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[6].

[7],

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[8].

[6 - 8]

$$\dot{Q} \quad -$$

$$(\quad) D_*,$$

$$U_* = \frac{4\dot{Q}}{\pi D_*^2 \cdot f}, \quad (1)$$

$$f - \quad (\quad), \quad -$$

$$I_* = \frac{U_*}{f}. \quad (2)$$

$$I_* \quad -$$

$$1 < \frac{I_*}{D_*} \leq 4, \quad (3)$$

$$\frac{I_*}{D_*} < 2,5\gamma \cdot f, \quad (4)$$

$$\gamma = 1,03 \left(\frac{I_*}{D_*} \right)^{\frac{1}{3}}. \quad (5)$$

$$U_0) \quad (\quad D_0$$

$$D_0 = \gamma D_*; \quad (6)$$

$$U_0 = 0,074\gamma^{\frac{3}{4}} \ln \left[3,76 \cdot \left(\frac{\text{Re}_*}{\gamma} \right)^{\frac{1}{4}} \right], \quad (7)$$

$$\text{Re}_* = \frac{D_* \cdot U_*}{2\nu}; \quad \nu -$$

$$L_{\max} = 5D_0 \left(\frac{D_0 \cdot U_0}{2\nu} \right)^{\frac{1}{3}}, \quad (8)$$

$$\nu -$$

$$L = \frac{D_0}{2\alpha} \left[\left(1 + \frac{8\alpha U_0}{D_0} \cdot t \right)^{\frac{1}{4}} - 1 \right], \quad (9)$$

$t -$.

$$D = D_0 + \alpha L, \quad (10)$$

$\alpha = 10^{-2} - 10^{-3};$

α

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10 20 [7].

[8, 9].

(1) – (10)

[6, 10 – 12]

[12],

$$\frac{R_m}{R_{m-1}} = \frac{\sqrt{2m-3}}{\sqrt{2m-1}} \cdot \frac{\sin \frac{\pi}{2N_1(2m-3)}}{\sin \frac{\pi}{2N_1(2m-1)}}, \quad (11)$$

$m -$; $N_1 -$ () -
;

$$N_1 = f/f_0, \quad (12)$$

$f_0 -$;

$$\frac{d_m}{d_{m-1}} = \frac{\sqrt{2m-3}}{\sqrt{2m-1}}; \quad (13)$$

$$\alpha_m = \frac{\pi}{N(2m-1)}. \quad (14)$$

()
[12],

$$m_\Sigma = 3.$$

$$3 \quad 5 \quad (13).$$

[12].

, . .) (-

$$R_{T_0}.$$

$$\varepsilon, \quad (11) - (14)$$

$$R_m = \frac{R_T + \varepsilon}{\left(\frac{1}{\sin \frac{\pi}{2N} - 1} \right) \sqrt{2m-1} \cdot \sin \frac{\pi}{2(2m-1)N}}; \quad (15)$$

$$d_m = \frac{2(R_T + \varepsilon)}{\left(\frac{1}{\sin \frac{\pi}{2N} - 1} - 1 \right) \sqrt{2m-1}}; \quad (16)$$

- c ()

$$F_\Sigma = \frac{\pi}{4} N \sum_{m=1}^{m_\Sigma} (2m-1) d_m^2; \quad (17)$$

[13, 14]

$$\bar{F} = \frac{4}{3\pi} F_\Sigma. \quad (18)$$

, D_* , D_k [6] I_* .

$$2 \leq \frac{D_k}{D_*} \leq 3. \quad (19)$$

(1) – (19)

(\dot{Q} , $3/$), (L_{\max} ,), (f , $^{-1}$)
(τ ,)

$$U_0 \approx \frac{L_{\max}}{\tau}, \quad (20)$$

$$D_0 = 0,36 \sqrt{L_{\max}^2 \cdot v \cdot \tau}. \quad (20)$$

$$D_0 = 0,36 \sqrt{L_{\max}^2 \cdot v \cdot \tau}. \quad (21)$$

[6]

$$D_x = 0,6 D_0. \quad (22)$$

()

$$I_* = \frac{4\dot{Q}}{\pi D_*^2 \cdot f} = 3,54 \frac{\dot{Q}}{f \cdot D_0^2}, \quad (23)$$

$$U_x = I_* \cdot f. \quad (24)$$

$$P = P_a + \frac{\rho}{2} \left(\frac{4\dot{Q}}{\mu \cdot \pi D_*^2} \right)^2, \quad (25)$$

$$P_a = \dots; \rho = \dots; \mu = \dots (\mu = 0,62 [15]),$$

$$P = P_a + P + \frac{\rho}{2} \left(\frac{\dot{Q}}{\mu \cdot \bar{F}} \right)^2, \quad (26)$$

$$\mu = \dots$$

$$\mu = \dots [14].$$

$$\begin{aligned} & : \\ - & L_{\max} = 40 \text{ ;} \\ - & U_0 = 40 \text{ / ;} \\ - & V_0 = 1,8 \text{ ;} \\ - & f = 10 \text{ .} \end{aligned}$$

$$D_0 = 0,14 \quad -$$

$$D_* = 0,085 \quad ,$$

$$D = 0,17 \quad , \quad D_p = 0,16 \quad . \quad -$$

$$- \quad R_1 = 0,032 \quad , \quad d_1 = 0,024 \quad ;$$

$$- \quad R_2 = 0,185 \quad , \quad d_2 = 0,014 \quad ;$$

$$- \quad R_3 = 0,143 \quad , \quad d_3 = 0,011 \quad .$$

$$(\quad) F_\Sigma = 0,006 \quad ^2,$$

$$- \quad \bar{F}_\Sigma = 0,0024 \quad ^2.$$

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