Modeling of the Air Duct is for the Selective Serve of Air to the Radio Electronic Blocks

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Abstract **Mathematic modeling is applied to identify the specificity of designing an air duct of constant cross-section with apertures different in area.**

Keywords - **air supply, of air pipe communication, various functions, recurrent model, aperture**.

I. INTRODUCTION

Therefore development of models of optimum design synthesis of systems of forced air supply both for electronic apparatus and special technological equipment seems to be an urgent problem. Such a model if developed will allow to determine the characteristics of the airflow and to solve a problem of choice of geometrical parameters of the duct.

II. INSTRUCTION FOR AUTHORS

The air duct of air section $F = a \times b$ and length l with n different in area apertures placed along its lateral surface is considered.

To calculate a design of the given air duct means to estimate the area of each k aperture, k = 1, … n providing for distribution of air flow in accordance with settled under thermal mode calculation part of an air flow removed through given k-aperture: $c_k = L_k/L_0$, where L_k - volumetric expenditure of air through the k- aperture. L_0 - air expenditure at the beginning of air duct. Neglecting losses of air (that is allowable for short air ducts), it is possible to assert, that

$$L_0 = \sum_{i=1}^{n} L_i$$

Then the area of k-aperture equals:

$$f_k = L_k / V_k \qquad (1)$$

where V_k is average air velocity through k-aperture.

Air velocity in k-aperture is found from the equation:

$$V_k = m\sqrt{2\Delta \mathbf{p}_k / r} \qquad (2)$$

where Δp is the redundant static pressure in k- aperture, which could be determined from the Bernoulli equation [1]:

$$\frac{rw_k^2}{2} + \Delta \mathbf{p}_k + \Delta \mathbf{p}_{MO(k-1)} = \frac{rw_{k-1}^2}{2} + \Delta \mathbf{p}_{k-1} \qquad (3)$$

where $\Delta \mathbf{p}_{MO(k-1)}$ - pressure loss on local resistances while air moving from (k-1) up to k-cross-sections.

We suppose pressure losses on (k-1) - aperture to be equal to dynamic pressure of the lost velocity.

$$\Delta \mathbf{p}_{MO(k-1)} = h\frac{r}{2}\left(w_{k-1} - w_k\right)^2 \qquad (4)$$

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where η = 0,4 - factor of impact mitigation;

w_k – air velocity in cross-section before k- aperture.

Let's express w_k through $w_0 = L_0/F$:

$$w_k = w_n \sum_{\mu=k}^{n\bullet} c_j \ ; \ w_{k-1} = w_n \sum_{i=k-1}^{n} c_j \qquad (5)$$

Substituting found w_k and w_{k-1} in expressions (3), (4) we find Δp_k:

$$\Delta \mathbf{p}_k = \Delta \mathbf{p}_{k-1} + \frac{rw_k^2}{2}\left[\left(\sum_{j=k-1}^{n} c_i\right)^2 - \left(\sum_{j=k}^{n} c_i\right)^2 - hc_{k-1}^2\right] \qquad (6)$$

Substituting Δp_k in (2) we derive the area k- aperture according to (1):

After transformations the expression *for* f_k looks like:

$$f_k = c_k \Big/ \sqrt{\frac{c_{k-1}^2}{f_{k-1}^2} + \frac{m^2}{F^2}\left[\left(\sum_{i=k-1}^{n} c_i\right)^2 - \left(\sum_{i=k}^{n} c_i\right)^2 - hc_k^2\right]} \qquad (7)$$

It is evident that got from (7) expression for f_k is a recurrent mathematical model of the air duct.

Considering that the air duct should contain at least one slot we values of f_k for any n, F, L_0. In a number of cases, practically it is impossible to receive analytical dependence of criterion function f_k on start value f_1. The obtained recurrent model was investigated for n = 5, c_1 = 0,14, c_2 = 0,1, c_3 = 0,25, c_4 = 0,4, c_5 = 0,3, F = 0,005ě2, m = 0,65 under change of f_1 from 0,0001 up to 0,008m^2.

The analysis of the results received allows to assert, that there exists a non-linear dependence between the area of the first aperture f_1 and areas of subsequent (n-1) of apertures. It seems interesting to establish this dependence because of the fact that the size value of static pressure inside air distributor depends on a ratio between the total area of apertures of the air distributor and the area of section F of the source channel.

Received dependences were approximated by various functions. The best concurrences were got under approximation by polynomial of the second degree, for which average square deviation appears to be within the limits of 0,9987... 1.

III. CONCLUSION

Thus, on the determined of the certain particular functional relations it becomes possible to choose values of the area of the first aperture f_1 providing the desired ratio $F/\sum f_k$.

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