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Amaliy mexanika fanidan tayyorlagan

KURS ISHI

MAVZU: <u>**BIR POG'ONALI SILINDRIK TISHLI YURITMANI HISOBLASH.**</u>

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Kirish

Ish mashinalarini harakatga keltirish uchun mexanik energiya zarur boʻladi. Bu energiya dvigateldan ish mashinasiga odatda aylanadigan val vositasida uzatiladi.

Uzatmalar deganda, dvigateldan energiyani mashinaning ish organlariga aylantiruvchi momentlarini, tezliklarini, ayrim hollarda harakat xarakterini oʻzgartirib uzatishga imkon beruvchi qurilma tushuniladi.

Silindrik uzatmada boʻluvchi silinbdr chizigʻI boʻylab joylashgan tishli gʻildirak qiyshiq slindrlidir. Tishli qiyshiqligi uni val oʻqiga nisbatan joylashgan B burchagi bilan aniqlanadi. Harakatni silliq va shovqinsiz uzatishi, yuklanish darajasining kattaligi qiyshiq jism gʻildiragining afzalligidir.

Lentali konveylerlarning foydali kuchi F_A=7.5 kN, lentaning tezligi ϑ_A=1.7 m/s, konveyler barabanining diametri D_δ=400 mm.

Berilgan

F_A=7.5 kN

ϑ_A=1.7 m/s

D_δ=400 mm

1. Uzatmaga elektr yuritma tanlash va kinematik hisoblash.

Elektrodvigatel talab qiladigan quvvatni topish.

$P_{Tal}=(F_A \cdot \vartheta_A)/\eta=7.5 \cdot 1.7/0.875=14.6$kV

Bu yerda

η_{tish} – tishli uzatmaning fodali ish koeffitsiyenti ;

η_{pod} – podshilnikni foydali ish koeffitsiyenti;

η_{bar} - barabanni foydali ish keffitsiyenti;

η_{zan} – zanjirli uzatmani foydali ish koeffitsiyenti;

k – reduktordagi tishlanishlar soni;

n – juft podshelniklar soni;

η_{tish} – 0.97 - 0.98

η_{pod} – 0.99

η_{bar} - 0.99

η_{zan} –0.80 – 0.95

$\eta_{um}=0.98 \cdot 0.99^2 \cdot 0.92 \cdot 0.99=0.875$.

P_{max}=14.6 kV.

Barabanning burchak tezligi.

$\omega_\delta=2\vartheta_A/D_\delta=2 \cdot 1.7/0.4=8.5$rad/s

Barabanning aylanishlar soni.

$$n_\delta = \frac{30 \cdot 85}{3.14} = 81.2$$

Tanlangan elektrodvigatel.

Markasi 4A160 M6 quvvati N=15 kV valning aylanishlar chastotasi soni n=1000 ayl/min sir.koef=2.6%

Nominal aylanish chastotasi

n_{dv}=1000-26=974 ayl/min

Burchak tezligi

$\omega_{dv} = \pi \cdot n_{dv}/30 = 101.9$ c^{-1}

Yuritmaning uzatishlar soni .

i= $\omega_{dv/}$ $\omega_1 = \frac{101.9}{8.5} = 11.99$

Aloxida uzatishlar soni. Redaktor uchun U_p=6

Zanjirli uzatma uchun.

$U_{zan} = \frac{U_{um}}{U_p} = \frac{11.99}{6} = 2$

Yetaklovchi baraban va redactor vallarining burchak tezlanishi va aylanishlar chastotasi

n_1= n_{dv}=974 ayl/min	ω_1= ω_{dv}=102 c^{-1}
$n_2 = \frac{n_1}{U_p} = $974/6=162 ayl/min	$\omega_2 = \frac{\omega_1}{U_n} = $ 102/6 = 17 c^{-1}
$n_3 = \frac{n_2}{U_{zan}} = $ 162/2= 81 ayl/min	$\omega_3 = \frac{\omega_2}{U_z} = $ 17/2= 8.5 c^{-1}

Burovchi momentlar

$M_1 = \dfrac{P_1}{\omega_1} = \dfrac{P_{T.e}}{\omega_{dv}} = \dfrac{14.6}{102} = 0.1431373 = 143 \cdot 10^3$ nmm

$M_2 = M_1 \cdot U_p = 143 \cdot 10^3 \cdot 6 = 858 \cdot 10^3$ nmm.

2. Reduktor tishli g'ildiraklarini hisoblash.

1. Uzatma g'ildiraklari uchun material tanlanadi.

Yetaklovchi va yetaklanuvchi tishli g'ildiraklar uchun termik qayta ishlanishi bir xil, ya'ni yaxshilash yoki yuqori chastotali tok yordamida toblash bo'lib shestirno tish yuzasini qattiqligi HB = 280 bo'lgan 45 markali po'lat material tanlanadi. Koleso uchun qattiqligi HB = 250 bo'lgan 45 markali po'lat material tanlanadi. Kolesoni qattiqlik birligi 30 kam, sababi koleso sekin aylanadi, dinamik zarblarga uchraydi.

Kontakt [σ_n] kuchlanishni joiz qiymati

$$[\sigma_n] = \frac{\sigma_n}{s_n}$$

Bu yerda σ_n – tishni asosiga ta'sir qiluvchi kontakt zo'riqishi.

K_{nl} – uzatmaning ishlash muddatini hisobga oluvchi koeffitsiyent.

[s_n] – ruxsat etiladigan xavfsizlik koeffitsiyenti.

Agar reduktor uzoq vaqt ishlashi hisobga olinsa, u holda

$K_{ln} = 1$ xavfsizlik koeffitsiyenti [s_n] =1.1.

Qiyshiq tishli uzatmalarda kuchlanish joizi quyidagicha topiladi.

$$[\sigma_n] = 0.45([\sigma_{n_1}] + [\sigma_{n_2}]);$$

Shestirno uchun

$$[\sigma_{n_1}] = \frac{(2 \cdot HB_1 + 70) \cdot K_{nl}}{[s_n]} = \frac{(2 \cdot 280 + 70) \cdot 1}{1.1} = 573 \text{mpa}$$

G'ildirak uchun.

$$[\sigma_{n_2}] = \frac{(2 \cdot HB_2 + 70) - K_{nl}}{[s_n]} = \frac{(2 \cdot 250 + 70)}{1.1} = 518 \text{ mPa}$$

U holda ruxsat etilgan joiz zo'riqishi quyidagicha bo'ladi.

$[\sigma_{n_1}]=0.45(573+518)=491$ mPa

O'qlar aro masofa a_ω, uzatish soni U_p , tish eni koeffitsenti Ψ_{va} va modul m va tishli qiyalik burchagi β tishli uzatmaning asosiy o'lchamlaridir.

$$a_\omega = k_a\,(U+1)\sqrt[3]{\dfrac{M_2 \cdot k_{HB}}{[\sigma_n^2]\cdot U^2 \cdot \Psi_{va}}}$$

bu yerda k_a – o'qlar aro masofa koeffitsiyenti (qiya tishli uzatmalar uchun k_a=43 , to'g'ri tishli uzatmalar uchun k_a=49.5).

σ_n - joiz kontakt kuchlanish, M_2 – yetaklanuvchi g'ildirak validagi burovchi moment.

k_{HB} – yuklanishning tez yuzasida notekis taqsimlanishini hisobga oluvchi koeffitsiyent bo'lib qiymati jadvaldan olinadi. $k_{HB} - 1.2$. Ψ_{va}ning qiymati g'ildiraklarning tayanchlariga nisbatan joylashishiga ko'ra tanlanadi, ya'ni g'ildirak tayanchlarga nisbatan joylashishi simmetrik holatda bo'lganda . Ψ_{va}=0.4÷0.5. nosimmetrik holatda . Ψ_{va}=0.25÷0.4.

Konsol holatda . Ψ_{va}=0.2÷0.25.

$$a_\omega = k_a\,(U+1)\sqrt[3]{\dfrac{M_2 \cdot k_{HB}}{[\sigma_n^2]\cdot U^2 \cdot \Psi_{va}}} = 43(6+1)\sqrt[3]{\dfrac{858\cdot 10^3 \cdot 1.2}{481^2 \cdot 6^2 \cdot 0.5}} = 160\text{mm}$$

Aniqlangan o'qlar aro masofa standart bo'yiga yaxlitlanishi kerak, ya'ni

a_ω = 160 deb qabul qilindi. Uzatmaning moduli m_n=3.5.

Qiya tishli g'ildiraklar uchun $\beta = 8^\circ \div 18^\circ$ bo'lib hisoblanganda aniqlik darajasi verguldan keyingi beshinchi xonagacha olinishi kerak $\beta = 15^\circ$ deb qabul qilamiz.

G'ildirak va shertirno tishlarining sonini aniqlaymiz.

$$Z_1 = \dfrac{2a_\omega cos\beta}{(U+1)\cdot m_n} = \dfrac{2\cdot 160 \cdot cos15^\circ}{(6+1)\cdot 3.5} = 12.6$$

$Z_1=13$ qabul qilamiz unda $Z_2=Z_1 \cdot U_p = 13 \cdot 6 = 78$

Tishlarning aniq qiyalik burchagi

$$cos\beta = \frac{(Z_1+Z_2) \cdot m_n}{2a_\omega} = \frac{(13+78) \cdot 3.5}{2 \cdot 160} = 0.9953 \quad \beta = 11°50$$

G'ildirak va shestirnoning geometric o'lchamlari.

Bo'luvchi aylananing diametri.

$$d_1 = \frac{m_n}{cos\beta} \cdot Z_1 = \frac{3.5 \cdot 13}{0.9953} = 45.71 mm$$

$$d_2 = \frac{m_n}{cos\beta} \cdot Z_2 = \frac{3.5 \cdot 78}{0.9953} = 274.3 \ mm$$

Tekshirish:

$$a_\omega = \frac{d_1+d_2}{2} = \frac{45.71+274.3}{3} = 160 \ mm$$

Tishlar uchining diametrlari.

$$d_{a_1} = d_1 + 2m_n = 45.71 + 2 \cdot 3.5 = 52.71 mm$$

$$d_{a_2} = d_2 + 2m_n = 274.3 + 2 \cdot 3.5 = 281.3 mm$$

G'ildirak eni

$$b_2 = \Psi_{va} \cdot a_\omega = 0.5 \cdot 160 = 80 mm$$

$$b_1 = b_2 + (5 \div 10) = 80 + 8 = 88 mm$$

G'ildirakni enini diametrga nisbatan belgilovchi koeffitsiyenti

$$\Psi_{vd} = \frac{b_1}{d_1} = \frac{88}{45.71} = 1.925$$

G'ildirakni aylana tezligi.

$$V = \frac{\omega_1 \cdot d_1}{2} = \frac{101.9 \cdot 45.71}{2} = 2.03 \ m/s$$

Bunday tezlikda 8-darajali aniqlik to'g'ri keladi.

Zo'riqish koeffitsiyenti.

$$K_H = K_{HB} \cdot K_{HA} \cdot K_{HV} = 1.25 \cdot 1.06 \cdot 1 = 1.325$$

$K_{HB}=1.25$

$K_{HA}=1.06$

$K_{HV}=1$

U holda kontakt zo'riqishi joizligi tekshirib ko'rilsin. Formula bo'yicha.

$$\sigma_n = \frac{270}{a_\omega} \sqrt{\frac{M_2 \cdot K_H (U+1)^3}{b_2 \cdot U^2}} = \frac{270}{160} \sqrt{\frac{858 \cdot 1000 \cdot 1.325 \cdot 7^3}{80 \cdot 49}} = 202.3 \text{ mPa} < [\sigma_n]$$

Ilashishda ta'sir etuvcni kuchlar. Doiraviy kuch

$$F_t = \frac{2M_1}{d_1} = \frac{2 \cdot 143 \cdot 10^3}{45.71} = 6256 \text{ N.}$$

Radial

$$F_z = F_b \cdot \frac{tg\alpha}{cos\beta} = 6256 \cdot \frac{0.3640}{0.9953} = 2287 \text{ N}$$

O'q bo'yich yo'nalgan kuch.

$$F_a = F_t \cdot tg\beta = 6256 \cdot tg\, 12°50' = 1424 \text{ N}$$

Egilish kuchlanishi bo'yicha tishlarni mustahkamlikka tekshirish.

$$\sigma_F = \frac{F_t \cdot k_f \cdot Y_F \cdot Y_B \cdot k_{Fa}}{b \cdot m_n} \leq [\sigma_F].$$

Bu yerda: $k_F = k_{FB} \cdot k \cdot V$ kuchlanish koeffitsiyenti $\Psi_{va} = 1.325$, qattiqlik HB≤350 va nosimmetrik joylashgan g'ildiraklar uchun $k_{FB}=1.33$ va $k_{FV} = 1.3$ qabul qilamiz. Unda $k_F = 1.73$

. Y_F- tish shaklini hisobga oluvchi va ekvivalent tishlar soniga Z_V bog'liq koeffitsientlarni aniqlaymiz.

Shestirno uchun

$$Z_{v_1} = \frac{Z_1}{cos^3\beta} = \frac{13}{0.9953} = 13.06 \qquad Y_{F_1} = 3.84$$

$$Z_{v_2} = \frac{Z_2}{\cos^3 \beta} = \frac{78}{0.986} = 79 \qquad Y_{F_2} = 3.60$$

Ruxsat etilgan kuchlanish

$$[\sigma_F] = \frac{\sigma^{\circ} \cdot limb}{[S_F]} \qquad$$ Po'lat 45 ni qattiqligi HB= 350 bo'lsa

σ_F limb=18HB

Shestirno uchun $\sigma^{\circ} \cdot limb = 18 \cdot 280 = 5040$

G'ildirak uchun $\sigma^{\circ} \cdot limb = 18 \cdot 250 = 4500$

- Xavfsizlik koeffitsiyenti
$[S_F]=[S_F]^l \cdot [S_F]^H$ shtampovkalar va toblanmalar uchun $[S_F]^l$=1.75
$[S_F]^H$=1 Shunday qilib $[S_F]$=1.75 .
Ruxsat etilgan kuchlanishlar.
Shestirno
$$[\sigma_{F_1}] = \frac{5040}{1.75} = 2880 \; mPa$$
va g'ildirak uchun

$$[\sigma_{F_2}] = \frac{4500}{1.75} = 2250 \; mPa$$

$\dfrac{[\sigma_F]}{Y_F}$ — munosabatni topamiz.

Shestirno uchun: $\dfrac{2880}{3.84} = 75 \; mPa$

G'ildirak uchun: $\dfrac{2250}{3.60} = 625 \; mPa$.

Bundan keying hisobni g'ildirak tishlari uchun olib boriladi, chunki topilgan munosabatlar g'ildirak uchun kerak.

$\varepsilon_\alpha = 1.5, \qquad K_{F\alpha} = 0.32 \; Y_\beta = 0.91$

G'ildirak tishini mustahkamligini tekshiramiz.

$$\sigma_{F_2} = \frac{6256 \cdot 1.73 \cdot 3.60 \cdot 0.91 \cdot 0.92}{80 \cdot 3.5} = \frac{33562}{280} = 113\ mPa \leq [\sigma_F].$$

3. Reduktorning vallarini taqribiy hisoblash.

Vallar asosan taqribiy yo'l bilan buralishga hisoblanadi.

1. Yetaklovchi val;

Reduktor korpusidan chiqib turgan valni diametrini buralish zo'riqishidagi joiz qiymati. $[\tau_k]= 25$ mPa qabul qilinadi.

U holda

$$d_{b_1} = \sqrt[3]{\frac{16 \cdot M_1}{\pi \cdot [\tau]}} = \sqrt[3]{\frac{16 \cdot 143 \cdot 10^3}{3.14 \cdot 25}} = \sqrt[3]{\frac{2288}{78.5}} = 30.78\ mm$$

Asosan reduktorni yetaklovchi vali elektrodvigatel vali bilan mufta orqali ulanadi. Shuning uchun elektrodvigatel tanlagan vaqtda elektrodvigatelni valini hamdiametrini yozib olish kerak. Tanlangan elektro dvigatel vali 42 yoki 48 mm bo'lishi mumkin. Mufti asosan $MYBU$ tilidan tanlanadi $GOST$ $24424\text{-}5$ elektrodvigatel 48 mm deb, yetaklovchi valni diametri $d_{b_1} = 48$ deb olish mumkin. Yarim muftani yo'nib qo'yiladi podshibnik turadigan joyni $d_{n_1} = 40\ mm$ deb olish mumkin. Ayrim hollarda mufta o'rnida tasmali uzatma qo'yish mumkin. Shestirnoni val bilan birga tayyorlanadi.

2. Yetaklanuvchi val

Valni zanjirni tortilishi natijasida egilishini hisobga olgan taqdirda $[\tau_k] = 20mPa$ deb qabul qilinadi.

Valni reduktor korpusidan chiqib turgan qismini diametric quyidagicha topiladi.

$$d_{b_2} = \sqrt[3]{\frac{16 \cdot M_2}{\pi \cdot [\tau_k]}} = \sqrt[3]{\frac{16 \cdot 858 \cdot 10^3}{3.14 \cdot 20}} = \sqrt[3]{218598.7261} = 60.24$$

Standart boʻyicha d_{b_2}=60.24 mm deb olinadi. Valni podshilnik joylashadigan qismini diametrini d_{n_2}=65 mm , tishli gʻildirak turadigan joyini diametri $d_k = 70mm$. Valni qolgan joylarini diametrlari konstruktiv holda olinadi.

3. <u>Shestirno va gʻildiraklarni konstruksion oʻlchamlari.</u>

Shestirno bilan birga qilingan, shuningdek uni oʻlchamlari quyidagicha boʻladi.

$$d_1 = 45.71 \, mm$$

$$d_{a_1} = 52.71 \, mm$$

b_1=88 mm

G'ildirak razmerlari:

$$d_2 = 274.3 \, mm$$

$$d_{a_2} = 281.3 \, mm$$

b_2=80 mm

Stulnitsani diametri:

$$d_{at} = 1.6 \cdot d_{b_2} = 1.6 \cdot 60.24 = 86.84$$

Stulnitsani uzunligi:

$$l_{st} = (1.2 \div 1.5)d_{b_2} = (1.2 \div 1.5) \cdot 60.24 = 70.3 \div 80.4.$$

l_{st}=70 deb qabul qilamiz.

G'ildirakni valga o'rnatadigan qismini qalinligi.

$$\sigma_0 = (2.5 \div 4) \cdot 3.5 = 8.75 \div 14mm$$

$\sigma_0 = 10mm$ deb qabul qilamiz.

Diskaning qalinligi.

$$C = 0.3 \cdot b_2 = 0.3 \cdot 80 = 24$$

$$\sigma = 0.025 \cdot a_\omega + 1 = 0.025 \cdot 160 + 1 = 5mm$$

5. <u>Zanjirli uzatmani hisoblash.</u>

Bir qatorli rolikli zanjirini qiymatlarini olamiz. Yetaklovchi yulduzchadagi burovchi moment.

T_3=858N·m

Oldindan qabul qilingan aylanishlar soni: $U_y = 1.20$

Yetaklovchi yulduzga tishlarining soni $Z_3 = 31 - 2U_y = 31 - 2 \cdot 1.20 = 28.6$

Yetaklovchi yulduzcha tishlarining soni $Z_4 = Z_3 \cdot U_3 = 28.6 \cdot 1.20 = 34.32$

Yuklanish koeffitsiyenti

$$K = K_g \cdot K_a \cdot K_H \cdot K_P \cdot K_{sm} \cdot K_l$$

bu yerda

K_g – dinamik koeffitsiyent;

K_a – o'qlar orasidagi masofani hisobga oluvchi koeffitsiyent;

K_H – gorizontal o'qqa nisbatan egilishini hisobga oluvchi koeffitsiyent;

K_P – zanjirning tarang turishini hisobga oluvchi koeffitsiyent;

$K_P = 1.32, \quad K_y = 1 \cdot 1 \cdot 1 \cdot 1.32 \cdot 1 \cdot 1 = 1.32$

Zanjirning qadami:

$$t = 2.5 \cdot \sqrt[3]{\frac{M_3 \cdot K_y}{Z_3 \cdot [P]}} = 2.5 \cdot \sqrt[3]{\frac{858 \cdot 1.32 \cdot 10^3}{29 \cdot 24}} = \sqrt[3]{\frac{11132560}{696}} = 11.76$$

Bu yerda [P] – nisbiy bosimni joiz qiymati, bu qiymat asosan yulduzchani aylanishiga bog'liq.

$$n_g = \frac{\omega_2 \cdot 30}{\pi} = \frac{17 \cdot 30}{3.14} = 162 \; ayl/min$$

Demak $t = 11.76 \; mm$ qabul qilamiz.

$$A = 39.6 \; mm, \quad q = 0.75 \frac{kg}{m}, \quad Q = 18.2 \; kN.$$

Zanjirning tezligi:

$$\vartheta = \frac{Z_3 \cdot t \cdot n_2}{60 \cdot 10^3} = \frac{29 \cdot 11.76 \cdot 162}{60 \cdot 10^3} = 0.92 \frac{m}{s}$$

Aylanma kuch:

$$F_{ay} = \frac{T_g \cdot \omega_g}{\vartheta} = \frac{858 \cdot 17}{0.92} = 15854 \; N$$

Sharnirdagi bosim:

$$P = \frac{F_{ay} \cdot K_y}{A} = \frac{15854 \cdot 1.32}{39.6} = 528.5 \; mPa$$

Ruxsat etilgan bosimni tekshiramiz.

[P]=22[1+0.01($Z_3 - 17$)]=22[1+0.01(29-17)]=24.64

$P \leq [°P]$ shart bajarildi.

Zanjirdagi zvenolar (bo'g'inlar) soni:

$$L_t = 2 \cdot a_t \cdot 0.5 \cdot Z_3 + \frac{\Delta^2}{at}$$

Bu yerda $a_y = 50 \cdot t = 50 \cdot 11.76$

$$a_t = \frac{a_y}{t} = \frac{50 \cdot 11.76}{11.76} = 50$$

$$Z_\varepsilon = Z_3 + Z_4 = 29 + 34.32 = 63.32$$

$$\Delta = \frac{Z_4 - Z_3}{2\pi} = \frac{34.32 - 29}{2 \cdot 3.14} = \frac{5.32}{6.28} = 0.85$$

U holda

$$L_t = 2 \cdot 50 + 0.5 \cdot 63.32 + \frac{(0.85)^2}{50} = 131.7$$

L_t=132 mm deb qabul qilamiz.

Zanjirli uzatmani o'qlar orasidagi masofa.

$$a_b = 0.25 \cdot t \left[L_t - 0.5 \cdot Z_\varepsilon + \sqrt{(t_t - 0.5 \cdot Z_\varepsilon)^2 - 8\Delta^2} \right] = 589.9 \approx 590$$

Zanjirni erkin tushishini hisobga olgan taqdirimizda

589.4·0.004=2.4 mm bo'luv diametri topiladi.

$$R_y = 15854 + 2 \cdot 132 = 161184$$

Yulduzchalarni

$$d_A = \frac{t}{sin\frac{180°}{Z_3}} = \frac{11.76}{sin\frac{180°}{29}} = 108.8 \, mm$$

$$d_m = \frac{t}{sin\frac{180°}{Z_4}} = \frac{11.76}{sin\frac{180°}{34.32}} = 170.7 \, mm.$$

Zanjirga ta'sir qiladigan kuchlar .

Aylanma kuch:

$$F_y = q \cdot \vartheta^2 = 0.75 \cdot 0.92^2 = 0.75 \cdot 0.8464 = 0.6348 \, N$$

Bu yerda   q=0.75 kg/m

  Zanjirni o'z og'irligidan hosil bo'lgan kuch:

$$F_t = 0.81 \cdot k_f \cdot q \cdot a_y = 9.81 \cdot 1.5 \cdot .75 \cdot 5.899 = 65 \, mm$$

Bu yerda k_f=1.5 koeffitsiyent .

Valga   ta'sir qiluvchi hisobli kuch:

$$F_b = F_{t2al} + 2 \cdot F_f = 15854 + 2 \cdot 65 = 15984$$

   Mustahkamlik koeffitsiyentini tekshirib ko'ramiz:

$$S = \frac{Q}{F_{ay} \cdot k_\delta + F_v + F_f} = \frac{18.2}{15854 \cdot 1 + 0.63 + 65} = 0.56$$

Bu yerda

Q – zanjirni uzuvchi kuch (N).

F_a - aylanma kuch (N).

F_v- markazdan qochma   kuch (N).

F_f- zanjir salqinligi tufayli hosil bo'luvchi kuch (N).

 [S]=1.1 janvaldan olinadi.

Demak shart bajariladi.

7. Reduktor komponovkasini   birinchi bosqichi.

   Komponovka asosan ikki bosqichdan iborat bo'ladi. Birinchi bosqichida shestirno va tishli shediraklarni asosiy qiymatlari qo'yiladi. Iloji boricha masshtab 1:1 bo'lishi kerak. Millimetrovkada bir ko'rinishida chiziladi. Reduktor korpusining ichki qiymatlari qo'yiladi.

1.   Shestirno bilan korpus ichki qismigacha $A_1 = 1.2 \cdot \delta.$
2.   Tishli g'ildirakni tashqi diametridan korpus ichki qismi
     A=δ oldindan valni diametriga qarab podshilniklarni tanlaymiz.
Podshilnik kiradigan joyini diametric $d_{n_1} = 40 \, mm \ va \ d_{n_2} = 65 \, mm$

Podshelnikni nomeri	d	D	B	Yuk ko'tarish qobilyati (kN)	
	O'lchamlari (mm)			C	$C_\circ$
308	40	90	23	31.3	22.3
313	65	140	33	92.3	56

8. Podshilnik chidamliligini tekshirish.

Yetaklovchi val, ilashmadagi ta'sir kuchlar

F_t=6256 N

F_τ=2287 N

F_a=1424 N

Dastlabki komponovkadan l=82 mm XZ tekisligida ta'sir qiluvchi kuchni aniqlaymiz.

$$\sum M_A = -F \cdot l_1 + R_{BX} \cdot 2l_1 = 0 \text{ va } R_{BX} = \frac{F}{2} = \frac{6256}{2} = 3128\,N$$

C nuqtadagi eguvchi moment.

$$M_c = K_{AX} \cdot l_1 = K_{BX} \cdot l_1 = 3128 \cdot 82 = 256496\,N$$

YZ tekisligida ta'sir qiluvchi kuchni aniqlaymiz.

$$\sum M_\beta = R_{Ay} \cdot 2l_1 - F_a \cdot \frac{d_1}{2} - F_\gamma \cdot l_1 = 0$$

Tenglamadan

$$R_{Ay} = \frac{1}{2l_1}\left(F_\gamma l_1 + F_a \frac{d_1}{2}\right) = \frac{1}{2 \cdot 82} \cdot \left(2287 \cdot 82 + 1424 \cdot \frac{45.71}{2}\right) = 13424$$

$$\sum M_\beta = -R_{By} \cdot 2l_1 - F_a \cdot \frac{d_1}{2} - F_\gamma \cdot l_1 = 0$$

Tenglamadan

$$R_{By} = \frac{1}{2l_1}\left(F_\gamma l_1 - F_a \frac{d_1}{2}\right) = \frac{1}{2 \cdot 82} \cdot \left(2287 \cdot 82 - 1424 \cdot \frac{45.71}{2}\right) = 945N$$

C nuqtadagi eguvchi moment

$$M_c = R_{Ay} \cdot l_1 = 1342 \cdot 82 = 110044\,Nmm$$

$$M_c = R_{By} \cdot l_1 = 945 \cdot 82 = 77490\,Nmm$$

Yetaklovchi valdagi aylantiruvchi moment uning kesimidagi burovchi momentni keltirib chiqaradi.

$$M_{\delta_1} = M_1 = 143 \cdot 10^3 \text{N·mm}$$

Tekshirish

$R_{y_1} + R_{y_2} - F_\gamma$=1342+945-2287=0

Reaktsiya kuchlari

$$F_{z_1} = R_1 = \sqrt{R_{x_1}^2 + R_{y_1}^2} = \sqrt{3128^2 + 1342} = \sqrt{11585348} = 3403\ N$$

$$F_{z_2} = R_2 = \sqrt{R_{x_1}^2 + 945} = \sqrt{9784384 + 893025} = 1368\ N$$

Nisbat: $\dfrac{F_a}{C_\circ} = \dfrac{1424}{22300} = 0.064$ da $l = 0.37$ qabul qilinadi.

$$\sum M_\beta = R_{AX} \cdot 2l_2 - F \cdot l_2 + R_{yx} \cdot l_3 = 0$$

Tenglamadan

$$R_{AX} = \frac{1}{2l_2}\left(F_1 l_2 - R_{yx}l_3\right) = \frac{1}{2 \cdot 82}(6256 \cdot 82 - 11363 \cdot 82) = -2553\ N$$

$$\sum M_A = F \cdot l_2 + R_{yx}(2l_2 + l_3) - R_{BX} \cdot 2l_2 = 0$$

Tenglamadan

$$R_{BX} = \frac{1}{2l_2}\left(F_1 l_2 + R_{yx}(2l_2 + l_3)\right) = \frac{1}{2 \cdot 82}(6556 \cdot 82 + 11363 \cdot 3 \cdot 82) = 20173\ N$$

$$R_{AX} + R_{BX} - \left(F_t + R_{yx}\right) = -2553 + 20173 - 6256 - 11363 = 0$$

C nuqtadan eguvchi moment

$$M_B = -R_{AX} \cdot 2l_2 + F \cdot l_2 = -2553 \cdot 82 = 209346\ Nmm$$

V nuqtadagi eguvchi moment

$$M_B = -R_{AX} \cdot 2l_2 = -2553 \cdot 2 \cdot 82 = -943000\ Nmm$$

$$M_B = (1363 \cdot 82) = 931766\ Nmm$$

Nisbat

$$\frac{F_a}{F_{21}} = \frac{1424}{3403} = 0.4177 > l \qquad \text{unda}\ \ k=0.56\ \ \text{va}\ \ y=1.91$$

$$P_y = (0.56 \cdot 3403 + 1.9 \cdot 1424) = 4612$$

Podshilnikning ishlash muddatini aylanishga

$$\left(\frac{C}{R_y}\right)^3 = \left(\frac{31.3 \cdot 10^3}{4612}\right)^3 = (6.73)^3 = 3130\frac{ayl}{min}$$

Podshilnikning ishlash muddatini soatda

$$L_n = \frac{L \cdot 10^6}{60 \cdot n} = \frac{1125 \cdot 10^6}{60 \cdot 970} = 19 \cdot 10^3 \, soat$$

Yetaklanuvchi val.

Yetaklanuvchi val ham yetaklovchi valga o'xshash kuchlarni qabul qiladi.

P=6256 N, P_1=2287 N P=1424 N

Zanjirli uzatma orqali ta'sir qiluvchi kuch. R_y=16118

Yig'uvchi kuch

$$R_{yx} = R_{yy} = R_y \cdot sin\varphi = 11363.2 \, N$$

Birinchi pog'onani komponovkadan quyidagilarni aniqlaymiz

$l_2 = 82$mm $l_3 = 82$mm

$tayanch \; nuqtalar \; XZ \; tekisligi \; bo'yicha$

YZ tekisligida

$$\sum M_\beta = -R_{Ay} \cdot 2l_2 - F_a \cdot \frac{d_2}{2} F_\gamma \cdot l_2 + R_{yy} \cdot l_3 = 0$$

$$R_{Ay} = \frac{1}{2l_2}\left(F_\gamma \cdot l_2 - F_a \cdot \frac{d_2}{2} + R_{yy} \cdot l_3\right) =$$

$$= \frac{1}{2 \cdot 164}\left(2287 \cdot 82 - 1424 \cdot \frac{274.3}{2} + 11363 \cdot 82\right) = 6706 \, N$$

$$\sum M_A = -R_{By} \cdot 2l_2 - F_a \cdot \frac{d_2}{2} + R_{yy} \cdot 2l_2 + l_3 = 0$$

$$R_{By} = \frac{1}{2l_2}\left(-F_\gamma \cdot l_2 - F_a \cdot \frac{d_2}{2} + R_{yy}(2l_2 + l_3)\right) =$$

$$= \frac{1}{2 \cdot 82}\left(-2287 \cdot 82 - 1424 \cdot \frac{274.3}{2} + 11363 \cdot 3 \cdot 82\right) = 14710.4$$

Tekshiramiz

$$R_{Ay} + R_{yy} - (F_\gamma + R_{By}) = 6706 + 11363 - 2287 - 14710 = 0$$

C nuqtadagi eguvchi moment

$$M_c = R_{Ay} \cdot l_2 = 6706 \cdot 82 = 549892 \, Nmm$$

$$M_c = R_{Ay} \cdot l_2 + F_a \cdot \frac{d_2}{2} = 549882 + 1424 \cdot \frac{274.3}{2} = 741376 \, Nm$$

V nuqtadagi eguvchi moment

$$M_B = R_{Ay} \cdot l_2 + F_a \cdot \frac{d_2}{2} - F_\gamma \cdot l_2 = 549832 + 195301 - 187534 = 554442$$

yoki

$$M_B = R_{yy} \cdot l_3 = 11363 \cdot 82 = 931766$$

Teng ta'sir etuvchi kuchlar

$$F_{\gamma_3} = R_3 = \sqrt{R_{x_2}^2 + R_{y_3}^2} = \sqrt{2553^2 + 6706^2} = \sqrt{51488245} = 7176 \ N$$

$$F_{\gamma_y} = R_4 = \sqrt{R_{x_y}^2 + R_{y_n}^2} = \sqrt{20173^2 + 14710^2} = 24321$$

Nisbat:

$$\frac{F_a}{S_0} = \frac{1424}{56 \cdot 10^3} = 0.025$$

$$\frac{F_a}{F_{\gamma n}} = \frac{1424}{24321} = 0.058$$

Unda $V_1 = 1$ $y=0$ va $P_y = 24321 \ N$

Podshibnikning ishlash muddati

$$L = \left(\frac{C}{P_y}\right)^3 = \left(\frac{92300}{24321}\right)^3 = 54.9 \frac{min}{ayl}$$

Podshebnikning ishlash muddati

$$L_1 = \frac{L \cdot 10^6}{60 \cdot n} = \frac{54900000}{11640} = 4176 \ soat$$

Vallarni mustahkamlikka hisoblash.

Egilishdagi normal kuchlanish simmetrik siklda va burilishdagi urinma kuchlanish tepkili siklda o'zgaradi. Vallarni mustahkamlikka to'liq hisoblash uni xavfli kesimlarida mustahkamlikka extiyotlik koeffitsiyentini aniqlashga qaratilgan.

Yetaklovchi val: $\alpha_{a_1} = 52.71 \ mm$

Diametr uchun mos $\sigma_b = 780 \frac{N}{mm^2}$, $\sigma_{og} = 440 mPa$,   HB=250

Kuchlanishni tanlaymiz

Simmetrik holatda chidamlilik chegarasi

$$\sigma_{-1} = 0.43 \cdot \sigma_b = 0.43 \cdot 780 = 335 \frac{N}{mm^2}$$

Simmetrik siklda urinma kuchlanishga chidamlilik chegarasi

$$\sigma_{-1} = 0.58 \cdot \sigma_{-1} = 0.58 \cdot 335 = 194 \frac{N}{mm^2}$$

kesim   A − A

Tepkili siklda o'rtacha kuchlanish

Bu yerda   d=48mm

$\qquad\qquad$ b=8mm

$\qquad\qquad$ t=6mm   bo'lsa

$$\tau_V = r_m = \frac{\tau_{max}}{2} = \frac{M_x \cdot l}{2W_{netta}}$$

$$W_{netta} = \frac{\pi d^3}{16} - \frac{bt_1(d - t_1)^2}{2d} = \frac{3.14 \cdot 48^3}{16} - \frac{8 \cdot 6(48 - 6)^2}{2 \cdot 48}$$
$$= 20.8 \cdot 10^3$$

$$\tau_V = r_m = \frac{143}{41.6} = 3.44 \frac{N}{mm}$$

$$\Psi_\sigma = 0.2 \quad \Psi_y = 0.1 \quad \Psi_\tau = 0.1$$

Mustahkamlikka ehtiyotlik koeffitsiyenti.

$$k_\sigma = 1.8 \qquad\qquad \sigma_\tau = 1.7 \qquad \varepsilon_\tau = 0.65 \qquad \varepsilon_0 = 0.76.$$

$$n = n_\tau = \frac{\tau_{-1}}{\frac{k_\tau}{\varepsilon_\tau}\tau_v + \Psi_y \tau_m} = 20$$

Yetaklovchi val.

Valni materiali – st-45

Termik ishlov berish normallashgan. $\sigma_b = 690 \frac{N}{mm^2}$

$$\sigma_\tau = 340 \qquad\qquad B_\beta = 200$$

Chidamlilik chegaralari.

$$\sigma_{-1} = 0.43 \cdot 690 = 296.7 \frac{N}{mm^2} \qquad \tau_{-1} = 0.58 \cdot 296.7 = 172 \frac{N}{mm^2}$$

Kesim A − A. Shponka o'rni evaziga qo'llanishlar konsentratsiyasi hosil bo'ladi.

Burovchi moment $M_{k_2} = 858 \cdot 10^3 Nmm$

Gorizontal tekislikdagi eguvchi moment.
$$M = R_{x3} \cdot l_2 = -2553 \cdot 82 = 209 \cdot 10^3 Nmm$$

Vertikal tekislikdagi eguvchi moment.
$$M^u = R_{y3} \cdot l_3 + F_a \cdot \frac{d_2}{2} = 625.2 \cdot 10^3 Nmm$$

$$M_A = \sqrt{(209 \cdot 10^3)^2 + (625 \cdot 10^3)^2} = \sqrt{43681 + 390625} = \sqrt{434306}$$
$$= 659 \cdot 10^3$$

buralishda qarshilik momenti

$$W_{netta} = \frac{\pi d^3}{16} - \frac{bt_1(d-t_1)^2}{2d} = 64 \cdot 10^3 mm$$

Urinma kuchlanish amplitudasi va o'rtacha qiymati.
$$\tau_V = \tau_m = \frac{M_{k2}}{2W_{netta}} = \frac{858}{128} = 6.7 \frac{N}{mm^2}$$

$$W_{netta} = \frac{\pi d^3}{32} - \frac{bt_1(d-t_1)^2}{2d} = \frac{3.14 \cdot 10^3}{32} - \frac{128 \cdot 62^2}{140} = 30 \cdot 10^3 mm^2$$

$$\sigma_V = \frac{M_A}{W_{netta}} = \frac{693 \cdot 10^3}{30 \cdot 10^3} = 23.1 \frac{N}{mm^2}$$

Normal kuchlanish bo'yicha mustahkamlikka extiyotlik koeffitsiyenti.

$$n_\tau = \frac{\sigma_{-1}}{\frac{k_\sigma}{\varepsilon_\sigma} \sigma_v + \Psi_\sigma \cdot \tau_V} = \frac{172}{\frac{1.69}{0.61} 6.7 + 0.1 \cdot 6.7} = 8.9$$

Umumiy ehtiyotlik koeffitsiyenti
$$n = \frac{n_{\sigma + n_\tau}}{\sqrt{n_\sigma{}^2 + n_\tau^2}} = 4.4$$

Kesim $k - K$

Tig'iz o'rnatilgan podshebnik evaziga kuchlanishlar konsentratsiyasi hosil bo'ladi.
$$M_U = 16118 \cdot 82 = 1321 \cdot 10^3 Nmm$$

Qarshilik momenti

$$W = \frac{\pi d^3}{32} = \frac{3.14 \cdot (70)^3}{32} = 33.7 \cdot 10^3 mm^3$$

$W_p = 2W$ urinma kuchlanish amplitudasi va o'rtacha qiymati.

$$\tau_V = \tau_m = \frac{M_{k2}}{2W_{netta}} = \frac{858 \cdot 10^3}{67.4 \cdot 2 \cdot 10^3} = 6.3 \frac{N}{mm^2}$$

Normal kuchlanish bo'yicha mustahkamlik ehtiyotlik koeffitsiyenti

$$\sigma = \frac{\sigma_{-1}}{\frac{k_\sigma}{\varepsilon_\sigma} C_V} = \frac{297}{3.40 \cdot 20} = 4.37$$

Urinma kuchlanish bo'yicha ehtiyotlik koeffitsiyenti.

$$n_\tau = \frac{\tau_{-1}}{\frac{k_\tau}{\varepsilon_\tau} \cdot \tau_v + \Psi_\tau \cdot \tau_V} = \frac{172}{2.58 \cdot 7.4 + 0.1 \cdot 7.4} = \frac{172}{19.84} = 8.67$$

Umumiy ehtiyotlik koeffitsiyenti.

$$n = \frac{n_{\sigma+n_\tau}}{\sqrt{n_\sigma^2 + n_\tau^2}} = \frac{4.37 \cdot 8.67}{\sqrt{4.37^2 + 8.67^2}} = \frac{37.9}{9.7} = 3.9$$

$Kesim\ L - L.$ Val pog'onasining diametrlari har xil bo'lishi evaziga kuchlanishlar konstruksiyasi hosil bo'ladi.

$$\frac{D}{d} = \frac{65}{60} = 1.08 \qquad \frac{V}{a} = \frac{2.5}{60} = 0.042$$

Koeffitsiyentlar. $k_\sigma = 1.69, \quad k_\tau = 1.24, \quad \varepsilon_\sigma = \varepsilon_\tau = 0.67$

Qarshilik momenti W=27·10³

Normal kuchlanish amplitudasi.

$$\sigma_V = \frac{420 \cdot 10^3}{27 \cdot 10^3} = 15.6 \frac{N}{mm^2}$$

Urinma kuchlanish amplitudasi.

$$\tau_V = \tau_m = \frac{858 \cdot 10^3}{2 \cdot 33 \cdot 10^3} = 13 \frac{N}{mm^2}$$

Ehtiyotlik koeffitsiyenti

$$n_\tau = \frac{\tau_{-1}}{\frac{k_\tau}{\varepsilon_\tau} \cdot \tau_v} = \frac{297}{\frac{1.69}{0.79} \cdot 20} = \frac{297}{43} = 6.9$$

$$n_\tau = \cfrac{\tau_{-1}}{\cfrac{k_\tau}{\varepsilon_\tau}\sigma_v + \Psi_\sigma \cdot \tau_m} = \cfrac{172}{\cfrac{1.24}{0.07}\cdot 6.3 + 0.1\cdot 6.3} = \frac{172}{12.33} = 14$$

Umumiy ehtiyotlik koeffitsiyenti

$$n = \cfrac{n_{\sigma + n_\tau}}{\sqrt{n_\sigma{}^2 + n_\tau^2}} = \cfrac{6.9 \cdot 14}{\sqrt{6.9^2 + 147^2}} = \frac{96.4}{15.6} = 6.2$$

Kesim $B - B$ shponka o'rni evaziga kuchlanishlar konsentratsiyasi hosil bo'ladi.

$$k_\tau = 1.69 \quad va \quad k_\tau = 1.49 \qquad \varepsilon_\sigma = \varepsilon_\tau = 0.79$$

Eguvchi moment

$$M_{B-B} = 161118 \cdot 60 = 916 \cdot 10^3$$

Qarshilik momenti.

B=18   t=11mm   d=60

$$W_{netto} = \frac{3.14 \cdot 60^3}{32} = 15451 = 15 \cdot 10^3 mm^3$$

Normal amplitudasi.

$$\sigma_V = M_{B-B} = \frac{916 \cdot 10^3}{15 \cdot 10^3} = 61\frac{N}{mm^2}$$

Buralishga qarshilik momenti .

$$W_{knetto} = \frac{3.14 \cdot 60^3}{16} = 40.3 \cdot 10^3 mm^3$$

Urinma kuchlanish amplitudasi.

$$\tau_V = \tau_m = \frac{858 \cdot 10^3}{2 \cdot 40.3 \cdot 10^3} = \frac{858}{80.6} = 10.65$$

Ehtiyotlik koeffitsiyentlari.

$$n_\sigma = \cfrac{297}{\cfrac{1.63}{0.79}\cdot 21.1} = \frac{297}{28.2} = 10.5 \approx 10$$

$$n_\tau = \cfrac{172}{\cfrac{1.49}{0.79}\cdot 10.65 + 0.1\cdot 10.65} = \frac{172}{21.2} = 8.11$$

Umumiy ehtiyotlik koeffitsiyenti.

$$n = \frac{10 \cdot 8.1}{\sqrt{10^2 + 8.1^2}} = \frac{81}{12.9} = 6.3$$

Shponkani birikmalarni mustahkamligini hisoblash.

Shponka materiali po'lat 40.

Egilishga mustahkamlik sharti.

$$\sigma_{e3} = \frac{2}{d(l - t_1)(l - b)} \leq [\sigma_{e3}]$$

Po'lat stupitsani ezishga ruxsat etilgan kuchlanish. $[\sigma_{e3}] = 100 \div 120$ va

cho'yan stupitsiya uchun $[\sigma_{e3}] = 50 \div 70$

$$\sigma_{e3} = \frac{2 \cdot 858 \cdot 10^3}{70(18 - 11)(82 - 18)} = \frac{1716 \cdot 10^3}{31360} = 54.7$$

Yetaklovchi val.

d=48, $b \cdot L = 18 \cdot 11$ $t_1 = 6$

shponkani uzunligi l=82mm va valdagi moment.

$$M_1 = 143 \cdot 10^3 \, Nmm$$

$$\sigma_{e3} = \frac{2 \cdot 143 \cdot 10^3}{48(18 - 6)(82 - 18)} = \frac{286 \cdot 10^3}{36846} = 7.76$$

Moy turini tanlash.

Moy reduktor korpusiga qo'yiladi. Moy sathi tishli g'ildirakning tupigacha bo'lishi kerak, yoki 0.25 N_{TE} orqali aniqlasak ham bo'ladi. – tezlik bilan $V = 60 \cdot 10^{-6} \, \frac{m^2}{s}$ bo'lganda $J = 70A$ moyni tanlaymiz. Podshibniklarga esa - US-2 solidolni tanlaymiz.

XULOSA

Xulosa qilib shuni takidlash mumkinki, silindr tishli uzatmalar mavzusini loyihalayotganda eng avvalo berilgan yuritmani loyihalashda elektr dvigatel tanlaymiz. Shu tariqa quvvatni, burchak tezliklarini ishlash muddatini, aylanishlar soni hisoblanib olinadi.

So'ngra mustahkamlikni tekshiramiz.

Silindrik uzatmalar sanoatda, kundalik hayotda korxona va zavodlarda, transport vositalarida,avtomobillarda ya'niu ma'lum burchak ostida harakatlarni uzatib berishda uzatmalar qo'llaniladi.

Silindrik uzatmalar ish unumdorligini oshiradi va quvvati yuqori bo'ladi.

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