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Summary of the PhD dissertation entitled:

„Dostosowanie podstawowych parametrów fali akustycznej oraz geometrii stosu do wydajności chłodniczej termoakustycznego urządzenia chłodniczego z falą stojącą zasilanego przetwornikiem elektroakustycznym"

Thermoacoustic technology is one of the development perspective of energy devices. Compared to conventional systems, the thermoacoustics utilizes acoustic power to transport energy between heat sources. The main advantages of thermoacoustic devices are environmentally friendly working fluids, simple construction and high reliability. The dissertation concerns certain issues of thermoacoustic technology, especially of thermoacoustic refrigerators with standing wave.

The main purpose of the work was to determine the influence of basis parameters of the acoustic wave and stack geometry on the performance of thermoacoustic refrigerator with standing wave and varying heat load applied to the low-temperature heat exchanger. The study involved experimental and numerical analysis depending on defined constructional and operational parameters of the refrigerator. The thesis provides also fundamental aspects concerning thermoacoustic effects and thermoacoustic devices. It describes the different types of thermoacoustic devices with the examples of applications, presents the linear model of thermoacoustic phenomena and characterizes the major elements and parameters of thermoacoustic refrigerators with standing wave.

The research was carried out at the experimental apparatus, designed and constructed for purposes of the study, under two working fluids – helium and air. The investigations included different frequencies and supply voltage of the electroacoustic driver, working as an acoustic wave source, different lengths and plate spacing of the stacks and different heat loads of the low-temperature heat exchanger. The experimental results were compared to the results achieved from the numerical program DeltaEC.

The research showed essential features of thermoacoustic effect in the terms of its utilization in the refrigeration devices. The results confirmed the possibility of the increase of performance of thermoacoustic refrigerators with standing wave by proper selection of acoustic wave parameters and stack geometry. This selection must also include the properties of working fluid. The investigation proved that the efficiency of the thermoacoustic devices working with electroacoustic drivers is strongly influenced by the parameters of the driver and that the efficiency can be increased by the match of the resonance frequency of the driver with the resonance frequency of the device. The comparison of experimental and numerical results showed the disadvantages of the commonly used program DeltaEC, which arise from limitations of mathematical models database. For the code reflecting the heat losses to the surroundings, occurring in the experimental set-up, a good qualitative and quantitative convergence was achieved.

Key words: thermoacoustics, thermoacoustic refrigerator, refrigeration.

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