Air Ion Technology

gives a start to a new generation of data center cooling systems

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In modern data centers, air cooling systems occupy a dominant position. This situation is explained by the fact that this technical solution has a unique complex of constructive and operational advantages: universality, scalability, simplicity of technical implementation and operation, etc.

However, the current generation of air cooling systems has inherent unavoidable flaws, since all manufacturers of conditioning systems for data centers develop their facilities based on a single thermodynamic model of heat transfer, in which the efficiency of heat removal is limited by permissible frequency of occurrence of electrostatic discharges. This situation is postulated by the TIA-942 standard (and the ASHRAE-2011 directive, as its development), which operates with a classic tool for electrostatics control - humidifying of cooling air. This approach has limited effectiveness both in terms of proper equipment protection (up to 25% of failures of electronic devices are associated with electrostatic discharges, since the main protective component - an electroconductive water film on hot and hydrophobic surfaces is not formed) and in parts of energy efficiency - every 4th kilowatt in the energy balance of the data center is consumed by refrigeration equipment, i.e. "Heats the sky".

Briefly summarizing the situation in the industry, it can be said that the performance of the "classical" version of the air-cooling technology has a "thermodynamic limit" associated with complex setting of the cooling flow rate, its temperature and relative humidity.

According to some estimates, this situation leads to the fact that the refrigeration equipment of data centers is already beginning to influence the climate of the planet, as it unproductively burns energy resources for its own needs to the amount ofUSD 100 billion annually.

BASIS OF AIR ION TECHNOLOGY - EXTENDED THERMODYNAMIC MODEL OF HEAT TRANSFER IN COOLING IT-EQUIPMENT

When developing the Air Ion Data Center cooling technology, we succeded to replace the inherited and limited effective mechanism of indirect control of electro-static charges of triboelectric nature for the direct controlled deionization process. The appearance of a new component (forced controlled ionization of cooling air) in the thermodynamic model of heat transfer made it possible to modify the requirements for the three basic thermodynamic parameters of cooling air: the cooling flow rate, its relative humidity and temperature. Within the framework of the new model, these parameters became mutually independent, thus made it possible to expand significantly the requirements for their permissible / operational values:

1. The cooling flow rate is no longer limited by triboelectric effects, but only by the mechanical strength of the elements of the electronic device.

2. The relative humidity of the cooling air is limited only to the upper limit (protection against short circuit through the water film), the lower limit is "removed".

3. The temperature of the cooling air works as an independent (from relative humidity) airflow parameter, which allows to expand its (temperature) operating range to the limits of the "thermal strength" of the element base of electronic equipment.

ENERGY EFFICIENCY OF AIR ION TECHNOLOGY

As already noted above, when using Air Ion Technology in cooling system of IT equipment, the cooling flow rate can be multiply increased. For the same reason, the upper limit of the cooling-air temperature can be increased both at the entrance to the cooled device and at its outlet. The resultant negative effect of temperature growth, i.e. decrease in the heat transfer intensity due to a decrease in the temperature gradient, can be completely compensated by an increase in the consumption of the refrigerant (air). The simultaneous control of cooling flow temperature and rate makes it possible to realize the required efficiency of heat transfer within the servers. During the experiments, it was confirmed that the energy-loaded components of IT equipment can be cooled by airflow with a temperature of up to + 45°C.

To demonstrate the quantitative indicators of energy efficiency of the new technology, it is possible to look at the basic ratio of heat transfer in air conditioning systems. The amount of heat dissipated from the IT device is determined by the following ratio:

$$Q = Vt\rho c\Delta T,$$

V – cooling air flow; t – operating time of the refrigeration unit; ρ – air density; c – air heat capacity; $\Delta T=(T2-T1)$ – the difference in air temperature at the outlet and in the entrance to the device.

With standard air cooling technology, one kilowatt of excess heat is discharged from the device by air flow at discharge of 300 m³/h with a temperature difference of 17°C:

$$Q_{ASHRAE}=300[m^3/h]t\rho c(37-20)[°C]$$

Air Ion technology allows to increase three times the air flow rate and significantly expand the temperature difference at the inlet and outlet of the cooled device:

$$Q_{IONOTRON}=3*300t\rho c(45-5)^*$$

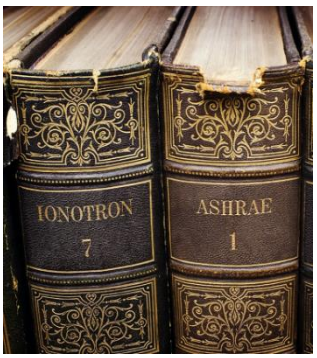
* These values are experimentally confirmed, but not maximum permissible.

INTELLECTUAL PROPERTY PROTECTION

"Electronic equipment cooling method and system for its implementation"

Patent Russian Federation 2498427
Priority 05/16/2012

Comparing the heat transfer equations for the classical and Air Ion cooling technologies, we can draw an unambiguous conclusion about the phenomenal potential that lies in the proposed innovative development:



$$\frac{Q_{IONOTRON}}{Q_{ASHRAE}} = \frac{7}{1}$$

Introduction of Air Ion technology **allows to achieve a 7-fold increase** in the performance of the data center cooling system.

The executive device for the Air Ion Technology is the air ion generator - **IONOTRON**. Own consumption of **IONOTRON** - no more than **0.5 W** per **1000 W** of server equipment heat.

COMPETITIVE ADVANTAGES AND PERSPECTIVE DIRECTIONS FOR INTRODUCING AIR ION TECHNOLOGY

Expansion of operating ranges and independent control of the cooling flow rate and temperature provide **an increase in the efficiency of the heat excess removal to 600%**.

The mechanism of direct controlled deionization provides **complete protection of IT equipment from electrostatic discharges of triboelectric nature.**

The unique high energy efficiency of cooling systems for IT equipment based on Air Ion Technology allows:

place the data center with installations for direct cooling of radio electronic equipment practically in any region of the planet;

create energy-loaded servers and super-computers without the use of complex and expensive liquid cooling systems.

EAC

Declaration of conformity
ТС № RU Д-RU.AT15.B.00114
ТР ТС 004/2011
"On the safety of low-voltage equipment"
ТР ТС 020/2011
"Electromagnetic compatibility of technical means "