Here's some math: $\eta_w = \frac{\eta_a}{\eta_1^2 * \eta_2^2 * \eta_3} = \frac{0.83287}{0.99^2 * 0.99^2 ** 0.96} = 0.9031610663$ $\eta_a = 0.83287$

η_w

$\mathrm{P}_w = 4.2\mathrm{kW}$

$P' = \frac{\mathrm{P}_w}{\eta_a} = 5.042797748\mathrm{kW}$

$\mathrm{n}_w = 59.447983\mathrm{r/min}$

| 中心高 H | 外形尺寸 L×HD | 安装尺寸 A×B | 地脚螺栓孔直径 K | 轴伸尺寸 D×E | 键部位尺寸 F×G | | :—: | :———-: | :———: | :———-: | :———: | :———: | | 132 | 515*315 | 216*178 | 12 | 38*80 | 10*33 | + 确定传动装置的总传动比和分配传动比 + 总传动比

$\mathrm{i}_a = \frac{n_m}{n_w} = \frac{960}{59.447983} = 16.14857$

+ 分配传动比

取箱外传动比 $\mathrm{i}_k = 5.0464$

减速器传动比为 $\mathrm{i}_1 = \frac{i_a}{i_v} = \frac{16.14857}{5.0464} = 3.2000178345 \approx 3.2$

+ 传动装置运动及动力参数计算

+ 计算各轴转速

高速轴：$\mathrm{n}_1 = n_m = 960 = 960\mathrm{r/min}$

$n_2 = \frac{n_1}{i_1} = \frac{960}{3.2000178345} = 300\mathrm{r/min}$

$n_3 = \frac{n_2}{i_k} = 59.4483\mathrm{r/min}$

+ 计算各轴输入功率

高速轴：$\mathrm{P}_1 = P_d\eta_1 = 5.04279775 \times 0.99 = 4.9923697728 \approx 4.99KW$

$P_2 = P_1\eta_2\eta_3 = 4.99 \times 0.99 \times 0.96 = 4.742496 \approx 4.74KW$

$P_3 = P_2\eta_2\eta_1\eta_w = 4.74 \times 0.99 \times 0.99 \times 0.90 = 4.1811066 \approx 4.2KW$

+ 计算各轴输入转矩

高速轴：$\mathrm{T}_1 = 9550P_1/n_1 = (9550 \times 4.99 \times /960)N \cdot m = 49.640N \cdot m$

$T_2 = 9550P_2/_2 = (9550 \times 4.74/300)N \cdot m = 150.89N \cdot m$

$T_3 = 9550P_3/n_3 = (9550 \times 4.2/59.4483)N \cdot m = 674.704N \cdot m$

传动零件 减速器内部传动零件设计——齿轮传动设计 选定齿轮类型、精度等级、材料及齿数 1. 根据传动方案，选用斜齿圆柱齿轮传动，压力角取为 =20° 2. 参考表 3-5 选用 8 级精度 3. 选用软齿面齿轮。材料选择小

齿轮 45 钢（调质处理），硬度为 230 255HBS，大齿轮 45 钢（正火处理），硬度为 190 217HBS 4. 选小齿轮齿数 $z_1 = 26$ $z_2 = z_1 \times u = 26 * 3.2 = 83$ 1. $3-16$

$d_{1t} \geq \sqrt[3]{\frac{2K_{Ht}T}{\Phi_d}\frac{u+1}{u}(\frac{Z_H Z_E Z_\varepsilon Z_\beta}{[\sigma_H]})^2}$

+ 确定公式中的各参数值 + 计算小齿轮传递的扭矩

T=49640N·mm

+ 选取齿宽系数$\Phi_d = 0.9 +$ $3-11$ $Z_H = 2.45 +$ $3-2$ $Z_E = 189.8\sqrt{\text{MPa}} +$ $Z_\varepsilon = 0.8 +$ $Z_\beta = \sqrt{\cos\beta} = 0.969$ $3-16$

$\sigma_{\text{Hlim1}} = 580\text{MPa}, \sigma_{\text{Hlim2}} = 550\text{MPa}$

计算应力循环次数

$N_1 = 60nat = 60 \times 1 \times 960 \times 16 \times 300 \times 10 = 2.765 \times 10^9$

$N_2 = \frac{N_1}{u} = \frac{2.765\times10^9}{3.2} = 8.641 \times 10^8$

插曲寿命系数 emsp; 由图 3-18 得 $Z_{N1} = Z_{N_2} = 1$ $3-4$ $S = 1.2$

$[\sigma_{H1}] = \frac{\sigma_{Hlim1}Z_{N1}}{S_H} = \frac{580\times1}{1.2} = 483.33\text{MPa}$

$_{=\frac{\sigma_{Hlim2}Z_{N2}}{S_H} = \frac{550\times1}{1.2} = 458.33\text{MPa}}^{H2}$

取 $[\sigma_{H1}]$ $[\sigma_{H2}]$

$[\sigma_H] = 458.33\text{MPa}$

由图 3-17 查得小齿轮和大齿轮的齿根弯曲疲劳极限分别为

$\sigma_{Flim1} = 220\text{MPa}$ $\sigma_{Flim2} = 210\text{MPa}$

由图 3-19 查取弯曲疲劳系数

$\text{Y}_{N1} = Y_{N2} = 1$

取弯曲疲劳安全系数 S=1.5 ，由式（10-14）得

$[\sigma_{F1}] = \frac{\sigma_{Flim1} Y_{ST} Y_{N1}}{S} = \frac{220\times2\times1}{1.5} = 293.33\text{MPa}$

^{F2}

$= \frac{\sigma_{Flim2} Y_{ST} Y_{N2}}{S} = \frac{210\times2\times1}{1.5} = 280\text{MPa}$

+ 计算实际载荷系数 $\text{K}_H + \ 3-1 \quad K_A = 1 + \quad K_V = 1.05 +$

$K_\alpha = 1.2 + \quad K_\beta = 1.15$

由此，得到实际载荷系数

$\text{K}_H = K_A K_V K_\alpha K_\beta = 1 \times 1.05 \times 1.2 \times 1.1 = 1.449$

+ 试算小齿轮分度圆直径

$$\mathrm{d}_1 \geq \sqrt[3]{\frac{zK_HT}{\Phi_d}\frac{u+1}{u}(\frac{Z_HZ_EZ_\varepsilon Z_\beta}{[\sigma]_H})^2}$$

$$= \sqrt[3]{\frac{2\times 1.449\times 49640}{0.9}\frac{3.2+1}{3.2}(\frac{2.45\times 189.8\times 0.8\times 0.969}{458.33})^2} = 50.628mm$$

$$m = \frac{\mathrm{d}_1\times\cos\beta}{Z_1} = \frac{50.628\times\cos 20^\circ}{26} = 1.830mm$$

按表 3-7，取标准模数 m=2mm，则

$$\mathrm{a}=(\mathrm{Z}_1+Z_2)\times m\frac{}{2\times\cos\beta=\frac{(26+83)\times 2}{2\times\cos 20^\circ}=115.99mm \quad 115mm}$$

修改螺旋角：

$$\beta = \arccos\frac{m\times(Z_1+Z_2)}{2a} = \arccos\frac{2\times(26+83)}{2\times 115} = 18^\circ 35'23''$$

$$\mathrm{d}_1 = \frac{mZ_1}{\cos\beta} = \frac{2\times 26}{\cos 18^\circ 35'23''} = 54.862mm$$

$$\mathrm{d}_2 = \frac{mZ_2}{\cos\beta} = \frac{2\times 83}{\cos 18^\circ 35'23''} = 175.138mm$$

$$v = \frac{\pi d_1 n}{60\times 1000} = \frac{\pi\times 54.862\times 960}{60\times 1000} = 2.749m/s$$

$$b = \Phi_d d_1 = 0.9\times 54.862 = 49.3758mm$$

取 $\mathrm{b}_2 = 52mm, b_1 = b_2 + (510) = (52+5)mm = 57mm$

$$\mathrm{Z}_{v1} = \frac{Z_1}{\cos^3\beta} = \frac{26}{\cos^3 18^\circ 35'23''} = 28.94$$

$$Z_{v1} = \frac{Z_1}{\cos^3\beta} = \frac{83}{\cos^3 18^\circ 35'23''} = 92.39$$

20°

$$\mathrm{Y}_{Fa}Y_{Sa}Y_{Fa1} = 2.6, Y_{Fa2} = 2.2$$

$$\mathrm{Y}_{Sa1} = 1.62, Y_{Sa2} = 1.81$$