DETERMINATION OF THE SOWING MOMENT IN THE SLOPE OF THE FLYER

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ABSTRACT

This article deals with the problem of calculating the vibration of the details of high-speed non-woven fabric making machines.

Keywords. *Nonwoven fabric, machine, strength, stiffness, shaft, bending, Krylov's function, deformation, boundary conditions, shear force, bending moment, resonance, frequency.*

АННОТАЦИЯ

В данной статье рассматривается проблема расчета вибрации деталей высокоскоростных станков по производству нетканых материалов.

Ключевые слова. *Нетканый материал, машина, прочность, жесткость, вал, изгиб, функция Крылова, деформация, граничные условия, поперечная сила, изгибающий момент, резонанс, частота.*

INTRODUCTION

The brushes of the needle mechanisms of weaving machines provide direct needle movement. In the current machines, the needle rods are fixed to the beam. The brushes, in turn, are mounted on the shaft, which leads to the mechanism.

The bending moment of M_a on the slope consists of 2 parts:

$$M_\alpha = M'_\alpha + M''_\alpha \qquad (1)$$

1) M'_α - the bending moment of the slope.

2) M''_{α} - bending moment of the vertical part.

Figure 1 shows a schematic of the slope.

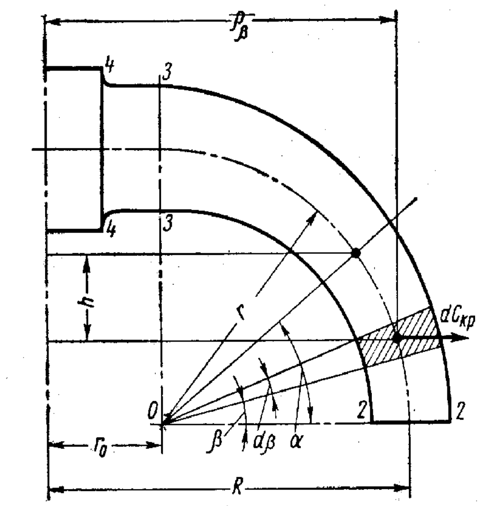

Figure 1. The sloping part of the horn.

We divide the elementary mass dm by two radial sections.

The volume of the allocated mass

$$F_\beta \cdot dS$$

F_β - cross-sectional area.

$dS - d\beta$ arc in the corner.

$$F_\beta = \pi a_\beta b_\beta, \qquad dS = \rho_\beta \, d\beta$$

$$dC_{kp} = dm\omega^2\rho_\beta = F_\beta dS\frac{\gamma}{g}\omega^2\rho_\beta = \pi a_\beta b_\beta Z\frac{\gamma}{g}\omega^2\rho_\beta d\beta$$

dCkr - the centrifugal force of the sloping part.

From Figure 2

$$\rho_\beta = r\cos\beta + r_0$$

So,

$$dC_{KP} = \frac{\pi z r\gamma}{g}\omega^2 a_\beta b_\beta (r\cos\beta + r_0)d\beta \qquad (2)$$

the length of the sloping part

$$L_\beta = r\beta$$

$$a_\beta = a_2(1+k_2\beta), \qquad в_\beta = в_2(1+k_3\beta),$$

Here :

$$k_2 = \frac{a_3 - a_2}{a_2}\cdot\frac{2}{\pi}, \qquad k_3 = \frac{b_3 - b_2}{в_2}\cdot\frac{2}{\pi}$$

$$dC_{KP} = \frac{\pi r\gamma}{g}\omega^2\left(A^1\beta^2 + B^1\beta + a_2 b_2\right)(r\cos\beta + r_0)d\beta \qquad (3)$$

Here :

$$A^1 = \frac{4}{\pi^2}(a_3 - a_2)(b_3 - b_2) \qquad (4)$$

$$B^1 = \frac{2}{\pi}\left[a_2(b_3 - b_2) + b_2(a_3 - a_2)\right] \qquad (5)$$

$$F_\beta = \pi\left(A^1\beta^2 + B^1\beta + a_2 b_2\right)$$

dCKP- bending moment generated by force

$$dM_\alpha = dC_{KP}\cdot h = dC_{KP}(r\sin\alpha - r\sin\beta) =$$

$$= \frac{\pi r^2}{g}\alpha\omega^2\left(A'\beta^2 + B'\beta + a_2 b_2\right)(r\cos\beta + r_0)(\sin\alpha - \sin\beta)d\beta \qquad (5)$$

Integrating (5), we come to the following formula:

$$M_{\alpha'} = \frac{\pi a_2 b_2 r^3\omega^2}{2g}\sin^2\alpha + \frac{\pi r^3\gamma}{g}\omega^2\Big[\sin^2\alpha\left(\frac{A'}{2}\alpha^2 + \frac{B'}{2}\alpha - \frac{7}{4}A'\right) + \sin 2\alpha\left(\frac{3}{4}A'\alpha + \frac{3}{8}B'\right) - B'\sin\alpha +$$

$$+\frac{1}{4}A'\alpha^2 + \frac{1}{4}B'\alpha + \frac{r_0}{r}\sin\alpha\left(\frac{A'}{3}\alpha^3 + \frac{B'}{2}\alpha^2 + a_2 b_2\alpha\right) + \frac{r_0}{r}A'\left(\alpha^2\cos\alpha - 2\alpha\sin\alpha - 2\cos\alpha + 2\right) +$$

$$+\frac{r_0}{r}B'(\alpha\cos\alpha - \sin\alpha) + \frac{r_0}{r}a_2 b_2(\cos\alpha - 1)\Big]$$

(6)

б) M''_α to determine

From 2 forms

$$M''_\alpha = C_{1-2}\left[(\ell - x_S) + x_\alpha\right] \qquad (7)$$

C1-2 – the centrifugal force of the mass of the vertical part brought to the center of gravity C;

X_S - coordinate of the center of gravity;

X_α - 2-2 the distance from the cut to the center of gravity.

The size of the vertical section.

$$V_{1-2} = \frac{\pi\ell}{6}\left[(2a_2 + a_1)b_2 + (2a_1 + a_2)b_1\right],$$

$$C_{1-2} = \frac{\pi\ell\gamma}{6g}\omega^2 R\left[(2a_2 + a_1)b_2 + (2a_1 + a_2)b_1\right] \qquad (8)$$

$$x_s = \frac{\int_0^\ell dv_{1-2}x}{v_{1-2}} \qquad (9)$$

elementary volume

$$dV_{1-2} = F_X dX = \pi\left(AX^2 + BX + a_1 b_1\right)dx$$

dV If we enter 1-2 (9)

$$x_s = \frac{1}{2}\frac{3a_2b_2 + a_1b_2 + a_2b_1 + a_1b_1}{2a_2b_2 + a_1b_2 + 2a_1b_1 + a_2b_1} \qquad (10)$$

$C_{1-2},\quad x_S \quad ва \quad x_\alpha = r\sin\ \alpha$ If We put (7)

$$M''_\alpha = \frac{\pi\ell^2\gamma}{12g}\omega^2 R(A_1 + A_2\sin\alpha) \qquad (11)$$

Here :

$$A_1 = a_2b_2 + a_1b_2 + a_2b_1 + 3a_1b_1 \qquad (12)$$

$$A_2 = \frac{2r}{\ell}\left[(2\alpha_2 + \alpha_1)b_2 + (2\alpha_1 + \alpha_2)b_1\right. \qquad (13)$$

(8) and (11), α ни $\alpha = \frac{\pi}{2}$ We determine the maximum torque in sections 3-3 by substituting:

$$M_{33} = \frac{\pi\ell^2\gamma}{12g}\omega^2 R(A_1 + A_2) + \frac{\pi a_2 b_2 \gamma r^3\omega^2}{2g} + \frac{\pi r^3\gamma}{g}\omega^2 x$$

$$x\left[0{,}1A' + 0{,}17B' + \frac{r_0}{r}\left(0{,}1A' + 0234B' + 0{,}571a_2b_2\right)\right] \qquad (14)$$

If the cross section of the balance horn does not change.

$$a_1 = a_2 = a_3 = a, \qquad b_1 = b_2 = b_3 = b,$$

$$A = B = A' = B' = 0, \qquad A_1 = 6ab, A_2 = 12ab\frac{r}{\ell}$$

in that case,

$$M_{22} = \frac{\pi ab}{g}\ell^2\omega^2R^2,$$

$$M_\alpha = M_{\alpha'} + M_{\alpha''} = \frac{\pi ab\gamma\omega^2}{2g}\left[2R\ell\left(\frac{\ell}{2} + r\sin\alpha\right) + \right.$$

$$\left. + r^2\left(r\sin^2\alpha + 2r_0\right)\left(\sin\alpha + \cos\alpha - 1\right)\ \right] \qquad (15)$$

$$M_{33} = \frac{\pi ab\gamma\omega^2}{2g}\left[R\ell(\ell + 2r) + r^2(r + 1{,}14r_0)\right] \qquad (16)$$

Consistency calculation.

Since there is a sloping part in the balance branch, we use the formula for calculating the sloping beam.

$$\sigma_2 = \frac{N}{F} + \frac{M}{S}\frac{h_2}{\rho - h_2}$$

$$\sigma_1 = \frac{N}{F} - \frac{M}{S}\frac{h_1}{\rho + h_1} \qquad (17)$$

σ_2 *ва* σ_1 - maximum tensile and compressive stresses,

N - is the normal force in the section under consideration;

S - is the static moment of the cross-sectional area obtained with respect to the normal axis.

ρ - slope radius of the neutral layer,

h2 and h1 - are the distances from the edge fibers to the neutral axis.

the distance from the center of gravity of the cross section to the neutral axis.

$S = F.\ell$

F- cross-sectional area

$$h_2 = b - \ell, \qquad \ell = r - \rho \qquad h_1 = b + \ell$$

$$\rho - h_2 = r - b, \qquad \rho + h_1 = r + b.$$

then,

$$\sigma_2 = \frac{N}{F} + \frac{M}{F\ell}\frac{b-\ell}{r-b}$$

$$\sigma_1 = \frac{N}{F} - \frac{M}{F\ell}\frac{b+\ell}{r-b} \qquad (18)$$

The voltage generated by the normal power will be less. For example, if n = 1000 min-1 for a R-130/250 brand roller $N_{\max} = 26 \div 27$ and voltage $170 \div 180'' / _{cm^2}$ therefore the first terms in formulas (17) and (18) can be ignored.

The value of is determined from the following equation.

$$\rho = \frac{1}{2}\left(r + \sqrt{r^2 - b^2}\right)$$

So,

$$\ell = r - \rho = \frac{1}{2}\left(r - \sqrt{r^2 - b^2}\right) \qquad (19)$$

The above formula can be simplified if we assume that the oblique part of the horn is a small burus of radius of inclination.

$$F\ell = \frac{i}{r}$$

then,

$$\sigma_2^1 = \frac{M}{W}\frac{1}{1-\frac{b}{2}} \qquad (20)$$

$$W = \frac{i}{b}$$

The difference between the approximate formula and the exact formula.

$$\delta = \frac{\sigma_2^1}{\sigma_2} - 1 = \frac{F\ell r}{W(b-\ell)} - 1$$

$$F = \pi ab, \qquad W = \frac{\pi ab^2}{4}$$

So,

$$\delta = \frac{8\ell\frac{r}{2b}}{b-\ell} - 1$$

P-130/ 250 for branded rogulka

$$r = 5_{см} \qquad 2b = 1{,}15_{см};\frac{\kappa}{2b} = 4{,}35, \qquad \ell = 0{,}015_{см}$$

$$P - 75/180 \qquad for \qquad r = 3_{см} \qquad 2b = 0{,}95 см.$$

$$\frac{r}{2b} = 3{,}16, \qquad \ell = 0{,}019_{см}, \qquad \delta = 0{,}05.$$

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