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AERODYNAMIC NOISE ELIMINATOR OF THE PNEUMATIC TOOLS

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INTRODUCTION

Sound data available for pneumatic tools both from their manufacturers and from experimental tests suggest that the problem of aerodynamic noise reduction has not,as yet,been solved.Now the constructional solutions of noise-control mufflers of pneumatic tools can be divided into a few different groups:

- the absorbing type,in which part of the acoustic energy of a gas flow is absorbed by the absorbing material of the muffler,
- the resonance-reflection type,in which noise reduction is the effect of sound wave cancellation and reflection,and
- the expansion type,this being rather an active one,in which the acoustic effect is attained by applying an expanding facility composed of multihole discs or cylinders.

The acoustic effectiveness of all these solutions is conditioned by the over-all dimensions of the muffler and the cost of its manufacture.A study of acoustic effects of gas expansion i porous materials showed a new possibility of the solution of the pneumatic tool expander.Some results of our laboratory and practical investigations are presented in this paper.

ACOUSTIC EFFECTS OF GAS EXPANSION IN POROUS ELEMENT

The use of controlled gas expansion in porous damping system and the application of noise eliminators in the gas-releasing system device let us eliminate total noise from any free gas stream[1],[2].

An analysis of the results obtained in laboratory and industrial tests of practical solutions permits us to formulate some important characteristics of the flow process:

- the choking of gas expansion process in porous material has a multistage character,the number of stages being great,

- the flow is characterized by small characteristic dimensions,
- the elementary sources of noise are surrounded by porous material,and
- the parameters of a damping process can be controlled arbitrary by using suitable granulations and geometrical shapes of the element.

The first of the characteristics mentioned makes it possible to obtain high choking at the relatively low mean gas velocity and to reduce the quantity of acoustic energy generated.
The small characteristic dimensions of the flow imply the generation high-frequency of acoustic energy.Such a kind of energy is easily absorbed and insulated by the porous material surrounding the elementary noise sources.
At last,the granulation and geometrical shape of the element used permits us to modify the parameters of the acoustic flow.
The results of a previous studies [3] confirm its practical usefulness for aerodynamic noise reduction in pneumatic tools.The applied system of gas expansion enables us to decrease the over-all dimensions of the tool and the costs of its manufacture.

STRUCTURE MODEL AND COMPUTATIONAL ALGORITHM

A structure model of the gas flow system of the aerodynamic noise eliminator is presented in Fig.1.

The model consists of k - working chamber,volume $V_k = f(t)$;c - eliminator chamber, V_c =cont.; w - porous element,flow characteristic $\dot{M}_w = f(P_c)$ and d - inlet flow,characteristic $\dot{M}_d = f(P_k)$;where P is the pressure, T the temperature,and A the area of the working chamber outlet gap and $A = f(t)$.

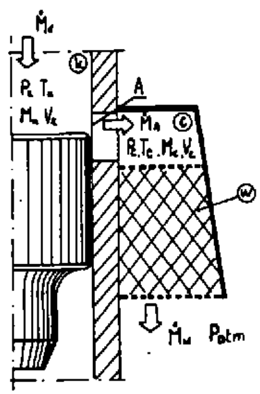
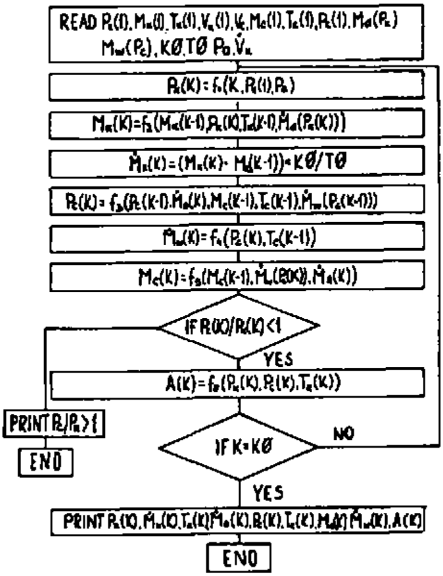


Fig.1 Structure model of the gas flow system of the aerodynamic noise eliminator.

The flow characteristic of the eliminator, $\dot{M}_w$, has to satisfy the condition $P_c(t) = P_{atm}$ at $t = t_r$, where t_r is the time of gas release from the chamber k during one cycle of the tool work.

It can be verified by using the algorithm presented in Fig.2.



For numerical computation has been assumed that the gas flow is quasi-steady, whereas the walve effects, the kinetic gas energy in chamber and the heat exchange between the gas and elements may be neglected.

Fig.2. Computational algorithm of the noise eliminator parameters.

CONCEPTION OF CONSTRUCTIONAL SOLUTIONS

Some examples of the constructional solutions of the aerodynamic noise eliminator of the pneumatic tools are shown in Fig.2.

The aerodynamic noise eliminator of the moulding-rammer type 6 X 1 is shown in Fig. 2 A, and the eliminator of the desruction-hammer type MP-26 A in Fig. 2 B, where: 1 - tool body, 2 - piston-rod, 3 - upper chamber, 4 - lower chamber, 5 - eliminator chamber and 6 - porous element.

In both cases the noise eliminator is built in, not added on, and it is designed to meet noise control standards.

The application of the aerodynamic noise eliminator increases the tools diameter only by about 5 to 6 cm and its weight by about 0.5 to 1.0 kilogram.

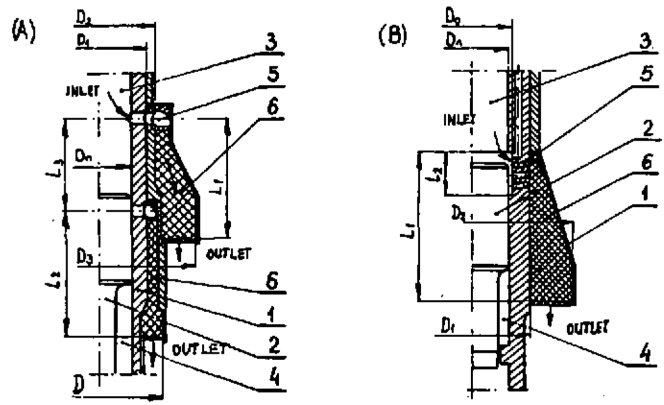
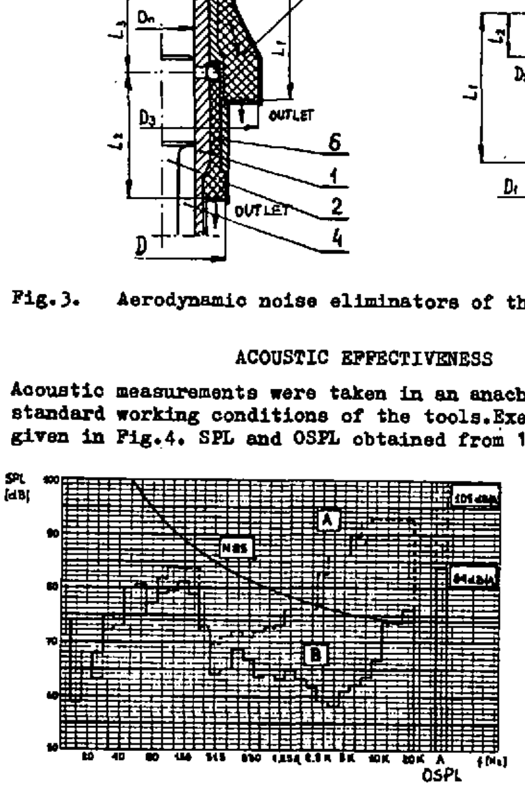


Fig.3. Aerodynamic noise eliminators of the pneumatic tools.

ACOUSTIC EFFECTIVENESS

Acoustic measurements were taken in an anachoic chamber under the standard working conditions of the tools.Exemplary results are given in Fig.4. SPL and OSPL obtained from 1/3 octave band analysis.



Curve A relates to the tool with the eliminator,B the tool without it and curve N-85 the Polish norm of the acceptable noise level. As can be seen from the graph OSPL is decreased by 20 dB in relation to the curve B and SPL is lower than the standard values over the whole range of frequency.

Fig.4. Acoustic effectiveness of the moulding-rammer eliminator.

1 W.Jungowski,W.Selerowicz,B.Niewczas,W.Stojanowski,"Prevention of noise generated by the release of gas..."INTERNOISE'79(1979).
2 W.Stojanowski,B.Niewczas,W.Jungowski,W.Selerowicz,"Noise eliminator of a gas stream its technical usability..."INTERNOISE'80(1980)
3 A.Troszok,an"Aerodynamic noise of the pneumatic hammer" NCC 82 .