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DETERMINATION OF THE POSSIBILITY OF ENERGY SAVING USING A RANGE OF REGULATORS IN CIVIL BUILDING AIR CONDITIONING SYSTEMS

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In order to determine the possibility of using variable speed compressors in air conditioning systems, a calculation was made analytical method of optimization of system operation with application package of calculation of compressors and refrigeration equipment Select 8 Emerson Climate Technologies Europe for heating and air conditioning systems [1]. The program is designed for the selection of compressors, capacitor units and air-conditioning quality management systems in residential, administrative and industrial buildings in conditions of providing the necessary parameters of the climate. The main energy consuming element in the air conditioning system is the compressor and the regulation of its operation determines the economy of the entire system.

The compressor ηk performance coefficient is defined as the energy that is removed during the evaporation process and assigned to the compressor's total energy consumption. According to the P-h compression diagram in the cooling cycle in Figure 1, the cycle performance can be presented as:

$$\eta = \frac{h_1 - h_4}{h_2 - h_1} = \frac{Q_{evap}}{W_{com}} \quad (1)$$

In this case, according to the Carnot cycle, for comparison of air conditioning systems with variable and constant speed compressors [2], the equation can be written as follows:

$$\eta = \frac{T_1(s_1 - s_4)}{(T_2 - T_1)(s_1 - s_4)} = \frac{T_1}{T_2 - T_1} \quad (2)$$

where: h_1 – heat content at compressor inlet, kJ/kg;
h_2 – heat content at compressor outlet, kJ/kg;

h_4 – heat content at the inlet to the evaporator, kJ/kg;
h_2 – heat content at compressor outlet, kJ/kg;
Q_{evap} – evaporation energy, kJ/kg;
W_{compr} – compression work, kJ/kg;
T_1– evaporation temperature, °C;
T_2 – condensation temperature, °C;
s_1 – entropy at the inlet to the compressor, kJ/kg K;
s_4 – compressor outlet entropy, kJ/kg K.

The main energy saving condition of the air conditioning system when using a proportional integral differential regulator can be described as follows[3]:

$$Э_s = \frac{Э_{t.p.} - Э_{p.d.}}{Э_{p.d.}} \quad (3)$$

где:

$Э_c$– saving energy;
$Э_{д.п.}$ – energy when using a two-position switch;
$Э_{п.д.}$ – energy when using a proportionally integral differential regulator

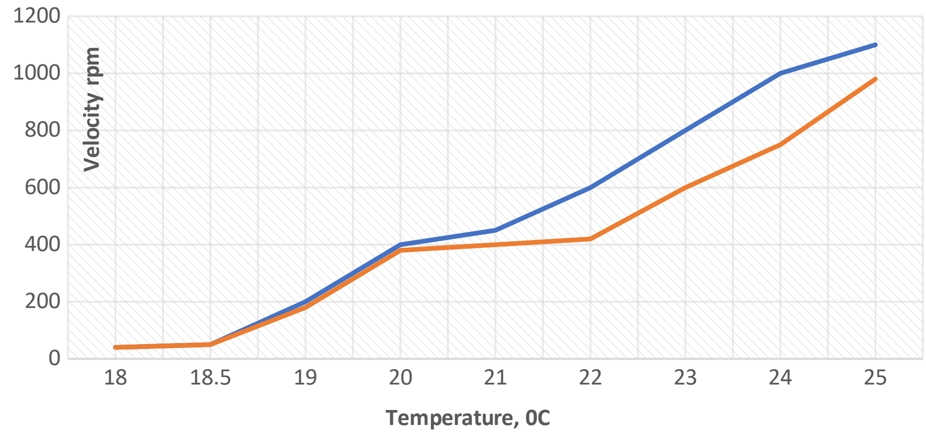

Figure 1 - Dependence of engine speed on indoor temperature when using two-position switch and proportional-integral differential regulator.

Figure 1 shows the variation of the engine speed depending on the temperature changes inside the room at the set initial frequency of the inverter 50 Hz. The engine speed decreases when the temperature drops and vice versa. The proportional-integral differential regulator regulates the speed of the engine depending on the climate sensor data. It is obvious that setting a lower temperature inside the room will require more cooling time and a longer cooling period, resulting in a correspondingly higher energy consumption. In addition, the increased internal heat load will also affect cooling times and energy consumption. At the same time, the use of proportionally-integral differentiated regulators allow to reduce the speed of the engine, correspondingly reduce energy consumption [4].

Presents the efficiency of the conducted cycles when using a two-position switch, a control gear and an ideal Karno cycle depending on the frequency. The performance coefficient for the process when using a two-position switch is between

4.0 and 2.2, when using the control AP is within the range of 4.5 to 3.0 at the same time the performance coefficient for the ideal Karno cycle is in the range of 7.5 to 11.5. The use of a variable speed compressor shows that cycle efficiency will increase when the compressor speed is reduced and the engine speed is reduced accordingly.

To summarize, a comparison of the operation of air conditioning systems using AP controllers and DP controllers to control the speed of the compressor showed that there is sufficient possibility of energy saving and temperature control when using AP controllers Data analysis showed that the AP regulator provides the most energy savings compared to the two-position controller in the temperature range, regulated by the Health Regulations for residential and industrial premises. The use of a PID controller for the air-conditioning system is characterized by high performance and short adjustment times compared to the regulation of two-position controllers. At the same time, the reduction of heating to a set temperature leads to a significant reduction in the consumption of energy.

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