TARQOQ MAGNIT PARAMETRLARGA EGA DTMUKO‘QNING DINAMIK TAVSIFLARI

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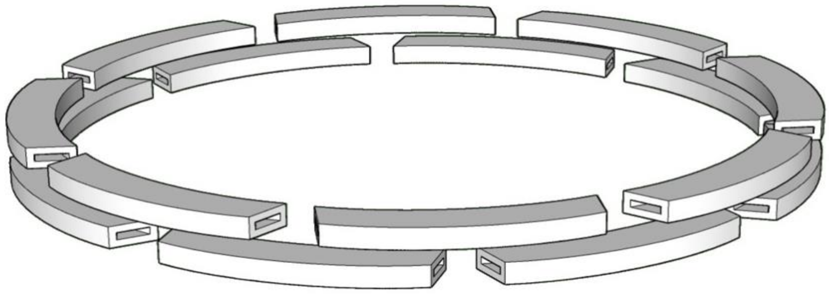
Annotatsiya
Maqolada doimiy toklarni magnitomodulyatsiya usulida kontaktsiz o‘lchashda integrallash konturidagi magnit zanjir tarqoq parametrli tavsifga ega uchastkalarga bo‘lingan bo‘lib, uning magnit zanjirini hisoblash uchun parametrik struktura sxemasiga muvofiq tenglamalar va ularning yechimlari keltirilgan.

Kalit so‘zlar: magnit zanjir, dinamik tavsiflar, parametrli struktura sxema, havo bo‘shlig‘i, ekvivalent vaqt doimiysi.

Doimiy toklarni magnitomodulyatsiya usulida kontaktsiz o‘lchash qurilmasi (DTMUKO‘Q)ning magnit zanjirlarining yuqoridagi va pastki qatordagi elementlari 1-rasmda ko‘rsatilganidek bir xil oraliq masofada joylashgan [1]. Shuning uchun 2-rasmda tasvirlangan DTMUKO‘Qning parametrli struktura sxemasida har bir qator uchun ikkita nosimmetrik kanal ko‘rsatilgan. Ko‘ndalang va bo‘ylama havo bo‘shliqlarini hisobga olish tegishli magnit sig‘imlar ($C_{\mu\delta q}$ va $C_{\mu\delta d}$) tomonidan amalga oshiriladi [2].



1-rasm. DTMUKO‘Q magnit zanjirining integrallovchi konturi.

Tarqoq magnit parametrlarga ega DTMUKO‘Qda dinamik tavsiflar jarayonini tasvirlash uchun 2-rasmga muvofiq quyidagi tenglamalarni tuzamiz:

a) o‘zgartirgichning chiqishidagi umumiy kuchlanish

$$U_{\text{э}\Sigma} = 2U_{\text{э}}; \qquad (1)$$

b) har bir kanalning chiqish kuchlanishi

$$U_{\text{э}}(P) = U_{\text{э}1}(P) = U_{\text{э}2}(P) = K_{I\mu\Sigma U_{\text{э}}} p C_{\mu\Sigma} K_{I_{\text{э}}-U_{\mu}-I_{\text{э}}}(P); \qquad (2)$$

c) umumiy magnit sig‘im

$$C_{\mu\Sigma} = \frac{1}{W_{\mu\Sigma}} = \frac{1}{W_{\mu\delta 2}+W_{\mu cm}}; \tag{3}$$

bu yerda

$$W_{\mu cm} = \frac{1}{C_{\mu cm}}; \tag{4}$$

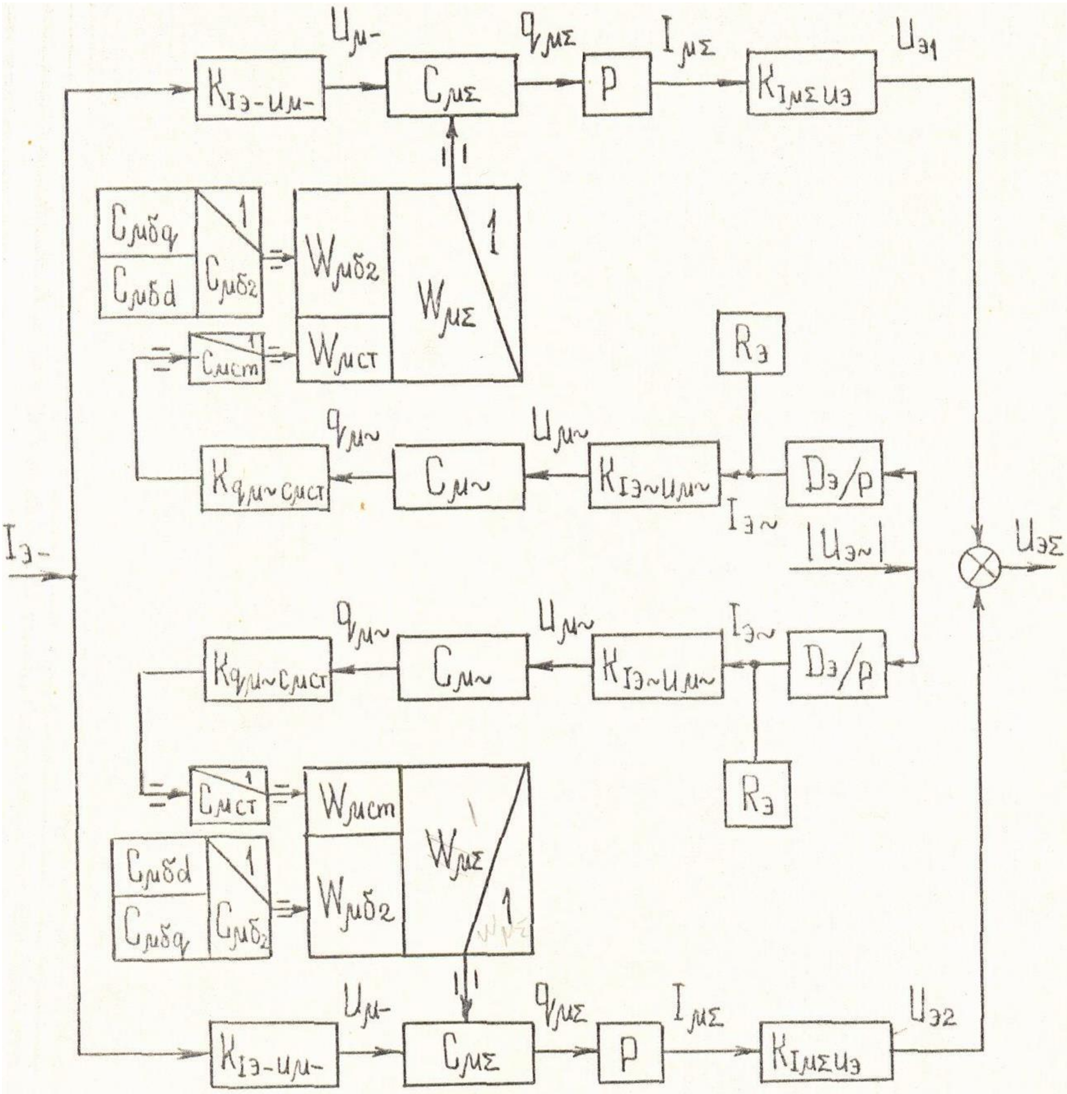
$$W_{\mu\delta 2} = \frac{1}{C_{\mu\delta}} = \frac{1}{C_{\mu\delta q}+C_{\mu\delta d}}; \tag{5}$$

$$C_{\mu\delta q} = \mu_0 \frac{(l_\mu+\delta)bn}{h}; \tag{6}$$

$$C_{\mu\delta d} = \mu_0 \frac{h_1 b}{\delta n}. \tag{7}$$

d) qo‘zg‘atish kuchlanishining modulyatsiya effekti (8) ifodaga teng

$$C_{\mu cm} = K_{q_{\mu\sim}C_{\mu cm}} C_{\mu\sim} K_{I_{\text{э}\sim}U_{\mu\sim}} \frac{1}{p} D_{\text{э}} |U_{\text{э}\sim}|. \tag{8}$$



3.15-rasm. DTMUKO‘Q uchun parametrli struktura sxemasi.

$$D_{\text{Э}} = \frac{D_{\text{ЭР}}}{1+\frac{D_{\text{ЭР}}\,R_{\text{Э}}}{P}} \tag{9}$$

(9) ifodani hisobga olgan holda, (1)-(4) va (8) tenglamalarni birgalikda yechib, quyidagini hosil qilamiz [3]

$$U_{\text{Э}\Sigma}(P) = \frac{2K_{I_{\mu\Sigma U_{\text{Э}}}}pK_{I_{\text{Э}-U_{\mu-}}}I_{\text{Э}}(P)}{W_{\mu\delta_2} + \dfrac{1}{K_{q_{\mu\sim}C_{\mu cm}}C_{\mu\sim}K_{I_{\text{Э}\sim U_{\mu\sim}}}\dfrac{1}{P}\dfrac{D_{\text{ЭР}}}{1+\frac{D_{\text{ЭР}}\,R_{\text{Э}}}{P}}|U_{\text{Э}\sim}|}} =$$

$$= \frac{2K_{I_{\mu\Sigma U_{\text{Э}}}}PK_{I_{\text{Э}-U_{\mu-}}}K_{I_{\text{Э}\sim U_{\mu\sim}}}C_{\mu\sim}K_{q_{\mu\sim}C_{\mu cm}}|U_{\text{Э}\sim}|I_{\text{Э}}(P)}{R_{\text{Э}}+W_{\mu\delta_2}K_{q_{\mu\sim}C_{\mu cm}}C_{\mu\sim}K_{I_{\text{Э}\sim U_{\mu\sim}}}|U_{\text{Э}\sim}|\,[1+\frac{P}{D_{\text{ЭР}}(R_{\text{Э}}+W_{\mu\delta_2}K_{q_{\mu\sim}C_{\mu cm}}C_{\mu\sim}K_{I_{\text{Э}\sim U_{\mu\sim}}}|U_{\text{Э}\sim}|)}]}. \tag{10}$$

Olingan ifodaning umumiy ko‘rinishi (11) tenglamaga to‘g‘ri keladi

$$U_{\text{Э}}(P) = \frac{K_{I_{\mu\Sigma U_{\text{Э}}}}PK_{I_{\text{Э}-U_{\mu-}}}I_{\text{Э}}(P)}{W_{\mu\delta_1} + \dfrac{1}{K_{q_{\mu\sim}C_{\mu cm}}C_{\mu\sim}K_{I_{\text{Э}\sim U_{\mu\sim}}}\dfrac{1}{P}\dfrac{D_{\text{ЭР}}}{1+\frac{D_{\text{ЭР}}\,R_{\text{Э}}}{P}}|U_{\text{Э}\sim}|}} =$$

$$= \frac{K_{I_{\mu\Sigma U_{\text{Э}}}}PK_{I_{\text{Э}-U_{\mu-}}}K_{I_{\text{Э}\sim U_{\mu\sim}}}C_{\mu\sim}K_{q_{\mu\sim}C_{\mu cm}}|U_{\text{Э}\sim}|I_{\text{Э}}(P)}{(R_{\text{Э}}+W_{\mu\delta_1}K_{I_{\text{Э}\sim U_{\mu\sim}}}C_{\mu\sim}K_{q_{\mu\sim}C_{\mu cm}}|U_{\text{Э}\sim}|)\,[1+\frac{P}{D_{\text{ЭР}}(R_{\text{Э}}+W_{\mu\delta_1}K_{I_{\text{Э}\sim U_{\mu\sim}}}C_{\mu\sim}K_{q_{\mu\sim}C_{\mu cm}}|U_{\text{Э}\sim}|)}]}, \tag{11}$$

$$U_{\text{Э}}(P) = -\frac{\omega_{\text{ўл}}PI_{\text{Э}}(P)}{[W_{\mu\delta_1}+D_{1\text{экв}}(U_{\text{Э}\sim})][T_1(U_{\text{Э}\sim})P+1]}. \tag{12}$$

shuning uchun (12) ifodaga o‘xshab, quyidagini yozishimiz mumkin

$$U_{\text{Э}\Sigma}(P) = -\frac{2\omega_{\text{ўл}}PI_{\text{Э}}(P)}{[W_{\mu\delta_2}+D_{\text{экв}2}(U_{\text{Э}\sim})][T_2(U_{\text{Э}\sim})P+1]}, \tag{13}$$

bunda

$$D_{\text{экв}2}(U_{\text{Э}\sim}) = D_{\text{экв}1}(U_{\text{Э}\sim}) = \frac{R_{\text{Э}}}{\frac{2}{\pi}U_{\text{Э}\sim m}\frac{\mu K\omega_{\sim}h_1 b}{\ell_{\text{ўр}}\ell_{\mu}n}[1-\frac{2}{3}\left(\cos 2\omega t+\frac{1}{5}\cos 4\omega t\right)]}; \tag{14}$$

$$T_2(U_{\text{Э}\sim}) = \frac{\mu\frac{h_1\Delta}{\ell_{\text{ўр}}}W_{\sim}^2}{R_{\text{Э}}+\frac{2}{\pi}U_{\text{Э}\sim m}\frac{\mu\omega_{\sim}Khh_1\delta[1-\frac{2}{3}\left(\cos 2\omega t+\frac{1}{5}\cos 4\omega t\right)]}{\mu_0\ell_{\text{ўр}}\ell_{\mu}[(\ell_{\mu}-\delta)\delta n^2+hh_1]}}; \tag{15}$$

$$W_{\mu\delta_2} = \frac{1}{C_{\mu\delta q}+C_{\mu\delta d}} = \frac{h\delta n}{\mu_0 b[(\ell_{\mu}-\delta)\delta n^2+hh_1]}. \tag{16}$$

(13) tenglamani yuqorida tavsiflangan usul bilan yechish natijasida quyidagi ifoda hosil bo‘ladi

$$P_2(t) = \frac{1}{T_2(U_{\text{Э}\sim})}$$

$$= \frac{\dfrac{2U_{\text{Э}\sim m}\mu\omega_{\sim}\,Khh_1\delta}{\pi\mu_0\ell_{\text{ўр}}\ell_{\mu}[(\,\ell_{\mu}-\delta\,)\delta n^2+hh_1]}\left[1-\dfrac{2}{3}\left(\cos2\omega t+\dfrac{1}{5}\cos4\omega t\right)\right]}{\dfrac{\mu h_1\Delta\,W_{\sim}^2}{\ell_{\text{ўр}}}};$$

$$S_2(t) = P_2(t) = \frac{1}{T_2(U_{\text{Э}\sim})} =$$

$$= \frac{\dfrac{2U_{\text{Э}\sim m}\mu\omega_{\sim}\,Khh_1\delta}{\pi\mu_0\ell_{\text{ўр}}\ell_{\mu}[(\,\ell_{\mu}-\delta\,)\delta n^2+hh_1]}\left[1-\dfrac{2}{3}\left(\cos2\omega t+\dfrac{1}{5}\cos4\omega t\right)\right]}{\dfrac{\mu h_1\Delta\,W_{\sim}^2}{\ell_{\text{ўр}}}};$$

$$S_2(t) = \int P_2(t)\,dt = \frac{1}{W_{\sim}\Delta}\left\{\frac{2U_{\text{Э}\sim m}\,Kh\delta}{\pi\mu_0\ell_{\mu}[(\,\ell_{\mu}-\delta\,)\delta n^2+hh_1]}+\frac{R_{\text{Э}}\,\ell_{\text{ўр}}}{\mu h_1W_{\sim}}\right\}t-$$
$$-\frac{2U_{\text{Э}\sim m}\,Kh\delta}{3\pi\omega\mu_0\ell_{\mu}W_{\sim}\Delta[(\,\ell_{\mu}-\delta\,)\delta n^2+hh_1]}(\sin2\omega t+0{,}1\sin4\omega t); \quad (17)$$

$$S_2(\varphi) = \frac{1}{W_{\sim}\Delta}\left\{\frac{2U_{\text{Э}\sim m}\,Kh\delta}{\pi\mu_0\ell_{\mu}[(\,\ell_{\mu}-\delta\,)\delta n^2+hh_1]}+\frac{R_{\text{Э}}\,\ell_{\text{ўр}}}{\mu h_1W_{\sim}}\right\}\varphi-$$
$$-\frac{2U_{\text{Э}\sim m}\,Kh\delta}{3\pi\omega\mu_0\ell_{\mu}W_{\sim}\Delta[(\,\ell_{\mu}-\delta\,)\delta n^2+hh_1]}(\sin2\varphi+0{,}1\sin4\varphi); \quad (18)$$

$$h_2(t-\varphi,\varphi) = \frac{2W_{\text{ўл}}}{T_2(U_{\text{Э}\sim})[W_{\mu\delta_2}+D_{\text{экв}2}(U_{\text{Э}\sim})]}\left[\frac{e^{S_2(\varphi)}}{e^{S_2(t)}}-1\right]. \quad (19)$$

(19) ifodadagi qiymatlarni (14)-(16), (17) va (18) tenglamalarning o‘rniga qo‘yamiz

$$h_2(t-\varphi,\varphi) = M_2(\omega t)\left\{\exp\left[S_2(\varphi)-\frac{t}{T_{\text{экв}2}}+V_2(\omega t)\right]-1\right\}, \quad (20)$$

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$$M_2(\omega t) = \frac{2W_{\text{ўл}}\left\{R_{\text{Э}}+\dfrac{2U_{\text{Э}\sim m}\,\mu W_{\sim}Khh_1\delta\left[1-\frac{2}{3}\left(\cos2\omega t+\frac{1}{5}\cos4\omega t\right)\right]}{\pi\mu_0\ell_{\text{ўр}}\ell_{\mu}[(\,\ell_{\mu}-\delta\,)\delta n^2+hh_1]}\right\}}{\dfrac{\mu h_1W_{\sim}^2\Delta}{\ell_{\text{ўр}}}\left\{\dfrac{h\delta n}{\mu_0 b[(\ell_{\mu}-\delta)\delta n^2+hh_1]}+\dfrac{\pi R_{\text{Э}}\,\ell_{\text{ўр}}\ell_{\mu}n}{2U_{\text{Э}\sim m}\,\mu KW_{\sim}h_1b\left[1-\frac{2}{3}\left(\cos2\omega t+\frac{1}{5}\cos4\omega t\right)\right]}\right\}}; \quad (21)$$

$$T_{\text{экв}2} = \frac{1}{\dfrac{1}{W_{\sim}\Delta}\left\{\dfrac{2U_{\text{Э}\sim m}\,Kh\delta}{\pi\mu_0\ell_{\mu}[(\ell_{\mu}-\delta)\delta n^2+hh_1]}+\dfrac{R_{\text{Э}}\,\ell_{\text{ўр}}}{\mu h_1W_{\sim}}\right\}} =$$
$$= \frac{W_{\sim}^2\mu\mu_0\pi\ell_{\mu}h_1\Delta[(\ell_{\mu}-\delta)\delta n^2+hh_1]}{2U_{\text{Э}\sim m}Kh\delta\mu h_1W_{\sim}+\pi\mu_0\ell_{\mu}R_{\text{Э}}\,\ell_{\text{ўр}}[(\ell_{\mu}-\delta)\delta n^2+hh_1]}; \quad (22)$$

$$V_2(\omega t) = \frac{2U_{\text{Э}\sim m}\,Kh\delta}{3\pi\omega\mu_0\ell_{\mu}W_{\sim}\Delta[(\ell_{\mu}-\delta)\delta n^2+hh_1]}(\sin2\omega t+0{,}1\sin4\omega t); \quad (23)$$

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$$T_{\text{экв}1} = \frac{1}{\frac{1}{h_1 W_{\sim}\Delta}\left(\frac{2U_{\text{Э}\sim m}\,K\delta}{\pi\mu_0 \ell_\mu} + \frac{R_{\text{Э}}\,\ell_{\breve{y}p}}{\mu W_{\sim}}\right)} = \frac{\pi\mu_0\mu\ell_\mu h_1 W_{\sim}^2\Delta}{2U_{\text{Э}\sim m}K\delta\mu W_{\sim} + \pi\mu_0 \ell_{\breve{y}p}\ell_\mu R_{\text{Э}}}. \quad (24)$$

Ekvivalent vaqt doimiysi (22) ifodasini tahlil qilib, biz (24) ifodada bo‘lgani kabi ishlash haqida ham xuddi shunday xulosalar chiqarishimiz mumkin [4]. Shuningdek, bu holatda ishlashni yaxshilash uchun h ko‘ndalang havo bo‘shlig‘ini oshirish kerak. Ekvivalent vaqt doimiysini (24) tahlil qilish shuni ko‘rsatadiki, DTMUKO‘Qning geometrik o‘lchamlari va parametrlari ishlash jarayoniga ta’sir qiladi. Ishlash vaqtida δ havo bo‘shlig‘ining ortishi, qo‘zg‘atish cho‘lg‘amiga ketma-ket ulangan $R_{\text{Э}}$ qarshilik, $W_{\sim}$ o‘ramlar sonining kamayishi va magnit zanjir elementining uzunligi ℓ_μ bilan ortadi.

Foydalanilgan adabiyotlar

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