
Development and testing of anti-icing heating system for ship air-inlet grids

© Yu.I. Dimitrienko¹, V.Yu.Chibisov¹,
A.G. Kirchanov², R.Yu. Voroshilov²

¹ Bauman Moscow State Technical University, Moscow, 105005, Russia

² Bee-Pitron, Saint Petersburg, 191014, Russia

The article presents the results of developing a domestic technology for creating an anti-icing system for air-inlet grid heating of ship ventilation and air conditioning. It describes designed and manufactured experimental specimens of the anti-icing system. Climatic tests conducted for the developed anti-icing system for air-inlet grid heating showed that the system completely met the operational requirements under exploitation temperatures up to -60 °C approximating the Arctic conditions. The developed heating system may be used for air-inlet grid anti-icing of ship ventilation of icebreakers designed to operate in Arctic conditions, the type of nuclear-powered icebreakers of the series "Moscow".

Keywords: anti-icing ship system, air-inlet grid, heating system, heat transfer, climatic testing, mathematical modeling

REFERENCES

- [1] Zakharov Yu.V. *Sudovyye ustanovki konditsionirovaniya vozdukha i kholodil'nyye mashiny* [Ship installations of air conditioning and refrigerators]. Leningrad, Sudostroenie Publ., 1972, 566 p.
 - [2] Yazykov V.N. *Teoreticheskiye osnovy sistem konditsionirovaniya vozdukha* [Theoretically bases of air conditioning systems]. Leningrad, Sudostroenie Publ., 1967, 234 p.
 - [3] Feher L., Thumm M. Design of Avionic Microwave De-/Anti-Icing Systems. In: Willert-Porada M., ed. *Microwave devices*. Springer, 2006, 792 p. ISBN 3540432523, pp. 695–702.
 - [4] Petrenko V.F., Sullivan C. *Methods and Systems for Removing Ice from Surfaces*. US Patent 6,653,598 B2, 25 November 2003.
 - [5] *Actual Anti-icing Systems*. Available at: <http://www.tpub.com/gunners/207.htm> (accessed 03.11.2015).
 - [6] Lozowski E., Szilder K., Makkonen L. Computer simulation of marine ice accretion. *Philosophical Trans of the Royal Society: Mathematical, Physical and Engineering Sciences*, 2000, vol. 358, pp. 2811–2845.
 - [7] http://raychem.kz/tyco_thermal_controls/ (accessed 02.11.2015).
 - [8] Kirchanov A.G., Kokotkov V.V., Ryzhkov A.V., Gavrilov A.Yu. *Sposob obogreva ventilyatsionnykh reshetok s zhalyuzi i ustroystvo dlya yego osushchestvleniya* [Way of heating of ventilating grates about blinds and the device for its implementation]. RF Patent no. 2 474 766. Publ. February 10, 2013.
 - [9] Kirchanov A.G., Kokotkov V.V., Dimitrienko Yu.I., Ryzhkov A.V., Gavrilov A.Yu. *Sposob zashchity vozdukhozabornykh reshetok s zhalyuzi ot obledeneniya i ustroystvo dlya yego osushchestvleniya* [Way of protection of air-intake lattices with blinds from frosting and the device for its implementation]. RF Patent no. 2563715. Publ. August 26, 2015.
-

-
- [10] Kirchanov A.G., Kokotkov V.V., Dimitrienko Yu.I. *Krupnogabaritnaya vozdukhopriyemnaya reshetka s obogrevayemyimi zhalyuzi* [Large-size air-reception lattice with the warmed blinds]. RF Patent no. 2563714. Publ. August 26, 2015.
- [11] Kirchanov A.G., Dimitrienko Yu.I., Chibisov V.Yu., Krasnov I.K. *Sposob kontrolya obledeneniya zhalyuzi vozdukhozabornoy reshetki* [Way of control of frosting of blinds of an air-reception lattice]. RF Patent no. 2563710. Publ. August 26, 2015.
- [12] Dimitrienko Yu.I., Koryakov M.N., Chibisov V. Yu. *Inzhenernyy zhurnal: nauka i innovatsii — Engineering Journal: Science and Innovation*, 2013, no. 9 (21). Available at: <http://engjournal.ru/articles/1116/1116.pdf>

Dimitrienko Yu.I. (b. 1962) graduated from Lomonosov Moscow State University in 1984. Dr. Sci. (Phys.&Math.), Professor, Head of the Computational Mathematics and Mathematical Physics Department, Director of the Scientific-educational Center of Supercomputer Engineering Modeling and Program Software Development at Bauman Moscow State Technical University. Member of the Russian Academy of Engineering Science. Author of over 300 publications in the field of computational mechanics, gasdynamics, thermomechanics of composite materials, mathematical simulations in material science. e-mail: dimit.bmtstu@gmail.com.

Chibisov V.Yu. (b. 1989) graduated from Moscow State University of Applied Biotechnology in 2011. A deputy director of the Scientific-educational Center of Supercomputer Engineering Modeling and Program Software Development of Bauman Moscow State Technical University. Author of a number of scientific papers in the field of ship electrical heating system development, system for diagnostics and electric-seismic exploration. e-mail: vitek2003@list.ru

Kirchanov A.G. (b. 1933) graduated from the Pacific Highest Naval School named after S.O. Makarov in 1956. Leading specialist of the Bee-Pitron Group of Companies. Author of several scientific publications in the field of shipbuilding. e-mail: voroshilov@beepitron.com

Voroshilov R.Yu. (b. 1964) graduated from F. Dzerzhinsky Higher Naval Engineering School in 1986. Leading specialist of the Bee-Pitron Group of Companies. Author of several scientific publications in the field of ship electrical cable system development. e-mail: voroshilov@beepitron.com
