WHAT IS CLAIMED IS:

CLAIMS:

1. A fan drive system for an air-cooled heat exchanger system, comprising:

a high-torque, low speed permanent magnet motor having a rotatable shaft;

a fan comprising a hub that is directly coupled to the rotatable shaft and a plurality of fan blades that are attached to the hub; and

a variable frequency drive device in electrical signal communication with the permanent magnet motor to control the rotational speed of the permanent magnet motor.

2. The fan drive system according to claim 2 wherein the high-torque, permanent magnet motor comprises no more than two bearings in operative association with the shaft.

3. The fan drive system according to claim 2 wherein the variable frequency drive device comprises:

a variable frequency controller that has an input for receiving AC power and an output for providing electrical signals that control the operational speed of the high-torque, permanent magnet motor; and

a user interface in electronic data signal communication with the variable frequency controller to allow a user to input data representing a desired motor speed.

4. The fan drive system according to claim 3 further comprising a plurality of sensors in electronic data signal communication with the user interface so as to provide sensor output data signals representing vibration and heat at the bearings of the motor, heat at the motor stator, and air flow created by rotation of the fan.

5. The fan drive system according to claim 4 further comprising a data signal processing resource in electronic data signal communication with the user interface to receive the sensor output data signals.

6. The fan drive system according to claim 5 wherein in response to the sensor output data signals, the data signal processing resource generates feedback signals that are inputted into the user interface to allow adjustment of the motor speed.

7. The fan drive system according to claim 6 wherein the data signal processing resource comprises a computer and a display device.

8. An air-cooled heat exchanger system having a forced draft configuration, comprising:

a structure supporting a tube bundle;

a fan rotatably mounted to the structure and positioned under the tube bundle;

a high-torque, low speed permanent magnet motor supported by the structure and having a rotatable shaft that is connected to the fan; and

a variable frequency drive device in electrical signal communication with the permanent magnet motor to control the rotational speed of the permanent magnet motor.

9. The air-cooled heat exchanger system according to claim 8 wherein the variable frequency drive device comprises:

a variable frequency controller that has an input for receiving AC power and an output for providing electrical signals that control the operational speed of high-torque, permanent magnet motor, and

a user interface in electronic data signal communication with the variable frequency controller to allow a user to input motor speed control data.

10. The air-cooled heat exchanger systems according to claim 8 further comprising a plurality of sensors in electronic data signal communication with the user interface so as to provide sensor data output signals representing vibration and heat at the bearings of the high-torque, permanent magnet motor, heat at the motor stator, and air flow created by operation of the fan.

11. The air-cooled heat exchanger systems according to claim 8 wherein the permanent magnet motor has a rotational speed between 0 RPM and about 350 RPM.

12. An air-cooled heat exchanger system having an induced draft configuration, comprising:

a structure supporting a tube bundle;

a fan rotatably mounted to the structure and positioned above the tube bundle, the fan having a hub to which are attached a plurality of fan blades;

a high-torque, low speed permanent magnet motor supported by the structure and having a rotatable shaft that is connected to the fan; and

a variable frequency drive device in electrical signal communication with the permanent magnet motor to control the rotational speed of the permanent magnet motor.

13. The air-cooled heat exchanger systems according to claim 12 wherein the variable frequency drive device comprises:

a variable frequency controller that has an input for receiving AC power and an output for providing electrical signals that control the operational speed of high-torque, permanent magnet motor, and

a user interface in electronic data signal communication with the variable frequency controller to allow a user to input motor speed control data.

14. The air-cooled heat exchanger systems according to claim 13 further comprising a plurality of sensors in electronic data signal communication with the user interface so as to provide sensor data output signals representing vibration and heat at the bearings of the high-torque, permanent magnet motor, heat at the motor stator, and air flow created by operation of the fan.

15. The air-cooled heat exchanger systems according to claim 12 wherein the high-torque, permanent magnet motor is positioned above the tube bundle.

16. The air-cooled heat exchanger systems according to claim 12 wherein the high-torque, permanent magnet motor is positioned below the tube bundle.

17. The air-cooled heat exchanger systems according to claim 16 further comprising a vertically oriented, elongated shaft connected to and between the hub of the fan and the shaft of the high-torque, permanent magnet motor, the vertically oriented, elongated shaft extending through the tube bundle.

18. The forced draft, air-cooled heat exchanger systems according to claim 12 wherein the permanent magnet motor has a rotational speed between 0 RPM and about 350 RPM.

CLAIMS

1. A forced-draft, air-cooled heat exchanger for cooling process fluids used in an industrial process, comprising:

a main support structure that supports the forced draft, air-cooled heat exchanger at a predetermined height above ground;

a tube bundle supported by the main support structure, the tube bundle configured to receive process fluids used in an industrial process;

a plenum connected to the main support structure and positioned beneath the tube bundle, the plenum being configured to direct air-flow through the tube bundle;

a fan supported by the main support structure and positioned beneath the plenum, the fan comprising a fan hub and a plurality of fan blades attached to the fan hub, wherein rotation of the fan produces an air-flow that is directed through the tube bundle by the plenum; and

a fan drive system supported by the main support structure and positioned beneath the fan, the fan drive system comprising a high-torque, low speed permanent magnet motor comprising a motor casing, a stator and a rotatable shaft, the rotatable shaft being connected to the fan hub.

2. The forced-draft air-cooled heat exchanger according to claim 1 wherein the fan drive system further comprises a variable frequency drive device to generate electrical signals that effect rotation of the motor rotatable shaft at a rotational speed in order to rotate the fan.

3. The forced-draft air-cooled heat exchanger according to claim 2 wherein the variable frequency drive device comprises electronic circuitry to receive control signals that represent a particular rotational speed and to generate electrical signals for the permanent magnet motor, wherein the electrical signals represent the rotational speed represented by the received control signals.

4. The forced-draft air-cooled heat exchanger according to claim 3 wherein the high-torque, low speed permanent magnet motor further comprises a dual bearing system having a pair of bearings that locate and support the rotatable shaft relative to the motor casing.

5. The forced-draft air-cooled heat exchanger according to claim 4 further comprising vibration sensors located within the motor casing to measure vibrations of the bearings and output signals representing the measured vibrations.

6. The forced-draft air-cooled heat exchanger according to claim 5 further comprising a plurality of heat sensors located within the motor casing to measure heat of the stator and of the bearings, the heat sensors outputting

signals representing the measured heat.

7. The forced-draft air-cooled heat exchanger according to claim 6 further comprising a processor for generating speed control signals for input into the electronic circuitry of the variable frequency drive device, wherein the speed control signals vary the speed of the high-torque, low speed permanent magnet motor, the processor being configured to process the signals outputted by the vibration and heat sensors to determine vibration level and heat of the stator, respectively.

8. The forced-draft air-cooled heat exchanger according to claim 7 further comprising an air-flow sensor to measure the air-flow generated by the fan and output signals that represent the level of air-flow generated by the fan, the processor being configured to process the signals outputted by the air-flow sensor.

9. The forced-draft air-cooled heat exchanger according to claim 1 further comprising a fan ring connected to the main support structure and positioned beneath the tube bundle, wherein the fan rotates within the fan ring.

10. An induced-draft, air-cooled heat exchanger for cooling high-temperature process fluids used in an industrial process, comprising:

a main support structure that supports the induced draft, air-cooled heat exchanger at a predetermined height above the ground;

a tube bundle supported by the main support structure, the tube bundle configured to receive process fluids used in an industrial process;

a plenum connected to the main support structure and positioned above the tube bundle;

a fan positioned above the plenum and comprising a fan hub, a plurality of fan blades attached to the fan hub, and a fan shaft attached to the hub, wherein the fan shaft extends downward through the plenum and tube bundle, wherein rotation of the fan induces an air-flow through the tube bundle; and

a fan drive system supported by the main support structure and positioned beneath the tube bundle, the fan drive system comprising a high-torque, low speed permanent magnet motor comprising a motor casing, a stator and a rotatable shaft, the rotatable shaft being connected to the fan shaft.

11. The induced-draft air-cooled heat exchanger according to claim 10 wherein the fan drive system further comprises a variable frequency drive device to generate electrical signals that effect rotation of the rotatable shaft of the motor in order to rotate the fan.

12. The induced-draft air-cooled heat exchanger according to claim 11 wherein the variable frequency drive device comprises electronic circuitry to

receive control signals that represent a particular rotational speed and generate electrical signals for the permanent magnet motor, wherein the electrical signals represent the rotational speed represented by the received control signals.

13. The induced-draft air-cooled heat exchanger according to claim 12 wherein the high-torque, low speed permanent magnet motor further comprises a dual bearing system having a pair of bearings that locate and support the rotatable shaft relative to the motor casing.

14. The induced-draft air-cooled heat exchanger according to claim 13 further comprising vibration sensors located within the motor casing to measure vibrations at the bearings and output signals representing the measured vibrations.

15. The induced-draft air-cooled heat exchanger according to claim 14 further comprising a plurality of heat sensors located within the motor casing to measure heat at the stator and at the bearings, the heat sensors outputting signals representing the measured heat.

16. The induced-draft air-cooled heat exchanger according to claim 15 further comprising a processor for generating speed control signals for input into the electronic circuitry of the variable frequency drive device, wherein the speed control signals vary the speed of the high-torque, low speed permanent magnet motor, the processor being configured to process the signals outputted by the vibration and heat sensors to determine vibration level and

the heat of the stator, respectively.

17. The induced-draft air-cooled heat exchanger according to claim 16 further comprising an air-flow sensor to measure the air-flow generated by the fan and output signals that represent the level of air-flow generated by the fan, the processor being configured to process the signals outputted by the air-flow sensor.

18. The induced-draft air-cooled heat exchanger according to claim 10 further comprising a fan ring connected to the main support structure and positioned above the plenum, wherein the fan rotates within the fan ring.

19. An induced-draft, air-cooled heat exchanger for cooling high-temperature process fluids used in an industrial process, comprising:

a main support structure that supports the induced draft, air-cooled heat exchanger at a predetermined height above ground;

a tube bundle supported by the main support structure, the tube bundle being configured to receive process fluids used in an industrial process;

a plenum connected to the main support structure and positioned above the tube bundle;

a fan drive system supported by plenum and positioned above the tube

bundle, the fan drive system comprising a high-torque, low variable speed permanent magnet motor comprising a motor casing, a stator and a rotatable shaft; and

a fan positioned above the tube bundle and comprising a fan hub and a plurality of fan blades attached to the fan hub, wherein the fan hub is connected to the rotatable shaft of the motor and wherein rotation of the fan induces an air-flow through the tube bundle.

20. The induced draft, air-cooled heat exchanger according to claim 19 further comprising a fan ring connected to the plenum, wherein the fan rotates within the fan ring.

21. An induced air-cooled heat exchanger for use in a petroleum refinery for cooling fluids used in a petroleum refining process wherein the air-cooled heat exchanger has a tube bundle for receiving the fluids, and a fan that causes an airflow that cools the fluid flowing through the tube bundle, characterized in that the induced air-cooled heat exchanger comprises:

a high-torque, low variable, speed permanent magnet motor comprising a rotatable shaft connected to the fan; and

a variable frequency drive device to generate electrical signals that effect rotation of the rotatable shaft of the motor in order to rotate the fan.

22. An industrial air-cooled heat exchanger for cooling fluids used in an industrial process wherein the industrial air-cooled heat exchanger has a support structure that supports the industrial air-cooled heat exchanger at a sufficient height above ground level and a tube bundle supported by the support structure, the tube bundle being configured to receive process fluids used in an industrial process, and a fan that causes an airflow that cools the fluid flowing through the tube bundle, characterized in that the industrial air-cooled heat exchanger comprises:

a variable speed, permanent magnet motor comprising a rotatable shaft connected to the fan; and

a variable frequency drive device to generate electrical signals that cause rotation of the rotatable shaft in order to rotate the fan.

23. An industrial air-cooled heat exchanger for cooling fluids used in an industrial process, comprising:

a support structure;

a tube bundle supported by the support structure, the tube bundle being configured to receive fluids to be cooled;

a variable speed permanent magnet motor supported by the support structure, the variable speed permanent magnet motor comprising a motor casing, a stator located within the motor casing and a rotatable shaft;

a fan connected to the rotatable shaft such that rotation of the rotatable shaft causes rotation of the fan which creates an airflow that cools the fluid flowing through the tube bundle;

wherein the support structure positions the tube bundle, the fan and the variable speed permanent magnet motor at a predetermined height above the ground; and

wherein the variable speed permanent magnet motor further comprises a bearing system that is configured to (i) support and locate the rotatable shaft with respect to the motor casing, (ii) enable the motor to rotate the fan in a forward direction or in a reverse direction, and (iii) bear the fan loads.

24. The industrial air-cooled heat exchanger according to claim 23 further comprising a motor speed control device to control the rotational speed of the variable speed permanent magnet motor.

25. The industrial air-cooled heat exchanger according to claim 24 wherein the motor speed control device comprises a variable frequency drive device.

26. The industrial air-cooled heat exchanger according to claim 23 further comprising at least one vibration sensor to sense vibrations of the bearings and output vibration sensor signals.

27. The industrial air-cooled heat exchanger according to claim 26 further comprising a signal processor to process the vibration sensor signals to determine the cause of the vibrations.

28. The industrial air-cooled heat exchanger according to claim 27 wherein the signal processor comprises a computer.

29. The industrial air-cooled heat exchanger according to claim 23 further comprising at least one temperature sensor to sense the heat of the stator and output temperature sensor signals.

30. The industrial air-cooled heat exchanger according to claim 29 further comprising a signal processor to process the temperature sensor signals.

31. The industrial air-cooled heat exchanger according to claim 30 wherein the signal processor comprises a computer.

32. The industrial air-cooled heat exchanger according to claim 23 further comprising an air-flow sensor to measure the air-flow created by rotation of the fan and output air-flow sensor signals.

33. The industrial air-cooled heat exchanger according to claim 32 further comprising a signal processor to process the air-flow sensor signals.

34. The industrial air-cooled heat exchanger according to claim 33 wherein

the signal processor comprises a computer.

35. The industrial air-cooled heat exchanger according to claim 23 further comprising a fan stack attached to the support structure, wherein the fan rotates within the fan stack.

36. The industrial air-cooled heat exchanger according to claim 23 further comprising a fan cylinder attached to the support structure, wherein the fan rotates within the fan cylinder.

37. The industrial air-cooled heat exchanger according to claim 23 wherein the variable speed permanent magnet motor is oriented such that the rotational shaft of the motor is vertically oriented.

38. An industrial air-cooled heat exchanger for cooling fluids used in an industrial process, comprising:

a support structure;

a tube bundle supported by the support structure, the tube bundle being configured to receive fluids to be cooled;

a variable speed permanent magnet motor supported by the support structure, the variable speed permanent magnet motor comprising a motor casing, a stator located within the motor casing and a rotatable shaft;

a fan connected to the rotatable shaft such that rotation of the rotatable shaft causes rotation of the fan which creates an airflow that cools the fluid flowing through the tube bundle;

wherein the support structure positions the tube bundle, the fan and the variable speed permanent magnet motor at a predetermined height above the ground;

wherein the variable speed permanent magnet motor further comprises a bearing system comprising bearings that are configured to (i) support and locate the rotatable shaft with respect to the motor casing, (ii) enable the motor to rotate the fan in a forward direction or in a reverse direction, and (iii) bear the fan loads;

at least one vibration sensor to measure vibrations of the bearings and output vibration sensor signals;

at least one bearing temperature sensor to measure temperature of at least one of the bearings and output bearing temperature sensor signals;

at least one stator temperature sensor to measure temperature of the stator and output stator temperature sensor signals;

a variable frequency drive device to generate electrical signals that cause rotation of the rotatable shaft of the variable speed permanent magnet motor at a predetermined rotational speed in order to rotate the fan, the variable frequency drive device having an input for receiving control signals representing the predetermined rotational speed of the variable speed permanent magnet motor; and

a signal processor to process the vibration sensor signals, the bearing temperature sensor signals, and the stator temperature sensor signals in order to generate control signals for input into the variable frequency drive device.

39. An industrial air-cooled heat exchanger for cooling fluids used in an industrial process, comprising:

a support structure;

a tube bundle supported by the support structure, the tube bundle being configured to receive fluids to be cooled;

a variable speed motor comprising a rotatable shaft, a stator and bearings that locate and support the rotatable shaft;

a fan connected to the rotatable shaft of the motor such that rotation of the rotatable shaft causes rotation of the fan which causes an airflow that cools the fluid flowing through the tube bundle;

wherein the support structure positions the tube bundle, the fan and the motor at a predetermined height above ground level;

at least one vibration sensor to measure vibrations of the bearings and output vibration sensor signals; and

a variable motor-speed control device to generate electrical signals that cause rotation of the rotatable shaft of the motor at a predetermined rotational speed in order to rotate the fan, the variable motor-speed control device having an input for receiving control signals representing the predetermined rotational speed of the motor.

40. The industrial air-cooled heat exchanger according to claim 39 wherein the variable speed motor comprises a variable speed permanent magnet motor.

41. The industrial air-cooled heat exchanger according to claim 39 wherein the variable motor-speed control device comprises a variable frequency drive device.

42. The industrial air-cooled heat exchanger according to claim 39 further comprising a signal processing resource in electronic signal communication with the variable motor-speed control device and the at least one vibration sensor, the signal processing resource processing the signals outputted by the at least one vibration sensor and generating the control signals that are inputted into the input of the variable motor-speed control device.

43. The industrial air-cooled heat exchanger according to claim 42 further comprising temperature sensors to measure heat of the stator and the bearings and output temperature sensor signals, the signal processing resource processing the temperature sensor signals.

44. The industrial air-cooled heat exchanger according to claim 42 further comprising at least one airflow sensor to measure airflow produced by rotation of the fan and output airflow sensor signals, the signal processing resource processing the airflow signals.

45. The industrial air-cooled heat exchanger according to claim 42 wherein the signal processing resource comprises a computer.

46. The industrial air-cooled heat exchanger according to claim 39 wherein the fan comprises a fan hub and the rotatable shaft of the variable speed

motor is connected to the fan hub.

47. The industrial air-cooled heat exchanger according to claim 39 wherein the variable speed motor comprises a variable speed permanent magnet motor and the rotatable shaft is oriented in a substantially vertical position.

48. The industrial air-cooled heat exchanger according to claim 47 wherein the fan is positioned above the variable speed permanent magnet motor.

49. The industrial air-cooled heat exchanger according to claim 47 wherein the fan is positioned below the variable speed permanent magnet motor.

50. The industrial air-cooled heat exchanger according to claim 47 wherein the variable speed motor comprises a variable speed permanent magnet motor configured to have a speed range of 0-350 RPM.

51. The industrial air-cooled heat exchanger according to claim 40 wherein the efficiency of the variable speed permanent magnet motor is greater than 90% when the motor speed is between about 200 RPM and 350 RPM and wherein the variable speed permanent magnet motor has substantially constant torque between about 70 RPM and 425 RPM.

52. An industrial air-cooled heat exchanger for cooling fluids used in a process, comprising:

a support structure;

a tube bundle supported by the support structure, the tube bundle

being configured to receive fluids to be cooled;

a variable speed permanent magnet motor comprising a rotatable shaft, a stator and bearings that locate and support the rotatable shaft;

a fan connected to the rotatable shaft of the variable speed permanent magnet motor such that rotation of the rotatable shaft causes rotation of the fan which causes an airflow that cools the fluid flowing through the tube bundle;

wherein the support structure positions the tube bundle, the fan and the variable speed permanent magnet motor at a predetermined height above ground level;

vibration sensors to measure vibrations of the bearings and output vibration sensor signals;

at least one airflow sensor to measure airflow produced by rotation of the fan and output airflow sensor signals;

a variable motor-speed control device to generate electrical signals that cause rotation of the rotatable shaft of the variable speed permanent magnet motor at a predetermined rotational speed in order to rotate the fan, the variable motor-speed control device having an input for receiving control signals representing the predetermined rotational speed of the variable speed permanent magnet motor; and

a signal processing resource external to the variable speed permanent magnet motor for processing the vibration sensor signals and airflow sensor signals and in response, generating the control signals for input into the variable motor-speed control device.

53. The industrial air-cooled heat exchanger according to claim 52 further comprising temperature sensors to measure heat of the stator and the bearings and output temperature sensor signals, the signal processing resource processing the output temperature sensor signals.

54. An apparatus for cooling water used in an industrial process, comprising:

a variable speed permanent magnet motor having a rotatable shaft, wherein the variable speed permanent magnet motor is oriented such that the rotatable shaft is substantially vertical and is oriented downward;

a variable motor-speed control device to generate electrical signals that effect rotation of the rotatable shaft of the variable speed permanent magnet motor;

a fan positioned beneath the variable speed permanent magnet motor, wherein the downward oriented rotatable shaft of the variable speed permanent magnet motor is directly connected to the fan such that rotation of the rotatable shaft causes rotation of the fan and the production of air-flow;

a water distribution structure positioned beneath the fan so that air-flow produced by rotation of the fan flows throughout the water distribution structure, the water distribution structure receiving water to be cooled and uniformly distributing the water throughout the water distribution structure so as to the maximize the surface area between the air-flow produced by the fan and

the water to be cooled; and

a structure for supporting the variable speed permanent magnet motor, fan and water distribution structure at a predetermined height above ground level.

55. The apparatus according to claim 54 wherein the water distribution structure comprises a tube bundle.

56. The apparatus according to claim 54 wherein the variable motor-speed control device comprises a variable frequency drive device.

57. The apparatus according to claim 54 further comprising vibration sensors to measure vibrations of the bearings and output vibration sensor signals.

58. The apparatus according to claim 57 further comprising a signal processing resource in electronic signal communication with the variable motor-speed control device and the vibration sensors, the signal processing resource processing the signals outputted by the vibration sensor signals and generating the control signals that are inputted into the input of the variable motor-speed control device.

59. The apparatus according to claim 58 further comprising temperature sensors to measure heat of the stator and the bearings and output temperature sensor signals, wherein the signal processing resource processes the temperature sensor signals.

60. The apparatus according to claim 58 further comprising at least one airflow sensor to measure airflow produced by rotation of the fan and output airflow sensor signals, the signal processing resource processing the airflow sensor signals.

61. An industrial air-cooled heat exchanger for cooling fluids used in an industrial process, comprising:

a support structure;

a tube bundle supported by the support structure, the tube bundle being configured to receive fluids to be cooled;

a variable speed permanent magnet motor comprising a rotatable shaft, a stator and bearings that locate and support the rotatable shaft, the variable speed permanent magnet motor being positioned below the tube bundle;

an elongate member attached to the rotatable shaft of the variable speed permanent magnet motor and extending through the tube bundle;

a fan positioned above the tube bundle and connected to the elongate member such that rotation of the rotatable shaft causes rotation of the fan which causes an airflow that cools the fluid flowing through the tube bundle;

wherein the support structure positions the fan, tube bundle and the variable speed permanent magnet motor at a predetermined height above the ground; and

a variable motor-speed control device to generate electrical signals that

cause rotation of the rotatable shaft of the variable speed permanent magnet motor at a predetermined rotational speed in order to rotate the fan, the variable motor-speed control device having an input for receiving control signals representing the predetermined rotational speed.

62. The industrial air-cooled heat exchanger according to claim 61 further comprising a fan ring mounted to the support structure, wherein the fan rotates within the fan ring.

63. The industrial air-cooled heat exchanger according to claim 61 wherein the variable motor-speed control device comprises a variable frequency drive device.

64 The industrial air-cooled heat exchanger according to claim 61 further comprising vibration sensors to measure vibrations of the bearings and output vibration sensor signals.

65. The industrial air-cooled heat exchanger according to claim 64 further comprising temperature sensors to measure heat of the stator and the bearings and temperature sensor signals.

66. The industrial air-cooled heat exchanger according to claim 65 further comprising at least one air-flow sensor to measure airflow produced by rotation of the fan and output air-flow sensor signals.

67. The industrial air-cooled heat exchanger according to claim 66 further comprising a signal processing resource in electronic signal communication with the variable motor-speed control device and the sensors, the signal processing resource processing the signals outputted by the sensors and generating the control signals that are inputted into the input of the variable motor-speed control device.

68. An apparatus for cooling water used in an industrial process, comprising:

a variable speed motor having a rotatable shaft, wherein the variable speed motor is oriented such that the rotatable shaft is substantially vertical and is oriented downward;

a variable motor-speed control device to generate electrical signals that effect rotation of the rotatable shaft of the variable speed motor motor;

a fan positioned beneath the variable speed motor motor, wherein the downward oriented rotatable shaft of the variable speed motor is directly connected to the fan such that rotation of the rotatable shaft causes rotation of the fan and the production of air-flow;

a water distribution structure positioned beneath the fan so that air-flow produced by rotation of the fan flows throughout the water distribution structure, the water distribution structure receiving water to be cooled and uniformly distributing the water throughout the water distribution structure so as to the maximize the surface area between the air-flow produced by the fan and the water to be cooled; and

a structure for positioning the variable speed motor, fan and water distribution structure at a predetermined height above ground level.

69. The apparatus according to claim 68 wherein the water distribution structure comprises a tube bundle.

70. The apparatus according to claim 68 wherein the variable speed motor comprises a variable speed permanent magnet motor.