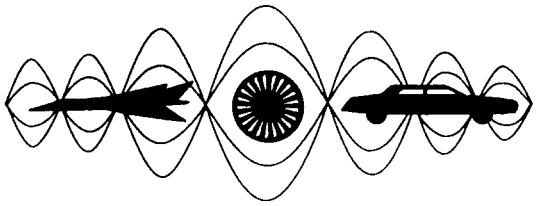

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A NEW NOISE REDUCED CONSTRUCTION FOR EXHAUST OF POWERFUL INTERNAL COMBUSTION ENGINES

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ABSTRACT

External and internal acoustical field of a vehicles is characterized by set of components which are generated by different sources. These sources are noise of engine and its units, noise of transmission, noise of elements of a vehicle body, noise of intake and exhaust systems, etc.

But, as follows from practice, noise of internal combustion engine (ICE) exhaust gases represents the main part of external acoustical field of a vehicle.

Exhaust noise reduction is one of the main and the most complicated problems. Traditional solution of this problem is elaboration of effective exhaust noise muffler. Such mufflers, as a rule, should be of 0.5-1.5 *m* in length to provide desirable effectiveness for each 100 horse power (*h.p.*) of ICE. To reduce noise of exhaust gases in vehicle with more than 500 *h.p.* ICE it is required a muffler of traditional construction which should be not less than 250-300 liters of volume, what brings problems of its placement at a vehicle, taking into account strong requirements to vehicle overall dimensions and weight. Therefore the vehicles which have the restrictions concerning their dimensions and weight often are produced without any muffler. This fact causes high acoustical overloads in the environment and, as a consequence, confines the application of such machines in national economy.

Therefore authors propound a new noise reduced construction to be placed at ICE exhaust of such vehicle. Developed noise reduced construction allows to avoid specific disadvantages of traditionally used mufflers mentioned above.

INTRODUCTION

Acoustical pollution of environment is one of the main problem of our century. One of the most significant and massive source this pollution is road - making vehicles, especially heavy tracklaying vehicles (HTLV). Heavy cars, bulldosers, tractors, tanks, road-making vehicles and military transport are widely used in building, transportation and other branches of national economy. This type of vehicles with high weight and power usually have tracklaying driver.

Heavy tracklaying vehicles are widely used in civil sphere (different engineer-building vehicles, vehicles dealing with extraordinary situations, building vehicles) and in military sphere (self-propelled artillery, self-propelled launcher missiles and others).

Heavy tracklaying vehicles are characterized by high external noise level which may achieve 120 *dBA* at the distance 1 meter distant from the vehicle. The work of such vehicles brings a considerable contribution to environmental acoustical pollution.

External and internal acoustical field of vehicles is characterized by set of components which are generated by different sources. These sources are noise of engine and its units, noise of transmission, noise of elements of a vehicle's body, noise of intake and exhaust systems, etc.

DISCUSSION

But, as follows from practice, noise of internal combustion engine (ICE) exhaust system represents the main part of external acoustical field of a vehicle.

Exhaust noise reduction is one of the main and the most complicated problems. Traditional solution of this problem is elaboration of effective exhaust noise muffler. Such mufflers, as a rule, should be of 0.5-1.5 *m* in length to provide desirable effectiveness for each 100 *h.p.* of ICE. Moreover traditional exhaust mufflers usually cause 40-80 *mm* of mercury column (*mm m.c.*) of pressure losses. Thus, to reduce noise of exhaust gases in vehicle with more than 500 *h.p.* ICE a muffler of traditional construction is required which should be not less than 250-300 liters of volume, what brings problems of its placement at a vehicle, taking into account strong requirements to vehicle overall dimensions and weight. Therefore the vehicles which have the restrictions concerning their dimensions and weight are often produced without any muffler. This fact causes high acoustical overloads in the environment and, as a consequence, confines the application of such machines in national economy.

INVESTIGATIONS AND PRACTICE RESULTS

This work presents the investigation of tracklaying vehicles with ICE of nearly 800 *h.p.*, weighing 50-70 tons. There was no any device to reduce noise of exhaust system on vehicle. According to technical assignment the problem was to reduce external and internal acoustical field of vehicle by 10-15 *dBA* with the constant dimension of vehicle and engine power. That is why the main idea was to influence the stream of engine exhaust gases system on the short distance near the cut of exhaust engine pipe.

New absorbing construction of engine exhaust gases consists of three main parts, which used three effects of noise reducing of exhaust stream.

The construction consists of:

-metal net-plates, installed in exhaust diffuser, which made the way of gases stream longer, during which the gases lose their acoustical power;

-set of metal nets of different cross-section installed at the cut of engine exhaust system (their main function is to disperse the gas stream, diminish the turbulence, and therefore to reduce the acoustical radiation);

-outlet pipe changing the direction of stream which smoothly change its direction reducing the effect of spreading acoustical power of stream at the considerable distance from vehicle;

During scientific-engineering work several valuation measures were taken:

-selection the most rational quantity and diminution of net-plates, installing in exhaust diffuser;

-selection the minimum necessary quantity of net layers in stream dispersion;

-selection the sequence of changing of cell diminution;

-selection the most effective angel of exhaust gases stream deflection to reduce maximum noise level by this method.

Experimental tests of this method's effectiveness were made along with the appropriate with measurement of control points.

Suggested measures were carried out as follows:

- change the net by the net with smaller cells;
- using double net;
- using triple net;
- installing slanting plate in diffuser;
- installing deflection on the cut of exhaust system;

Experimental values on engine exhaust gases noise with using different constructive units which is offered by authors are showed on Fig. 1.

It appears, this method allows to reduce engine exhaust system noise by 6,6 *dB(A)* of sound level and from 5 to 20 *dB* in the specification frequency

range. The reducing of engine exhaust system noise and changing of it direction allows to reduce external noise and direction of its spreading along HTLV

The spectra of external noise of HTLV with noise protection at the distances of 1 and 7,5 meter are showed on Fig. 2

The developed noise reduced construction consists of a set of metal nets with different cross sections, it has small overall dimensions and does not generate additional ICE exhaust pressure losses. This construction was installed at a heavy vehicle with 870 *h.p.* engine with dimensions of exhaust cross section of 1×0.3 *m*.

Tests showed that installation of developed construction gives ICE exhaust gases pressure loss of not more than 10 mm m.c. while acoustical effectiveness of the construction is 4-12 *dB* in the frequency range of 100-8000 *Hz*.

CONCLUSION

During investigation new noise absorption construction was tested on several vehicles with engine power range from 750 to 850 *h.p.* and was introduced on one of the Russian enterprises.

This highly effective acoustical construction didn't change vehicle exhaust system dimensions and its pressure losses.

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The spectra of exhaust noise of HTLV

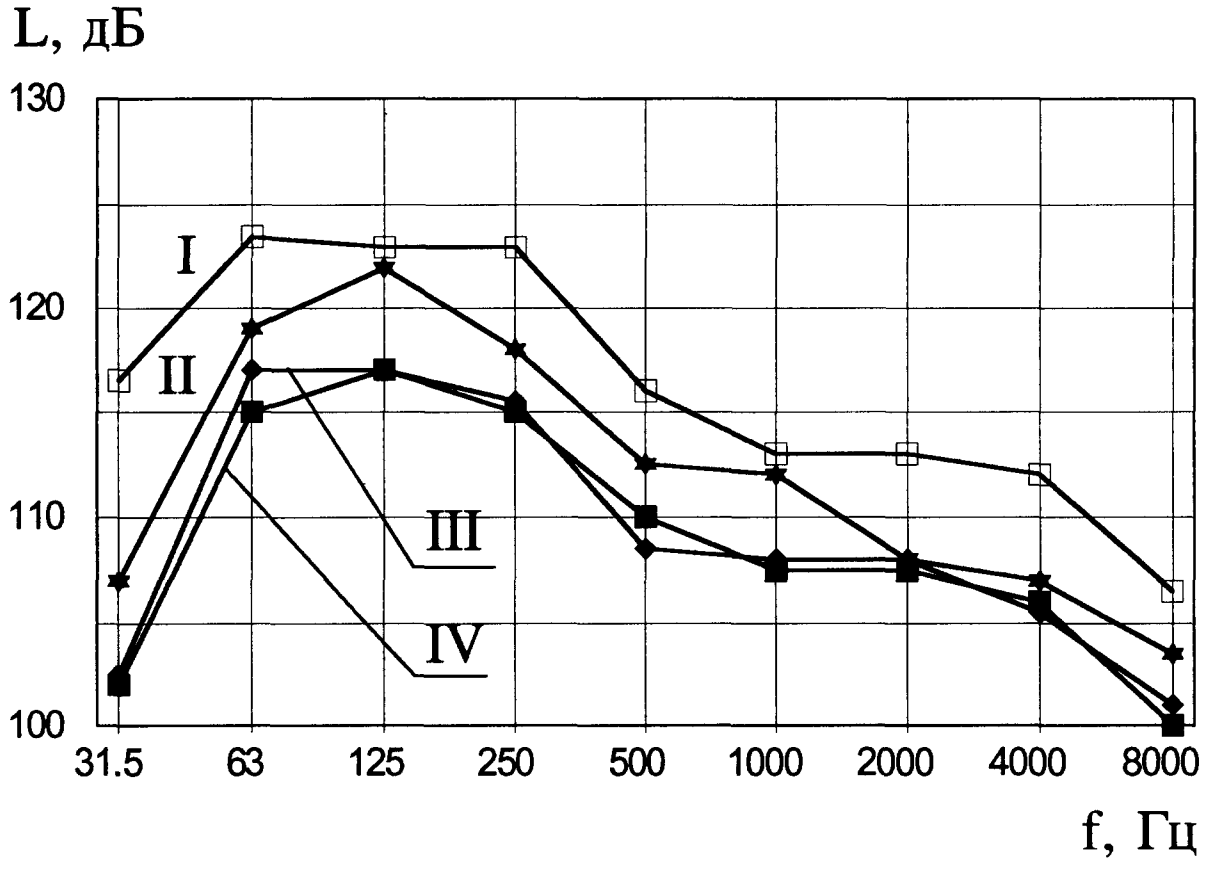

Fig. 1.

I - Production type

II - The muffler with three net plates

III - The muffler with three net plates and slating plae

IV - The muffler with three net plates and slating plae and the cut of exhaust system

The spectra of external noise of HTLV at distance 1 and 7.5 m

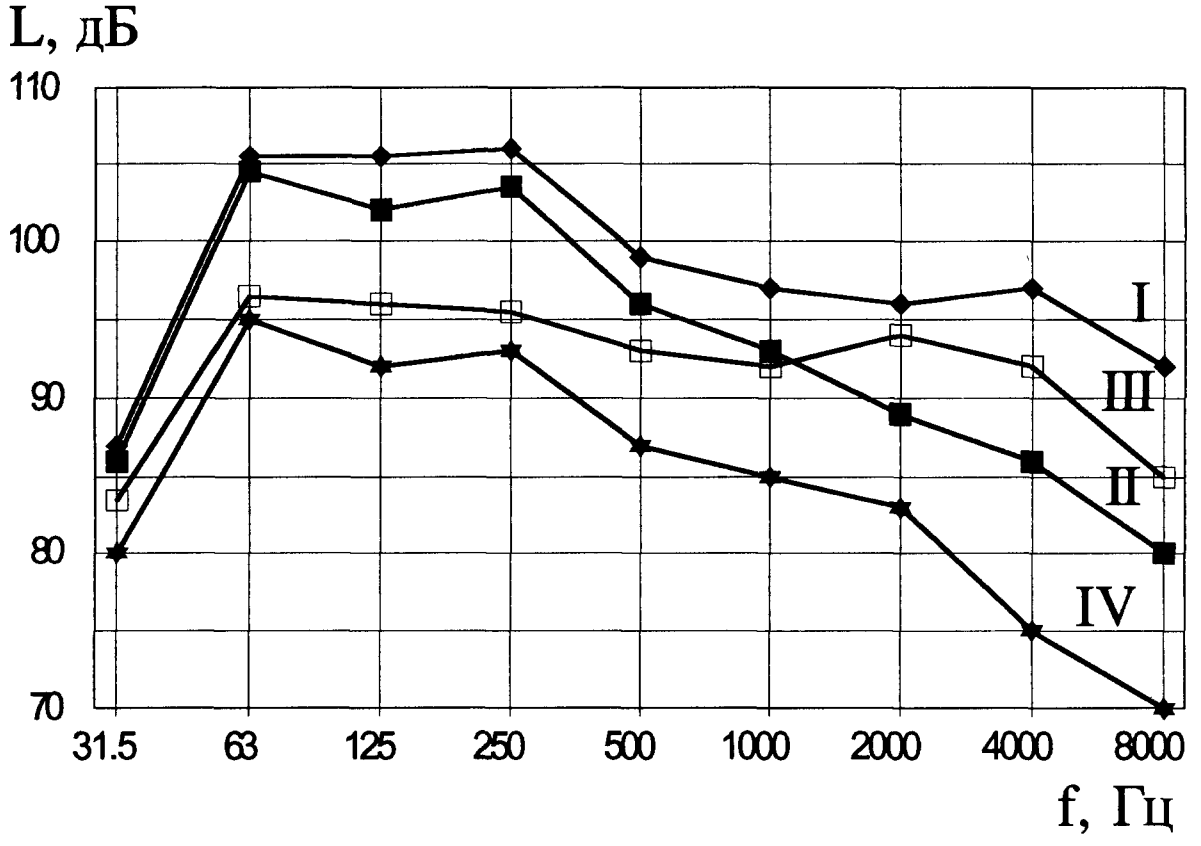

Fig. 2.

I, III - Production type (1 and 7.5 m)
II IV - Noise-proofed type (1 and 7.5 m)