Available online at www.sciencedirect.com

ScienceDirect

Transportation Research Procedia 20 (2017) 412 – 417

Transportation Research Procedia

www.elsevier.com/locate/procedia

12th International Conference "Organization and Traffic Safety Management in Large Cities", SPbOTSIC-2016, 28-30 September 2016, St. Petersburg, Russia

Catalytic Converter with Storage Device of Exhaust Gas Heat for City Bus

Vladimir Lozhkin*, Olga Lozhkina

Saint Petersburg University of State Fire Service of EMERCOM of Russia, 149 Moskovskij prospekt, 19610, Russia

Abstract

The heat of exhaust gases in the device of vehicle converter patented by us gets accumulated in the course of vehicle movement by the heat-accumulation substance and transmitted in the process of its crystallization (300 - 4500C) to a converter for increasing its efficiency during short-time stops. The purpose of investigation was the development of mathematic model of catalysis process in the mode of heat rejection ("discharge") of phase change storage device and substantiation of high efficiency of cleaning from harmful substances and possibility of device arrangement in the engine compartment of a bus instead of noise suppressor using calculation method proceeding from experimental data of converter operation in the city cycle. The relevancy of mathematic model and expected results have been proven at KamAZ-740.10 (8ЧН 12/12) engine tested at KAMAZ OJSC.

Peer-review under responsibility of the organizing committee of the 12th International Conference "Organization and Traffic Safety Management in large cities"

Keywords: City bus; diesel engine; exhaust gases; heat storage device of phase change storage device "melting-crystallization"; catalytic converter; physical-and-chemical and mathematic model

1. Introduction

The city buses have been furnished with catalytic converters-noise suppressors in Saint-Petersburg with direct participation of the authors of this article [Lozhkin and Lozhkina (2011)]. This work complies with the requirements

* Corresponding author. Tel.: +0-000-000-0000 ; fax: +0-000-000-0000 .
E-mail address: vnlojkin@yandex.ru *, olojkina@yandex.ru

Peer-review under responsibility of the organizing committee of the 12th International Conference "Organization and Traffic Safety Management in large cities"
doi:10.1016/j.trpro.2017.01.067

of Technical Regulations of the Customs Union “On safety of wheeled vehicles” (TRCU 018/2011) effective since 01.01.2015. It complies with the Directive of European Council 2009/33/EC dated 23.04.2009, Regulations of European Council 510/2011 dated 11.05.2011, 582/2011 dated 25.05.2011, etc. [EU (2011)].

However, according to Martin Weilenmann together with the contributing authors [Weilenmann et al. (2009)]. the solution of this task being considered with respect to colds starts can be hampered by inefficient operation of converter at idle diesel runs in case of bus stops due to low temperature of exhaust gases (100 - 120^0C). The unit combining the heat storage device of phase transition “melting-crystallization” and catalytic converter (Fig. 1) patented by ourselves [Lozhkin (2003)] became a prerequisite for solving the problem.

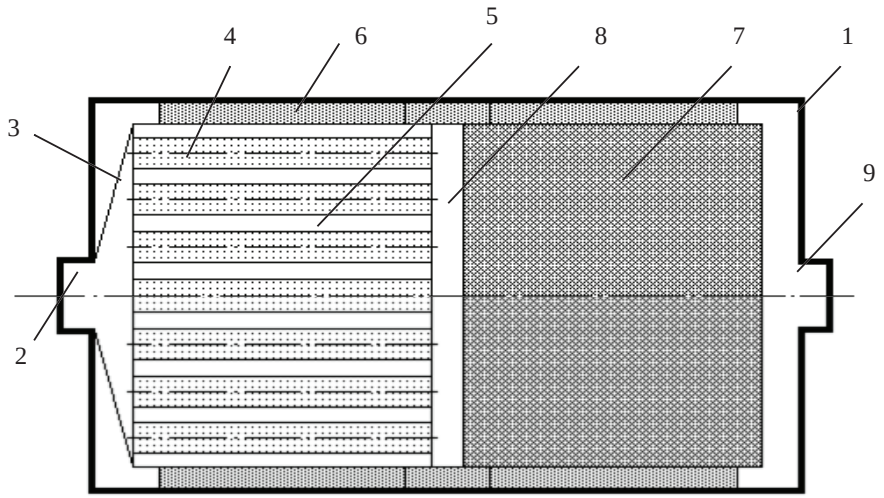

Fig. 1. Design of catalytic converter combined with heat storage device of phase transition “Melting-Crystallization”

Structurally, it consists of cylindrical body 1, insulation layer 6, inlet branch pipe 2, diffuser 3 and heat exchanger. The heat exchanger includes a central capsule of cylindrical shape and some coaxially arranged capsules 4 filled with heat-insulating matter, between which the free flow of exhaust gases is provided via coaxially annular cylindrical passages 5. The catalytic converter comprises a modular mesh-connected array 7, blind expansion cavity 8 and branch pipe 9 for gas discharge to atmosphere.

The purpose of investigation has been to prove in calculated substantiation the efficiency of using patented device on the basis of development and experimental check of mathematic model of heterogeneous catalysis of carbon oxide (CO), hydrocarbons (CH) and soot particles during short-time bus stops with heating exhaust gas using heat disposed in the storage device.

2. Methodology of investigation – mathematic model and experiment methods

A concerted operation of the converter and heat storage device in the mode of "discharge" is attractive for modeling the task to be solved on the assumption that at the initial moment of time $\tau = 0$ in the period of “charging” the heat-accumulating matter is in hard crystalline state, while in the period of “discharging” it is in a liquid state. We consider the temperature to be uniform and equal to phase transition temperature T_{ph}.