Claims:

1. A solar energy converter comprising:
a solar energy absorber, the solar energy absorber comprising a photovoltaic element;
a heat transfer element in thermal contact with the solar energy absorber;
a primary heat exchanger in thermal contact with the heat transfer element;
a secondary heat exchanger; and
a heat transfer control element;
wherein the heat transfer control element is arranged to selectively place the secondary heat exchanger either in thermal contact with the heat transfer element or out of thermal contact with the heat transfer element.

2. A solar energy converter according to claim 1, wherein the solar energy absorber is located within an envelope.

3. A solar energy converter according to claim 2, wherein the envelope is a tube.

4. A solar energy converter according to claim 3, wherein the envelope has a circular cross-section.

5. A solar energy converter according to claim 3, wherein the envelope has an elliptical cross-section.

6. A solar energy converter according to any preceding claim, wherein the envelope is at least partially transparent.

7. A solar energy converter according to any one of claims 2 to 6, wherein the envelope is at least partially evacuated.

8. A solar energy converter according to claim 7, wherein the envelope is at a pressure of

10^{-3} mbar or less.

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9. A solar energy converter according to claim 8, wherein the envelope is at a pressure of 10^{-6} mbar or less.

10. A solar energy converter according to any preceding claim, wherein the photovoltaic element is arranged to generate electrical energy when exposed to solar radiation.

11. A solar energy converter according to claim 10, and further comprising conductors arranged to output generated electrical energy.

12. A solar energy converter according to any preceding claim, wherein the photovoltaic element comprises a semiconductor material.

13. A solar energy converter according to claim 12, wherein the photovoltaic element comprises silicon.

14. A solar energy converter according to claim 12, wherein the photovoltaic element comprises gallium arsenide.

15. A solar energy converter according to any preceding claim, wherein one or more thermally conductive layers are disposed between the photovoltaic element and the heat transfer element.

16. A solar energy converter according to claim 15, wherein the one or more of the thermally conductive layers is also an electrically insulating layer.

17. A solar energy converter according to claim 15 or claim 16, wherein the one or more of the thermally conductive layers comprise an adhesive.

18. A solar energy converter according to claim 17, wherein the adhesive is a flexible adhesive.

19. A solar energy converter according to claim 17 or claim 18, wherein the adhesive comprises an epoxy resin.

20. A solar energy converter according to claim 17 or claim 18, wherein the adhesive comprises a double sided adhesive tape.

21. A solar energy converter according to any preceding claim, wherein the heat transfer element is substantially rigid.

22. A solar energy converter according to any preceding claim, wherein the solar energy absorber comprises a plurality of photovoltaic elements.

23. A solar energy converter according to any preceding claim, wherein the primary heat exchanger transfers heat from the heat transfer element to a first fluid.

24. A solar energy converter according to claim 23, wherein the first fluid is water.

25. A solar energy converter according to any preceding claim, wherein the secondary heat exchanger transfers heat from the heat transfer element to a second fluid.

26. A solar energy converter according to claim 25, wherein the second fluid is air.

27. A solar energy converter according to claim 25, wherein the second fluid is water.

28. A solar energy converter according to any preceding claim, wherein the heat transfer control element is arranged to selectively place the secondary heat exchanger either in thermal contact with the heat transfer element or out of thermal contact with the heat

transfer element in response to a sensed temperature.

29. A solar energy converter according to claim 28, wherein the sensed temperature is a temperature of the primary heat exchanger.

30. A solar energy converter according to any preceding claim, wherein the heat transfer element comprises a heat transfer device comprising:

a fluid flow means extending between a first surface and a second surface, at least a part of the fluid flow means being inclined to the horizontal;

the fluid flow means being partially filled with a liquid and being arranged so that the first surface is in thermal contact with the liquid in at least a first part of the fluid flow means inclined to the horizontal and containing the liquid; and

the first part of the fluid flow means being divided into a first fluid flow channel and a second fluid flow channel arranged so that the liquid in the first fluid flow channel is in better thermal contact with the first surface than the liquid in the second fluid flow channel;

wherein the part of the fluid flow means above the surface of the liquid is at least partially evacuated;

whereby, when the first surface is hotter than the second surface, heat energy from the first surface causes the liquid in the first fluid flow channel to vaporize, and the vapor travels through the liquid in the first fluid flow channel to the surface of the liquid, such that the liquid circulates around the first fluid flow channel and the second fluid flow channel;

vapor travels from the surface of the liquid to the second surface and condenses at the second surface; and

condensed liquid returns from the second surface to the first part of the fluid flow means;

whereby heat energy is transported from the first surface to the second surface.

31. A solar energy converter according to any one of claims 1 to 29, wherein the heat

transfer element comprises a heat transfer device comprising:

a first fluid flow channel inclined to the horizontal and containing a liquid;

a second fluid flow channel connected to the first fluid flow channel and containing the liquid; and

a first surface in thermal contact with the liquid in the first fluid flow channel;

wherein heat energy from the first surface causes liquid in the first fluid flow channel to vaporize;

the vapor travels upwardly along the first fluid flow channel; and

the vapor drives a flow of liquid from the second fluid flow channel to the first fluid flow channel and upwardly along the first fluid flow channel;

whereby heat energy is transported away from the first surface.

32. A solar energy converter according to any one of claims 1 to 29, wherein the heat transfer element comprises a heat transfer device comprising:

a first surface;

a second surface;

a liquid reservoir in thermal contact with the first surface and containing a liquid; and

a tube connecting the liquid reservoir to the second surface;

wherein the liquid reservoir comprises a first fluid flow channel inclined to the horizontal and containing the liquid and a second fluid flow channel connected to the first fluid flow channel and containing the liquid;

the first surface is in thermal contact with the liquid in the first fluid flow channel; and

at least a part of the tube is at least partially evacuated;

whereby, when the first surface is hotter than the second surface, heat energy from the first surface causes liquid in the first fluid flow channel to vaporize;

the vapor travels upwardly along the first fluid flow channel and through the tube, and condenses at the second surface;

the vapor drives a flow of liquid from the second fluid flow channel to the first fluid flow channel and upwardly along the first fluid flow channel; and

condensed liquid returns from the second surface to the liquid reservoir;
whereby heat energy is transported away from the first surface to the second surface.

33. A solar energy converter according to any one of claims 1 to 29, wherein the heat transfer element comprises a heat transfer device comprising:
a first surface;
a second surface;
a liquid reservoir in thermal contact with the first surface and containing a liquid; and
a tube connecting the liquid reservoir to the second surface;
wherein at least a part of the tube is at least partially evacuated;
whereby, when the first surface is hotter than the second surface, heat energy from the first surface causes liquid in the liquid reservoir to vaporize;
the vapor travels through the tube and condenses at the second surface; and
condensed liquid returns from the second surface to the liquid reservoir;
whereby heat energy is transported from the first surface to the second surface.

34. A solar energy converter according to any one of claims 1 to 29, wherein the heat transfer element comprises a heat transfer device having a working fluid capable of circulating around a fluid flow path, the circulation around the fluid flow path bringing the working fluid in and out of thermal contact with a heat source, the heat transfer device comprising:
a fluid containing portion internally defining a working fluid flow path;
a heat source at least partially in thermal contact with the fluid containing portion;
a gas substance generator at least partially within the fluid containing portion, and arranged to generate bubbles of gas or vapor capable of driving the working fluid along a portion of the working fluid flow path in thermal contact with the heat source;
wherein, in use, the driven working fluid absorbs heat from the heat source and transports the heat away from the heat source; and
the driven working fluid returns to the gas substance generator to be recycled about the fluid flow path.

35. A solar energy converter according to any one of claims 30 to 34, wherein the fluid flow means, tube, or fluid containing portion of the heat transfer device extends from the solar energy absorber through the primary heat exchanger and into the secondary heat exchanger.

36. A solar energy converter according to claim 35, wherein the heat transfer control element is arranged to selectively block the fluid flow means, or tube, of the heat transfer device.

37. A solar energy converter comprising:
a solar energy absorber, the solar energy absorber comprising a photovoltaic element; and
a heat transfer device in thermal contact with the solar energy absorber;
wherein the heat transfer device is in thermal contact with the photovoltaic element; and
the heat transfer device is arranged to transfer heat energy away from the photovoltaic element to cool the photovoltaic element.

38. A solar energy converter according to claim 37, wherein the heat transfer device comprises:
a fluid flow means extending between a first surface and a second surface, at least a part of the fluid flow means being inclined to the horizontal;
the fluid flow means being partially filled with a liquid and being arranged so that the first surface is in thermal contact with the liquid in at least a first part of the fluid flow means inclined to the horizontal and containing the liquid; and
the first part of the fluid flow means being divided into a first fluid flow channel and a second fluid flow channel arranged so that the liquid in the first fluid flow channel is in better thermal contact with the first surface than the liquid in the second fluid flow channel;

wherein the part of the fluid flow means above the surface of the liquid is at least partially evacuated;

whereby, when the first surface is hotter than the second surface, heat energy from the first surface causes the liquid in the first fluid flow channel to vaporize, and the vapor travels through the liquid in the first fluid flow channel to the surface of the liquid, such that the liquid circulates around the first fluid flow channel and the second fluid flow channel;

vapor travels from the surface of the liquid to the second surface and condenses at the second surface; and

condensed liquid returns from the second surface to the first part of the fluid flow means;

whereby heat energy is transported from the first surface to the second surface.

39. A solar energy converter according to claim 37, wherein the heat transfer device comprises:

a first fluid flow channel inclined to the horizontal and containing a liquid;

a second fluid flow channel connected to the first fluid flow channel and containing the liquid; and

a first surface in thermal contact with the liquid in the first fluid flow channel;

wherein heat energy from the first surface causes liquid in the first fluid flow channel to vaporize;

the vapor travels upwardly along the first fluid flow channel; and

the vapor drives a flow of liquid from the second fluid flow channel to the first fluid flow channel and upwardly along the first fluid flow channel;

whereby heat energy is transported away from the first surface.

40. A solar energy converter according to claim 37, wherein the heat transfer device comprises:

a first surface;

a second surface;

a liquid reservoir in thermal contact with the first surface and containing a liquid; and

a tube connecting the liquid reservoir to the second surface;

wherein the liquid reservoir comprises a first fluid flow channel inclined to the horizontal and containing the liquid and a second fluid flow channel connected to the first fluid flow channel and containing the liquid;

the first surface is in thermal contact with the liquid in the first fluid flow channel; and

at least a part of the tube is at least partially evacuated;

whereby, when the first surface is hotter than the second surface, heat energy from the first surface causes liquid in the first fluid flow channel to vaporize;

the vapor travels upwardly along the first fluid flow channel and through the tube, and condenses at the second surface;

the vapor drives a flow of liquid from the second fluid flow channel to the first fluid flow channel and upwardly along the first fluid flow channel; and

condensed liquid returns from the second surface to the liquid reservoir;

whereby heat energy is transported away from the first surface to the second surface.

41. A solar energy converter according to claim 37, wherein the heat transfer device comprises:

a first surface;

a second surface;

a liquid reservoir in thermal contact with the first surface and containing a liquid; and

a tube connecting the liquid reservoir to the second surface;

wherein at least a part of the tube is at least partially evacuated;

whereby, when the first surface is hotter than the second surface, heat energy from the first surface causes liquid in the liquid reservoir to vaporize;

the vapor travels through the tube and condenses at the second surface; and

condensed liquid returns from the second surface to the liquid reservoir;

whereby heat energy is transported from the first surface to the second surface.

42. A solar energy converter according to claim 37, wherein the heat transfer device has a working fluid capable of circulating around a fluid flow path, the circulation around the fluid flow path bringing the working fluid in and out of thermal contact with a heat source and a second surface, the heat transfer device comprising:
a fluid containing portion internally defining a working fluid flow path;
a heat source at least partially in thermal contact with the fluid containing portion;
a gas substance generator at least partially within the fluid containing portion, and arranged to generate bubbles of gas or vapor capable of driving the working fluid along a portion of the working fluid flow path in thermal contact with the heat source;
wherein, in use, the driven working fluid absorbs heat from the heat source and transports the heat away from the heat source; and
the driven working fluid returns to the gas substance generator to be recycled about the fluid flow path.

43. A solar energy converter according to any one of claims 38 to 42, further comprising:
a heat exchanger in thermal contact with the heat transfer device;
wherein the second surface is in thermal contact with the heat exchanger and the heat transfer device is arranged to transfer heat energy from the photovoltaic element to the heat exchanger to cool the photovoltaic element.

44. A solar energy converter according to claim 43, wherein the heat exchanger comprises the second surface.

45. A solar energy converter according to any one of claims 37 to 44, wherein the solar energy absorber is located within an envelope.

46. A solar energy converter according to claim 45, wherein the envelope is a tube.

47. A solar energy converter according to claim 46, wherein the envelope has a circular cross-section.

48. A solar energy converter according to claim 46, wherein the envelope has an elliptical cross-section.

49. A solar energy converter according to any one of claims 45 to 48, wherein the envelope is at least partially transparent.

50. A solar energy converter according to any one of claims 45 to 49, wherein the envelope is at least partially evacuated.

51. A solar energy converter according to claim 50, wherein the envelope is at a pressure of 10^{-3} mbar or less.

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52. A solar energy converter according to claim 51, wherein the envelope is at a pressure of 10^{-6} mbar or less.

53 A solar energy converter according to any one of claims 37 to 52, wherein the photovoltaic element is arranged to generate electrical energy when exposed to solar radiation.

54. A solar energy converter according to claim 53, and further comprising conductors arranged to output generated electrical energy.

55. A solar energy converter according to any one of claims 37 to 54 wherein the photovoltaic element comprises a semiconductor material.

56. A solar energy converter according to claim 55, wherein the photovoltaic element comprises silicon.

57. A solar energy converter according to claim 55, wherein the photovoltaic element

comprises gallium arsenide.

58. A solar energy converter according to any one of claims 37 to 57, wherein one or more thermally conductive layers are disposed between the photovoltaic element and the heat transfer element.

59. A solar energy converter according to claim 58, wherein the one or more of the thermally conductive layers is also an electrically insulating layer.

60. A solar energy converter according to claim 58 or claim 59, wherein the one or more of the thermally conductive layers comprise an adhesive.

61. A solar energy converter according to claim 60, wherein the adhesive is a flexible adhesive.

62. A solar energy converter according to claim 60 or claim 61, wherein the adhesive comprises an epoxy resin.

63. A solar energy converter according to claim 60 or claim 61, wherein the adhesive comprises a double sided adhesive tape.

64. A solar energy converter according to any one of claims 37 to 63, wherein the heat transfer element is substantially rigid.

65. A solar energy converter according to any one of claims 37 to 64, wherein the solar energy absorber comprises a plurality of photovoltaic elements.

66. A solar energy converter comprising:
a photovoltaic element; and
a cooled element having a substantially isothermal cooled surface;

the photovoltaic element being located in thermal contact with the substantially isothermal cooled surface of the cooled element.

67. A solar energy converter according to claim 66, further comprising:

a heat transfer device comprising:

a fluid flow means extending between a first surface and a second surface, at least a part of the fluid flow means being inclined to the horizontal;

the fluid flow means being partially filled with a liquid and being arranged so that the first surface is in thermal contact with the liquid in at least a first part of the fluid flow means inclined to the horizontal and containing the liquid; and

the first part of the fluid flow means being divided into a first fluid flow channel and a second fluid flow channel arranged so that the liquid in the first fluid flow channel is in better thermal contact with the first surface than the liquid in the second fluid flow channel;

wherein the part of the fluid flow means above the surface of the liquid is at least partially evacuated;

whereby, when the first surface is hotter than the second surface, heat energy from the first surface causes the liquid in the first fluid flow channel to vaporize, and the vapor travels through the liquid in the first fluid flow channel to the surface of the liquid, such that the liquid circulates around the first fluid flow channel and the second fluid flow channel;

vapor travels from the surface of the liquid to the second surface and condenses at the second surface; and

condensed liquid returns from the second surface to the first part of the fluid flow means;

whereby heat energy is transported from the first surface to the second surface;

wherein the substantially isothermal cooled surface of the cooled element is the first surface.

68. A solar energy converter according to claim 66, further comprising:

a heat transfer device comprising:

a first fluid flow channel inclined to the horizontal and containing a liquid;

a second fluid flow channel connected to the first fluid flow channel and containing the liquid; and

a first surface in thermal contact with the liquid in the first fluid flow channel;

wherein heat energy from the first surface causes liquid in the first fluid flow channel to vaporize;

the vapor travels upwardly along the first fluid flow channel; and

the vapor drives a flow of liquid from the second fluid flow channel to the first fluid flow channel and upwardly along the first fluid flow channel;

whereby heat energy is transported away from the first surface.

69. A solar energy converter according to claim 66, further comprising:

a heat transfer device comprising:

a first surface;

a second surface;

a liquid reservoir in thermal contact with the first surface and containing a liquid; and

a tube connecting the liquid reservoir to the second surface;

wherein the liquid reservoir comprises a first fluid flow channel inclined to the horizontal and containing the liquid and a second fluid flow channel connected to the first fluid flow channel and containing the liquid;

the first surface is in thermal contact with the liquid in the first fluid flow channel; and

at least a part of the tube is at least partially evacuated;

whereby, when the first surface is hotter than the second surface, heat energy from the first surface causes liquid in the first fluid flow channel to vaporize;

the vapor travels upwardly along the first fluid flow channel and through the tube, and condenses at the second surface;

the vapor drives a flow of liquid from the second fluid flow channel to the first fluid flow channel and upwardly along the first fluid flow channel; and

condensed liquid returns from the second surface to the liquid reservoir;
whereby heat energy is transported away from the first surface to the second surface;
wherein the substantially isothermal cooled surface of the cooled element is the first surface.

70. A solar energy converter according to claim 66, further comprising:
a heat transfer device comprising:
a first surface;
a second surface;
a liquid reservoir in thermal contact with the first surface and containing a liquid; and
a tube connecting the liquid reservoir to the second surface;
wherein at least a part of the tube is at least partially evacuated;
whereby, when the first surface is hotter than the second surface, heat energy from the first surface causes liquid in the liquid reservoir to vaporize;
the vapor travels through the tube and condenses at the second surface; and
condensed liquid returns from the second surface to the liquid reservoir;
whereby heat energy is transported from the first surface to the second surface;
wherein the substantially isothermal cooled surface of the cooled element is the first surface.

71. A solar energy converter according to claim 66, further comprising:
a heat transfer device having a working fluid capable of circulating around a fluid flow path, the circulation around the fluid flow path bringing the working fluid in and out of thermal contact with a heat source, the heat transfer device comprising:
a fluid containing portion internally defining a working fluid flow path;
a heat source at least partially in thermal contact with a first surface of the fluid containing portion;
a gas substance generator at least partially within the fluid containing portion, and arranged to generate bubbles of gas or vapor capable of driving the working fluid along a portion of the working fluid flow path in thermal contact with the heat source;

wherein, in use, the driven working fluid absorbs heat from the heat source and transports the heat away from the heat source to a second surface; and

the driven working fluid returns to the gas substance generator to be recycled about the fluid flow path;

wherein the substantially isothermal cooled surface of the cooled element is the first surface.

72. A solar energy converter according to any one of claims 66 to 71, further comprising:

a heat exchanger in thermal contact with the heat transfer device;

wherein the second surface is in thermal contact with the heat exchanger and the heat transfer device is arranged to transfer heat energy from the photovoltaic element to the heat exchanger to cool the photovoltaic element.

73. A solar energy converter according to claim 72, wherein the heat exchanger comprises the second surface.

74. A solar energy converter according to any one of claims 66 to 73, wherein the solar energy absorber is located within an envelope.

75. A solar energy converter according to claim 74, wherein the envelope is a tube.

76. A solar energy converter according to claim 75, wherein the envelope has a circular cross-section.

77. A solar energy converter according to claim 75, wherein the envelope has an elliptical cross-section.

78. A solar energy converter according to any one of claims 74 to 77, wherein the envelope is at least partially transparent.

79. A solar energy converter according to any one of claims 74 to 78, wherein the envelope is at least partially evacuated.

80. A solar energy converter according to claim 79, wherein the envelope is at a pressure of 10^{-3} mbar or less.

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81. A solar energy converter according to claim 80, wherein the envelope is at a pressure of 10^{-6} mbar or less.

82. A solar energy converter according to any one of claims 66 to 81, wherein the photovoltaic element is arranged to generate electrical energy when exposed to solar radiation.

83. A solar energy converter according to claim 82, and further comprising conductors arranged to output generated electrical energy.

84. A solar energy converter according to any one of claims 66 to 83, wherein the photovoltaic element comprises a semiconductor material.

85. A solar energy converter according to claim 84, wherein the photovoltaic element comprises silicon.

86. A solar energy converter according to claim 84, wherein the photovoltaic element comprises gallium arsenide.

87. A solar energy converter according to any one of claims 66 to 86, wherein one or more thermally conductive layers are disposed between the photovoltaic element and the substantially isothermal cooled surface.

88. A solar energy converter according to claim 87, wherein the one or more of the

thermally conductive layers is also an electrically insulating layer.

89. A solar energy converter according to claim 87 or claim 88, wherein the one or more of the thermally conductive layers comprise an adhesive.

90. A solar energy converter according to claim 89, wherein the adhesive is a flexible adhesive.

91. A solar energy converter according to claim 89 or claim 90, wherein the adhesive comprises an epoxy resin.

92. A solar energy converter according to claim 89 or claim 90, wherein the adhesive comprises a double sided adhesive tape.

93. A solar energy converter according to any one of claims 67 to 71, wherein the heat transfer device is substantially rigid.

94. A solar energy converter according to any one of claims 66 to 93, wherein the solar energy absorber comprises a plurality of photovoltaic elements.

95. A solar energy converter comprising:
a solar energy absorber; and
a heat transfer device arranged to cool the solar energy absorber; and
a cooling control element arranged to control the degree of cooling applied to the solar energy absorber by the heat transfer device.

96. A solar energy converter according to claim 95, wherein the heat transfer device comprises:
a fluid flow means extending between a first surface and a second surface, at least a part of the fluid flow means being inclined to the horizontal;

the fluid flow means being partially filled with a liquid and being arranged so that the first surface is in thermal contact with the liquid in at least a first part of the fluid flow means inclined to the horizontal and containing the liquid; and

the first part of the fluid flow means being divided into a first fluid flow channel and a second fluid flow channel arranged so that the liquid in the first fluid flow channel is in better thermal contact with the first surface than the liquid in the second fluid flow channel;

wherein the part of the fluid flow means above the surface of the liquid is at least partially evacuated;

whereby, when the first surface is hotter than the second surface, heat energy from the first surface causes the liquid in the first fluid flow channel to vaporize, and the vapor travels through the liquid in the first fluid flow channel to the surface of the liquid, such that the liquid circulates around the first fluid flow channel and the second fluid flow channel;

vapor travels from the surface of the liquid to the second surface and condenses at the second surface; and

condensed liquid returns from the second surface to the first part of the fluid flow means;

whereby heat energy is transported from the first surface to the second surface.

97. A solar energy converter according to claim 95, wherein the heat transfer device comprises:

a first fluid flow channel inclined to the horizontal and containing a liquid;

a second fluid flow channel connected to the first fluid flow channel and containing the liquid; and

a first surface in thermal contact with the liquid in the first fluid flow channel;

wherein heat energy from the first surface causes liquid in the first fluid flow channel to vaporize;

the vapor travels upwardly along the first fluid flow channel; and

the vapor drives a flow of liquid from the second fluid flow channel to the first fluid

flow channel and upwardly along the first fluid flow channel;

whereby heat energy is transported away from the first surface.

98. A solar energy converter according to claim 95, wherein the heat transfer device comprises:

a first surface;

a second surface;

a liquid reservoir in thermal contact with the first surface and containing a liquid; and

a tube connecting the liquid reservoir to the second surface;

wherein the liquid reservoir comprises a first fluid flow channel inclined to the horizontal and containing the liquid and a second fluid flow channel connected to the first fluid flow channel and containing the liquid;

the first surface is in thermal contact with the liquid in the first fluid flow channel; and

at least a part of the tube is at least partially evacuated;

whereby, when the first surface is hotter than the second surface, heat energy from the first surface causes liquid in the first fluid flow channel to vaporize;

the vapor travels upwardly along the first fluid flow channel and through the tube, and condenses at the second surface;

the vapor drives a flow of liquid from the second fluid flow channel to the first fluid flow channel and upwardly along the first fluid flow channel; and

condensed liquid returns from the second surface to the liquid reservoir;

whereby heat energy is transported away from the first surface to the second surface.

99. A solar energy converter according to claim 95, wherein the heat transfer device comprises:

a first surface;

a second surface;

a liquid reservoir in thermal contact with the first surface and containing a liquid; and

a tube connecting the liquid reservoir to the second surface;

wherein at least a part of the tube is at least partially evacuated;

whereby, when the first surface is hotter than the second surface, heat energy from the first surface causes liquid in the liquid reservoir to vaporize;

the vapor travels through the tube and condenses at the second surface; and

condensed liquid returns from the second surface to the liquid reservoir;

whereby heat energy is transported from the first surface to the second surface.

100. A solar energy converter according to claim 95, wherein the heat transfer device has a working fluid capable of circulating around a fluid flow path, the circulation around the fluid flow path bringing the working fluid in and out of thermal contact with a heat source, the heat transfer device comprising:

a fluid containing portion internally defining a working fluid flow path;

a heat source at least partially in thermal contact with the fluid containing portion;

a gas substance generator at least partially within the fluid containing portion, and arranged to generate bubbles of gas or vapor capable of driving the working fluid along a portion of the working fluid flow path in thermal contact with the heat source;

wherein, in use, the driven working fluid absorbs heat from the heat source and transports the heat away from the heat source; and

the driven working fluid returns to the gas substance generator to be recycled about the fluid flow path.

101. A solar energy converter according to any one of claims 96 to 100, wherein the cooling control element is arranged to change the degree of cooling by changing the vacuum pressure within the heat transfer device.

102. A solar energy converter according to any one of claims 96 to 101, further comprising:

a heat exchanger in thermal contact with the heat transfer device;

wherein the heat exchanger transfers heat energy from the heat transfer device to an operating fluid; and

the cooling control element is arranged to change the degree of cooling by changing a

flow rate of the operating fluid through the heat exchanger.

103. A solar energy converter according to any one of claims 95 to 102, wherein the solar energy absorber is located within an envelope.

104. A solar energy converter according to claim 103, wherein the envelope is a tube.

105. A solar energy converter according to claim 104, wherein the envelope has a circular cross-section.

106. A solar energy converter according to claim 104, wherein the envelope has an elliptical cross-section.

107. A solar energy converter according to any one of claims 103 to 106, wherein the envelope is at least partially transparent.

108. A solar energy converter according to any one of claims 103 to 107, wherein the envelope is at least partially evacuated.

109. A solar energy converter according to claim 108, wherein the envelope is at a pressure of 10^{-3} mbar or less.

110. A solar energy converter according to claim 109, wherein the envelope is at a pressure of 10^{-6} mbar or less.

111. A solar energy converter according to any one of claims 96 to 110, wherein the cooling control element is arranged to change the degree of cooling of the solar energy absorber by changing the pressure within the envelope.

112. A solar energy converter according to any one of claims 96 to 111, further comprising

an orientation control element arranged to control the orientation of the solar energy absorber;

wherein the cooling control element is arranged to change the orientation of the solar energy absorber to change the amount of solar energy incident on the solar energy absorber.

113. A solar energy converter according to any one of claims 96 to 112, further comprising an insolation control element arranged to control the amount of solar energy impinging on the solar energy absorber;

wherein the cooling control element is arranged to change the amount of solar energy impinging on the solar energy absorber.

114. A solar energy converter according to any one of claims 96 to 113, wherein the solar energy absorber comprises a photovoltaic element.

115. A solar energy converter according to claim 114, wherein the photovoltaic element is arranged to generate electrical energy when exposed to solar radiation.

116. A solar energy converter according to claim 115, and further comprising conductors arranged to output generated electrical energy.

117. A solar energy converter according to any one of claims 114 to 116, wherein the photovoltaic element comprises a semiconductor material.

118. A solar energy converter according to claim 117, wherein the photovoltaic element comprises silicon.

119. A solar energy converter according to claim 117, wherein the photovoltaic element comprises gallium arsenide.

120. A solar energy converter according to any one of claims 114 to 119, wherein one or more thermally conductive layers are disposed between the photovoltaic element and the heat transfer device.

121. A solar energy converter according to claim 120, wherein the one or more of the thermally conductive layers is also an electrically insulating layer.

122. A solar energy converter according to claim 120 or claim 121, wherein the one or more of the thermally conductive layers comprise an adhesive.

123. A solar energy converter according to claim 122, wherein the adhesive is a flexible adhesive.

124. A solar energy converter according to claim 122 or claim 123, wherein the adhesive comprises an epoxy resin.

125. A solar energy converter according to claim 122 or claim 123, wherein the adhesive comprises a double sided adhesive tape.

126. A solar energy converter according to any one of claims 96 to 125, wherein the heat transfer device is substantially rigid.

127. A solar energy converter according to any one of claims 114 to 125, wherein the solar energy absorber comprises a plurality of photovoltaic elements.

128. A solar energy converter comprising:
a photovoltaic element;
a cooled element having a cooled surface with an adjustable temperature;
a temperature sensor; and
a temperature control element arranged to adjust the temperature of the cooled surface

of the cooled element;

the photovoltaic element being located in thermal contact with the cooled surface of the cooled element; and

the temperature control element being arranged adjust the temperature of the cooled surface of the cooled element in response to the temperature sensed by the temperature sensor.

129. A solar energy converter according to claim 128, wherein the temperature sensor is arranged to sense the temperature of the cooled surface.

130. A solar energy converter according to claim 129, wherein the temperature sensor is arranged to sense the temperature of the photovoltaic element.

131. A solar energy converter according to any one of claims 128 to 130, further comprising a heat transfer device comprising:

a fluid flow means extending between a first surface and a second surface, at least a part of the fluid flow means being inclined to the horizontal;

the fluid flow means being partially filled with a liquid and being arranged so that the first surface is in thermal contact with the liquid in at least a first part of the fluid flow means inclined to the horizontal and containing the liquid; and

the first part of the fluid flow means being divided into a first fluid flow channel and a second fluid flow channel arranged so that the liquid in the first fluid flow channel is in better thermal contact with the first surface than the liquid in the second fluid flow channel;

wherein the part of the fluid flow means above the surface of the liquid is at least partially evacuated;

whereby, when the first surface is hotter than the second surface, heat energy from the first surface causes the liquid in the first fluid flow channel to vaporize, and the vapor travels through the liquid in the first fluid flow channel to the surface of the liquid, such that the liquid circulates around the first fluid flow channel and the second fluid

flow channel;

vapor travels from the surface of the liquid to the second surface and condenses at the second surface; and

condensed liquid returns from the second surface to the first part of the fluid flow means;

whereby heat energy is transported from the first surface to the second surface.

132. A solar energy converter according to any one of claims 128 to 130, further comprising a heat transfer device comprising:

a first fluid flow channel inclined to the horizontal and containing a liquid;

a second fluid flow channel connected to the first fluid flow channel and containing the liquid; and

a first surface in thermal contact with the liquid in the first fluid flow channel;

wherein heat energy from the first surface causes liquid in the first fluid flow channel to vaporize;

the vapor travels upwardly along the first fluid flow channel; and

the vapor drives a flow of liquid from the second fluid flow channel to the first fluid flow channel and upwardly along the first fluid flow channel;

whereby heat energy is transported away from the first surface.

133. A solar energy converter according to any one of claims 128 to 130, further comprising a heat transfer device comprising:

a first surface;

a second surface;

a liquid reservoir in thermal contact with the first surface and containing a liquid; and

a tube connecting the liquid reservoir to the second surface;

wherein the liquid reservoir comprises a first fluid flow channel inclined to the horizontal and containing the liquid and a second fluid flow channel connected to the first fluid flow channel and containing the liquid;

the first surface is in thermal contact with the liquid in the first fluid flow channel;

and

at least a part of the tube is at least partially evacuated;

whereby, when the first surface is hotter than the second surface, heat energy from the first surface causes liquid in the first fluid flow channel to vaporize;

the vapor travels upwardly along the first fluid flow channel and through the tube, and condenses at the second surface;

the vapor drives a flow of liquid from the second fluid flow channel to the first fluid flow channel and upwardly along the first fluid flow channel; and

condensed liquid returns from the second surface to the liquid reservoir;

whereby heat energy is transported away from the first surface to the second surface.

134. A solar energy converter according to any one of claims 128 to 130, further comprising a heat transfer device comprising:

a first surface;

a second surface;

a liquid reservoir in thermal contact with the first surface and containing a liquid; and

a tube connecting the liquid reservoir to the second surface;

wherein at least a part of the tube is at least partially evacuated;

whereby, when the first surface is hotter than the second surface, heat energy from the first surface causes liquid in the liquid reservoir to vaporize;

the vapor travels through the tube and condenses at the second surface; and

condensed liquid returns from the second surface to the liquid reservoir;

whereby heat energy is transported from the first surface to the second surface.

135. A solar energy converter according to any one of claims 128 to 130, further comprising a heat transfer device having a working fluid capable of circulating around a fluid flow path, the circulation around the fluid flow path bringing the working fluid in and out of thermal contact with a heat source, the heat transfer device comprising:

a fluid containing portion internally defining a working fluid flow path;

a heat source at least partially in thermal contact with the fluid containing portion;

a gas substance generator at least partially within the fluid containing portion, and arranged to generate bubbles of gas or vapor capable of driving the working fluid along a portion of the working fluid flow path in thermal contact with the heat source;

wherein, in use, the driven working fluid absorbs heat from the heat source and transports the heat away from the heat source; and

the driven working fluid returns to the gas substance generator to be recycled about the fluid flow path.

136. A solar energy converter according to any one of claims 131 to 135, wherein the temperature control element is arranged to adjust the temperature of the cooled surface by changing the vacuum pressure within the heat transfer device.

137. A solar energy converter according to any one of claims 131 to 136, further comprising:

a heat exchanger in thermal contact with the heat transfer device;

wherein the heat exchanger transfers heat energy from the heat transfer device to an operating fluid; and

the temperature control element is arranged to adjust the temperature of the cooled surface by changing a flow rate of the operating fluid through the heat exchanger.

138. A solar energy converter according to any one of claims 128 to 137, wherein the solar energy absorber is located within an envelope.

139. A solar energy converter according to claim 138, wherein the envelope is a tube.

140. A solar energy converter according to claim 139, wherein the envelope has a circular cross-section.

141. A solar energy converter according to claim 139, wherein the envelope has an elliptical cross-section.

142. A solar energy converter according to any one of claims 138 to 141, wherein the envelope is at least partially transparent.

143. A solar energy converter according to any one of claims 138 to 142, wherein the envelope is at least partially evacuated.

144. A solar energy converter according to claim 143, wherein the envelope is at a pressure of 10^{-3} mbar or less.

145. A solar energy converter according to claim 144, wherein the envelope is at a pressure of 10^{-6} mbar or less.

146. A solar energy converter according to any one of claims 138 to 145, wherein the temperature control element is arranged to adjust the temperature of the cooled surface by changing the pressure within the envelope.

147. A solar energy converter according to any one of claims 128 to 146, further comprising an orientation control element arranged to control the orientation of the photovoltaic element;
wherein the cooling control element is arranged to adjust the temperature of the cooled surface by changing the orientation of the photovoltaic element to change the amount of solar energy incident on the photovoltaic element.

148. A solar energy converter according to any one of claims 128 to 147, further comprising an insolation control element arranged to control the amount of solar energy impinging on the photovoltaic element;
wherein the temperature control element is arranged to adjust the temperature of the cooled surface by changing the amount of solar energy impinging on the photovoltaic element.

149. A solar energy converter according to any one of claims 128 to 148, wherein the photovoltaic element is arranged to generate electrical energy when exposed to solar radiation.

150. A solar energy converter according to claim 149, and further comprising conductors arranged to output generated electrical energy.

151. A solar energy converter according to any one of claims 128 to 150, wherein the photovoltaic element comprises a semiconductor material.

152. A solar energy converter according to claim 151, wherein the photovoltaic element comprises silicon.

153. A solar energy converter according to claim 151, wherein the photovoltaic element comprises gallium arsenide.

154. A solar energy converter according to any one of claims 128 to 153, wherein one or more thermally conductive layers are disposed between the photovoltaic element and the cooled surface with an adjustable temperature.

155. A solar energy converter according to claim 154, wherein the one or more of the thermally conductive layers is also an electrically insulating layer.

156. A solar energy converter according to claim 154 or claim 155, wherein the one or more of the thermally conductive layers comprise an adhesive.

157. A solar energy converter according to claim 156, wherein the adhesive is a flexible adhesive.

158. A solar energy converter according to claim 155 or claim 156, wherein the adhesive comprises an epoxy resin.

159. A solar energy converter according to claim 155 or claim 156, wherein the adhesive comprises a double sided adhesive tape.

160. A solar energy converter according to any one of claims 128 to 159, wherein the heat transfer device is substantially rigid.

161. A solar energy converter according to any one of claims 128 to 160, wherein the solar energy absorber comprises a plurality of photovoltaic elements.

162. A solar energy converter comprising:
a photovoltaic element; and
a heat transfer device arranged to transfer heat from the photovoltaic element to a fluid to cool the photovoltaic element and heat the fluid; and
a temperature control element arranged to control the temperature of the photovoltaic element;
wherein the temperature control element is arranged to control the temperature of the photovoltaic element to vary the relative amounts of electrical energy output by the photovoltaic element and useable heat energy output in the heated fluid.

163. A solar energy converter according to claim 162, wherein the temperature control element is arranged to control the temperature of the photovoltaic element to a lower temperature value and increase the amount of electrical energy output by the photovoltaic element.

164. A solar energy converter according to claim 162 or claim 163, wherein the temperature control element is arranged to control the temperature of the photovoltaic element to a lower temperature value and decrease the temperature of the heated fluid.

165. A solar energy converter according to any one of claims 162 to 164, wherein the temperature control element is arranged to control the temperature of the photovoltaic element to a higher temperature value and decrease the amount of electrical energy output by the photovoltaic element.

166. A solar energy converter according to any one of claims 162 to 165, wherein the temperature control element is arranged to control the temperature of the photovoltaic element to a higher temperature value and increase the temperature of the heated fluid.

167. A solar energy converter according to any one of claims 162 to 166, wherein the heat transfer element comprises a heat transfer device comprising:

a fluid flow means extending between a first surface and a second surface, at least a part of the fluid flow means being inclined to the horizontal;

the fluid flow means being partially filled with a liquid and being arranged so that the first surface is in thermal contact with the liquid in at least a first part of the fluid flow means inclined to the horizontal and containing the liquid; and

the first part of the fluid flow means being divided into a first fluid flow channel and a second fluid flow channel arranged so that the liquid in the first fluid flow channel is in better thermal contact with the first surface than the liquid in the second fluid flow channel;

wherein the part of the fluid flow means above the surface of the liquid is at least partially evacuated;

whereby, when the first surface is hotter than the second surface, heat energy from the first surface causes the liquid in the first fluid flow channel to vaporize, and the vapor travels through the liquid in the first fluid flow channel to the surface of the liquid, such that the liquid circulates around the first fluid flow channel and the second fluid flow channel;

vapor travels from the surface of the liquid to the second surface and condenses at the second surface; and

condensed liquid returns from the second surface to the first part of the fluid flow means;

whereby heat energy is transported from the first surface to the second surface.

168. A solar energy converter according to any one of claims 162 to 166, wherein the heat transfer element comprises a heat transfer device comprising:

a first fluid flow channel inclined to the horizontal and containing a liquid;

a second fluid flow channel connected to the first fluid flow channel and containing the liquid; and

a first surface in thermal contact with the liquid in the first fluid flow channel;

wherein heat energy from the first surface causes liquid in the first fluid flow channel to vaporize;

the vapor travels upwardly along the first fluid flow channel; and

the vapor drives a flow of liquid from the second fluid flow channel to the first fluid flow channel and upwardly along the first fluid flow channel;

whereby heat energy is transported away from the first surface.

169. A solar energy converter according to any one of claims 162 to 166, wherein the heat transfer element comprises a heat transfer device comprising:

a first surface;

a second surface;

a liquid reservoir in thermal contact with the first surface and containing a liquid; and

a tube connecting the liquid reservoir to the second surface;

wherein the liquid reservoir comprises a first fluid flow channel inclined to the horizontal and containing the liquid and a second fluid flow channel connected to the first fluid flow channel and containing the liquid;

the first surface is in thermal contact with the liquid in the first fluid flow channel; and

at least a part of the tube is at least partially evacuated;

whereby, when the first surface is hotter than the second surface, heat energy from the

first surface causes liquid in the first fluid flow channel to vaporize;
the vapor travels upwardly along the first fluid flow channel and through the tube, and condenses at the second surface;
the vapor drives a flow of liquid from the second fluid flow channel to the first fluid flow channel and upwardly along the first fluid flow channel; and
condensed liquid returns from the second surface to the liquid reservoir;
whereby heat energy is transported away from the first surface to the second surface.

170. A solar energy converter according to any one of claims 162 to 166, wherein the heat transfer element comprises a heat transfer device comprising:
a first surface;
a second surface;
a liquid reservoir in thermal contact with the first surface and containing a liquid; and
a tube connecting the liquid reservoir to the second surface;
wherein at least a part of the tube is at least partially evacuated;
whereby, when the first surface is hotter than the second surface, heat energy from the first surface causes liquid in the liquid reservoir to vaporize;
the vapor travels through the tube and condenses at the second surface; and
condensed liquid returns from the second surface to the liquid reservoir;
whereby heat energy is transported from the first surface to the second surface.

171. A solar energy converter according to any one of claims 162 to 166, wherein the heat transfer element comprises a heat transfer device having a working fluid capable of circulating around a fluid flow path, the circulation around the fluid flow path bringing the working fluid in and out of thermal contact with a heat source, the heat transfer device comprising:
a fluid containing portion internally defining a working fluid flow path;
a heat source at least partially in thermal contact with the fluid containing portion;
a gas substance generator at least partially within the fluid containing portion, and arranged to generate bubbles of gas or vapor capable of driving the working fluid

along a portion of the working fluid flow path in thermal contact with the heat source;

wherein, in use, the driven working fluid absorbs heat from the heat source and transports the heat away from the heat source; and

the driven working fluid returns to the gas substance generator to be recycled about the fluid flow path.

172. A solar energy converter according to any one of claims 167 to 171, wherein the temperature control element is arranged to adjust the temperature of the cooled surface by changing the vacuum pressure within the heat transfer device.

173. A solar energy converter according to any one of claims 162 to 172, further comprising:

a heat exchanger in thermal contact with the heat transfer device;

wherein the heat exchanger transfers heat energy from the heat transfer device to an operating fluid; and

the temperature control element is arranged to adjust the temperature of the cooled surface by changing a flow rate of the operating fluid through the heat exchanger.

174. A solar energy converter according to any one of claims 162 to 173, wherein the solar energy absorber is located within an envelope.

175. A solar energy converter according to claim 174, wherein the envelope is a tube.

176. A solar energy converter according to claim 174, wherein the envelope has a circular cross-section.

177. A solar energy converter according to claim 174, wherein the envelope has an elliptical cross-section.

178. A solar energy converter according to any one of claims 174 to 177, wherein the

envelope is at least partially transparent.

179. A solar energy converter according to any one of claims 174 to 178, wherein the envelope is at least partially evacuated.

180. A solar energy converter according to claim 179, wherein the envelope is at a pressure of 10^{-3} mbar or less.

181. A solar energy converter according to claim 180, wherein the envelope is at a pressure of 10^{-6} mbar or less.

182. A solar energy converter according to any one of claims 174 to 181, wherein the temperature control element is arranged to adjust the temperature of the cooled surface by changing the pressure within the envelope.

183. A solar energy converter according to any one of claims 162 to 182, further comprising an orientation control element arranged to control the orientation of the photovoltaic element;
wherein the cooling control element is arranged to adjust the temperature of the cooled surface by changing the orientation of the photovoltaic element to change the amount of solar energy incident on the photovoltaic element.

184. A solar energy converter according to any one of claims 162 to 183, further comprising an insolation control element arranged to control the amount of solar energy impinging on the photovoltaic element;
wherein the temperature control element is arranged to adjust the temperature of the cooled surface by changing the amount of solar energy impinging on the photovoltaic element.

185. A solar energy converter according to any one of claims 162 to 184, wherein the

photovoltaic element is arranged to generate electrical energy when exposed to solar radiation.

186. A solar energy converter according to claim 185, and further comprising conductors arranged to output generated electrical energy.

187. A solar energy converter according to any one of claims 162 to 186, wherein the photovoltaic element comprises a semiconductor material.

188. A solar energy converter according to claim 187, wherein the photovoltaic element comprises silicon.

189. A solar energy converter according to claim 188, wherein the photovoltaic element comprises gallium arsenide.

190. A solar energy converter according to any one of claims 162 to 189, wherein one or more thermally conductive layers are disposed between the photovoltaic element and the heat transfer device.

191. A solar energy converter according to claim 190, wherein the one or more of the thermally conductive layers is also an electrically insulating layer.

192. A solar energy converter according to claim 190 or claim 191, wherein the one or more of the thermally conductive layers comprise an adhesive.

193. A solar energy converter according to claim 192, wherein the adhesive is a flexible adhesive.

194. A solar energy converter according to claim 192 or claim 193, wherein the adhesive comprises an epoxy resin.

195. A solar energy converter according to claim 192 or claim 193, wherein the adhesive comprises a double sided adhesive tape.

196. A solar energy converter according to any one of claims 162 to 195, wherein the heat transfer device is substantially rigid.

197. A solar energy converter according to any one of claims 162 to 196, wherein the solar energy absorber comprises a plurality of photovoltaic elements.

198. A solar energy converter according to any one of claims 162 to 197, wherein the solar energy converter is a hybrid solar energy converter arranged to output electrical energy and useable heat energy.

199. A solar energy converter array comprising a plurality of solar energy converters according to any one of the claims 162 to 198.

200. A solar energy converter comprising:
a solar energy absorber;
a heat transfer element in thermal contact with the solar energy absorber;
a primary heat exchanger in thermal contact with the heat transfer element;
a secondary heat exchanger; and
a heat transfer control element;
wherein the heat transfer control element is arranged to selectively place the secondary heat exchanger either in thermal contact with the heat transfer element or out of thermal contact with the heat transfer element.

201. A solar energy converter according to claim 200, wherein the solar energy absorber is located within an envelope.

202. A solar energy converter according to claim 201, wherein the envelope is a tube.

203. A solar energy converter according to claim 202, wherein the envelope has a circular cross-section.

204. A solar energy converter according to claim 202, wherein the envelope has an elliptical cross-section.

205. A solar energy converter according to any one of claims 201 to 204, wherein the envelope is at least partially transparent.

206. A solar energy converter according to any one of claims 201 to 205, wherein the envelope is at least partially evacuated.

207. A solar energy converter according to claim 206, wherein the envelope is at a pressure of 10^{-3} mbar or less.

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208. A solar energy converter according to claim 207, wherein the envelope is at a pressure of 10^{-6} mbar or less.

209. A solar energy converter according to any one of claims 200 to 208, wherein the primary heat exchanger transfers heat from the heat transfer element to a first fluid.

210. A solar energy converter according to claim 209, wherein the first fluid is water.

211. A solar energy converter according to any one of claims 200 to 210, wherein the secondary heat exchanger transfers heat from the heat transfer element to a second fluid.

212. A solar energy converter according to claim 211, wherein the second fluid is air.

213. A solar energy converter according to any one of claims 200 to 212, wherein the heat transfer control element is arranged to selectively place the secondary heat exchanger either in thermal contact with the heat transfer element or out of thermal contact with the heat transfer element in response to a sensed temperature.

214. A solar energy converter according to claim 213, wherein the sensed temperature is a temperature of the primary heat exchanger.

215. A solar energy converter according to any one of claims 200 to 214, wherein the heat transfer element comprises a heat transfer device comprising:
a fluid flow means extending between a first surface and a second surface, at least a part of the fluid flow means being inclined to the horizontal;
the fluid flow means being partially filled with a liquid and being arranged so that the first surface is in thermal contact with the liquid in at least a first part of the fluid flow means inclined to the horizontal and containing the liquid; and
the first part of the fluid flow means being divided into a first fluid flow channel and a second fluid flow channel arranged so that the liquid in the first fluid flow channel is in better thermal contact with the first surface than the liquid in the second fluid flow channel;
wherein the part of the fluid flow means above the surface of the liquid is at least partially evacuated;
whereby, when the first surface is hotter than the second surface, heat energy from the first surface causes the liquid in the first fluid flow channel to vaporize, and the vapor travels through the liquid in the first fluid flow channel to the surface of the liquid, such that the liquid circulates around the first fluid flow channel and the second fluid flow channel;
vapor travels from the surface of the liquid to the second surface and condenses at the second surface; and
condensed liquid returns from the second surface to the first part of the fluid flow

means;

whereby heat energy is transported from the first surface to the second surface;

the solar energy absorber comprising the first surface and the primary heat exchanger and secondary heat exchanger comprising the second surface.

216. A solar energy converter according to any one of claims 200 to 214, wherein the heat transfer element comprises a heat transfer device comprising:

a first fluid flow channel inclined to the horizontal and containing a liquid;

a second fluid flow channel connected to the first fluid flow channel and containing the liquid; and

a first surface in thermal contact with the liquid in the first fluid flow channel;

wherein heat energy from the first surface causes liquid in the first fluid flow channel to vaporize;

the vapor travels upwardly along the first fluid flow channel; and

the vapor drives a flow of liquid from the second fluid flow channel to the first fluid flow channel and upwardly along the first fluid flow channel; and

the vapor condenses on a second surface;

whereby heat energy is transported away from the first surface to the second surface;

the solar energy absorber comprising the first surface and the primary heat exchanger and secondary heat exchanger comprising the second surface.

217. A solar energy converter according to any one of claims 200 to 214, wherein the heat transfer element comprises a heat transfer device comprising:

a first surface;

a second surface;

a liquid reservoir in thermal contact with the first surface and containing a liquid; and

a tube connecting the liquid reservoir to the second surface;

wherein the liquid reservoir comprises a first fluid flow channel inclined to the horizontal and containing the liquid and a second fluid flow channel connected to the first fluid flow channel and containing the liquid;

the first surface is in thermal contact with the liquid in the first fluid flow channel; and

at least a part of the tube is at least partially evacuated;

whereby, when the first surface is hotter than the second surface, heat energy from the first surface causes liquid in the first fluid flow channel to vaporize;

the vapor travels upwardly along the first fluid flow channel and through the tube, and condenses at the second surface;

the vapor drives a flow of liquid from the second fluid flow channel to the first fluid flow channel and upwardly along the first fluid flow channel; and

condensed liquid returns from the second surface to the liquid reservoir;

whereby heat energy is transported away from the first surface to the second surface;

the solar energy absorber comprising the first surface and the primary heat exchanger and secondary heat exchanger comprising the second surface.

218. A solar energy converter according to any one of claims 200 to 214, wherein the heat transfer element comprises a heat transfer device comprising:

a first surface;

a second surface;

a liquid reservoir in thermal contact with the first surface and containing a liquid; and

a tube connecting the liquid reservoir to the second surface;

wherein at least a part of the tube is at least partially evacuated;

whereby, when the first surface is hotter than the second surface, heat energy from the first surface causes liquid in the liquid reservoir to vaporize;

the vapor travels through the tube and condenses at the second surface; and

condensed liquid returns from the second surface to the liquid reservoir;

whereby heat energy is transported from the first surface to the second surface;

the solar energy absorber comprising the first surface and the primary heat exchanger and secondary heat exchanger comprising the second surface.

219. A solar energy converter according to any one of claims 200 to 214, wherein the heat

transfer element comprises a heat transfer device having a working fluid capable of circulating around a fluid flow path, the circulation around the fluid flow path bringing the working fluid in and out of thermal contact with a heat source, the heat transfer device comprising:

a fluid containing portion internally defining a working fluid flow path;

a heat source at least partially in thermal contact with a first surface of the fluid containing portion;

a gas substance generator at least partially within the fluid containing portion, and arranged to generate bubbles of gas or vapor capable of driving the working fluid along a portion of the working fluid flow path in thermal contact with the heat source;

wherein, in use, the driven working fluid absorbs heat from the heat source and transports the heat away from the heat source to a second surface of the fluid containing portion; and

the driven working fluid returns to the gas substance generator to be recycled about the fluid flow path;

the solar energy absorber comprising the first surface and the primary heat exchanger and secondary heat exchanger comprising the second surface.

220. A solar energy converter according to any one of claims 200 to 219, wherein the solar energy converter is arranged to allow passage of vapor through the primary heat exchanger and into the secondary heat exchanger.

221. A solar energy converter according to claim 220, wherein the heat transfer control element is arranged to selectively block passage of vapor through the primary heat exchanger and into the secondary heat exchanger.

222. A solar energy converter array comprising a plurality of solar energy converters according to any one of claims 200 to 221.

223. A solar energy converter comprising:

a solar energy absorber; and

a heat transfer device in thermal contact with the solar energy absorber;

wherein the heat transfer device is in thermal contact with the solar energy absorber; and

the heat transfer device is arranged to transfer heat energy away from the solar energy absorber.

224. A solar energy converter according to claim 223, wherein the heat transfer device comprises:

a fluid flow means extending between a first surface and a second surface, at least a part of the fluid flow means being inclined to the horizontal;

the fluid flow means being partially filled with a liquid and being arranged so that the first surface is in thermal contact with the liquid in at least a first part of the fluid flow means inclined to the horizontal and containing the liquid; and

the first part of the fluid flow means being divided into a first fluid flow channel and a second fluid flow channel arranged so that the liquid in the first fluid flow channel is in better thermal contact with the first surface than the liquid in the second fluid flow channel;

wherein the part of the fluid flow means above the surface of the liquid is at least partially evacuated;

whereby, when the first surface is hotter than the second surface, heat energy from the first surface causes the liquid in the first fluid flow channel to vaporize, and the vapor travels through the liquid in the first fluid flow channel to the surface of the liquid, such that the liquid circulates around the first fluid flow channel and the second fluid flow channel;

vapor travels from the surface of the liquid to the second surface and condenses at the second surface; and

condensed liquid returns from the second surface to the first part of the fluid flow means;

whereby heat energy is transported from the first surface to the second surface.

225. A solar energy converter according to claim 223, wherein the heat transfer device comprises:

a first fluid flow channel inclined to the horizontal and containing a liquid;

a second fluid flow channel connected to the first fluid flow channel and containing the liquid; and

a first surface in thermal contact with the liquid in the first fluid flow channel;

wherein heat energy from the first surface causes liquid in the first fluid flow channel to vaporize;

the vapor travels upwardly along the first fluid flow channel; and

the vapor drives a flow of liquid from the second fluid flow channel to the first fluid flow channel and upwardly along the first fluid flow channel;

whereby heat energy is transported away from the first surface.

226. A solar energy converter according to claim 223, wherein the heat transfer device comprises:

a first surface;

a second surface;

a liquid reservoir in thermal contact with the first surface and containing a liquid; and

a tube connecting the liquid reservoir to the second surface;

wherein the liquid reservoir comprises a first fluid flow channel inclined to the horizontal and containing the liquid and a second fluid flow channel connected to the first fluid flow channel and containing the liquid;

the first surface is in thermal contact with the liquid in the first fluid flow channel; and

at least a part of the tube is at least partially evacuated;

whereby, when the first surface is hotter than the second surface, heat energy from the first surface causes liquid in the first fluid flow channel to vaporize;

the vapor travels upwardly along the first fluid flow channel and through the tube, and

condenses at the second surface;

the vapor drives a flow of liquid from the second fluid flow channel to the first fluid flow channel and upwardly along the first fluid flow channel; and

condensed liquid returns from the second surface to the liquid reservoir;

whereby heat energy is transported away from the first surface to the second surface.

227. A solar energy converter according to claim 223, wherein the heat transfer device comprises:

a first surface;

a second surface;

a liquid reservoir in thermal contact with the first surface and containing a liquid; and

a tube connecting the liquid reservoir to the second surface;

wherein at least a part of the tube is at least partially evacuated;

whereby, when the first surface is hotter than the second surface, heat energy from the first surface causes liquid in the liquid reservoir to vaporize;

the vapor travels through the tube and condenses at the second surface; and

condensed liquid returns from the second surface to the liquid reservoir;

whereby heat energy is transported from the first surface to the second surface.

228. A solar energy converter according to claim 223, wherein the heat transfer device has a working fluid capable of circulating around a fluid flow path, the circulation around the fluid flow path bringing the working fluid in and out of thermal contact with a heat source and a second surface, the heat transfer device comprising:

a fluid containing portion internally defining a working fluid flow path;

a heat source at least partially in thermal contact with the fluid containing portion;

a gas substance generator at least partially within the fluid containing portion, and arranged to generate bubbles of gas or vapor capable of driving the working fluid along a portion of the working fluid flow path in thermal contact with the heat source;

wherein, in use, the driven working fluid absorbs heat from the heat source and transports the heat away from the heat source; and

the driven working fluid returns to the gas substance generator to be recycled about

the fluid flow path.

229. A solar energy converter according to any one of claims 224 to 228, further comprising:

a heat exchanger in thermal contact with the heat transfer device;

wherein the second surface is in thermal contact with the heat exchanger and the heat transfer device is arranged to transfer heat energy from the solar energy absorber to the heat exchanger.

230. A solar energy converter according to claim 229, wherein the heat exchanger comprises the second surface.

231. A solar energy converter according to any one of claims 223 to 230, wherein the solar energy absorber is located within an envelope.

232. A solar energy converter according to claim 231, wherein the envelope is a tube.

233. A solar energy converter according to claim 232, wherein the envelope has a circular cross-section.

234. A solar energy converter according to claim 232, wherein the envelope has an elliptical cross-section.

235. A solar energy converter according to any one of claims 231 to 234, wherein the envelope is at least partially transparent.

236. A solar energy converter according to any one of claims 231 to 235, wherein the envelope is at least partially evacuated.

237. A solar energy converter according to claim 236, wherein the envelope is at a pressure

of 10^{-3} mbar or less.

238. A solar energy converter according to claim 237, wherein the envelope is at a pressure of 10^{-6} mbar or less.

239. A solar energy converter array comprising a plurality of hybrid solar energy converters according to any one of the claims 223 to 238.

240. A solar energy converter array comprising at least one solar energy converter according to any one of claims 37 to 65, and at least one solar energy converter according to any one of claims 223 to 239.

241. A solar energy converter comprising:
a solar energy absorber, the solar energy absorber comprising a photovoltaic element;
a heat transfer element in thermal contact with the solar energy absorber;
a heat exchanger in thermal contact with the heat transfer element; and
an at least partially evacuated tube;
wherein the solar energy absorber is inside the evacuated tube.

242. A solar energy converter comprising:
a solar energy absorber;
a heat transfer element in thermal contact with the solar energy absorber;
a heat exchanger in thermal contact with the heat transfer element; and
an at least partially evacuated envelope;
wherein the solar energy absorber is inside the evacuated envelope.

243. A solar energy converter substantially as shown in, or as described with reference to, the accompanying figures.

244. A hybrid solar energy converter substantially as shown in, or as described with

reference to, the accompanying figures.

Claims:

1. A solar energy converter comprising:

a solar energy absorber, the solar energy absorber comprising a photovoltaic element; and

a heat transfer device in thermal contact with the solar energy absorber;

wherein the heat transfer device is in thermal contact with the photovoltaic element; and the heat transfer device comprises;

a first fluid flow channel inclined at least partially to the horizontal and containing a liquid;

a second fluid flow channel connected to the first fluid flow channel and containing the liquid; and

a first surface in thermal contact with the liquid in the first fluid flow channel;

wherein heat energy from the first surface causes liquid in the first fluid flow channel to vaporize; and wherein

the vapor travels upwardly along the first fluid flow channel by means of a rolling boil such that the vapor drives a flow of liquid from the second fluid flow channel to the first fluid flow channel and upwardly along the first fluid flow channel; and

whereby the heat transfer device is arranged to transfer heat energy away from the photovoltaic element to cool the photovoltaic element.

2. A solar energy converter according to claim 1, wherein the solar energy absorber is located within an envelope.

3. A solar energy converter according to claim 2, wherein the envelope is a tube.

4. A solar energy converter according to claim 3, wherein the envelope has a circular cross-section.

5. A solar energy converter according to claim 3, wherein the envelope has an elliptical cross-section.

6. A solar energy converter according to any preceding claim, wherein the envelope is at least partially transparent.

7. A solar energy converter according to any one of claims 2 to 6, wherein the envelope is at least partially evacuated.

8. A solar energy converter according to claim 7, wherein the envelope is at a pressure of 10^{-3} mbar or less.

9. A solar energy converter according to claim 8, wherein the envelope is at a pressure of 10^{-6} mbar or less.

10. A solar energy converter according to any preceding claim, wherein the photovoltaic element is arranged to generate electrical energy when exposed to solar radiation.

11. A solar energy converter according to claim 10, and further comprising conductors arranged to output generated electrical energy.

12. A solar energy converter according to any preceding claim, wherein the photovoltaic element comprises a semiconductor material.

13. A solar energy converter according to claim 12, wherein the photovoltaic element comprises silicon.

14. A solar energy converter according to claim 12, wherein the photovoltaic element comprises gallium arsenide.

15. A solar energy converter according to any preceding claim, wherein one or more thermally conductive layers are disposed between the photovoltaic element and the heat transfer element.

16. A solar energy converter according to claim 15, wherein the one or more of the thermally conductive layers is also an electrically insulating layer.

17. A solar energy converter according to claim 15 or claim 16, wherein the one or more of the thermally conductive layers comprise an adhesive.

18. A solar energy converter according to claim 17, wherein the adhesive is a flexible adhesive.

19. A solar energy converter according to claim 17 or claim 18, wherein the adhesive comprises an epoxy resin.

20. A solar energy converter according to claim 17 or claim 18, wherein the adhesive comprises a double sided adhesive tape.

21. A solar energy converter according to any preceding claim, wherein the heat transfer element is substantially rigid.

22. A solar energy converter according to any preceding claim, wherein the solar energy absorber comprises a plurality of photovoltaic elements.

23. A solar energy converter according to any preceding claim further comprising:
a primary heat exchanger in thermal contact with the heat transfer element;
a secondary heat exchanger; and
a heat transfer control element.

24. A solar energy converter according to claim 23, wherein the primary heat exchanger transfers heat from the heat transfer element to a first fluid.

25. A solar energy converter according to claim 24, wherein the first fluid is water.

26. A solar energy converter according to claim 23 to claim 25, wherein the secondary heat exchanger transfers heat from the heat transfer element to a second fluid.

27. A solar energy converter according to claim 26, wherein the second fluid is air.

28. A solar energy converter according to claim 26, wherein the second fluid is water.

29. A solar energy converter according to claim 23, wherein the heat transfer control element is arranged to selectively place the secondary heat exchanger either in thermal contact with the heat transfer element or out of thermal contact with the heat transfer element in response to a sensed temperature.

30. A solar energy converter according to claim 29, wherein the sensed temperature is a temperature of the primary heat exchanger.