

## CLAIMS:

What is claimed is:

1. A system for cooling one or more hard disk drives of one or more computing systems, the one or more hard disk drives having heat generating electronic and mechanical components, the system comprising:
  - a dielectric liquid coolant;
  - at least one tank defining an interior volume for holding the dielectric coolant;
  - first one or more members positioned within the interior volume for mounting the one or more computing systems thereon, the first one or more mounting members being configured to allow the one or more computing systems to be at least partially submerged within the dielectric liquid coolant when the dielectric liquid coolant is in the interior volume for sufficiently cooling the one or more computing systems;
  - second one or more mounting members positioned within the interior volume for mounting the one or more hard disk drives thereon, the second one or more mounting members being configured to keep the one or more hard disk drives mounted thereon above the dielectric liquid coolant when the dielectric liquid coolant is in the interior volume, the second one or more mounting members having at least one heat conductive extension thermally coupled with the one or more hard disk drives at one end and immersed into the dielectric liquid coolant at another end, the at least one heat conductive extension for transferring at least a portion of heat generated by the heat generating electronic and mechanical components of the one or more hard disk drives to the dielectric liquid coolant for absorption in order to sufficiently cool the one or more hard disk drives;
  - a heat exchanger thermally coupled to the dielectric liquid coolant for cooling the dielectric liquid coolant in the tank.
2. The system of Claim 1 further including a splash guard coupled to the one or more hard disk drives for protecting the one or more hard disk drives against dielectric liquid coolant splashes from circulating dielectric liquid coolant in the tank.
3. The system of Claim 1 further including at least one heat sink thermally coupled to the at least one heat conductive extension, the at least one heat sink being immersed

at one end into the dielectric liquid coolant for coupling heat from the hard disk drives to the dielectric liquid coolant, thereby providing further cooling to the hard disk drive.

4. The system of Claim 1 wherein the at least one heat conductive extension includes an electrical connector at the end immersed in the dielectric liquid coolant, the one or more computing systems having at least one hard disk drive slot having a mating electrical connector therein, the electrical connector being connected to the one or more hard disk drives at one end and to the mating connector at another end to thereby electrically connect the one or more hard disk drives to the one or more computing systems.
5. The system of Claim 1 further including a controller, the controller for maintaining the dielectric liquid coolant at substantially a particular temperature.
6. The system of Claim 1 further including a controller for maintaining the dielectric liquid coolant at a specific elevated temperature, the specific elevated temperature being a temperature that sufficiently cools the one or more computing systems and the one or more hard disk drives while reducing energy consumption.
7. The system of Claim 6 further including a pump for pumping warmer dielectric liquid coolant from the interior volume of the tank and for pumping cooler dielectric liquid coolant into the interior volume of the tank.
8. The system of Claim 7 wherein the at least one tank includes a coolant inlet and a coolant outlet, a pressure manifold on one side and a suction manifold on another side, the pressure manifold being fluidly coupled to a coolant inlet for facilitating the flow of the cooler dielectric liquid coolant into the interior volume and the suction manifold being fluidly coupled to the coolant outlet for facilitating the flow of the warmer dielectric liquid coolant out of the interior volume.
9. The system of Claim 8 wherein the pressure manifold and the suction manifold having a plurality of flow augmentation devices for enhancing and directing the flow of the dielectric liquid coolant inside the interior volume.

10. An apparatus for cooling one or more hard disk drives of one or more computing systems, the one or more hard disk drives having heat generating electronic and mechanical components, the apparatus comprising:
- at least one tank defining an interior volume for holding a dielectric liquid coolant;
  - first one or more members positioned within the interior volume for mounting the one or more computing systems thereon, the first one or more mounting members being configured to allow the one or more computing systems to be at least partially submerged within the dielectric liquid coolant when the dielectric liquid coolant is in the interior volume for sufficiently cooling the one or more computing systems;
  - second one or more mounting members positioned within the interior volume for mounting the one or more hard disk drives thereon, the second one or more mounting members being configured to keep the one or more hard disk drives mounted thereon above the dielectric liquid coolant when the dielectric liquid coolant is in the interior volume, the second one or more mounting members having at least one heat conductive extension thermally coupled with the one or more hard disk drives at one end and immersed into the dielectric liquid coolant at another end, the at least one heat conductive extension for transferring at least a portion of heat generated by the heat generating electronic and mechanical components of the one or more hard disk drives to the dielectric liquid coolant for absorption in order to sufficiently cool the one or more hard disk drives;
  - a heat exchanger thermally coupled to the dielectric liquid cooling for cooling the dielectric liquid coolant in the tank.
11. The apparatus of Claim 10 further including a splash guard coupled to the one or more hard disk drives for protecting the one or more hard disk drives against dielectric liquid coolant splashes from circulating dielectric liquid coolant in the tank.
12. The apparatus of Claim 10 further including at least one heat sink thermally coupled to the at least one heat conductive extension, the at least one heat sink being immersed at one end into the dielectric liquid coolant for coupling heat from the hard

disk drives to the dielectric liquid coolant, thereby providing further cooling to the hard disk drive.

13. The apparatus of Claim 10 wherein the at least one heat conductive extension includes an electrical connector at the end immersed in the dielectric liquid coolant, the one or more computing systems having at least one hard disk drive slot having a mating electrical connector therein, the electrical connector being connected to the one or more hard disk drives at one end and to the mating connector at another end to thereby electrically connect the one or more hard disk drives to the one or more computing systems.
14. The apparatus of Claim 10 further including a controller, the controller for maintaining the dielectric liquid coolant at substantially a particular temperature.
15. The apparatus of Claim 10 further including a controller, the controller for maintaining the dielectric liquid coolant at a specific elevated temperature, the specific elevated temperature being a temperature that sufficiently cools the one or more computing systems and the one or more hard disk drives while reducing energy consumption.
16. The apparatus of Claim 15 further including a pump for pumping warmer dielectric liquid coolant from the interior volume and for pumping cooler dielectric liquid coolant into the interior volume.
17. The apparatus of Claim 16 wherein the at least one tank includes a coolant inlet and a coolant outlet, a pressure manifold on one side and a suction manifold on another side, the pressure manifold being fluidly coupled to a coolant inlet for facilitating the flow of the cooler dielectric liquid coolant into the interior volume and the suction manifold being fluidly coupled to the coolant outlet for facilitating the flow of the warmer dielectric liquid coolant out of the interior volume.

18. The apparatus of Claim 17 wherein the pressure manifold and the suction manifold having a plurality of flow augmentation devices for enhancing and directing the flow of the dielectric liquid coolant inside the interior volume.
19. A method of cooling one or more hard disk drives of one or more computing systems, the one or more hard disk drives having heat generating electronic and mechanical components, the method comprising:
- a dielectric liquid coolant;
  - holding a dielectric liquid coolant in at least one tank defining an interior volume;
  - mounting the one or more computing systems to a first one or more members positioned within the interior volume, the first one or more mounting members being configured to allow the one or more computing systems to be at least partially submerged within the dielectric liquid coolant when the dielectric liquid coolant is in the interior volume for sufficiently cooling the one or more computing systems;
  - mounting the one or more hard disk drives to a second one or more mounting members positioned within the interior volume, the second one or more mounting members being configured to keep the one or more hard disk drives mounted thereon above the dielectric liquid coolant when the dielectric liquid coolant is in the interior volume, the second one or more mounting members having at least one heat conductive extension thermally coupled with the one or more hard disk drives at one end and immersed into the dielectric liquid coolant at another end, the at least one heat conductive extension for transferring at least a portion of heat generated by the heat generating electronic and mechanical components of the one or more hard disk drives to the dielectric liquid coolant for absorption in order to sufficiently cool the one or more hard disk drives;
  - cooling the dielectric liquid coolant in the tank with a heat exchanger.
20. The method of Claim 19 further including protecting the one or more hard disk drives with a splash guard coupled thereto against dielectric liquid coolant splashes from circulating dielectric liquid coolant in the tank.

21. The method of Claim 19 further including thermally coupling at least one heat sink to the at least one heat conductive extension, the at least one heat sink being immersed at one end into the dielectric liquid coolant for coupling heat from the hard disk drives to the dielectric liquid coolant, thereby providing further cooling to the hard disk drive.
22. The method of Claim 19 wherein the at least one heat conductive extension includes an electrical connector at the end immersed in the dielectric liquid coolant, the one or more computing systems having at least one hard disk drive slot having a mating electrical connector therein, the electrical connector being connected to the one or more hard disk drives at one end and to the mating connector at another end to thereby electrically connect the one or more hard disk drives to the one or more computing systems.
23. The method of Claim 19 further including using a controller for maintaining the dielectric liquid coolant at substantially a particular temperature.
24. The method of Claim 19 further including a controller, the controller for maintaining the dielectric liquid coolant at substantially a specific elevated temperature, the specific elevated temperature being a temperature that sufficiently cools the one or more computing systems and the one or more hard disk drives while reducing energy consumption.
25. The method of Claim 24 further including pumping warmer dielectric liquid coolant from the interior volume and for pumping cooler dielectric liquid coolant into the interior volume using a pump.
26. The method of Claim 25 wherein the at least one tank includes a coolant inlet and a coolant outlet, a pressure manifold on one side and a suction manifold on another side, the pressure manifold being fluidly coupled to a coolant inlet for facilitating the flow of the cooler dielectric liquid coolant into the interior volume and the suction manifold being fluidly coupled to the coolant outlet for facilitating the flow of the warmer dielectric liquid coolant out of the interior volumewherein the pressure

manifold and the suction manifold having a plurality of flow augmentation devices for enhancing and directing the flow of the dielectric liquid coolant inside the interior volume.

## CLAIMS

What is claimed is:

1. A system for cooling one or more hard disk drives of one or more computing systems, the one or more hard disk drives having heat generating electronic and mechanical components, the system comprising:

a dielectric liquid coolant;

at least one tank defining an interior volume for holding the dielectric coolant;

first one or more members positioned within the interior volume for mounting the one or more computing systems thereon, the first one or more mounting members being configured to allow the one or more computing systems to be at least partially submerged within the dielectric liquid coolant when the dielectric liquid coolant is in the interior volume for sufficiently cooling the one or more computing systems;

second one or more mounting members positioned within the interior volume for mounting the one or more hard disk drives thereon, the second one or more mounting members being configured to keep the one or more hard disk drives mounted thereon above the dielectric liquid coolant when the dielectric liquid coolant is in the interior volume, the second one or more mounting members having at least one heat conductive extension thermally coupled with the one or more hard disk drives at one end and immersed into the dielectric liquid coolant at another end, the at least one heat conductive extension for transferring at least a portion of heat generated by the heat generating electronic and mechanical components of the one or more hard disk drives to the dielectric liquid coolant for absorption in order to sufficiently cool the one or more hard disk drives;

a heat exchanger thermally coupled to the dielectric liquid coolant for cooling the dielectric liquid coolant in the tank.

2. The system of Claim 1 further including a splash guard coupled to the one or more hard disk drives for protecting the one or more hard disk drives against dielectric liquid coolant splashes from circulating dielectric liquid coolant in the tank.

3. The system of Claim 1 further including at least one heat sink thermally coupled to the at least one heat conductive extension, the at least one heat sink being immersed at one end into the dielectric liquid coolant for coupling heat from the hard disk drives to the dielectric liquid coolant, thereby providing further cooling to the hard disk drive.

4. The system of Claim 1 wherein the at least one heat conductive extension includes an electrical connector at the end immersed in the dielectric liquid coolant, the one or more computing systems having at least one hard disk drive slot having a mating electrical connector therein, the electrical connector being connected to the one or more hard disk drives at one end and to the mating connector at another end to thereby electrically connect the one or more hard disk drives to the one or more computing systems.

5. The system of Claim 1 further including a controller, the controller for maintaining the dielectric liquid coolant at substantially a particular temperature.

6. The system of Claim 1 further including a controller for maintaining the dielectric liquid coolant at a specific elevated temperature, the specific elevated temperature being a temperature that sufficiently cools the one or more computing systems and the one or more hard disk drives while reducing energy consumption.

7. The system of Claim 6 further including a pump for pumping warmer dielectric liquid coolant from the interior volume of the tank and for pumping cooler dielectric liquid coolant into the interior volume of the tank.

8. The system of Claim 7 wherein the at least one tank includes a coolant inlet and a coolant outlet, a pressure manifold on one side and a suction manifold on another side, the pressure manifold being fluidly coupled to a coolant inlet for facilitating the flow of the cooler dielectric liquid coolant into the interior volume and the suction manifold being fluidly coupled to the coolant outlet for facilitating the flow of the warmer dielectric liquid coolant out of the interior volume.

9. The system of Claim 8 wherein the pressure manifold and the suction manifold having a plurality of flow augmentation devices for enhancing and directing the flow of the dielectric liquid coolant inside the interior volume.

10. An apparatus for cooling one or more hard disk drives of one or more computing systems, the one or more hard disk drives having heat generating electronic and mechanical components, the apparatus comprising:

at least one tank defining an interior volume for holding a dielectric liquid coolant;

first one or more members positioned within the interior volume for mounting the one or more computing systems thereon, the first one or more mounting members being configured to allow the one or more computing systems to be at least partially submerged within the dielectric liquid coolant when the dielectric liquid coolant is in the interior volume for sufficiently cooling the one or more computing systems;

second one or more mounting members positioned within the interior volume for mounting the one or more hard disk drives thereon, the second one or more mounting members being configured to keep the one or more hard disk drives mounted thereon above the dielectric liquid coolant when the dielectric liquid coolant is in the interior volume, the second one or more mounting members having at least one heat conductive extension thermally coupled with the one or more hard disk drives at one end and immersed into the dielectric liquid coolant at another end, the at least one heat conductive extension for transferring at least a portion of heat generated by the heat generating electronic and mechanical components of the one or more hard disk drives to the dielectric liquid coolant for absorption in order to sufficiently cool the one or more hard disk drives;

a heat exchanger thermally coupled to the dielectric liquid cooling for cooling the dielectric liquid coolant in the tank.

11. The apparatus of Claim 10 further including a splash guard coupled to the one or more hard disk drives for protecting the one or more hard disk drives against dielectric liquid coolant splashes from circulating dielectric liquid coolant in the tank.

12. The apparatus of Claim 10 further including at least one heat sink thermally coupled to the at least one heat conductive extension, the at least one heat sink being immersed at one end into the dielectric liquid coolant for coupling heat from the hard disk drives to the dielectric liquid coolant, thereby providing further cooling to the hard disk drive.

13. The apparatus of Claim 10 wherein the at least one heat conductive extension includes an electrical connector at the end immersed in the dielectric liquid coolant, the one or more computing systems having at least one hard disk drive slot having a mating electrical connector therein, the electrical connector being connected to the one or more hard disk drives at one end and to the mating connector at another end

to thereby electrically connect the one or more hard disk drives to the one or more computing systems.

14. The apparatus of Claim 10 further including a controller, the controller for maintaining the dielectric liquid coolant at substantially a particular temperature.

15. The apparatus of Claim 10 further including a controller, the controller for maintaining the dielectric liquid coolant at a specific elevated temperature, the specific elevated temperature being a temperature that sufficiently cools the one or more computing systems and the one or more hard disk drives while reducing energy consumption.

16. The apparatus of Claim 15 further including a pump for pumping warmer dielectric liquid coolant from the interior volume and for pumping cooler dielectric liquid coolant into the interior volume.

17. The apparatus of Claim 16 wherein the at least one tank includes a coolant inlet and a coolant outlet, a pressure manifold on one side and a suction manifold on another side, the pressure manifold being fluidly coupled to a coolant inlet for facilitating the flow of the cooler dielectric liquid coolant into the interior volume and the suction manifold being fluidly coupled to the coolant outlet for facilitating the flow of the warmer dielectric liquid coolant out of the interior volume.

18. The apparatus of Claim 17 wherein the pressure manifold and the suction manifold having a plurality of flow augmentation devices for enhancing and directing the flow of the dielectric liquid coolant inside the interior volume.

19. A method of cooling one or more hard disk drives of one or more computing systems, the one or more hard disk drives having heat generating electronic and mechanical components, the method comprising:

a dielectric liquid coolant;

holding a dielectric liquid coolant in at least one tank defining an interior volume;

mounting the one or more computing systems to a first one or more members positioned within the interior volume, the first one or more mounting members being configured to allow the one or more computing systems to be at least partially

submerged within the dielectric liquid coolant when the dielectric liquid coolant is in the interior volume for sufficiently cooling the one or more computing systems;

mounting the one or more hard disk drives to a second one or more mounting members positioned within the interior volume, the second one or more mounting members being configured to keep the one or more hard disk drives mounted thereon above the dielectric liquid coolant when the dielectric liquid coolant is in the interior volume, the second one or more mounting members having at least one heat conductive extension thermally coupled with the one or more hard disk drives at one end and immersed into the dielectric liquid coolant at another end, the at least one heat conductive extension for transferring at least a portion of heat generated by the heat generating electronic and mechanical components of the one or more hard disk drives to the dielectric liquid coolant for absorption in order to sufficiently cool the one or more hard disk drives;

cooling the dielectric liquid coolant in the tank with a heat exchanger.

20. The method of Claim 19 further including protecting the one or more hard disk drives with a splash guard coupled thereto against dielectric liquid coolant splashes from circulating dielectric liquid coolant in the tank.

21. The method of Claim 19 further including thermally coupling at least one heat sink to the at least one heat conductive extension, the at least one heat sink being immersed at one end into the dielectric liquid coolant for coupling heat from the hard disk drives to the dielectric liquid coolant, thereby providing further cooling to the hard disk drive.

22. The method of Claim 19 wherein the at least one heat conductive extension includes an electrical connector at the end immersed in the dielectric liquid coolant, the one or more computing systems having at least one hard disk drive slot having a mating electrical connector therein, the electrical connector being connected to the one or more hard disk drives at one end and to the mating connector at another end to thereby electrically connect the one or more hard disk drives to the one or more computing systems.

23. The method of Claim 19 further including using a controller for maintaining the dielectric liquid coolant at substantially a particular temperature.

24. The method of Claim 19 further including a controller, the controller for maintaining the dielectric liquid coolant at substantially a specific elevated temperature, the specific elevated temperature being a temperature that sufficiently cools the one or more computing systems and the one or more hard disk drives while reducing energy consumption.

25. The method of Claim 24 further including pumping warmer dielectric liquid coolant from the interior volume and for pumping cooler dielectric liquid coolant into the interior volume using a pump.

26. The method of Claim 25 wherein the at least one tank includes a coolant inlet and a coolant outlet, a pressure manifold on one side and a suction manifold on another side, the pressure manifold being fluidly coupled to a coolant inlet for facilitating the flow of the cooler dielectric liquid coolant into the interior volume and the suction manifold being fluidly coupled to the coolant outlet for facilitating the flow of the warmer dielectric liquid coolant out of the interior volume wherein the pressure manifold and the suction manifold having a plurality of flow augmentation devices for enhancing and directing the flow of the dielectric liquid coolant inside the interior volume.