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Research on Noise in Hotel Rooms

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Abstract: The paper presents the results of a research concerning devices that emit sound vibrations in hotel rooms. Among all the devices installed in hotel rooms, the research places special emphasis on a refrigerator, because it works day and night. The corrected sound power level index in hotel rooms which is strictly regulated accounts for the use of refrigerators with small active storage capacity and their incorporation into pieces of furniture, which leads to an increase in electricity running costs. The research of noise generation revealed that the main source of noise in a refrigerator is a hermetically sealed compressor that emits sound waves and vibrations. The paper presents recommendations for the design of refrigeration equipment that allow significant reduction in corrected sound power level of a refrigerator.

Key words:

INTRODUCTION

The noise in a refrigerator depends on vibration and noise characteristics of a compressor [1] and dynamic pneumatic processes taking place in a refrigerating unit [2, 3] (condensation, closed-cycle flow throttling of fluorocarbon refrigerant and so on), aerodynamic processes, initiated by forced air circulation [4-6], resonance phenomena of a refrigerating unit and structural elements of a cabinet in a refrigerator [7], able to generate and transfer noise.

It is known [7,3], that the largest contribution into noise generation of a compression refrigerator is made by a hermetically sealed compressor. It is required to introduce a concept of amplification (attenuation) factor of compressor sound power level by a refrigerator and its frequency response characteristic through the difference of their noise parameters "D". It is experimentally confirmed that refrigerators amplify the sound power level emitted by a compressor within the frequency range (50÷3000 Hz) [7].

The goal of the paper is to research the process of noise formation in refrigerators installed in hotel rooms. The specific task is to allocate the component of acoustic vibrations generated by a hermetically sealed halocarbon compressor and to conduct quantitative analysis of the weight of this noise source aimed at developing new structural recommendations as for the object of research.

The following objects of research were tested: a single-chamber refrigerator M3M 268, type KШ-240; a double-chamber refrigerator M3M 268, type "K SH D" – 260/27 with top freezing compartment; compressors NL E6F and TL ES6F with crank movement mechanism by the Danfoss; compressors of the series C-KO 140 H5 (¹97i) manufactured by the Baranovichi Machine-Tool Plant and the Minsk Refrigerator Factory "Atlant" under the license of the Japanese company "Sanyo".

Research Methods and Procedure: The research was based on step-by-step exclusion/inclusion of noise sources within the object of research, i.e. a refrigerator. A hermetically sealed halocarbon compressor was used as the source of acoustic vibrations. At the factory manufacturing refrigerators three refrigerators M3M-286 (¹258710c) were selected by random sampling method. The refrigerators [8] were subject to comparative sound tests with different national and foreign compressors (C-KO 140 H5 ¹97i, C-KO 120 H5 ¹3, C-KO 120 H5 ¹4, NLE 6F, TLES

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6F) with the following sound power levels: 37.9 dBA, 36.8 dBA, 37.4 dBA, 34.3 dBA, 36.1 dBA (data supplied by the Baranovichi Machine-Tool Plant and the Minsk Refrigerator Factory "Atlant")

Research Tools: Noise meter, spectral analyzer, model 2800 V No. 0591; Thermal hygrometer "ÈÂÀ-6À" No. 1382

RESULTS

As a result of conducted research the following tendencies were revealed: the compressors C-KO 140 and NLE 6F with sound power level of 37.9 and 37.4 dB (difference makes 0.5 dBA) in a refrigerator are characterized by sound power level of 45.4 and 46.4 dBA correspondently with amplification factor of 7.5 and 9 dBA (difference makes 1.5 dBA); the compressors TLES 6F and C-KO 120 H5 No. 4 with sound power level of 34.1 è 36.1 dBA (difference makes 2 dBA) in a refrigerator are characterized by sound power level of 41 and 41.1 dBA, but with different amplification factors of 6.7 and 5 dBA.

CONCLUSION

Based on the experimental data it may be concluded that:

The refrigerators of the same type differ in acoustic vibrations amplification factor for the same noise source, namely the compressor.

The analysis of spectral component of acoustic radiation of a refrigerator in one-third octave frequency range showed the amplification of acoustic vibrations of a refrigerator (by 24% with reference to the noise source, namely the compressor) within the frequency range of 100÷3150 Hz. The results of research prove that the reason of amplification lies in the noise source itself, i.e. the compressor, characterized by high acoustic indices of the valves impact sounds. The compressor CKO 120 is fitted with patented structure which dampers the acoustic power of valves operation.

The acoustic vibrations of a refrigerator are amplified, among other things, due to the acoustic impact of the valves operation, caused by strokes against enclosing surfaces and transferred with the gas column and mechanical linkage to the refrigerating unit, which results in resonance processes and approximately twofold amplification of sound power level (by 55%).

Damping the acoustic power of a valve mechanism allows reducing the noise amplification induced by a refrigerator by 7.5 dBA at the excitation frequency of 500 Hz, which may serve as a particular technical solution within the framework of designing low-noise compressor refrigerating equipment for hotel rooms.

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