THE RESULTS OF EXPERIMENTAL TESTS ON A DEVICE FOR EFFICIENT HEAT UTILIZATION FROM DIESEL POWER STATION EQUIPMENT

Raykhonov Shukhrat.,
Almalyk branch of the Tashkent State Technical University, Almalyk, Uzbekistan

Abstract: In the beneficial use of the heat of the internal combustion engine of drilling equipment has great scientific and practical importance.

The article presents a heat exchange device for the beneficial use of thermal energy, which occurs during operation of an engine with an internal combustion chamber of a diesel power plant used in drilling operations and experimental studies to increase the efficiency of work using a thermoelectric generator.

Key words: Diesel power plant, heat, thermal energy, internal combustion engine, fuel energy, energy losses, drilling, heat consumption, energy losses.

Tests were carried out to determine the operability and efficiency of the device for utilizing the heat of the internal combustion engine of the developed drilling equipment, as well as the values of the electrical and heat flows generated in it.

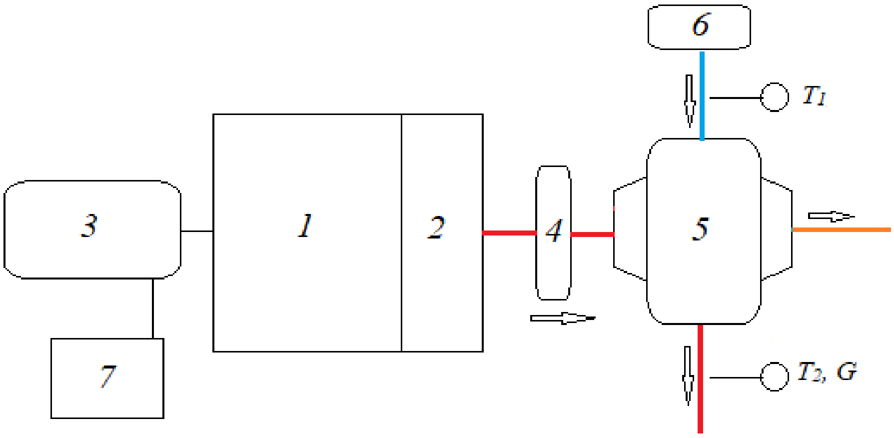
The first stage of the experiments was carried out during industrial production at the DES-100.1 diesel power plant with a nominal power of 100 kW. During the experiments, it was found that the heat released in the radiator of the cooling system of the internal combustion engine of a diesel power plant can be usefully used with the help of a heat exchanger, that the heat generated in the radiator depends on the load applied to the engine and the magnitude of heat flows.

The following tools and equipment were used in the experimental work:

- diesel power station;
- cooling radiator;
- fan (2 pcs.);
- heat exchanger;

- water heater for loading the engine;
- airflow direction pipes;
- animometer to measure the speed of the air flow;
- thermometer to measure temperature.

The schematic view of the experimental equipment is presented in Fig. 1.



1-internal combustion engine, 2-cooling radiator, 3-generator, 4- and 6-fans, 5-heat exchanger, 7-water heater, T1, T2 - points for measuring the temperature of the inlet and outlet air flow to the heat exchanger. (°C) , G-point for measuring the air flow rate at the outlet of the heat exchanger (kg/s).

Figure 1. Schematic view of the experimental device

The experiments were carried out in the following order: after starting the internal combustion engine (2), a water heater (7) with a rated power of 50 kW was connected to the generator (3). The fan (4) was installed outside the radiator (2) and connected to the heat exchanger (5) by an air duct. The heat exchanger (5) was cooled by a fan (6).

After the internal combustion engine reached its nominal operating mode, a load of 10 kW was supplied to it using a water heater, and the hot air flow was transferred from the fan (4) to the heat exchanger (5). The coolant was supplied to the heat exchanger from the fan (6) and the air flow rate and temperature were measured at the outlet of the heat exchanger. In the course of experimental work, the temperature and air flow were recorded at engine loads of 10, 20, 30, 40, and 50 kW. The air flow directed from the radiator to the heat exchanger is 0.3; 0.5; 0.7 and 0.9 kg/s, the air flow was provided by changing the fan speed.

The air flow in the heat exchanger was determined from the air flow, and the temperature of the incoming and outgoing air was measured using a two-channel thermometer.

The air flow rate from the engine radiator, as well as the flow rate of air entering and exiting the heat exchanger, were determined by knowing the pipe diameter and air flow rate using the following expression 1.

$$G=v_x \cdot \frac{\pi d_x^2}{4} \cdot \rho_x, \text{ kg/s;} \quad (1)$$

where, v_x is the speed of air flow, m/c;

d_x – pipe diameter, m;

ρ_x - air density, kg/m^3.

We determined the power of the heat flow using the following 2nd expression.

$$Q=s_x \cdot G(t_1-t_2), \text{ Vt;} \quad (2)$$

where, s_x – heat capacity of air; J/kg·°S;

G – air consumption, kg/c;

t_2 – heated air temperature, °C;

s_x – heat capacity of air, J/(kg·grad);

t_1 – temperature of the air entering the heat exchanger, °C.

As a result of the analysis of experimental work, the dependence of the power of the heat flow coming out of the heat exchanger (Q), the air flow (G) at different loads (N) to the engine, this dependence is presented in a graphic form in Fig. 2.

An analysis of the results of experimental work shows that when the internal combustion engine is running in a cold state, the heat release from the radiator of its cooling system is less, that is, when the hot air flow is directed from the radiator to the heat exchanger, the secondary air coolant flow rate is 0.3 kg/s, the heat flow rate is , used in the heat exchanger, was 8.82 kW, with an increase in the flow rate of the secondary heat carrier air to 0.9 kg / s, it was 19 kW. By increasing the consumption of secondary heat-carrying air, it is possible to increase the power of the utilized heat flow.

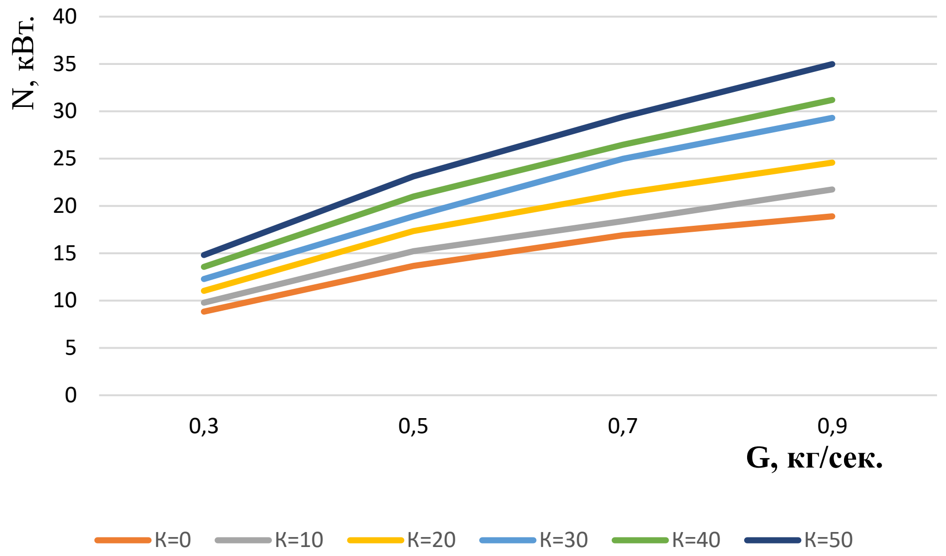


Figure 2. The graph of the dependence of the power of the heat flow (Q) on the heat exchanger and the consumption of the air flow (G) at different loads

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As a result of increasing the loads applied to the engine, it is possible to increase the power of the heat flow from the heat exchanger. At an engine load of 50 kW, the secondary air-coolant consumption was 0.3 kg/s, the power of the heat flow used in the heat exchanger was 14.8 kW, with the secondary air-coolant consumption increased to 0.9 kg/s, it was 35 kW.

As can be seen from the results of the above experimental work, by increasing the load applied to the engine, it is possible to increase the power of the heat flow from the heat exchanger. But, on the other hand, as a result of an increase in loads, an increase in fuel consumption also occurs, and this aspect must be taken into account when designing or using heat recovery devices.

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