

**O`ZBEKISTON RESPUBLIKASI OLIY VA O`RTA
MAXSUS TA'LIM VAZIRLIGI**

ANDIJON MASHINASOZLIK INSTITUTI

“MASHINASOZLIK” FAKULTETI

«Yer usti transport tizimlari » kafedrası

KURS ISHI

Mavzu: Avtomobillarni yig'ish uchun plitali konveyer yuritmasini loyixalash

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Andijon 2015

MAVZU: AVTOMOBILLARNI YIG'ISH UCHUN PLITALI KONVEYER YURITMASINI LOYIHALASH.

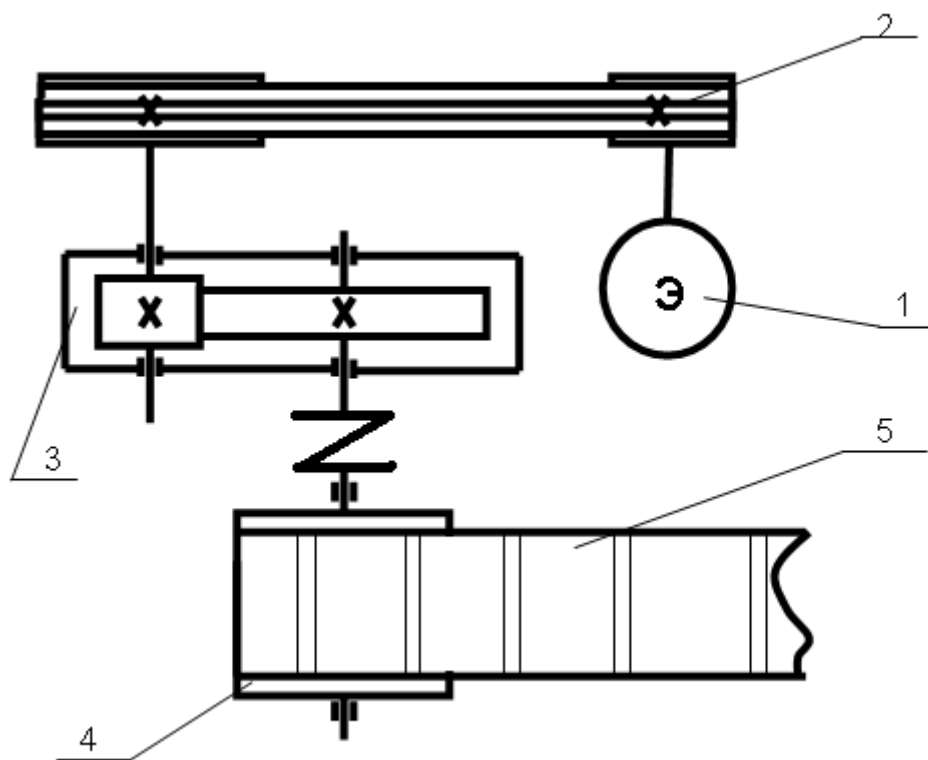
Berilgan:

Reduktor yetaklanuvchivalidagiquvvat

$$P_3 = 7,5 \text{ kv}t$$

Shu valning burchak tezligi

$$\omega_3 = 2,7\pi = 8,5 \text{ rad / sek}$$



- 1-elektrodvigatel
- 2-ponasimon tasmaliuzatma
- 3-reduktor
- 4-baraban
- 5-plitalilenta

1-rasm. Yuritmaxemasi

I. ELEKTRODVIGATEL TANLASH VA KINEMATIK HISOBLASH.

1.Yuritma uchun F.I.K. aniqlash.

Kinematik sxemaga binoan, uzatmalar uchun F.I.K. tanlaymiz (1-jadval).

Tasmaliuzatma F.I.K. $\eta_1 = 0,96$

Tishliuzatma F.I.K. $\eta_2 = 0,97$

Birjuftpodshipnik uchun F.I.K $\eta_3 = 0,99$

Yuritma uchun F.I.K. quyidagicha topiladi:

$$\eta_{um} = \eta_1 \cdot \eta_2 \cdot \eta_3^3 = 0,96 \cdot 0,97 \cdot 0,99^3 \approx 0,9$$

2.Talab etilgan quvvatni topish.

Elektrodvigatel uchun talab etilgan quvvat:

$$P_T = \frac{P_3}{\eta_{um}} = \frac{7,5}{0,9} \approx 8,3 \text{ kvT}$$

3.Elektrodvigatel tanlash.

Talab etilgan quvvat bo'yicha 4A 160M8 markali elektrodvigatel tanlaymiz. Elektrodvigatel quvvati $P=11$ kBr, sinxron aylanishlar soni $n_c=1000$ ayl/min, sirpanish koeffitsienti $S=2.7\%$.

4.Elektrodvigatel valining haqiqiy aylanishlari sonini topamiz:

$$n_{dv} = n_1 = n_c \left(1 - \frac{s\%}{100\%}\right) = 1000 \left(1 - \frac{2,7\%}{100\%}\right) = 973 \text{ ayl/min}$$

5.Yuritmaning uzatish sonini topamiz:

$$U = \frac{n_1}{n_3} = 973/81 \approx 12,01$$

$$\text{Buyerda, } n_3 = \frac{30\omega_3}{\pi} = \frac{30 \cdot 2,7\pi}{\pi} = 81 \text{ ayl/min}$$

6.Yuritma uzatish sonini uzatmalarga taqsimlash.

Yuritma uzatish soni quyidagicha topiladi:

$$U = U_1 \cdot U_2 = \frac{n_1}{n_2} = 12,01$$

Bu yerda, U_1 -tasmaliuzatmauzatishsoni

U_2 -reduktorninguzatishsoni

Qabulqilamiz: $U_1=3$ (2-jadval)

U holda, $U_2 = U / U_1 = 12,01/3 = 4,004$

Qabulqilamiz: $U_2=4$ (5.1-jadval)

Farqni hisoblaymiz:

$$\Delta U = \frac{4,004 - 4}{4} 100\% = 0,05\% \leq 3\%$$

Sart bajariladi.

Shundayqilib: $U_1=3$, $U_2=4$

7.Vallarning aylanishlari sonini topamiz:

$$n^1 = n^{dv} = 973 \text{ ayl/min}$$

$$n^2 = \frac{n_1}{u_1} = \frac{973}{3} = 324 \text{ ayl/min}$$

$$n^3 = \frac{n_2}{u_2} = \frac{324}{4} = 81 \text{ ayl/min}$$

8.Vallarning burchak tezliklari:

$$\omega_1 = \frac{\pi n_1}{30} = \frac{3,14 \cdot 973}{30} = 101,84 \text{ rad/sek}$$

$$\omega_2 = \frac{\pi n_2}{30} = \frac{3,14 \cdot 324}{30} = 33,91 \text{ rad/sek}$$

$$\omega_{31} = \frac{\pi n_3}{30} = \frac{3,14 \cdot 81}{30} = 8,48 \text{ rad/sek}$$

9. Vallardagiburovchimomentlarnitopamiz:

$$T_1 = \frac{P_T}{\omega_1} = \frac{8,3}{101,84} = 0,08 \text{ kN}\cdot\text{m}$$

$$T_2 = T_1 * U_1 = 0,08 * 3 = 0,24 \text{ kN}\cdot\text{m}$$

$$T_3 = T_2 * U_2 = 0,24 * 4 = 0,96 \text{ kN}\cdot\text{m}$$

II. TASMALI UZATMA HISOBI.

1.Yetaklovchi shkivaylanishlarisoniyuqoridanma'lum
 $n_1=973\text{ayl/min}$

2.Ponasimontasmako`ndalangkesiminitanlaymiz(46-jadval)

Nomagrammaga binoan B tipli tasmali tanlaymiz .

15-jadvalga binoan esa

$$A=138\text{mm}^2, \quad T_0=10,5\text{mm}$$

3.Avvalgi hisoblashlardan ma'lumki, yetaklovchi
shkivdagi burovchi moment quydagiga teng

$$T_1=0,08\text{kN}\cdot\text{m}=80\text{N}\cdot\text{m}$$

4.Yetklovchi shkiv diametrini topamiz:

$$d_1 \approx (3 \div 4) \cdot \sqrt[3]{T_1} = (3 \div 4) \sqrt[3]{80 \cdot 10^3} = 129 \div 172 \text{ mm}$$

Qabulqilamiz: $d_1=160 \text{ mm}$ (46-jadval)

5. Yetklovchi shkiv diametrini topamiz:

$$d_2 = d_1 \cdot U_1 \cdot (1 - \epsilon) = 160 \cdot 3 \cdot (1 - 0,02) = 470,4 \text{ mm}$$

Qabul qilamiz: $d_2=450 \text{ mm}$

6.tasmali uzatmani uzatish sonini xaqiqiy qiymatini topamiz:

$$U = \frac{d_2}{(d_1 \cdot (1 - \epsilon))} = \frac{450}{160(1 - 0,02)} = 2,87$$

7.Tasmali uzatmani xaqiqiy va xisobiy uzatishlar soni orasidagi farqni
xisoblaymiz:

$$\Delta U = \frac{3 - 2,87}{3} \cdot 100\% = 4,3\%$$

$$\Delta U \leq 5\%$$

Demak shart bajariladi. Shuning uchun

$$U_1=2,87 \quad D_1=160\text{mm} \quad D_2=450\text{mm}$$

8.O`qlar aro masofani topamiz:

$$a_{\min}=0,55(d_1+d_2)+T_0=0,55(160+450)+10,5=170 \text{ mm}$$

$$a_{\max}=d_1+d_2=160+450=610 \text{ mm} \quad \text{o`rtacha qiymat}$$

$$a_{o`r}=(a_{\max}+a_{\min})/2=390 \text{ mm}$$

$$\text{qabul qilamiz} \quad a_{o`r}=400\text{mm}$$

9.Tasmali uzatmani topamiz:

$$L=2a_{o`r}+0,5\pi(d_1+d_2)+\frac{(d_2-d_1)^2}{4a_{o`r}}=2\cdot 400+0,5\cdot 3,14(160+450)+\frac{(450-160)^2}{4\cdot 400}=1810,26\text{mm}$$

$$\text{qabul qilamiz } L=1800\text{mm (46-jadval)}$$

10.O`qlar aro masofani aniq o`lchamini topamiz:

$$a=0,25\left((L-W)+\sqrt{(L-W)^2-2y}\right)$$

$$\text{bu yerda } W=0,5\pi(d_1+d_2)=957,7$$

$$y=(d_1+d_2)^2=(450-160)^2=84100$$

$$a=0,25\left((L-W)+\sqrt{(L-W)^2-2y}\right)=394,5 \text{ mm}$$

Tasmani qo`shish va almashtirishda a 2% ga qisqartiriladi, ishlash jarayonida tasma cho`zilishi evaziga a 5,5% ga uzayishi mumkun.

$$\text{Qisqarish } 0,02\cdot 400=8\text{mm}$$

$$\text{Uzayish } 0,055\cdot 400=2,0\text{mm}$$

11.Yetaklovchishkivqamrovburchaginitopamiz:

$$\alpha_1^0=180^0-57^0\cdot\frac{d_2-d_1}{a}=180^0-57^0\cdot(450-160)/400=139^0$$

12. Tasma tezligini topamiz:

$$v = \frac{d_1}{2} \omega_1 \approx 8,15 \text{ m/s}$$

13. Tasmalar sonini topamiz:

$$Z = (P \cdot C_P) / (P_0 \cdot C_L \cdot C_\alpha \cdot C_Z) = 8,3 \cdot 1 / (1,8 \cdot 0,98 \cdot 0,89 \cdot 0,95) = 5,6$$

Qabul qilamiz $z=6$ ta

Bu yerda jadvaldan

$$C_P = 1,0 \quad C_L = 0,98$$

$$P_0 = 1,8 \quad C_\alpha = 0,89 \quad C_Z = 0,95$$

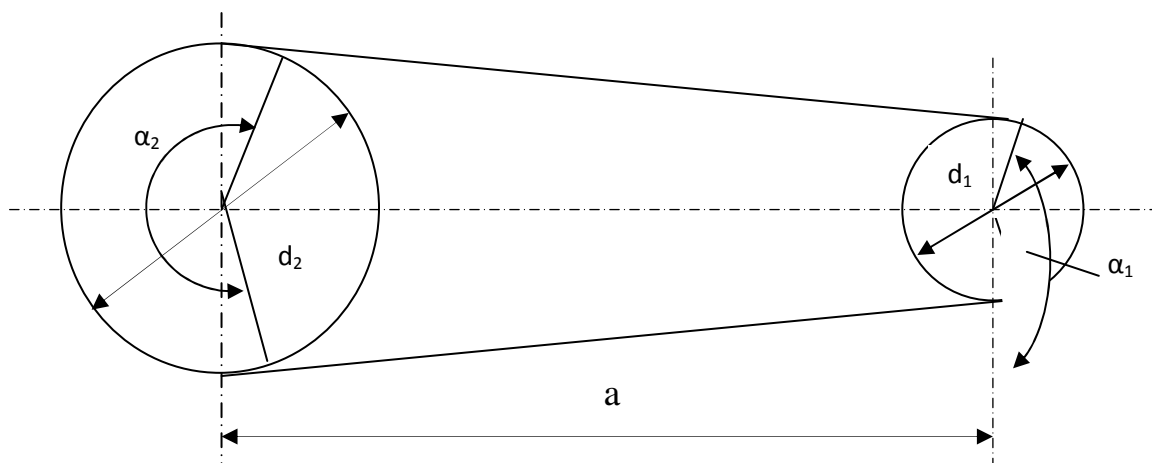
14. Tasma tarmog` taranglik kuchini topamiz:

$$F_0 = 850 P C_P C_L / (Z \cdot v C_L) + \theta \cdot v^2 = 156,75 \text{ N}$$

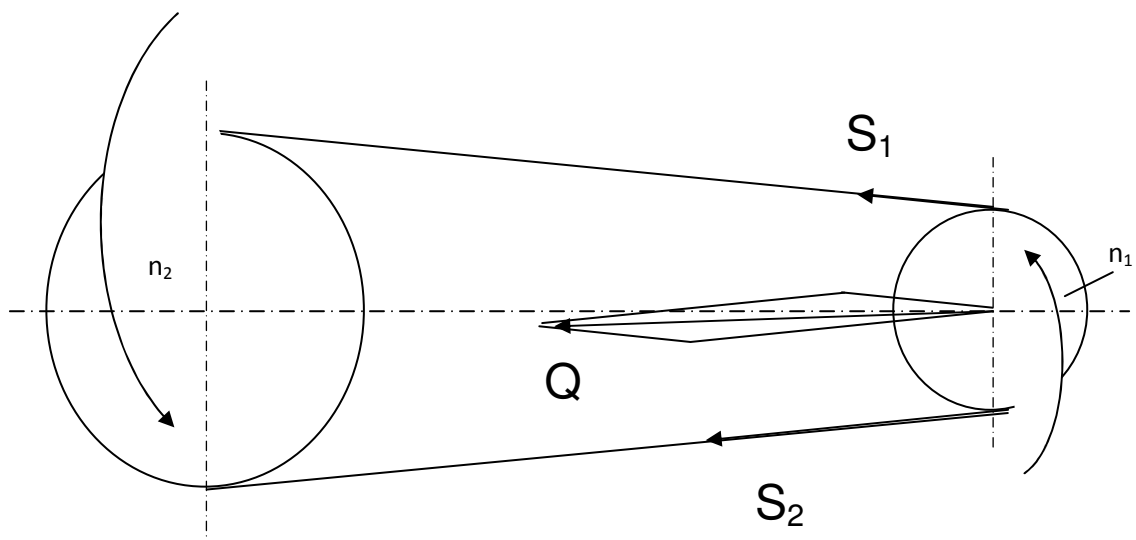
bu yerda $\theta = 0,18$

15. Valga tasir etuvchi kuchni topamiz:

$$F_B = 2 \cdot F_0 \cdot z \cdot \sin(\alpha_1/2) = 2 \cdot 156,75 \cdot 6 \cdot \sin 69,5^\circ = 2 \cdot 156,75 \cdot 0,90 \cdot 6 = 1693 \text{ N}$$



2 – rasm. Tasmaliuzatmaning kinematik sxemasi



3 – rasm. Tasmali uzatmada xosil bo`ladigan kuchlar.

III. REDUKTOR HISOBI

Oldingi hisoblardan ma'lumki, vaiiarning aylanishlar soni:

$$n_1 = n_{dv} = 973 \text{ ayl / min}$$

$$n_2 = 324 \text{ ayl / min}$$

$$n_3 = 81 \text{ ayl / min}$$

Burchak tezliklar:

$$\omega_1 = \omega_{dv} = 101,84 \text{ rad / s}$$

$$\omega_2 = 33,91 \text{ rad / s}$$

$$\omega_3 = \omega_{\sigma} = 8,48 \text{ rad / s}$$

Burovchi momentlar:

$$T_1 = 80N \cdot m$$

$$T_2 = 240N \cdot m$$

$$T_3 = 960N \cdot m$$

1. Material tanlash:

O`rtacha mexanik harakteristikali material tanlaymiz.

Shesternya uchun St 45, termik ishlash-yaxshilash qattiqligi HB 230.

Tishli g`ildirak uchun St 45, termik ishlash-yaxshilash qattiqligi HB 200.

2. Ruxsat etilgan kuchlanish.

Ruxsat etilgan kontakt kuchlanish quyidagicha topiladi:

$$[\sigma]_H = \sigma_{H \lim b} = K_{HL} / [n]_H$$

bu erda, $\sigma_{H \lim b}$ - tsiklning bazaviy sonidagi kontakt kuchlanish. Qattiqligi < HB 350, termik ishlanadigan po`lat uchun:

$$\sigma_{H \lim b} = 2HB + 70 \quad (4\text{-jadval})$$

K_{HL} - ishda ishonchlilik koeffitsienti. Uzoq vaqt ishlashda

$$K_{HL=1,0}$$

$[n]_H$ - xavfsizlik koeffitsienti. Normallashtirilgan va yaxshilangan po`lat materiallaridan tayyorlangan tishli g`ildiraklar uchun:

$$[n]_H = 1,1 \dots 1,2$$

Qoʻrtacha qiymatni qabul qilamiz $[n]_H = 1,15$. Tishli gʻildirak uchun ruxsat etilgan kuchlanishni topamiz:

$$[\sigma]_H = (2 \cdot 200 + 70) \cdot 1/1,15 = 408,7 \text{ N} \cdot \text{mm}^2$$

3. Oʻqlararo masofani topamiz:

$$a_w = (U_2 + 1)^3 \sqrt{\left(\frac{270}{[\sigma]_H}\right)^2 \cdot \frac{T_3 \cdot K_{H\beta}}{U_2^2 \cdot \Psi_{\epsilon\alpha}}}$$

bu erda,

$K_{H\beta}$ - yuklamakoeffitsienti.

$\Psi_{\epsilon\alpha}$ - Tishli gʻildirakni koeffitsienti $\Psi_{\epsilon\alpha} = 0,4$

$U_2 = 4$

$$[\sigma]_H = 408 \text{ N} \cdot \text{mm}^2; \quad T_3 = 960 \text{ N} \cdot \text{m} = 960 \cdot 10^3 \text{ N} \cdot \text{mm}, \quad K_{H\beta} = 1,25$$

Bu erda $K_{H\beta}$, yuklamakoeffitsienti. Gʻildirakning tayanchlarga nisbatan simmetrik joylashuviga qaramasdan tavsiya qilingandan kattaroq qiymat olingan. Sababi tasmasli uzatmadan ta'sir qiluvchi kuchlar yetaklanuvchi valning qo'shimcha deformatsiyasiga sabab bhladi, bu esa tishlarni o'zaro tegishini yomonlashtiradi.

$$a_w = (4 + 1)^3 \sqrt{\left(\frac{270}{408}\right)^2 \cdot \frac{960 \cdot 10^3 \cdot 1,25}{4^2 \cdot 0,4}} \approx 217 \text{ mm}$$

Yaqin standart qiymat 224 mm. (5.1-jadval)

Qabul qilamiz: $a_w = 224 \text{ mm}$.

4. Ilashmaning normal modulini topish .

$$m_n = (0,01 \dots 0,02) a_w = (0,01 \dots 0,02) \cdot 224 = 2,24 \dots 4,48 \text{ mm}$$

Qabul qilamiz: $m_n = 4 \text{ mm}$ (5.1-jadval)

Tishlarning umumiy sonini topish

$$Z_{\Sigma} = 2a_{\omega} \cos \beta / m_n$$

bu erda, β – tishlarning qiyalik burchagi. Qiyatishlig`ildirakuchun  $\beta = 8 \dots 15^\circ$  oraliqdabo`ladi.

Qabul qilamiz: $\beta = 10^\circ$

$$Z_{\Sigma} = 2 \cdot 224 \cos 10^\circ / 4 = 2 \cdot 224 \cdot 0,9848 / 4 = 109.76$$

Qabul qilamiz: $Z_{\Sigma} = 110_{\text{ta}}$

Shesternya uchun tishlar soni

$$Z_1 = \frac{Z_{\Sigma}}{U + 1} = \frac{Z_{\Sigma}}{i + 1} = \frac{110}{4 + 1} = 22$$

Qabul qilamiz: $Z_1 = 22_{\text{ta}}$,

Tishli g`ildiraklar uchun tishlar soni:

$$Z_2 = Z_{\Sigma} - Z_1 = 110 - 22 = 88_{\text{ta}}$$

6. Tishlarning qiyalik burchagini topamiz.

$$\cos \beta = \frac{(Z_1 + Z_2)m_n}{2a_{\omega}} = \frac{(22 + 88) \cdot 4}{2 \cdot 224} = 0.98$$

$$\beta = 10^\circ$$

7. Shesternya va tishli g`ildirakning asosiy elementlari

a) Bo`luvchi aylana diametrlari:

$$d_1 = m_n \cdot Z_1 / \cos \beta = 4 \cdot 22 / 0.98 = 89.8 \text{ mm}$$

$$d_2 = m_n \cdot Z_2 / \cos 10^\circ = 4 \cdot 98 / 0.98 = 359.2 \text{ mm}$$

Tekshirish:

$$a_{\omega} = (d_1 + d_2) / 2 = (89,8 + 359,2) / 2 = 224,5 \text{ mm}$$

b). Tish ustidan o'tuvchi aylana diametrlari.

$$d_{a_1} = d_1 + 2m_n = 89,8 + 2 \cdot 4 = 97,8 \text{ mm}$$

$$d_{a_2} = d_2 + 2m_n = 359,2 + 2 \cdot 4 = 367,2 \text{ mm}$$

c) Tishostidano'tuvchi aylana diametrlari:

$$d_{f1} = d_1 - 2,5m_n = 89,8 - 2,5 \cdot 4 = 89,8 \text{ mm}$$

$$d_{f2} = d_2 - 2,5m_n = 359,2 - 2,5 \cdot 4 = 369,2 \text{ mm}$$

d) Tishli g'ildirak eni

$$b_2 = \psi_{ba} a_{\omega} = 0,4 \cdot 224,5 = 89,8 \text{ mm}$$

Shesternya eni

$$b_1 = 89,8 + 5 = 94,8 \text{ mm}$$

8. Tishli g'ildirak aylanma tezligini topi shva uzatmaning aniqlik darajasi

$$v = \omega_1 d_1 / 2 = \frac{101,84 \cdot 89,8}{2 \cdot 10^3} = 4,57 \text{ m/s}$$

Bu tezlik uchun 8 sinf aniqlik darajasi qabul qilinadi.

9. Yuklama koeffitsientini aniqligi

$$K_H = K_{H\beta} \cdot K_{H\alpha} \cdot K_{Hv}$$

$$\Psi_{ba} = 1,03 \quad K_{H\beta} = 1,11 \quad K_{H\alpha} = 1,09 \quad K_{Hv} = 1,0$$

bu erda

$$K_{H\beta} -$$

tishlig'ildiraklarning enibo'yichakuchlarnitekistaqsimlanmasligini hisobga oluvchi koeffitsient;

$K_{H\alpha}$ – Kuchlarnitishlararotekistaqsimlanmasliginihisobgaoluvchikoeffitsient;

$K_{H\nu}$ – dinamikkoeffitsient.

$$K_H = 1,11 \cdot 1,09 \cdot 1,0 = 1,21$$

10. Kontakt kuchlanishini topamiz:

$$\sigma_H = \frac{270}{a_\omega} \sqrt{\frac{K_H \cdot T_3 (U_2 + 1)^3}{b_2 U_2^2}},$$

$$\sigma_H = \frac{270}{224} \sqrt{\frac{1,21 \cdot 960 \cdot 10^3 (4 + 1)^3}{89,6 \cdot 4^2}} = 382 \text{ N/mm}^2$$

$$382 < 408 \text{ N/mm}^2$$

11. Ilashmaga ta'sir etuvchi kuchlar:

Aylanma kuch,

$$F_t = 2T_2/d_1$$

$$F_t = \frac{2 \cdot 240 \cdot 10^3}{89 \cdot 8} = 5345 \text{ N}$$

Radial kuch

$$F_z = F_t \cdot \frac{\tan \alpha}{\cos \beta} = 5345 \frac{\tan 20^\circ}{\cos 10^\circ} = 19635 \text{ N}$$

O`q bo`ylab yo`nalgan kuch

$$F_a = F_t \cdot \tan \beta = 5345 \cdot \tan 10^\circ = 971 \text{ N}$$

12. Tishlarni egilish kuchlanishi bo'yicha mustaxkamlikka hisobi .

$$\sigma_F = \frac{F_t K_F \cdot Y_F \cdot Y_\beta \cdot K_{F\alpha}}{b_1 m_n} \leq [\sigma]_F$$

Bu erda yuklama koefitsienti

$$K_F = K_{F\beta} \cdot K_{F\vartheta}$$

bu erda

Y_F -ekvivalenttishlarsonigabog'liq koefitsient,

Y_β - yaxlitlarnikompetsatsiyalovchi koefitsient

$K_{K\beta}$ - tishlararokuchlarni tekis taqsimlanmasligini hisobga oluvchi koefitsient,

β –tishlarni qiyalik burchagi.

Jadvaldan

$$K_{F\beta} = 1,23 \quad K_{F\vartheta} = 1,3$$

uxolda ,
$$K_F = 1,23 \cdot 1,3 = 1,6$$

Ekvivalenttishlarsoni Z_{ϑ} shesternyauchun

$$Z_{\vartheta 1} = \frac{Z_1}{\cos^3 \beta} = \frac{22}{\cos^3 10^0} \approx 23$$

Tishli g'ildirak uchun

$$Z_{\vartheta 2} \frac{Z_2}{\cos^3 \beta} = \frac{88}{\cos^3 10^0} \approx 94$$

Bunda
$$Y_{F1} = 3,87 \quad \text{va} \quad Y_{F2} = 3,6$$

$$Y_{\beta} = 1 - \frac{\beta}{140} = 1 - \frac{10}{140} = 0,928$$

$\varepsilon_a = 1,5$ va $F_{\alpha} = 0,75$ qiymatlar uchun ruxsat etilgan kuchlanishni topamiz

$$[\sigma]_F = \frac{\sigma_{F \lim b}^{\circ}}{[n]_F}$$

bu erda $\sigma_{F \lim b}^{\circ}$ chidamlilik chegarasi

$$\sigma_{F \lim b}^{\circ} = 1,8 \text{ HB.}$$

$[n]_F$ - mustaxkamlik zapas koeffitsienti.

$$[n]_F = [n]_F' \cdot [n]_F''$$

bu erda;

$[n]_F'$ - tishlig' ildirak material ixossalarini hisobga oluvchi koeffitsient,

$[n]_F''$ - tishlig' ildirak zagatovkasini olish usulini hisobga oluvchi koeffitsient.

$$[n]_F' = 1,75;$$

$$[n]_F'' = 1,0;$$

demak,
$$[n]_F = 1,75 \cdot 1,0 = 1,75$$

Ruxsat etilgan kuchlanish,

Shesternya uchun
$$[\sigma]_{F1} = \frac{1,8 \cdot 230}{1,75} = 237 \text{ n/mm}^2$$

Tishlig' ildirak uchun
$$[\sigma]_{F2} = \frac{1,8 \cdot 200}{1,75} = 206 \text{ n/mm}^2$$

Nisbatnitopamiz: $[\sigma]_F / Y_F$

$$237/3,87 = 61,2 \text{ } n/mm^2 \quad 206/3,6 = 57,5 \text{ } n/mm^2$$

Tishning mustaxkamligini tekshiramiz:

$$G_F = \frac{5345 \cdot 1,6 \cdot 3,87 \cdot 0,928 \cdot 0,75}{94,6 \cdot 4} = 60,87 \text{ } N/mm^2$$

$$60,87 < 237 \text{ } N/mm^2$$

Shunday qilib mustaxkamlik sharti bajariladi.

IV. VALLARNING TAXMINIY HISOBI

Yetaklovchi val

Yetaklovchi val uchi diametri quyidagicha topiladi:

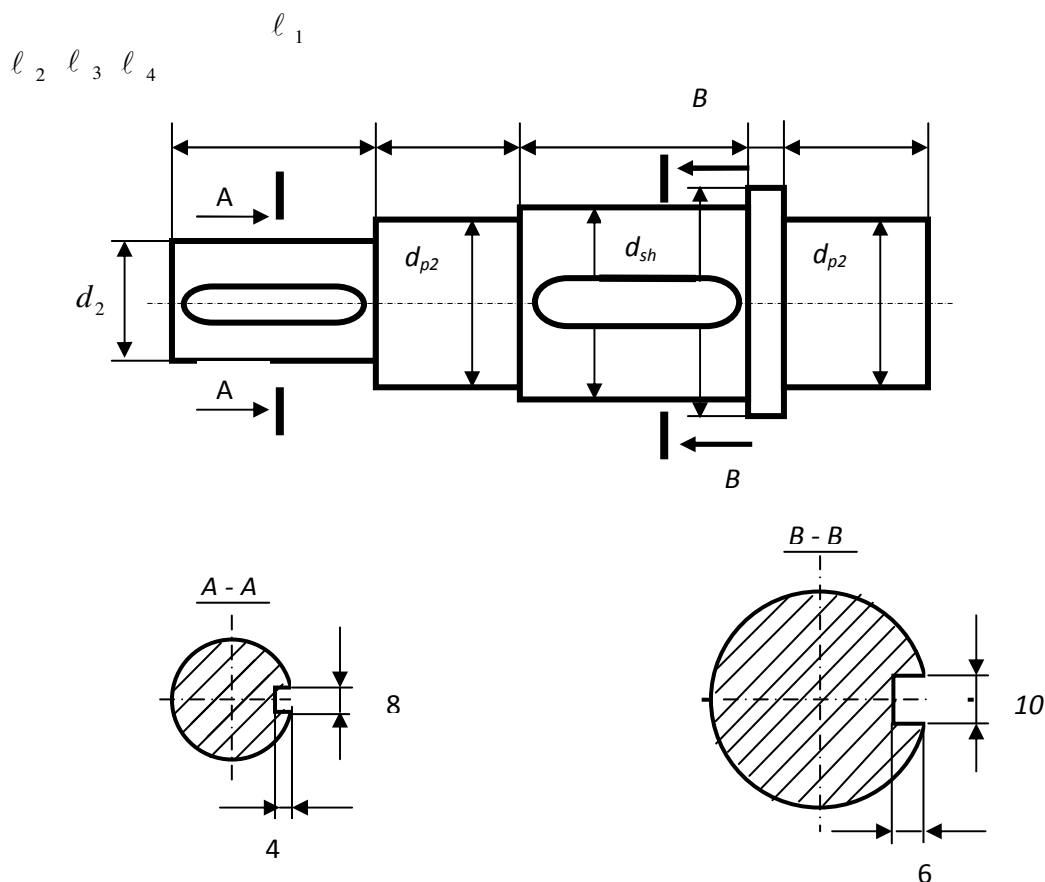
$$d_2 = \sqrt[3]{\frac{16 T_2}{\pi [\tau]_K}},$$

bu erda, $[\tau]_{kp}$ - buralishdagiruxsatetilgankuchlanish: 40-45 markalipo`latuchun ,

$$[\tau]_K = 25 \text{ } n/mm^2$$

$$d_2 = \sqrt[3]{\frac{16 T_2}{\pi [\tau]_K}} = \sqrt[3]{\frac{16 \cdot 240 \cdot 10^3}{3,14 \cdot 25}} = 36,6 \text{ } mm$$

Qabulqilamiz: $d_2 = 40 \text{ mm}$ shesternyaning ichki diametri $d_{sh} = 50 \text{ mm}$,
podshipnikostidiametri $d_{p2} = 45 \text{ mm}$



4 – rasm. Yetaklovchi val konstruktsiyasi

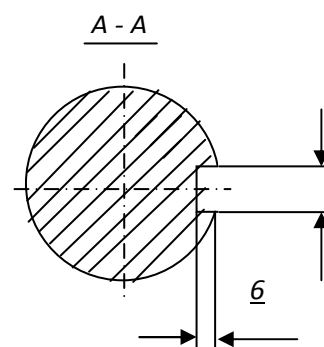
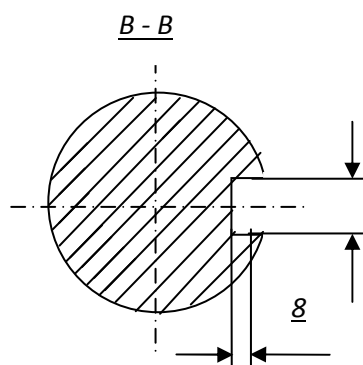
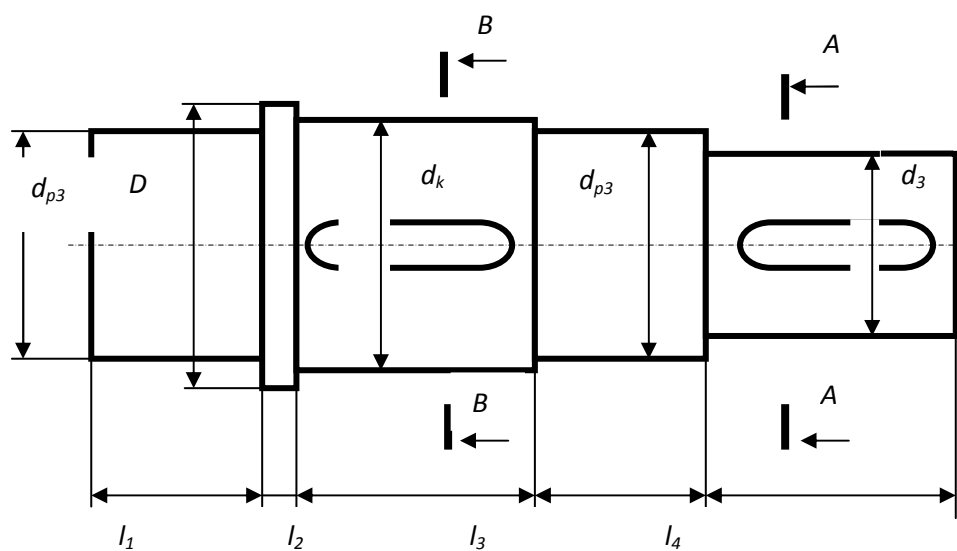
Yetaklanuvchi val

$$d_3 = \sqrt[3]{\frac{16 \cdot 960 \cdot 10^3}{3,14 \cdot 25}} = 58,1 \text{ mm}$$

Qabulqilamiz: $d_3 = 60 \text{ mm}$,

podshipnikuchundiametr $d_{p3} = 65 \text{ mm}$

Tishlig`ildirakichkidiametri: $d_K = 70 \text{ mm}$



5 – rasm. Yetaklanuvchival

V.

SHESTERNYAVATISHLIG`ILDIRAKKONSTRUKTIVO`LCHAMLARINIANI QLASH

1.Shesternyauchun.

Ma'lumki,

$$d_1 = 89.8 \text{ mm}, d_{a_1} = 97.8 \text{ mm}, d_{f_1} = 99.8 \text{ mm}, e_1 = 94.6 \text{ mm}, d_{sh} = 50 \text{ mm}$$

Gupchakdiametri

$$d_{st_1} = 1,6 \cdot d_{sh} = 1,6 \cdot 50 = 80 \text{ mm}$$

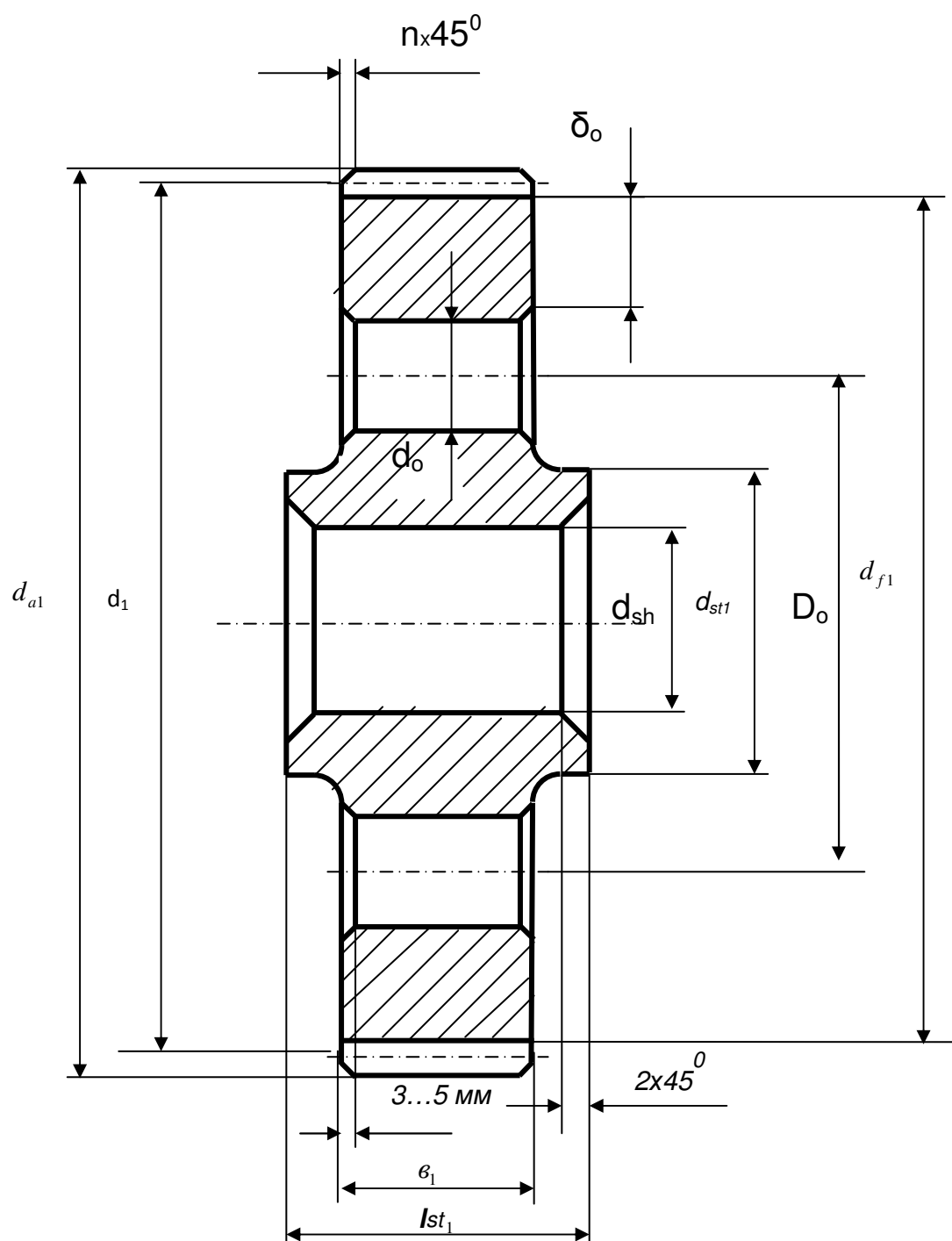
Gupchakuzunligi: $l_{st1} = (1.2 \dots 1.5) d_{sh} = 60 \dots 70 \text{ mm}$

Qabulqilamiz $l_{st1} = 65 \text{ mm}$

Obodaqalinligi:

$$\delta_{0_1} = (2,5 \dots 4) m = (2,5 \dots 4) \cdot 4 = 10 \dots 16 \text{ mm}$$

$$\delta_{0_1} = 14 \text{ mm}$$



6 – rasm. Shesternya

2. Tishlig`ildirakuchun.

Ma'lumki,

$$d_2 = 359,2 \text{ mm}, d_{a_2} = 367,2 \text{ mm}, d_{f_2} = 369,2 \text{ mm}, e_2 = 89,6 \text{ mm}, d_{sh} = 70 \text{ mm}.$$

Gupchak diametri,

$$d_{st_2} = 1,6 \cdot 70 = 112 \text{ mm}$$

Gupchak uzunligi

$$l_{st_2} = (1,2 \dots 1,5) \cdot 70 = 84 \dots 105 \text{ mm}$$

qabulqilamiz: $l_{st_2} = 100,0 \text{ mm}$

Obodaqalinligi $\delta_{0_2} = (2,5 \dots 4) \cdot 4 = 10 \dots 16 \text{ mm}$

qabul qilamiz

$$\delta_{0_2} = 12 \text{ mm}$$

VI. REDUKTOR KORPUSINI KONSTRUKTIV O`LCHAMLARI ANIQLASH

Korpus va qopqoq devori qalinligi.

$$\delta = 0,025 \cdot a_{\omega} + 1 = 0,025 \cdot 224 + 1 = 6,6 \text{ mm}$$

qabulqilamiz: $\delta = 7 \text{ mm}$

$$\delta_1 = 0,02 a_{\omega} + 1 = 0,02 \cdot 224 + 1 = 5,48 \text{ mm}$$

qabulqilamiz $\delta_1 = 6 \text{ mm}$

Korpus ustki belbog`i flanetsi qalinligi,

$$e = 1,5 \cdot \delta = 1,5 \cdot 7 = 10,5 \text{ mm}$$

qopqog belbog'i flanetsi qalinligi

$$e_1 = 1,5 \cdot \delta_1 = 1,5 \cdot 6 = 9 \text{ mm}$$

Korpus pastki belbog'i

$$P = 2,35 \cdot \delta = 2,35 \cdot 7 = 16,45 \text{ mm},$$

qabul qilamiz: $P = 17 \text{ mm}$.

Bolt diametrlari:

d_1 – fundamentga maxkamlovchi bolt diametri

$$d_1 = (0,03 \dots 0,036) a_w + 12 = (0,03 \dots 0,036) \cdot 224 + 12 = 18,72 \dots 20,064 \text{ mm},$$

qabul qilamiz: M20 – rezba.

Podshipnik qopqog'ini korpusga maxkamlovchi bolt diametri

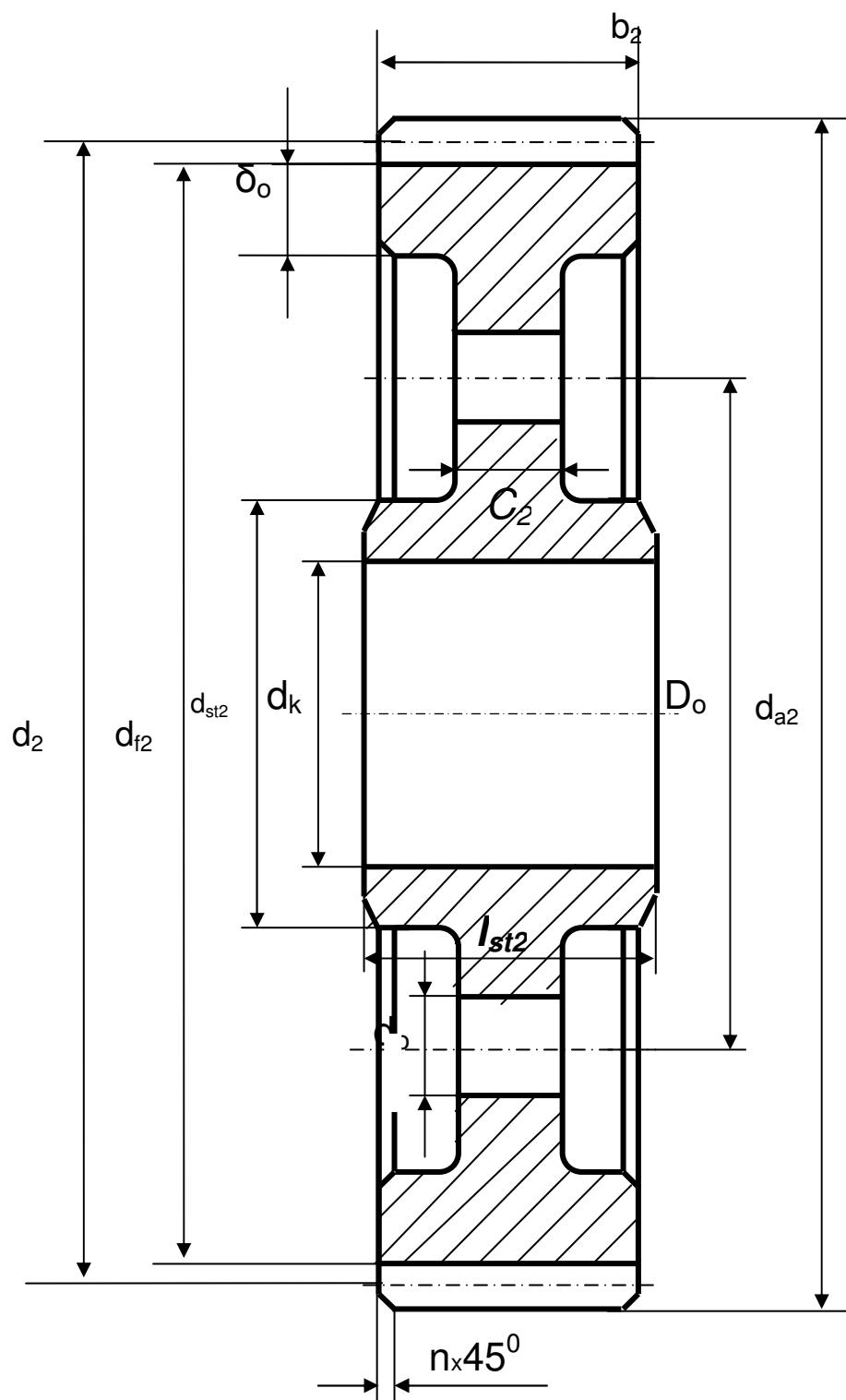
$$d_2 = (0,7 \dots 0,75) d_1 = (0,7 \dots 0,75) \cdot 20 = 14 \dots 15 \text{ mm},$$

qabul qilamiz: M16 – rezba.

qopqog'ini korpusga maxkamlovchi bolt diametri

$$d_3 = (0,5 \dots 0,6) d_1 = (0,5 \dots 0,6) \cdot 20 = 10 \dots 12 \text{ mm}.$$

qabul qilamiz: M12 – rezba.



6-rasm. Tishli g'ildirak

VII. KOMPONOVKANING BIRINCHI BOSQICHI.

Komponovka chizmasi reduktor qopqog'i olingan xolda vallarning geometrik

o'lchamlari bo'yicha qirqma bajariladi. O'qlararomasofa a_w o'lchangach, shesternya va tishli g'ildirak to'g'ri to'rtburchak shaklida tasvirlanadi. Korpus devorining ichki chizig'ini chizamiz.

1. Shesternya yon qirradi va korpus devori oralig'i.

$$A_1 = 1,2\delta = 1,2 \cdot 7 = 8,4 \text{ qabulqilamiz: } A_1 = 9 \text{ mm}$$

2. Tishli g'ildirak tish ustidan o'tuvchi aylana diametr iva korpus devori qalinligi orasidagi masofa $A = \delta$, qabulqilamiz: $A = 7 \text{ mm}$.

3. Etaklovchi va podshipnigita shqidi diametr iva korpus devori orasidagi masofa $A = \delta$.

Engil seriyadagi podshipniklarni val diametrlari bo'yicha $dn_1 = 50 \text{ mm}$ va $dn_2 = 75 \text{ mm}$ qabul qilamiz. Etaklovchi va etaklanuvchi vallar uchun N310 va N314 podshipnik qabul qilamiz.

4. Moylash turini tanlaymiz. Ilashma tishli g'ildirak moy vannasiga bosim bilan, podshipniklar esa moy sachrashi bilan moylanadi.

5. quyidagilarni topamiz:

$$l_1 = \frac{B_1}{2} + Y_1 + A_1 + \frac{b_1}{2} = \frac{27}{2} + 12 + 9 + \frac{94,6}{2} = 81,8 \text{ mm.}$$

$$l_2 = \frac{B_2}{2} + Y_2 + A_2 + \frac{b_2}{2} = \frac{35}{2} + 12 + 7 + \frac{89,6}{2} = 81,25 \text{ mm.}$$

qabul qilamiz: $l_1 = l_2 = 82 \text{ mm}$.

VIII. PODSHIPNIKNING ISH MUDDATINI HISOBLASH

Ma'lumki:

$$F_t = 5345 \text{ N}, \quad F_r = 1963,5 \text{ N}, \quad F_a = 971 \text{ N} \quad \text{hamda} \quad l_1 = l_2 = 82 \text{ mm}.$$

Yetaklovchi val.

XZ tekisligida tayanch reaksiya kuchlari:

$$R_{x1} = R_{x2} = \frac{F_t}{2} = \frac{5345}{2} = 2672,5 \text{ N}$$

YZ tekisligida:

$$R_{y1} = \frac{0,5(F_z l_1 + F_a \frac{d_1}{2})}{l_1} = \frac{0,5\left(1963,5 \cdot 82 + \frac{971 \cdot 89,8}{2}\right)}{82} = 1246,7 \text{ N} \quad R_{y1} = 1246,7 \text{ N}$$

$$R_{y2} = \frac{0,5(F_z \cdot l_2 - F_a \frac{d_1}{2})}{l_1} = \frac{0,5(1963,5 \cdot 82 - 971 \cdot \frac{89,8}{2})}{82} = 716,8 \text{ N} \quad R_{y2} = 716,8 \text{ N}$$

Tekshiramiz:

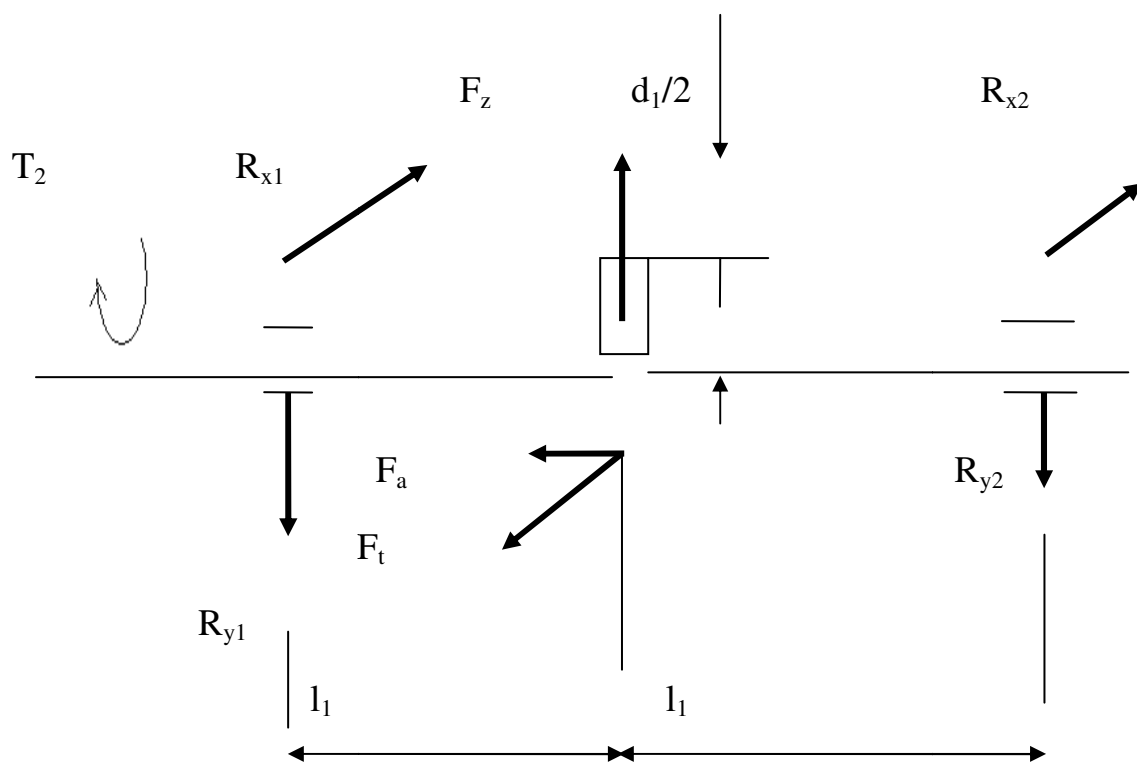
$$\sum \text{np.} Y = 0.$$

$$R_{y1} + R_{y2} - F_z = 1246,7 + 716,8 - 1963,5 = 0.$$

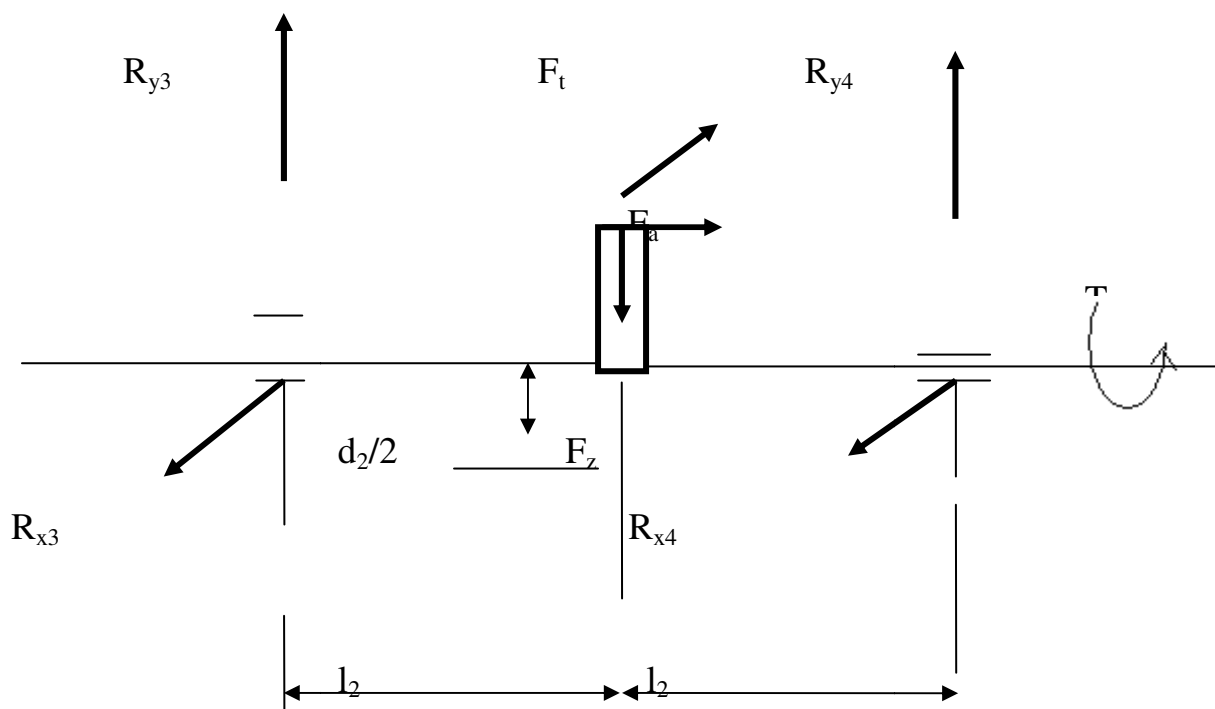
Umummiy reaksiya kuchlari:

$$F_{z1} = R_1 = \sqrt{R_{x1}^2 + R_{y1}^2} = \sqrt{2672,5^2 + 1246,7^2} = \sqrt{8696517} = 2949 \text{ N}$$

$$F_{z2} = R_2 = \sqrt{R_{x2}^2 + R_{y2}^2} = \sqrt{2672,5^2 + 716,8^2} = \sqrt{7656058,4} \approx 2767 \text{ N}$$



8 – rasm. Yetaklovchi valni hisoblash sxemasi



9 – rasm. Yetaklanuvchi valni hisoblash sxemasi

F_{z1} , bo'yicha podshipnik tanlanadi $F_{z1} > F_{z2}$ bo'lganligi uchun engil seriyadagi radial sharikli podshipnik tanlaymiz:

$d_1 = 45 \text{ mm}$, $D = 85 \text{ mm}$, $B = 19 \text{ mm}$, $C = 25.2 \text{ kN}$, $C_0 = 17.8 \text{ kN}$.

Ekvivalent kuch quyidagicha topiladi:

$$P = (XV F_2 + Y F_a) \cdot K_\sigma \cdot K_T$$

Bu erda

X-Radial kuch koeffitsienti;

V-Xalqaning aylanishini hisobga oluvchi koeffitsient;

F_z –radial kuch, N;

Y-o'q bo'yicha ta'sir etuvchi kuch koeffitsienti;

F_a -o'q bo'ylab yo'nalgan kuch; N;

K_σ -xavfsizlik koeffitsienti;

K_T -temperatura koeffitsienti.

Ma'lumki:

$$F_{r1} = 2949 \text{ N}, F_a = P_a = 971 \text{ N}.$$

$$\text{Jadvaldan: } K_\sigma = 1, K_T = 1.$$

$$X = 0,56; Y = 1,71$$

E va u ning qiymatlari inertsia kuchi bilan aniqlangan

$$P_3 = (0,56 \cdot 2949 + 1,71 \cdot 971) = 3312 \text{ N}$$

Mln. aylanishlar sonida ish muddati

$$L = \left(\frac{C}{P_3} \right)^m$$

Sharikli podshipniklar uchun $m = 3$.

$$L = \left(\frac{25,2 \cdot 10^3}{3312} \right)^3 = 439 \text{ mln. ayl.}$$

Xaqiqiy ish muddati, soat

$$L_h = \frac{L \cdot 10^6}{60n} = \frac{439 \cdot 10^6}{(60 \cdot 973)} = 7520 \text{ soat}$$

Yetaklanuvchi val.

Ma'lumki, $F_t = 5345 \text{ N}$, $F_z = 1963.5 \text{ N}$, $F_a = 971 \text{ N}$ va $l_2 = 82 \text{ mm}$.

Tayanch reaksiya kuchi:

$$\text{XZ tekislikda: } R_{x1} = R_{x2} = R_{x3} = R_{x4} = 2672.5 \text{ N}$$

YZ tekislikda:

$$R_{y3} = \frac{F_z \cdot l_2 - \frac{F_a d_2}{2}}{2 \cdot l_2} = \frac{1963,5 \cdot 82 - \frac{971 \cdot 359,2}{2}}{2 \cdot 82} = -81.61 \text{ N.}$$

⊖ ishora reaksiya kuchi qarama-qarshi yo`nalishda ekanligini bildiradi.

$$R_{y4} = \frac{F_z \cdot l_2 + F_a \cdot \frac{d_2}{2}}{2 \cdot l_2} = \frac{1963,5 \cdot 82 + 971 \cdot \frac{359,2}{2}}{2 \cdot 82} = 2045.11 \text{ N}$$

Tekshirish:

$$Y=0. R_{y3} + R_{y4} - F_z = -81.61 + 2045.11 - 1963.5 = 0$$

Umumiy reaksiya kuchi:

$$F_{z3} = R_3 = \sqrt{R_{x3}^2 + R_{y3}^2} = \sqrt{2672,5^2 + (-81,61)^2} = \sqrt{7148916,4421} = 2673.75 \text{ N}$$

Ko`proq kuch ta'sir etuvchi tayanchga qarab podshipnik tanlaymiz. 215 yengil seriyadagi radial sharikli podshipnik: $d=65 \text{ mm}$, $D=120 \text{ mm}$, $B=23 \text{ mm}$, $r=2,5 \text{ mm}$, $C=44 \text{ kN}$, $C_0=34.0 \text{ kN}$.

jadvaldan $V=1$, $X=0.56$, $Y=1.92$ $K_\sigma=1$, $K_\tau=1$.

$$\text{Ekvivalent kuch, } P_3 = (0,56 \cdot 1963.5 + 1,92 \cdot 971) \cdot 1 = 2963.88 \text{ N}$$

Mln aylanishlar sonida hisobiy xizmat muddati:

$$L = \left(\frac{44 \cdot 10^3}{2963,88} \right)^3 = 3271.72 \text{ mln.ayl.}$$

Soatlarda hisobiy xizmat muddati, soat

$$L_h = \frac{3271,72 \cdot 10^6}{(60 \cdot 81)} = 673193.4 \text{ soat.}$$

IX. KOMPONOVKANING IKKINCHI BOSQICHI

Komponovkaning ikkinchi bosqichida reduktor detallari, shesternya, tishli g`ildirak, vallar va boshqa detallar konstruktiv jixozdan rasmiylashtiriladi va vallarni mustaxkamlikka hisoblash uchun qiymatlar tayyorlanadi.

X. SHPONKALI BIRIKMANI MUSTAXKAMLIKKA HISOBLASH

Shponka uchun normallashtirilgan St.45 markali po`lat material tanlaymiz.

Shponka egilish kuchlanishi bo`yicha quyidagi formula bilan hisoblanadi:

$$\sigma_{ez} = \frac{2T}{d(h-t_1) \cdot (l-b)} \leq [\sigma]_{ez}$$

Ruxsat etilgan ezilish kuchlanishi

$$[\sigma]_{ez} = 100 \cdot 120 \frac{N}{mm^2}.$$

Yetaklovchi val.

A-A kesim uchun:

$d=40\text{mm}$, $b=12\text{mm}$, $h=8\text{mm}$, $t_1=5,5\text{mm}$, $l=60\text{mm}$. $T_2=240 \cdot 10^3 \text{ N} \cdot \text{mm}$;

$$\sigma_{ez} = \frac{2 \cdot 240 \cdot 10^3}{40(10-5.5) \cdot (60-12)} = 55.55 \frac{N}{mm^2} < [\sigma]_{ez}$$

B-B kesim uchun:

$d=50\text{mm}$, $b=16\text{mm}$, $h=10\text{mm}$, $t_1=6\text{mm}$, $l=75\text{mm}$

$$\sigma_{ez} = \frac{2 \cdot 240 \cdot 10^3}{50(10-6) \cdot (75-16)} = 40,7 \frac{N}{mm^2}.$$

Yetaklanuvchi val.

Yetaklanuvchi valda ikkinchi shponka bo`lib mufta o`rnashiladigan qismi nozikroq hisoblanadi.

Shuning uchun $d=70$ mm, $b=20$ mm, $h=12$ mm, $t_1=7.5$ mm, $l=75$ mm. Etaklovchi valga burovchi moment

$$T_3=960\text{N}\cdot\text{m}.$$

$$G_{ez}=\frac{2\cdot 960\cdot 10^3}{70(12-7.5)\cdot (75-20)}=110,8\frac{N}{\text{mm}^2}.$$

$$G_{ez}<[G]_{ez}=120\frac{N}{\text{mm}^2}.$$

XI. VALLARNING ANIQ HISOBI

Yetaklovchi val.

Val materiali St.45, normallashtirilgan, $\sigma_b=590$ N/mm².

$$\text{Chidamlilik chegarasi } \sigma_{-1}=0,4, \sigma_B=0,43\cdot 590=254\frac{N}{\text{mm}^2}$$

$$\tau_{-1}=0,586 \quad \sigma_{-1}=0,58\cdot 254=147\frac{N}{\text{mm}^2}$$

A-A-kesim

Bu xolatda faqat urinma kuchlanish paydo bo`ladi.

$$\text{Mustaxkamlikzapasikoeffitsienti } n=n_{\tau}=\frac{\tau_{-1}}{\left(\frac{k_{\tau}\cdot \tau_v}{\varepsilon_{\tau}}+\varphi_{\tau}\tau_m\right)},$$

Bu erda

$$\tau_v=\tau_m=\frac{\tau_{\max}}{2}=\frac{\mu_k}{(2W_{\text{netto}})}$$

$d=45\text{mm}$, $b=14\text{mm}$, va $t_1=5,5\text{mm}$

$$W_{netto} = \frac{\pi d^3}{16} - \frac{bt_1(d - t_1)^2}{2d} = \frac{3,14 \cdot 45^3}{16} + \frac{14 \cdot 5,5(45 - 5,5)^2}{2 \cdot 45} = 17883,28 - 334,88 = 16548,4\text{mm}^3.$$

$$\tau_v = \tau_m = \frac{375 \cdot 10^3}{(2 \cdot 16,548 \cdot 10^3)} = 11,33 \frac{N}{\text{mm}^2}.$$

Moment jadvaldan $E_t=0,72$

$K_t=1,75$, $\varphi \approx 0,1$.

Shunday qilib

$$n=n_t = \frac{\frac{147}{1,75 \cdot 11,33}}{0,72} + 0,1 \cdot 11,33 = \frac{147}{128,67} = 5,13 > [n] = 2,5.$$

Hisoblashlardan ko`rinadiki, vallning mustaxkamlik zapasi koeffitsienti ruxsat etilganga qaraganda ikki marta katta. Shuning uchun B-B kesim uchun hisoblash shart emas

XII. REDUKTORNI CHIZISH

Reduktor ikki proektsiyada A1 formatli (594 x 841 mm) oq chizma qog`ozga chiziladi. Agar chizma 1:1 masshtab bilan chizilsa ancha qulay bo`ladi. Odatda chizmaning gorizontal proektsiyasi, reduktorning ichki detallarning joylashuvi yaqqol ko`rinib turishi uchun uni qopqog`iga olingan xolda chiziladi.

Reduktorning vertikal proektsiyasida esa tashqi ko`rinishi chiziladi. Chizma tayyor bo`lgandan so`ng detallarni harakterlovchi spetsifikatsiya chiziladi.

XIII. MOY NAVINI TANLASH

Reduktorning tishli uzatmasini moylashda, reduktor quyidagicha qo'yilgan moyga tegishli g'ildirak taxminan 10 mm o'lib botirilgan bo'lishi kerak. Bunda g'ildirakdagi tishlar orqali moy shesternya tishlariga o'tishi natijasida tishli uzatma moylanadi.

Moy vannasining xajmi I kVt quvvatga $0,25 \text{ dm}^2$ qilib belgilanadi. U xolda mazkur reduktor uchun $0,25 \times 5,16 = 1,29 \text{ dm}^2$

30 – jadvalga muvofiq moyning qovushqoqligini belgilaymiz. Kontakt kuchlanish $G_H = 383 \text{ n/mm}^2$ va tezligi $V = 1,23 \text{ m/c}$ bo'lgandgi tavsiya etilgan moy qovushqoqligi $Y = 40 \cdot 10^{-6} \text{ m}^2/\text{s}$ bo'lishi kerak.

31 – jadvaldagi standartga muvofiq I-40 A markali industrial moy qabul qilamiz.

Moylash uchun podshipniklar uyasini plastik moylash materiali bilan to'ldiramiz. Ish jarayon vaqti – vaqti bilan shprints yoki maslyanka yordamida podshipnik uyachalari to'latib turiladi.

XIV. REDUKTORNI YIG'ISH

Reduktorni yig'ishdan oldin, uning ostki qutichasi obdon tozalanib, moyga chidamli bo'lgan bo'yoq bilan bo'yaladi.

Redukotrni yig'ish chizmasiga asosan, uning vallariga o'rnatiladigan detallardan boshlanadi: etaklovchi valga moyqaytargich xalqa qo'yiladi, so'ng podshipniklar 80 - 100 gradus temperaturadagi moyda qizdirilib valga o'rnatiladi (qizdiriladi): etaklanuvchi valga...18x11x76.

Shponka o'rnatilib tishli g'ildirakni tig'iz xolda kirgiziladi va uni valdagi boltga qadalguncha tig'izlanadi, so'ngra tayanch vtulka va moy to'sqich quyiladi. Undan keyin moyda qizdirilgan podshipniklar o'rnatiladi. Yig'ilgan etaklovchi va etaklanuvchi vallar reduktorning ostki korpusiga (qutichaga) yotkiziladi.

Reduktor korpusi bilan uning qopqog'i oralig'iga qistirma (prokladka) qo'yiladi, so'ngra boltlar bilan maxkamlanadi. Reduktorning ostki korpusi bilan qopqog'i (ustkorpusi) o'zaro maxkamlangandan so'ng podshipnik uyalari plastik moyi bilan to'lgiziladi, o'istirmalar bilan birgalikda podshipniklar qopqoqlari qotiriladi. Etaklovchi valga shponka yordamida shkiv o'rnatiladi. Vallarni aylantirilganda biror qismga tegmasligi va xoli aylanishini ta'sir etish kerak bo'ladi.

So'ng reduktorga hisoblangan miqdorda moy quyiladi.

Yig'ilgan reduktorga maxsus stenda berilgan rejimda ma'lum vaqt ishlatiladi, va shu davrda uning detallarini qizib ketishi va ravon ishlashi kuzatiladi.

Reduktor belgilangan muddatda sinab ishlatib ko`rilgandan so`ng uni ishlab chiqarishda ishlatish uchun tayyor deb hisoblanadi.

FOYDALANILGAN ADABIYOTLAR

1. Sh.A.Shoobidov, S.U.Musayev. «Yuritmalar»,
Tasmalivazanjirliuzatmalarniloyixalash. Toshkent 2000-82 b.

2. Sh.A.Shoobidov, S.U.Musaev. «Tishlivachervyakliuzatmalarniloyixalash». Toshkent 2005-80 b.
3. Tojiboev R.N vaboshqalar, «Mashinadetallarikursidanmasalalarto'plami», Toshkent -1992, 144 bet
4. ShoobidovSh.A., Usmonov A.A., Atametov D.T.
«Ajraladiganvaajralmaydiganbirikmalarnihisoblash». Toshkent. 1993.
5. Musaev S.U., Sulaymonov I., Qosimxo'jaev S.K.
«Mashinadetallarini loyixalash», Toshkent, 1992.
6. I.Sulaymonov. "Mashinadetallari". O'qituvchi, Toshkent: 1981.-306 b.
7. Sh.A.Shoobidov «Mashinadetallari», Toshkent 2000-87 b.
8. Sh.A.Shoobidov «Mashinadetallari», Toshkent 2004-120 b.
9. М.Н. Иванов «Детали машин», Москва «Высшая школа», 1991.-383 с.
10. Дунаев П.Ф., Леликов О.П. Конструирование узлов и деталей машин. Учебн.пособие для машиностроительных спец.вузов. М.Высшая школа, 1985,-416 стр.
- 11.Чернавский С.А. и др. «Проектирование механических передач», Москва. 2005.
- 12.Чернавский С.А. и др. "Курсовое проектирование деталей машин" М.: 1987.
- 13.Шейнблит А.Е. «Курсовое проектирование узлов и деталей машин» М.: 1991
- 14.Мамарозиқов Ҳа.Е."Mashinadetallarini loyixalash bo'yicha qo'llanma" 2-qism.A.: 1996.

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fanidan kurs loyihasi uchun
taqriz va reyting ballari

№	Mavzular	Ballar
(Hisobot uchun)		
I.	“Kirish”, “Elektro dvigatel tanlash va kinematik hisoblash”, “Reduktor hisobi”, “Vallarning taxminiy hisobi”, “Reduktor korpusini konstruktiv o’lchamlari”, “Podshipnikni ish muddatini hisoblash”, “Vallarni aniq hisobi”, “Reduktorni yig’ish bolim”lari uchun.	
Grafikqism		
1.	Узатманинг кинематик схемаси.	
2.	Reduktorning yig’ma chizmasi.	
3.	Reduktor detallarining ishchi chizmalari.	
Jami:		
II.	Tayyorlangan kurs loyihasi bo’yicha ma’ruzalar uchun	
III	Kurs loyihasi bo’yicha savol-javoblar uchun	
Jami:		

Komissiya a’zolari: _____
