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System of Ejection Cooling of the Charged Air and Evaluation of its Effectiveness in the Engine

E.A. Lazarev[a], A.N. Pomaz[a], A.Y. Salov[a,*]

[a] *South Ural State University, 76, Lenin Avenue, Chelyabinsk, 454080, The Russian Federation*

Abstract

At high pressures boost intercooling of the charged air between the compressor and the inlet manifold of the engine further contributes to the air density and the mass filling of cylinders, power, fuel efficiency on operational modes, reduces harmful emissions, the exhaust gas temperature in the areas before the turbine and heat-stressed details. The article deals with the charged air cooling system in which air circulation through the cooler is provided by an ejector - a gas-dynamic-device using the exhaust gas energy for working. Parameters that evaluate the effectiveness of the ejection charged air cooling are given.

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Keywords: Diesel engine; an ejector cooling system; an ejector method; the ejection rate; efficiency;

1. Review

Charge-air cooling (CAC) in a supercharged engine is carried in charge air coolers of the 'air-to-liquid' or 'air-to-air' type [1]. Dissipation of heat abstracted from the charge air to the environment is carried out using as a source of the fan air flow through the matrix of charge air coolers. The fan is usually driven in rotation by the crankshaft of the engine and requires the expenditure of power. The need to reduce the power cost has led to the need to find other ways of creating an air flow such as an ejector [2], disposing exhaust energy of the engine (Fig. 1).

* Corresponding author. Tel.: +7-919-116-36-20;
E-mail address: an1990s@gmail.com

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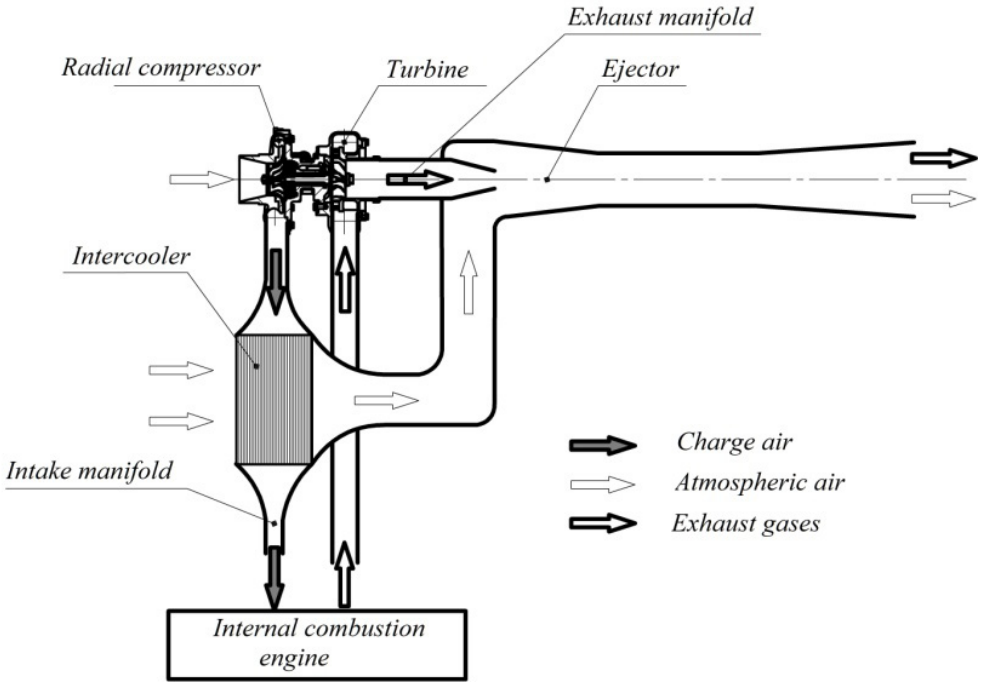

Fig. 1. Scheme of the ejection charge air cooling system

In such a system cooling air from the atmosphere enters into the compressor where its pressure and temperature increase. After the compressor is directed to the CAC where the heat from the charge air is given a cooling air circulating through the cooler matrix from the environment. Non-discontinuous flow of cooling air through the matrix NVG created ejector. After cooling NVG airflow from the compressor is directed into the inlet duct and further into the engine cylinders. The exhaust gases leaving the cylinders pass first through a turbine, which operates in a part of the energy. Then they enter the gas ejector, where the flow, accelerating in the nozzle, passes a part of the kinetic energy of the cooling air, drawing and creating his movement through the matrix of charge air coolers.

2. Problem definition

When designing such a system the main task is to provide the maximum density $\rho_к$ charge air inlet in front of the motor organs. To determine the best performance at a given engine operating mode, you must obtain the dependence of linking together the work of elements in the system. Especially important is the connection of the turbine and the ejector, as these devices convert the exhaust gas energy to increase as a result of the density of the charge air. The basis of the calculation of the project is the question of the distribution of power between the turbine exhaust and ejector.

In accordance with the equation of Guye-Stodola [3, 4] in an isolated system useful work L exhaust gas is the difference between the available (maximum) and the loss of work L_{max} $T_0\Delta S$ performance. This is a job that can be used in the turbine and ejector

$$L = L_{max} - T_0\Delta S = L_t + L_e, \qquad (1)$$

where

L_t – turbine work,

L_e – ejector work,