or tube. Preferably at least one air supply tube extends into the mixing chamber for supply of air thereto. Preferably the air supply comprises an oxygenated air supply. At least one liquid supply tube may also extend into the mixing chamber for supply of liquid thereto. The air supply tubes and liquid supply tubes may be formed so as to allow the directional flow of air and/or liquid. For example the tubes may have their side walls perforated.

Preferably the outer elongated housing or tube is covered by a layer of permeable material which restricts the passage of liquid and air and therefore enhances the production of foam.

The mixing chamber alternatively may be defined by the annular space between the air supply tube and outer housing or chamber and the solution is supplied to the annular space.

In accordance with a further aspect, the present invention provides a foam production unit for growing plants having a chamber with an axis, a peripheral wall extending about said axis and having axially spaced apart opposite ends, and end walls closing said peripheral wall at said opposite ends, said peripheral wall and said end walls providing said foam producing unit with an interior; said foam production unit comprising: an inlet means to said chamber, the inlet means having an inlet for oxygenated air and an inlet for liquid; a coaxial pipe or tube assembly with an elongated inner pipe which is perforated along its length and an outer pipe which is coaxially arranged with the inner pipe and perforated along its length; a mixing chamber formed in an annular space located between the inner elongated pipe and the outer elongated pipe; and a plurality of shaped projections extending outwardly from the peripheral wall of the foam production unit; a root chamber comprising a top wall, a bottom wall and side walls enclosing the root chamber and spaced apart end walls, at least one end wall having a complimentary shaped projection to receive the shaped projection extending from the peripheral wall of the foam production unit, said top wall having an opening for receiving a plant; and a means for controlling the flow of said oxygenated air and liquid through or from said foam producing unit and into said root chamber to thereby create a liquid foam which contains a plant nutrient or nutrients to promote the growth of plants.

Preferably, the peripheral wall of said foam producing unit may be formed in the

shape of any one of the following: a) a polygon or b) a cylinder.

Preferably, the shaped projections extending from the peripheral wall may be either in the shape of a polygon or a cylinder.

Preferably, the foam production unit may further comprise projections extending outwardly from said end walls to receive said oxygenated gas and liquid, and said projections are used to mount said apparatus for growing plants in a vertical arrangement. The projections may be mounted into a carousel for rotating the growing apparatus. At least one reflector may be mounted to an edge or side of said chamber to reflect light to promote the growth of the plants, and at least one light source to promote the growth of plants.

Preferably, the foam production unit may further comprise forming the liquid foam from a solution of nutrients and a foaming agent, the foaming agent comprises a soluble organic emulsifying concentrate.

In accordance with a further aspect, the present invention provides a method of growing plants using a growing medium which comprises a liquid foam. Preferably the liquid foam may be formed by one or more of the above described methods and apparatus. Preferably, the foam may comprise a foam which contains a plant nutrient or nutrients to promote the growth of plants.

Preferably the liquid foam may be formed in a foam production unit as referred to above from a solution of nutrients and a foaming agent. The foaming agent may comprise a soluble organic emulsifying concentrate.

Apparatus in accordance with the invention for growing plants may be in a number of different configurations.

In accordance with a still further aspect, the present invention provides a foam producing apparatus for growing plants, the apparatus comprising: an elongated chamber in the form of a pipe or tube; a foam production unit extending inside the elongated chamber with an inlet means to said chamber, the inlet means having an inlet for oxygenated air and an inlet for liquid, a coaxial pipe or tube assembly with an elongated inner pipe which is perforated along its length and an outer pipe which is coaxially arranged with the inner pipe and perforated along its length, and a mixing chamber formed in an annular space located between the inner elongated pipe and the outer elongated pipe; and a plurality of spaced openings in the elongated chamber in which plants to be grown are located; and wherein the foam production unit provides a liquid foam from a solution of nutrients and a foaming agent, wherein the liquid foam

containing the nutrients is supplied to the plants to promote the growth of the plants.

Preferably, the foam production unit may be located externally of the elongated chamber and the liquid foam is fed inside the chamber by a feed tube extending inside the elongated chamber, and the elongated chamber is oriented substantially horizontally or oriented substantially vertically. When oriented substantially vertically, the elongated chamber may be defined by a plurality of separate compartments, and the foam production unit extends through and can be located within the chamber or compartments, the foam production unit is arranged externally with foam from the unit supplied to the respective compartments.

Preferably, the elongated chambers may be mounted on a rotatable carousel to be rotatable about a vertical axis or the elongated chambers are mounted on a frame for rotation about a horizontal axis.

Preferably, the foam producing apparatus for growing plants may further comprise an open topped tray or compartment and the foam production unit extending through the tray for supply of foam thereto for promoting the growth of plants, wherein the trays are mounted on a rotatable frame for movement about a horizontal axis, wherein a pivot means is provided to support the trays to maintain the trays in a substantially horizontal orientation when rotated and the foam production unit is provided in the base of the tray or compartment.

. The foam production unit may extend through and be located within the chamber or compartments. Alternatively, the foam production unit may be arranged externally with foam from the unit supplied to the respective compartments.

According to a further aspect, the present invention provides an apparatus for growing plants, the apparatus comprising: an elongated chamber in the form of a pipe or tube; a foam production unit extending inside the elongated chamber; a plurality of spaced openings in the elongated chamber in which plants to be grown are located; and wherein the foam production unit provides a liquid foam from a solution of nutrients and a foaming agent, wherein the liquid foam containing the nutrients is supplied to the plants to promote the growth of the plants.

The foam production unit may be located externally of the elongated chamber and the liquid foam may be fed inside the chamber by a feed tube extending inside the elongated chamber. The elongated chamber may be oriented substantially horizontally or oriented substantially vertically. When oriented substantially vertically, the elongated chamber may be defined by a plurality of separate compartments, and the

foam production unit extends through and be located within the chamber or compartments. The foam production unit may be arranged externally with foam from the unit supplied to the respective compartments.

Preferably the elongated chambers may be mounted on a rotatable carousel to be rotatable about a vertical axis. The elongated chambers may be mounted on a frame for rotation about a horizontal axis.

According to a further aspect, the present invention provides an apparatus for growing plants according to any of the features of the above foam production unit wherein the elongated chamber may be formed in any shape which allows the growth of plants.

According to a still further aspect, the present invention provides an apparatus for growing plants comprising: an open topped tray or compartment; a foam production unit extending through the tray for supply of foam thereto for promoting the growth of plants.

Preferably, the trays may be mounted on a rotatable frame for movement about a horizontal axis, wherein a pivot means may be provided to support the trays to maintain the trays in a substantially horizontal orientation when rotated. The foam production unit may be provided in the base of the tray or compartment.

According to a further aspect, the present invention provides an apparatus for growing plants comprising: a foam producing unit having an axis, a peripheral wall extending about said axis and having axially spaced apart opposite ends, and end walls closing said peripheral wall at said opposite ends, said peripheral wall and said end walls providing said foam producing unit with an interior for receiving an oxygenated air and liquid; a plurality of shaped projections extending outwardly from the peripheral wall of the foam production unit; a root chamber comprising a top wall, a bottom wall and side walls enclosing the root chamber and spaced apart end walls, at least one end wall having a complimentary shaped projection to receive the shaped projection extending from the peripheral wall of the foam production unit, said top wall having an opening for receiving a plant; and a means for controlling the flow of said oxygenated air and liquid through or from said foam producing unit and into said root chamber to thereby create a liquid foam which contains a plant nutrient or nutrients to promote the growth of plants.

Preferably, the peripheral wall of said foam producing unit may be formed in the shape of a polygon or the peripheral wall of said foam producing unit may be formed in

the shape of a cylinder.

Preferably, the shaped projections extending from the peripheral wall may be either in the shape of a polygon or a cylinder.

Preferably, the foam production unit may further comprise projections extending outwardly from said end walls to receive said oxygenated gas and liquid. Said projections may be used to mount said apparatus for growing plants in a vertical arrangement. Said projections may be mounted into a carousel for rotating the growing apparatus.

Preferably, the apparatus for growing plants may further comprise at least one reflector mounted to an edge of side of said growing apparatus to reflect light to promote the growth of the plants.

Preferably, the apparatus for growing plants may further comprise at least one light source to promote the growth of plants.

The foam production method and apparatus described above may also be used for producing foam for fire suppression applications or any other applications where liquid foam is required. The liquid for forming the foam may include or comprise a fire suppressant liquid.

Brief Description of the Drawings

Reference will now be made to the accompanying drawings which illustrate preferred embodiments of the invention. The following embodiments are described in relation to the production of foam for growing of plants and a method and apparatus of growing plants in a liquid foam. It will be appreciated however that the described and illustrated foam production methods and apparatus may be used in any other application where liquid foam is required and thus the following description is not to be considered as limiting on the application of the invention or parts thereof. In the drawings:-

Fig. 1 illustrates in schematic sectional view, a foam production unit according to a first embodiment of the present invention;

Figs. 2 and 3 are schematic sectional views of alternative foam production units of the type illustrated in Fig. 1;

Fig. 4 illustrates in schematic sectional view of a portion of a foam production unit according to a further embodiment of the invention;

Fig. 5 is a schematic sectional view of a portion of a further foam production unit according to yet a further embodiment of the invention;

Fig. 6 illustrate in schematic sectional view a foam production unit according to a

Claims

1. A foam production unit comprising:

a chamber with an inlet means to said chamber, the inlet means having an inlet for oxygenated air and an inlet for liquid, said chamber comprising:

a coaxial pipe or tube assembly with an elongated inner pipe which is perforated along its length and an outer pipe which is coaxially arranged with the inner pipe and perforated along its length;

a mixing chamber formed in an annular space located between the inner elongated pipe and the outer elongated pipe; and

a means for controlling the flow of mixed air and liquid through or from the chamber to create a back pressure in the inner elongated pipe to thereby create a liquid foam.

2. A foam production unit as claimed in claim 1, wherein the inlet means comprises one or more inlets for oxygenated air and one or more inlets for liquid, and the chamber has one or more outlets and the means for controlling the flow is provided for controlling or restricting flow from the one or more inlets of oxygenated air and liquid to or through the one or more outlets.

3. A foam production unit as claimed in claim 1 or claim 2, wherein the means for controlling the flow of mixed air and liquid through or from the chamber comprises an air pervious layer extending along the length of the outer elongated pipe which restricts the passage of the mixed air and liquid exiting from the chamber to create the back pressure to thereby create the liquid foam.

4. A foam production unit as claimed in claim 3, wherein the air pervious layer comprises a flexible open cell plastics foam or any other air pervious material.

5. A foam production unit as claimed in claim 3 or claim 4, wherein the air pervious layer is wrapped spirally around the outer elongated pipe.

6. A foam production unit as claimed in claim 3 or claim 4, wherein the air pervious layer is formed into a self-supporting sleeve which is located around the outer elongated pipe.

7. A foam production unit as claimed in claim 1 or claim 2, wherein the means for controlling the flow of mixed air and liquid through or from the chamber comprises means in the chamber which provide a controlled directional path for oxygenated air and liquid from the oxygenated air and liquid inlet means to the outlet.

8. A foam production unit as claimed in claim 7, wherein the means for controlling or restricting flow comprises a plurality of discrete elements within the chamber, wherein the discrete elements comprise a plurality of spherical members or members of any other shape, and the discrete elements substantially fill the mixing chamber.

9. A foam production unit as claimed in claim 8, wherein the discrete elements only partially fill the chamber, therefore the discrete elements are free for movement in the chamber so as to mix liquid and oxygenated air in the chamber to enhance liquid foam production.

10. A foam production unit as claimed in claim 1 or claim 2, wherein the chamber comprises a coaxial tube assembly with an elongated inner pipe with slots extending along its length and an elongated outer pipe which is coaxially arranged with the inner pipe and has slots extending along its length, and the means for controlling the flow is provided for controlling or restricting flow from the one or more inlets of oxygenated air and liquid to or through the coaxial tube assembly.

11. A foam production unit as claimed in claim 10, wherein the means for controlling the flow of mixed air and liquid through or from the chamber comprise a permeable material or member formed in an annular space located between the inner elongated pipe and the outer elongated pipe, wherein the permeable material comprises a solid foam, and the foam is a flexible open cell solid foam such as an organic or other foam.

12. A foam production unit as claimed in 11, wherein the permeable material is selectively compressed to vary its permeability and thus the foam production.

13. A foam production unit comprising a nozzle, wherein the nozzle comprises a housing to which liquid and oxygenated air are supplied, the housing having an outlet which is restricted by a solid permeable material, wherein the nozzle controls the flow of said oxygenated air and liquid through or from said foam production unit to thereby create a liquid foam, wherein the solid permeable material is in the form of a layer of such material.

14 A foam production unit as claimed in claim 13, wherein the permeable material comprises a perforated member.

15. A foam production unit as claimed in any one of the preceding claims, wherein the foam contains a plant nutrient or nutrients to promote the growth of plants.

16. A foam production unit for growing plants having a chamber with an axis, a peripheral wall extending about said axis and having axially spaced apart opposite ends, and end walls closing said peripheral wall at said opposite ends, said peripheral wall and said end walls providing said foam producing unit with an interior; said foam production unit comprising:

an inlet means to said chamber, the inlet means having an inlet for oxygenated air and an inlet for liquid;

a coaxial pipe or tube assembly with an elongated inner pipe which is perforated along its length and an outer pipe which is coaxially arranged with the inner pipe and perforated along its length;

a mixing chamber formed in an annular space located between the inner elongated pipe and the outer elongated pipe; and

a plurality of shaped projections extending outwardly from the peripheral wall of the foam production unit;

a root chamber comprising a top wall, a bottom wall and side walls enclosing the root chamber and spaced apart end walls, at least one end wall having a complimentary shaped projection to receive the shaped projection extending from

the peripheral wall of the foam production unit, said top wall having an opening for receiving a plant; and

a means for controlling the flow of said oxygenated air and liquid through or from said foam producing unit and into said root chamber to thereby create a liquid foam which contains a plant nutrient or nutrients to promote the growth of plants.

17. A foam production unit as claimed in claim 16, wherein the peripheral wall of said foam producing unit is formed in the shape of any one of the following:

a) a polygon or

b) a cylinder.

18. A foam production unit as claimed in claim 16 or claim 17, wherein the shaped projections extending from the peripheral wall are either in the shape of a polygon or a cylinder.

19. A foam production unit as claimed in any one of claims 16 to 18, further comprising projections extending outwardly from said end walls to receive said oxygenated gas and liquid, and said projections are used to mount said apparatus for growing plants in a vertical arrangement.

20. A foam production unit as claimed in claim 19, wherein said projections are mounted into a carousel for rotating the growing apparatus.

21. A foam production unit as claimed in any one of claims 16 to 20, further comprising at least one reflector mounted to an edge or side of said chamber to reflect light to promote the growth of the plants, and at least one light source to promote the growth of plants.

22. A foam production unit as claimed in claim 21, further comprising forming the liquid foam from a solution of nutrients and a foaming agent, the foaming agent comprises a soluble organic emulsifying concentrate.

23. A foam producing apparatus for growing plants, the apparatus comprising:

an elongated chamber in the form of a pipe or tube;

a foam production unit extending inside the elongated chamber with an inlet means to said chamber, the inlet means having an inlet for oxygenated air and an inlet for liquid, a coaxial pipe or tube assembly with an elongated inner pipe which is perforated along its length and an outer pipe which is coaxially arranged with the inner pipe and perforated along its length, and a mixing chamber formed in an annular space located between the inner elongated pipe and the outer elongated pipe; and

a plurality of spaced openings in the elongated chamber in which plants to be grown are located; and

wherein the foam production unit provides a liquid foam from a solution of nutrients and a foaming agent, wherein the liquid foam containing the nutrients is supplied to the plants to promote the growth of the plants.

24. A foam producing apparatus for growing plants as claimed in claim 23, wherein the foam production unit is located externally of the elongated chamber and the liquid foam is fed inside the chamber by a feed tube extending inside the elongated chamber, and the elongated chamber is oriented substantially horizontally or oriented substantially vertically.

25. A foam producing apparatus for growing plants as claimed in claim 24 wherein when oriented substantially vertically, the elongated chamber is defined by a plurality of separate compartments, and the foam production unit extends through and can be located within the chamber or compartments, the foam production unit is arranged externally with foam from the unit supplied to the respective compartments.

26. A foam production apparatus for growing plants as claimed in any one of claims 23 to 25, wherein the elongated chambers are mounted on a rotatable carousel to be rotatable about a vertical axis or the elongated chambers are mounted on a frame for rotation about a horizontal axis.

27. A foam producing apparatus for growing plants as claimed in any one of claims 23 to 26, further comprising an open topped tray or compartment and the foam production unit extending through the tray for supply of foam thereto for promoting the growth of plants, wherein the trays are mounted on a rotatable frame

for movement about a horizontal axis, wherein a pivot means is provided to support the trays to maintain the trays in a substantially horizontal orientation when rotated and the foam production unit is provided in the base of the tray or compartment.