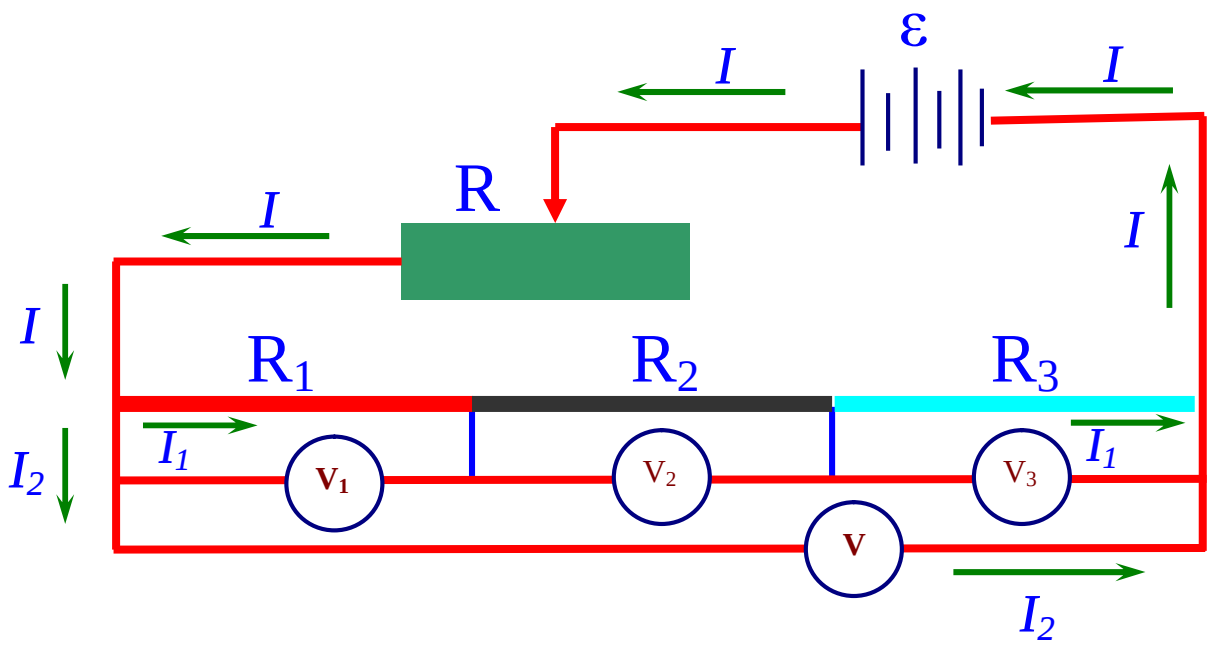
O’ZBEKISTON RESPUBLIKASI
OLIY VA O’RTA MAXSUS TA’LIM VAZIRLIGI

O’RTA MAXSUS, KASB – HUNAR TA’LIMI MARKAZI

“Zamonaviy o’qitish vositalari va axborot texnologiyalari” o`quv, ilmiy-uslubiy ishlab chiqarish laboratoriyasi

ELEKTROTEXNIKADAN
rangli o`quv – uslubiy ko`rgazmalar



$$V = V_1 + V_2 + V_3$$

$$IR = I(R_1 + R_2 + R_3)$$

$$R = R_1 + R_2 + R_3$$

$R_V >> R_1, R_2, R_3$ bo`lganligi uchun $I_2 << I_1$ natijada $I \approx I_1$

Kasb – hunar kollejlar uchun mo’ljallangan

Toshkent – 2004

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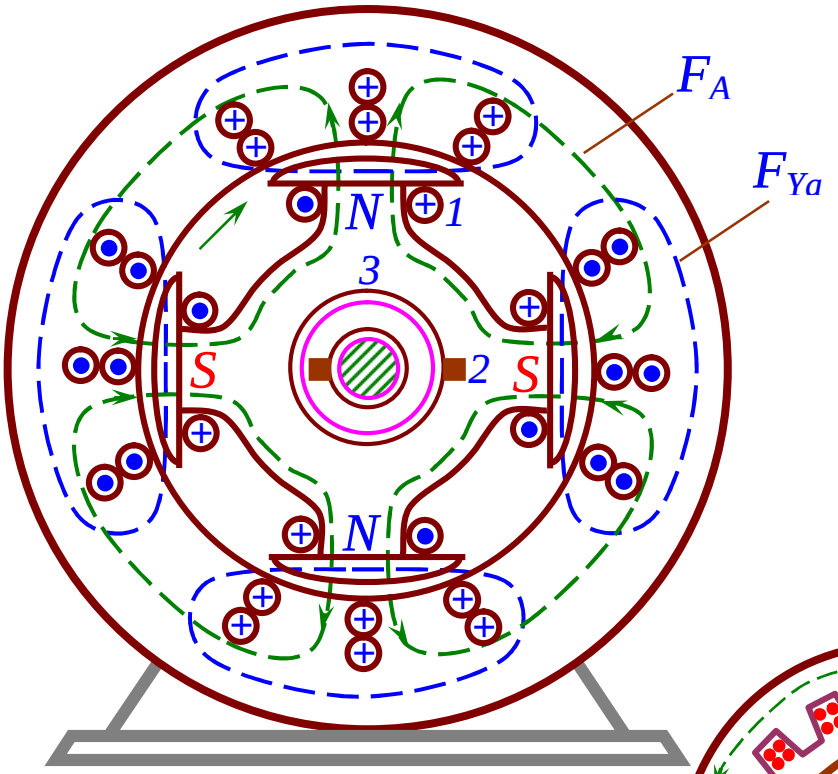
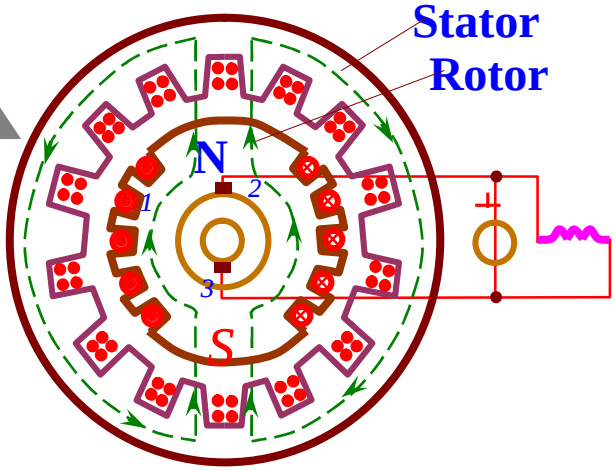


F_A, F_{Ya} - magnit oqimlari



Kasb – hunar kollejlar uchun mo’ljallangan

Toshkent – 2004

Ushbu o`quv – uslubiy qo`llanma "Osiyo taraqqiyoti banki" loyihasi bo`yicha ishlab chiqilgan

Loyihaning ilmiy raxbari: *"Zamonaviy o`qitish vositalari va axborot texnologiyalari" o`quv, ilmiy–uslubiy ishlab chiqarish laboratoriya boshlig`i*
f.m.f.n., dots. Xasanov E.G.

Mualliflar: *Zamonaviy o`qitish vositalari va axborot texnologiyalari" o`quv, ilmiy–uslubiy ishlab chiqarish laboratoriya boshlig`i*
f.m.f.n., dots. Xasanov E.G.

katta ilmiy xodimi
f.m.f.n., dots. Yusupov R.A.

ilmiy izlanuvchi – tadqiqodchi
Ernazarova G.O.

kichik ilmiy xodimi
Qo`ziyev K.T.

MUNDARIJA

K i r i s h s o‘z i

Kadrlar tayyorlash milliy dasturining ikkinchi bosqichida oqitish samaradorligini va sifatini zamonaviy talab darajasiga ko‘tarish maqsadida yangi o‘qitish vositalaridan keng foydalanish lozim.

Shu maqsadga erishish uchun "Zamonaviy o‘qitish vositalari va axborot texnologiyalari" laboratoriyasi tomonidan e’tiboringizga havola qilinayotgan elektron ko`rgazmalar yaratildi va ma’lumotlar kompakt diskga (CD) yozildi.

Ushbu o‘quv – elektron ko`rgazmalarda kasb – hunar kollejlarining “Elektrotexnika” maxsus kursi dasturiga mos keluvchi mavzular kiritilgan.

Undan tashqari bu o‘quv mahsulotlaridan kasb – hunar kollejlarining quyidagi maxsus kurslarini o‘tish jarayonida foydalanish tavsiya etiladi: “Umumiy elektrotexnika asoslari”, “Elektronika asoslari”, “Elektr zanjirlar nazariyasi”.

Kompakt diskdan foydalanish usullari:

1. Dars o‘tish jarayonida o‘qituvchi kompakt diskni kompyuterga o‘rnatib, multimedia – proektor orqali ma’lumotni ekranga tushirib, kerak ko`rgazmalarni tanlaydi va o‘quvchilarga tushuntiradi.
2. Kompyuter sinfida o‘quvchilar mustaqil ravishda ko`rgazmalarni o‘rganishlari mumkin.
3. Printer yordamida qog’ozga chiqarilgan ko`rgazmalar televizorga yoki multimedia-proektorga ulangan video – ko‘z orqali tasviri ekranga tushirilib, o‘qituvchi tomonidan tushuntiriladi.
4. Printer yordamida slaydga chiqarilgan ko`rgazmalar kodoskop yordamida ekranga uzatiladi va tushuntiriladi.

Diqqat: 9, 44, 56, 60, 61 – betlarda animatsiyalar berilgan

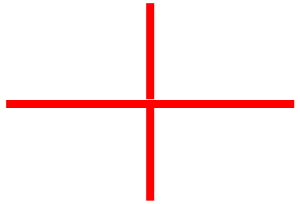
ANIMATSIYA

CTRL tugmasini bosib, sichqonchaning chap tugmasini bosing

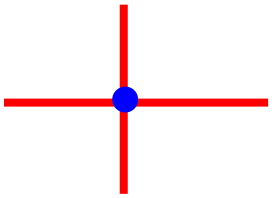
Elektr zanjirlarda foydalaniladigan sxemalarning shartli belgilari

1. o`tkazgich

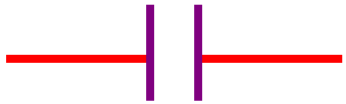
2. bir–biriga ulanmagan ikkita o`tkazgichlar



3. bir–biriga ulangan ikkita o`tkazgichlar



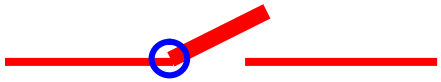
5. kondensator (elektr sig`im)

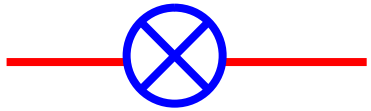


6. o`zgarmas tok manbai

7. o`zgaruvchan tok manbai

9. rezistor, (qarshilik)

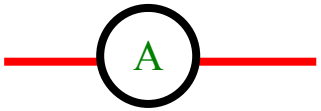
10.  *otkazgichlarni bir – biriga ulovchi kalit*

11.  *elektr lampasi*

12.  *elektr qong`iroq*

13. 

galvonometr

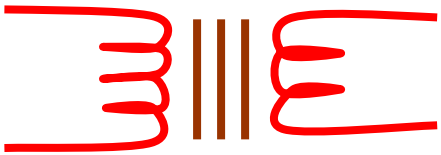
14. 

ampermetr

15. 

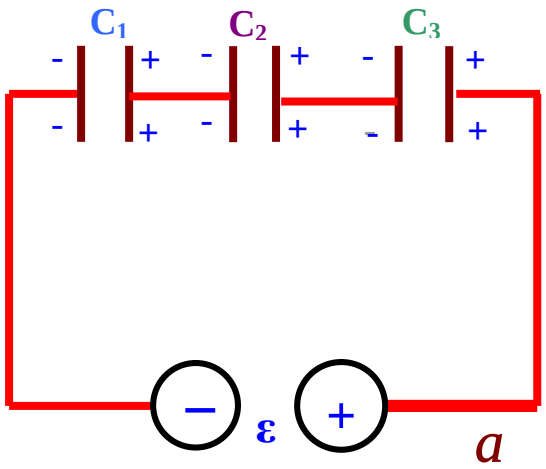
voltmetr

16.  *elektr g`altak*

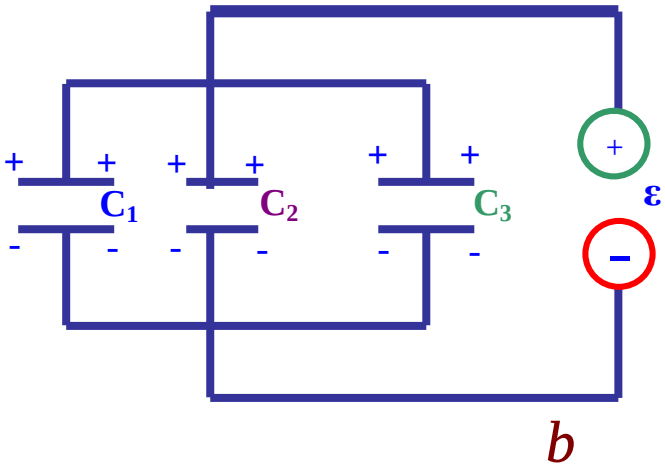
17.  *elektr transformator*

Kondensatorlar, ularni ketma-ket va parallel ulash

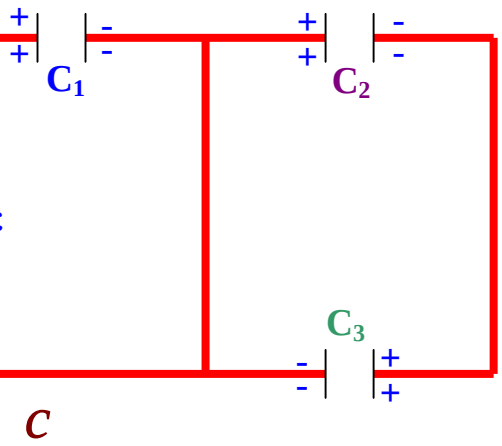
Yassi kondensatorlarni ketma-ket ulash



Yassi kondensatorlarni parallel ulash



Yassi kondensatorlarni aralash ulash



S - kondensator qoplamining yuzasi;
ε_0 - elektr doyimiy;
ε - nisbiy dielektrik singdiruvchanlik;
r - kondensator qoplamlari orasidagi masofa;

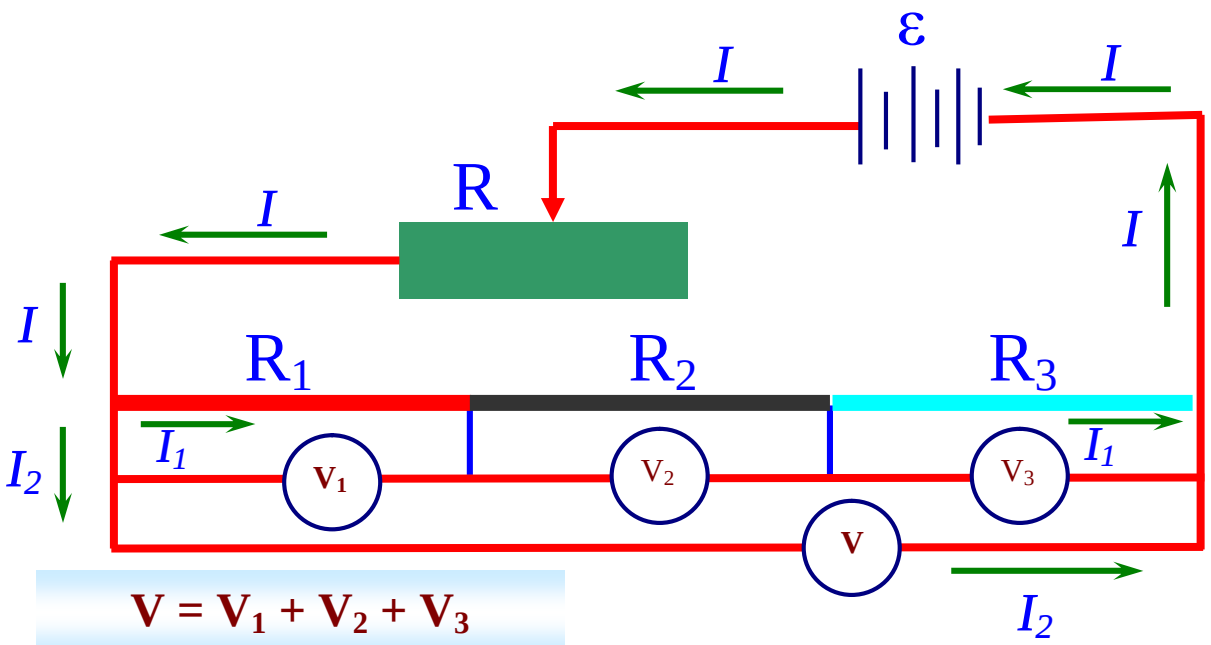
$$C = \frac{ee_0 S}{r}$$

a $$\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$$

b $$C = C_1 + C_2 + C_3$$

c $$\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2 + C_3}$$

Qarshiliklarni ketma – ket ulash



$$V = V_1 + V_2 + V_3$$

$$IR = I(R_1 + R_2 + R_3)$$

$$R = R_1 + R_2 + R_3$$

ANIMATSIYA

CTRL tugmasini bosib, sichqonchaning chap tugmasini bosing

$R_V >> R_1, R_2, R_3$ *bo`lganligi uchun*

$I_2 << I_1$

natijada

$I \approx I_1$

ε – o`zgarmas tok manbai

R – potensiometrik qarshilik

R_1 – mis simning qarshiligi,

R_2 – temir simning qarshiligi

R_3 – alyuminiy simning qarshiligi

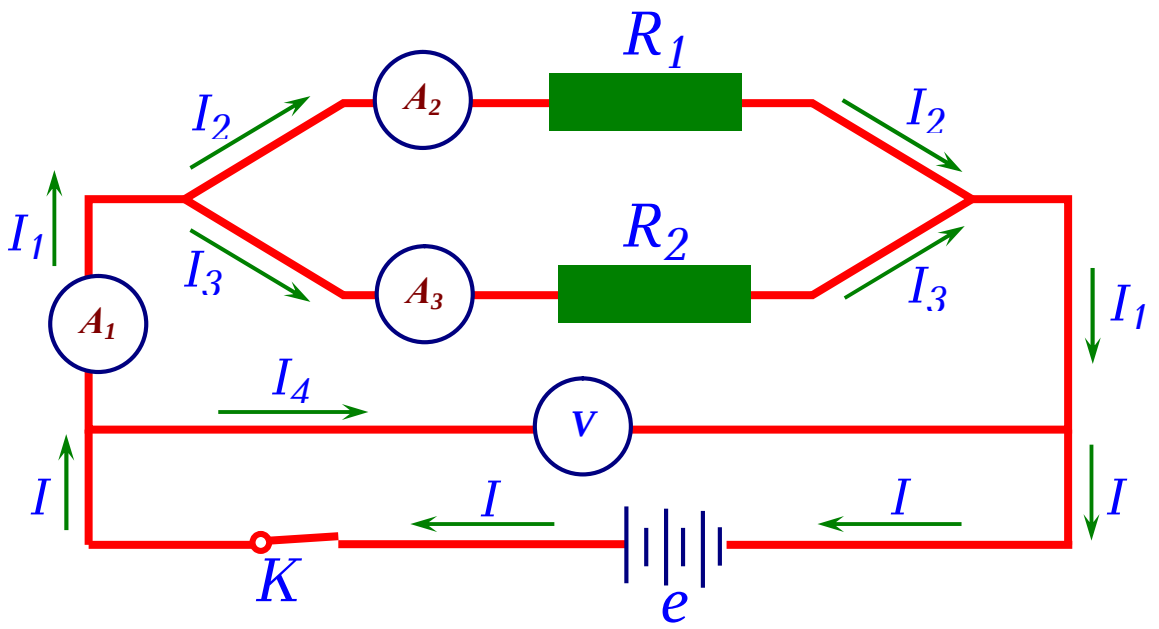
V_1 – mis simdagi kuchlanish tushish

V_2 – temir simdagi kuchlanish tushish

V_3 – alyuminiy simdagi kuchlanish tushish

V – umumiy kuchlanish tushish

Qarshiliklarni parallel ulash



K – *kalit*

A_i – *ampermetrlar*

i – *1,2,3*

V – *voltmetr*

e – *doimiy tok manbai*

$R_V >> R_1, R_2$

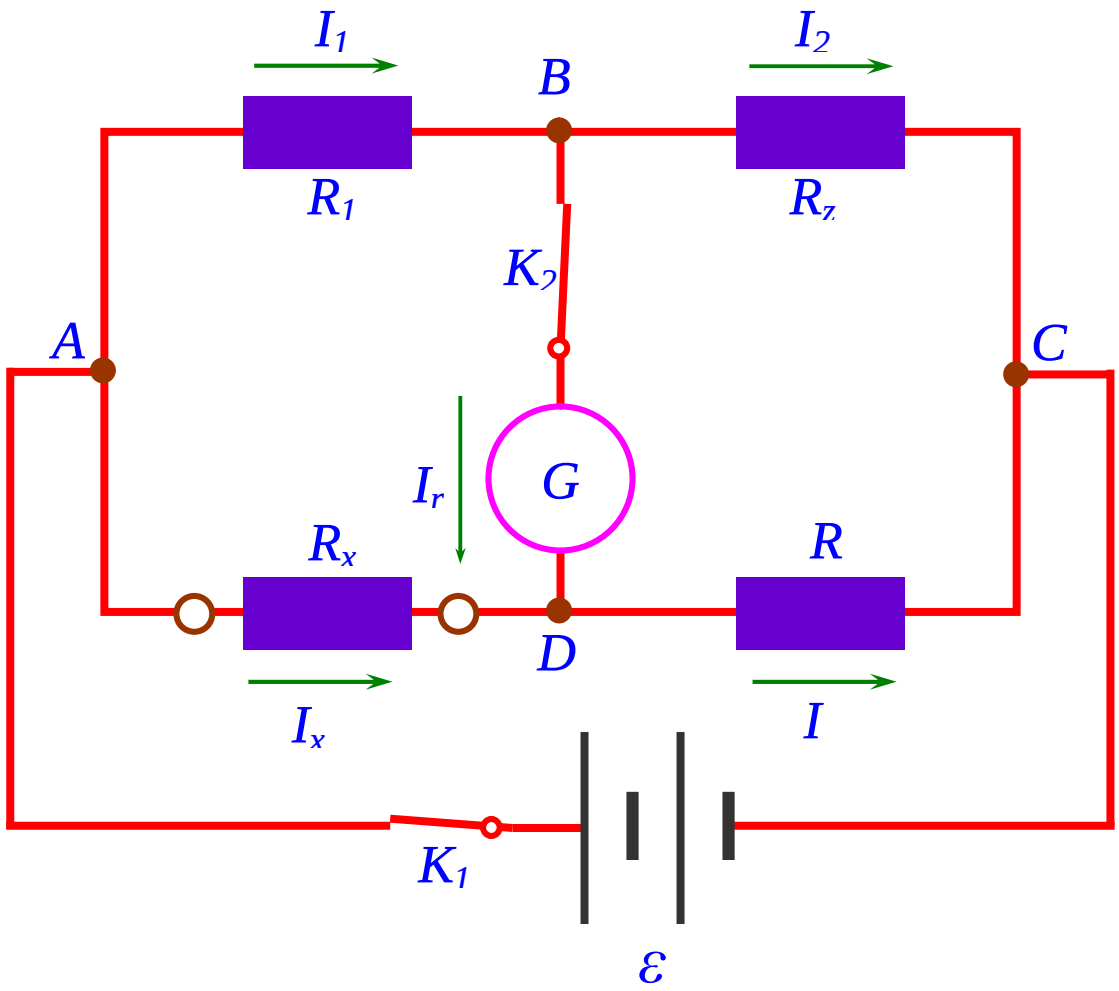
shuning uchun

$I_4 << I_1$, *ya'ni* $I \approx I_1$

Kirxgofning **I** va **II** *qoidalariga asosan zanjirning umumiy qarshiligi*

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$$

Taqqoslash usuli bilan qarshilikni aniqlash



ε - *doimiy tok manbai*

K_1, K_2 – *kalitlar*

R_1, R_2, R - *qarshiliklar*

R_x – *noma'lum qarshilik*

G – *galvonometr*

A, B, C, D – *tugunlar*

$V_B = V_D$

bo`lganda,

$I_1 = I_2$

$I_x = I$

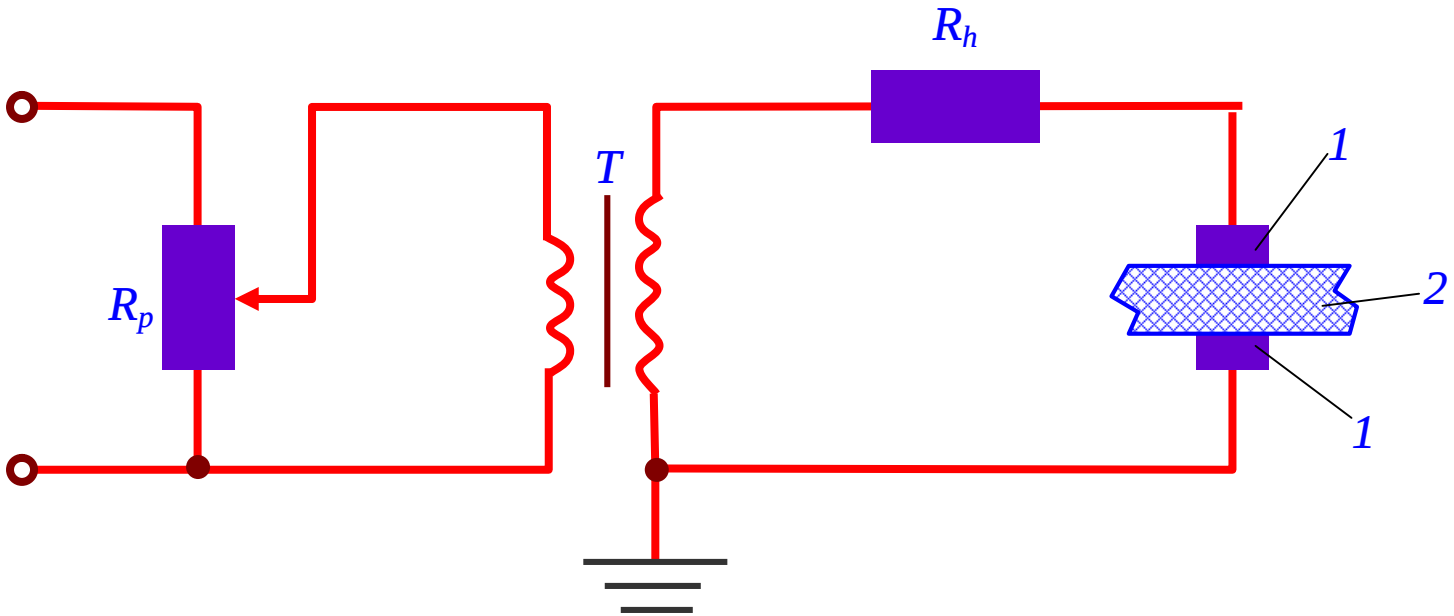
$I_1R_1 = I_xR_x$

$I_2R_2 = IR$

tengliklar bajariladi. Undan

$$R_x = \frac{RR_1}{R_2}$$

Dielektrikning elektr mustahkamligini aniqlash usuli

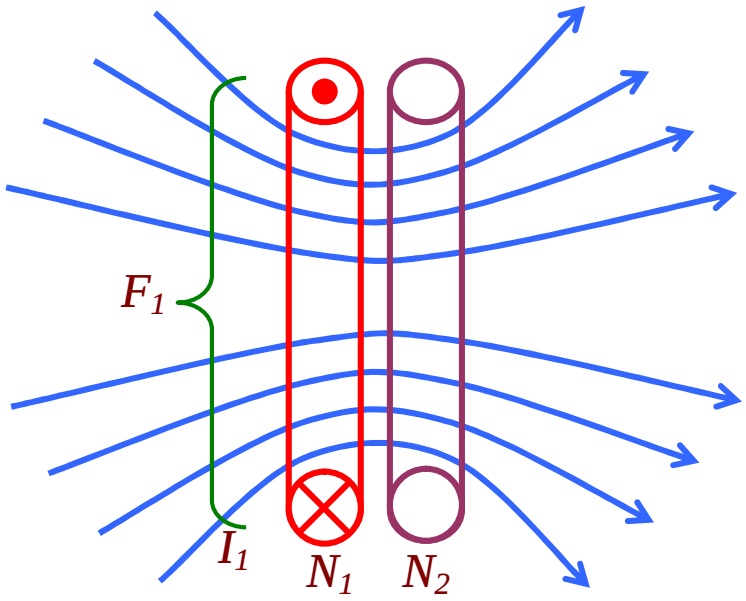


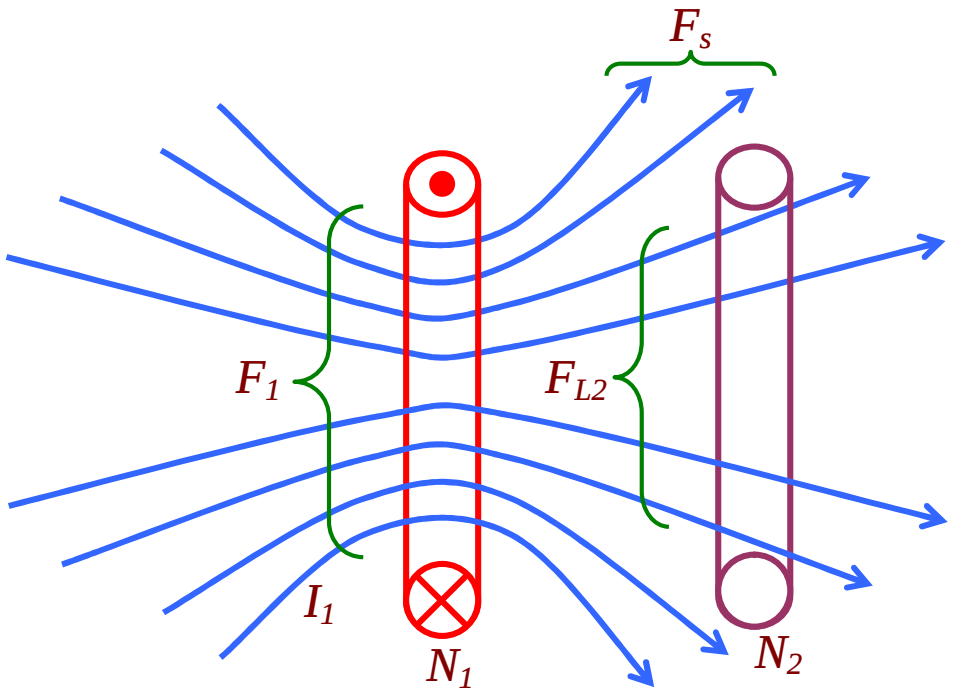
R_p – sozlovchi potensemetrik qarshilik
T – kuchaytiruvchi transformator
R_h – himoyalovchi qarshilik
1 – elektrodlar
2 – tekshiriluvchi dielektrik namuna

$$E_m = \frac{U}{h}$$

E_m – elektr mustahkamlik, kV/mm
U – kuchlanish, kV
h – elektr izolyatsiyalangan moddaning qalinlugi, mm

Tokli ikki o`tkazgichda o`zinduksiya xodisasi





N_1, N_2 – *1 va 2-chi o`tkazgichlar*

I_1 – *1-chi o`tkazgichdan o`tayotgan tokning kattaligi*

F_1 – *1-chi o`tkazgich atrofida hosil bo`lgan magnit oqimlari*

F_{L2} – *2-chi o`tkazgichdan o`tayotgan oqimlar qismi*

F_s – *2-chi o`tkazgichda o`tmaydigan o`qimlar*

Birinchi g`altakning xususiy oqimlashuvi

$$\psi_{1.1} = F_1 N_1 = L_1 I_1$$

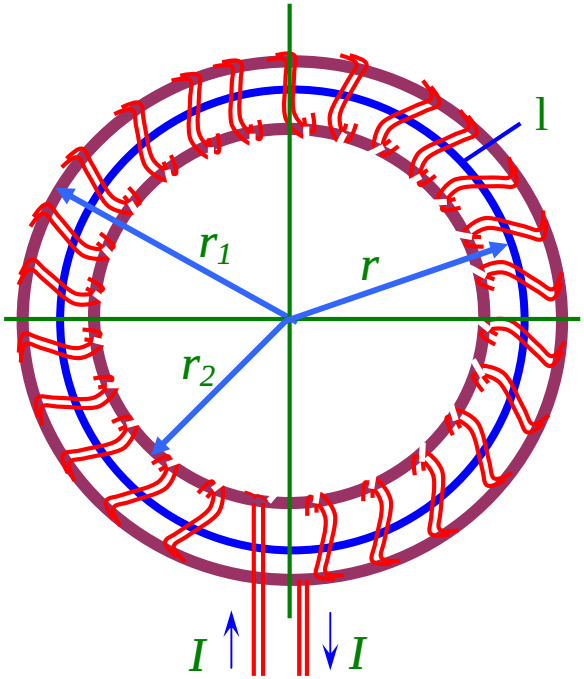
va o`zaro oqimlashuvi

$$\psi_{1.2} = F_1 N_2 = M_{1.2} I_1$$

L_1 – 1-chi g`altakning induktivligi

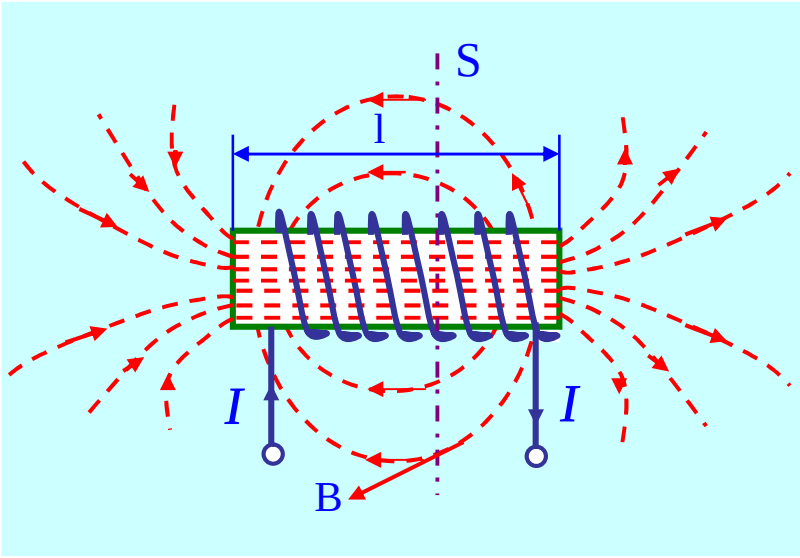
$M_{1.2}$ – o`zaro induktivlik

Magnit induksiyasi



I – toroiddan o`tuvchi tok kuchi
r_1 – toroidning tashqi kuchi
r_2 – toroidning ichki radiusi
r – toroidning markazgacha bo`lgan masofa

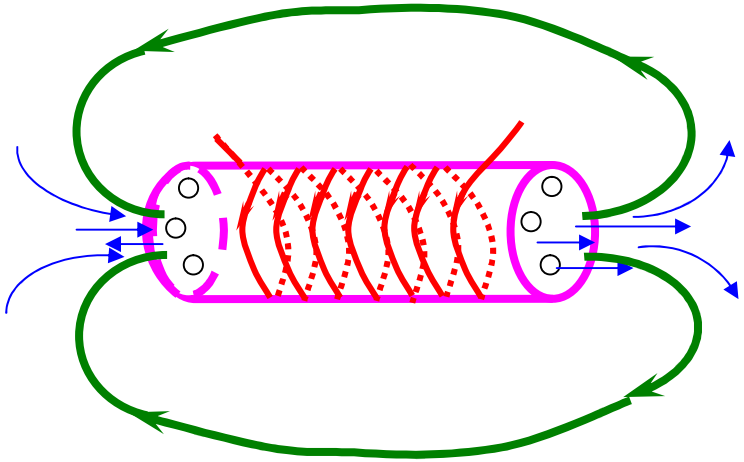
Bir jinsli magnit maydon hosil qilishda toroiddan foydalaniladi

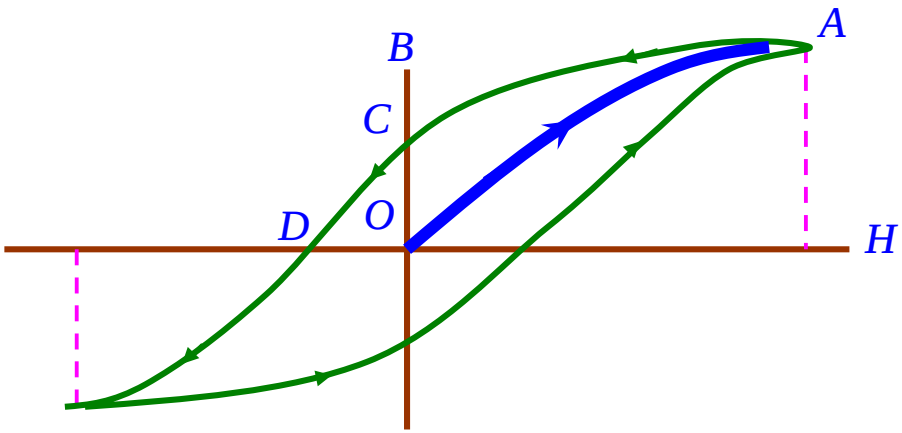


I – solinoidning uzunligi
I – tok kuchi
→ – magnit kuch chizig`larining yo`nalishi
B – magnit induksiya vektorining yo`nalishi

Solenoidning markazida bir jinsli magnit maydon hosil bo`ladi

Diyamagnetik va ferromagnetik jismlar

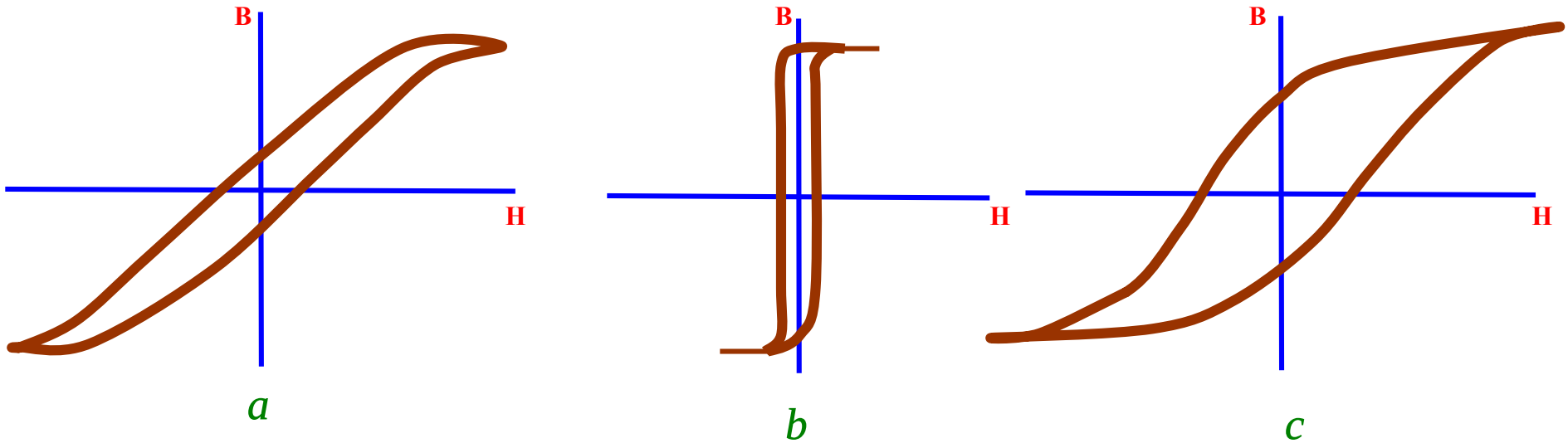




Diyamagnetik jismlarda tashqi magnit maydon ta'sirida uning magnitik xususiyati oshadi, $\mu > 1$. Normal sharoitda elementar toklarning yonalishlari issiqlik xarakati tufayli betartib bo`ladi, shu sababdan diyamagnetik jismlarda magnetik xususiyati sezilmaydi.

Ferromagnetik jismlarda B = f(H) funksional bog`lanish chiziqli bo`lmasdan murakkab ko`rinishda bo`ladi. Uni gesterezis sirtmog`i deyiladi. H ning qiymati oshganda B ning ham qiymati oshib OA chizig`i yyonaladi. H ning teskari yyonalishda kamaytirganimizda B ning qiymati AC chizig`i bo`yicha kamayib, H = 0 bo`lganda B≠0 bo`ladi. DO qismi koertsiativ kuch deyiladi

Moddalarning magnit xossalari



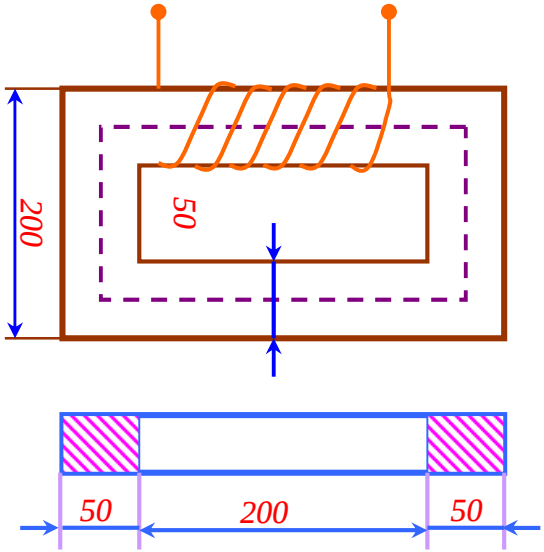
a *b* *c*

Magnit – yumshoq materiallar boshlang`ich va maksimal singdiruvchanlik qiymatlarining kattaligi va koersitiv kuch qiymatining kichigligi ($H_c \leq 400$ A/m) bilan tavsiflanadi. Ularning gistirizis sirtmog`i tor bo`ladi (a, b – rasmlar).

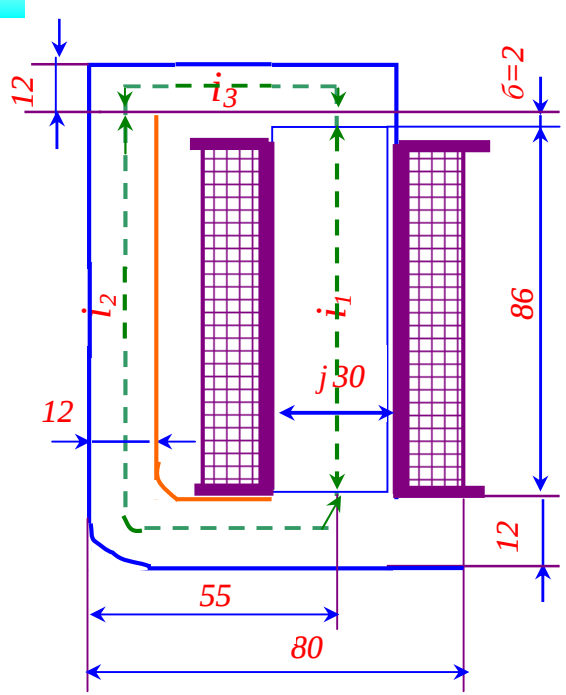
Temir – nikelli qotishmalar – permaloylarning magnit singdiruvchanligi yuqori, koersativ kuchi kam (b – rasm).

Asosiy metall magnit – yumshoq materiallar – kam uglerodli po`latlar, cho`yan doimiy magnit o`tkazgichlar sifatida ishlatiladi.

Tarmoqlanmagan magnit zanjirlar



Magnit zanjirning magnit oqimi tutashadigan qismi asosan ferromagnit materialdan tayyorlanadi va ***magnit o`tkazgich*** *deyiladi.*



Bir jinsli zanjir magnit o`tkazgichi butun uzunligi davomida bitta materialdan tayyorlangan va ko`ndalang kesimning shakli hamda o`lchamlari bir xil bo`ladi.

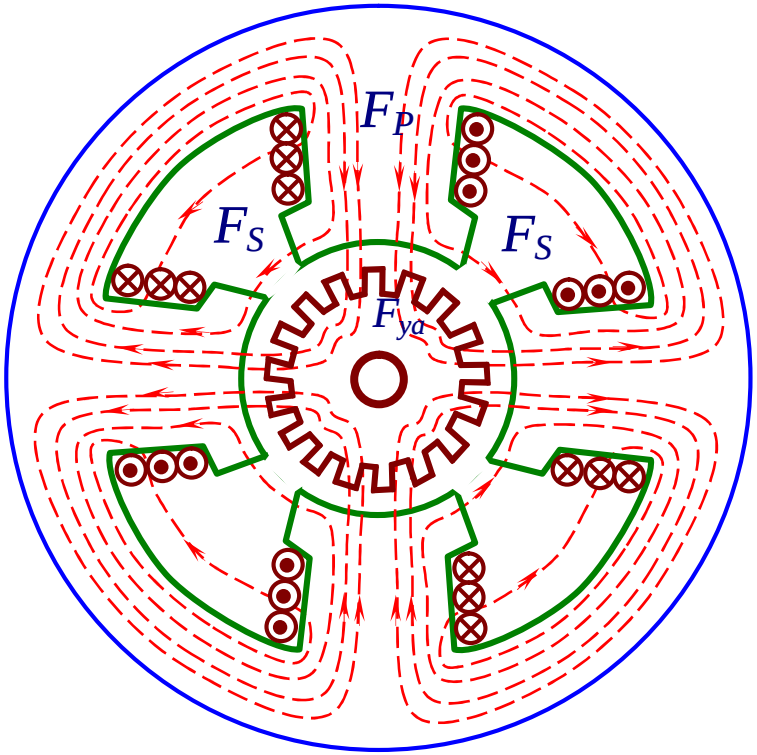
Har xil jinsli zanjirda magnit o`tkazgich bir – biridan umumiy holda uzunligi, ko`ndalang kesimi, materiali jihatidan farq qiladigan bir necha qismdan iborat.

Elektromagnit qurilmaning ferromagnit jismli qismida magnitlovchi kuch bo`lganda magniy oqimi hosil bo`ladi va u shu qismda tutashadigan bo`lsa, qurilmaning shu qismi ***magnit zanjiri*** *deyiladi.*

Tarmoqlangan magnit zanjirlar

Magnit oqimlar umumiy holda turli tarmoqlarda turlicha bo`ladi. Tarmoqlangan magnit zanjirlar uchun

$$\Sigma \Phi = 0$$
$$\Sigma F = \Sigma H l$$



Simmetrik tarmoq-langan magnit zan-jirlarini shartli ravishda shunday konturlarga ajratish mumkinki, ajratil-gan konturning barcha qismlarda magnit oqimi bir xil bo`lsin.

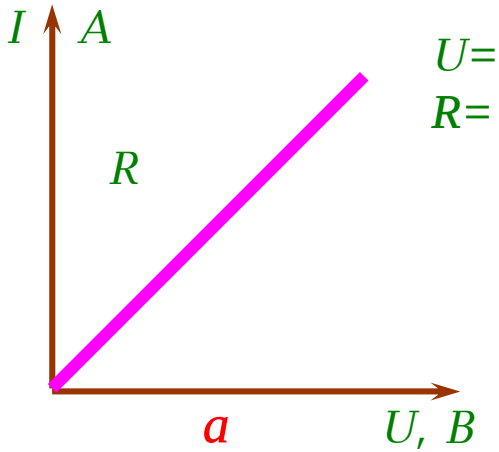
$$\Phi = \frac{IN}{R_M} = \frac{F}{R_M}$$

F_P – *normal magnit oqimlari*
F_S – *magnit oqimlar*
F_{Ya} – *yakor hosil qiluvchi magnit oqimlar*

$$\sum_1^k F_k = \sum_1^n H_n l_n = \sum_1^n U_{mn}$$

O`tkazgich, gaz – lampalari va diodlar VAXi

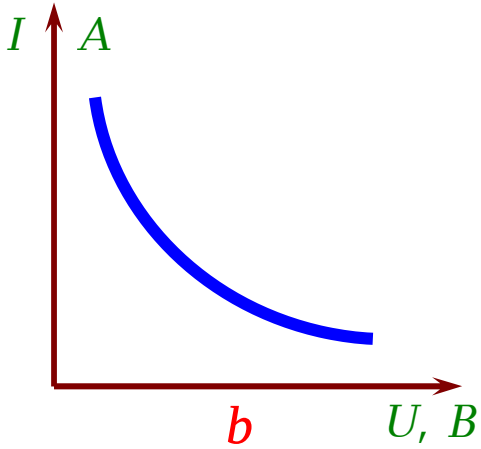
O`tkazgichning volt – amper (VAX) xarakteristikasi



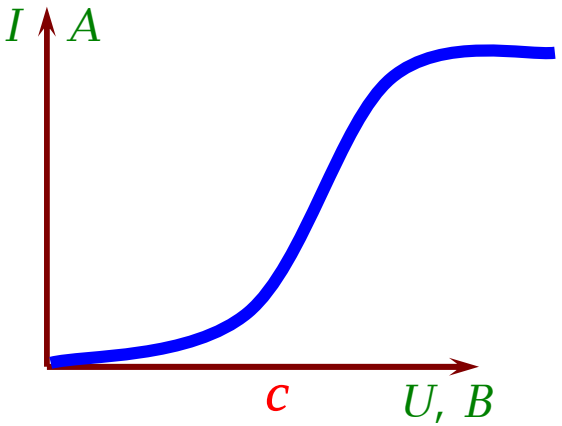
$U = RI$

R = const, qarshilik

Gaz (neon, argon, ksenon) to`ldirilgan lampalar VAX



Elektron lampa diodining VAX



VAX – volt-amper xarakteristika

I = f(U) – funksiyaning grafiklari

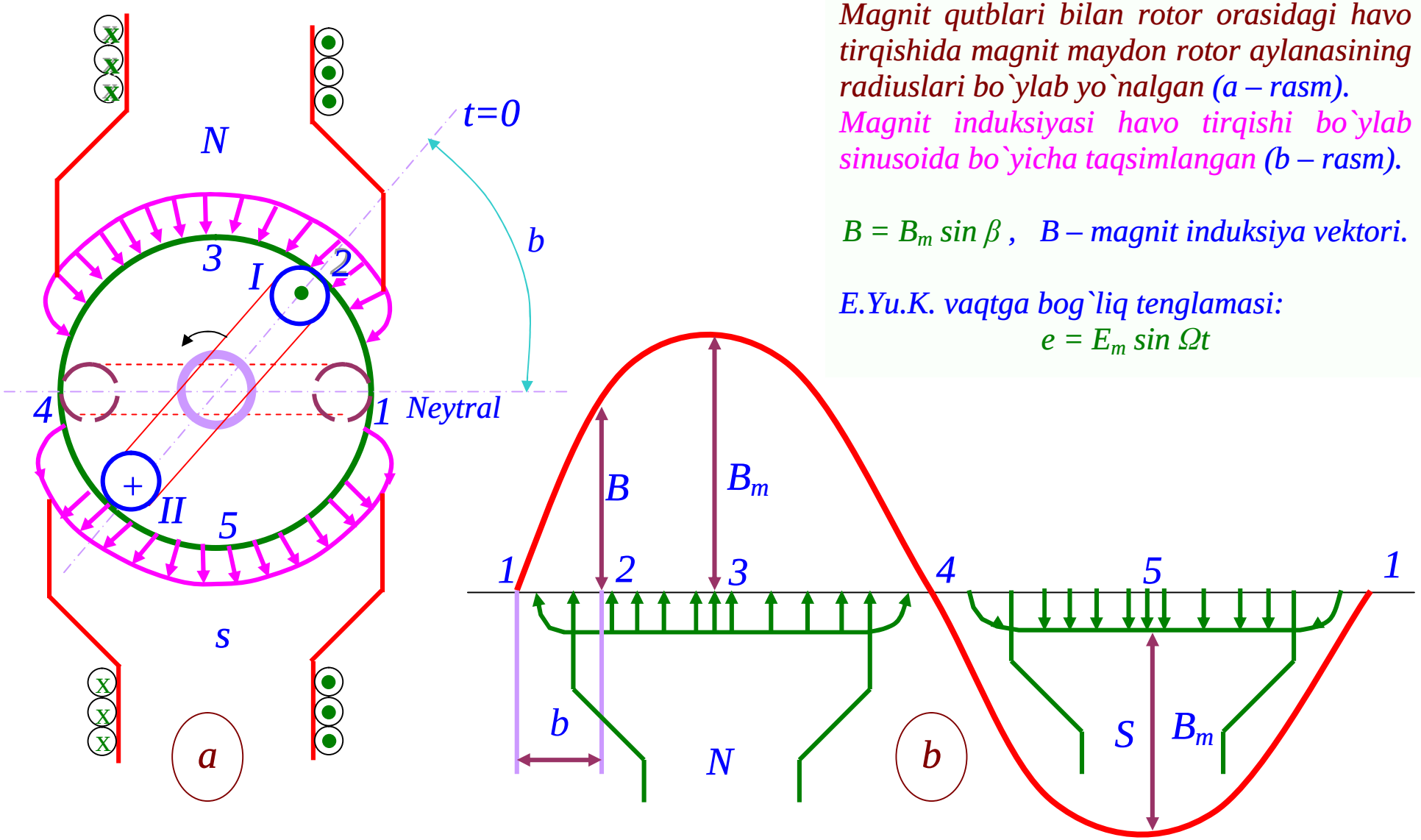
O`zgaruvchan tok generatorining E.Yu.K.si

Magnit qutblari bilan rotor orasidagi havo tirqishida magnit maydon rotor aylanasining radiuslari bo`ylab yo`nalgan (a – rasm).
Magnit induksiyasi havo tirqishi bo`ylab sinusoida bo`yicha taqsimlangan (b – rasm).

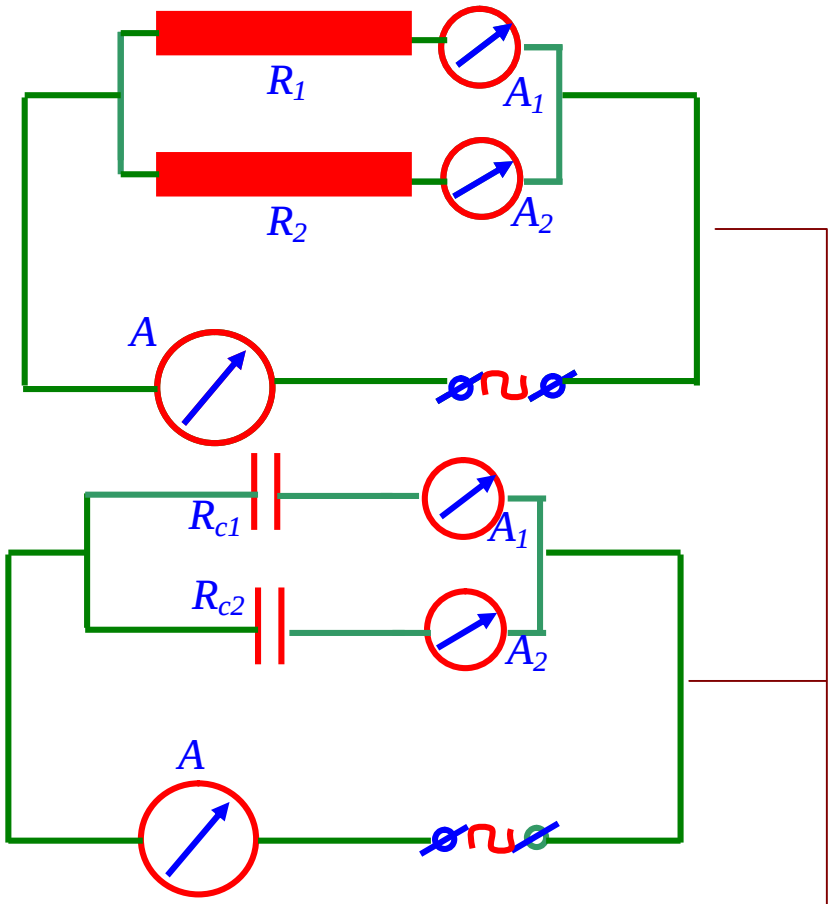
$B = B_m \sin \beta$, *B – magnit induksiya vektori.*

E.Yu.K. vaqtga bog`liq tenglamasi:

$$e = E_m \sin \Omega t$$

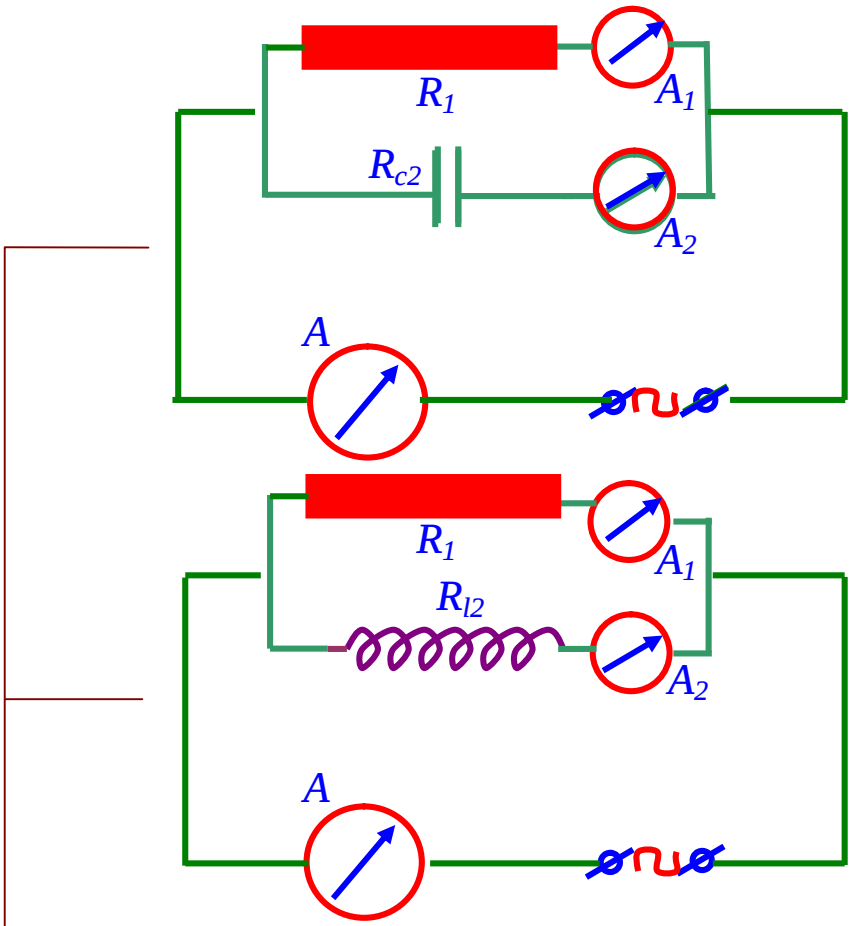


O`zgaruvchan tok zanjiriga qarshiliklar parallel ulanganda



O`zgaruvchi tok zanjiriga bir xil qarshiliklarni parallel ulanganda

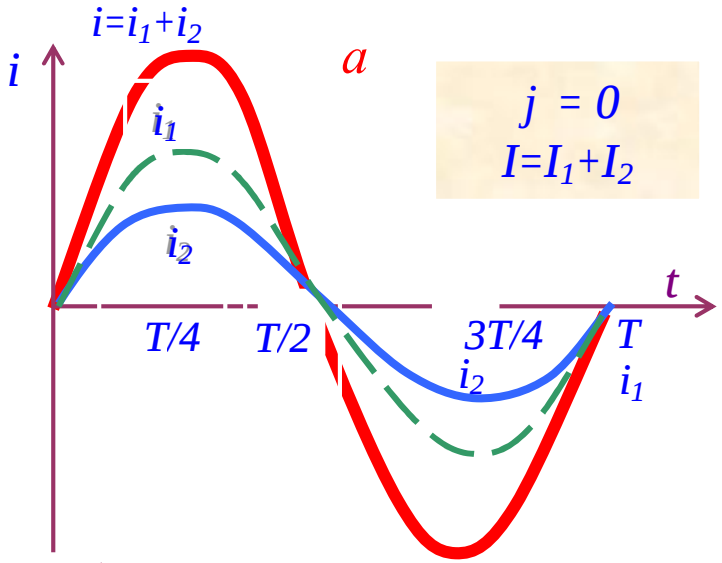
$$I = I_1 + I_2$$



O`zgaruvchi tok zanjiriga har xil qarshiliklarni parallel ulanganda

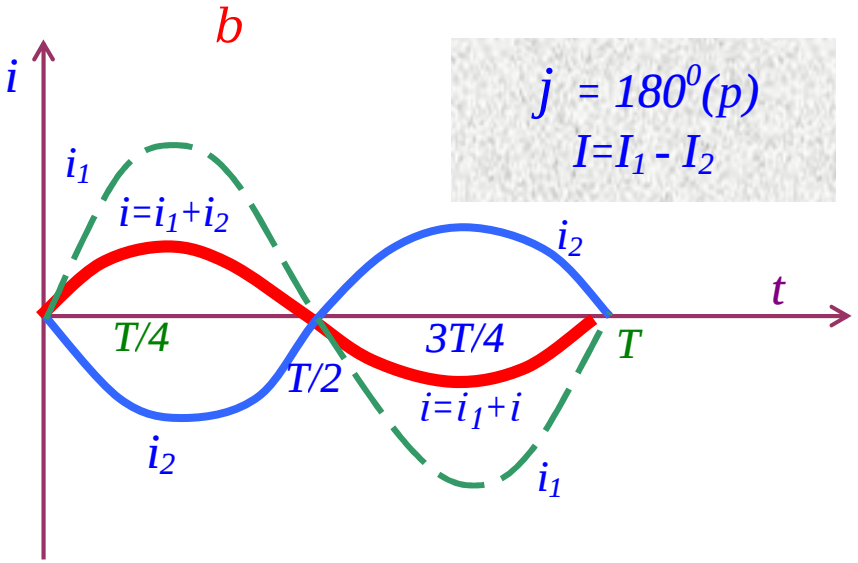
$$I_1 + I_2 > I > I_1 - I_2$$

O`zgaruvchan sinusoidal ikkita toklarni qo`shish grafiklari



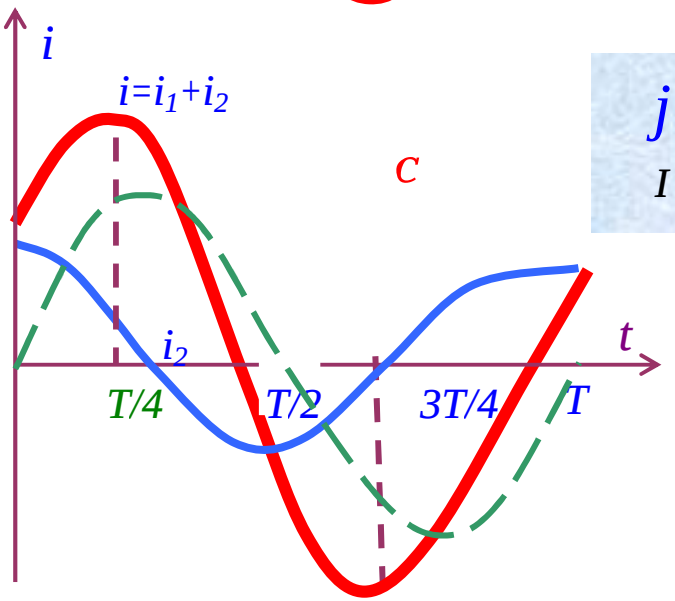
$j = 0$

$I = I_1 + I_2$



$j = 180^0(p)$

$I = I_1 - I_2$



$j = 90^0(p/2)$

$I = \sqrt{I_1^2 + I_2^2}$

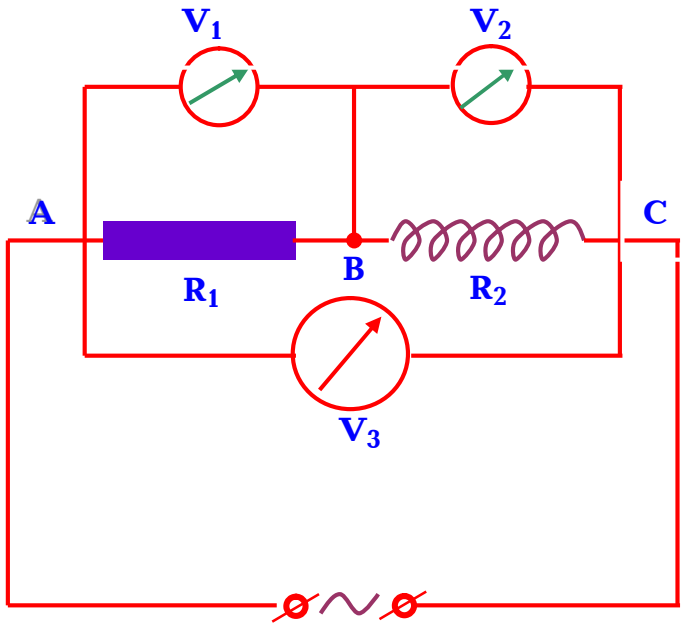
Qo`shiluvchi toklarning fazalari bir xil (a-rasm).

Qo`shiluvchi toklarning fazalari qarama qarshi (b-rasm).

Qo`shiluvchi toklarning fazalari 90^0 farq qiladi (c-rasm).

Natijaviy o`zgaruvchan tokning oniy qiymati toklarning fazalar farqiga bog`liq.

O`zgaruvchan tok zanjiriga qarshiliklar ketma-ket ulanganda



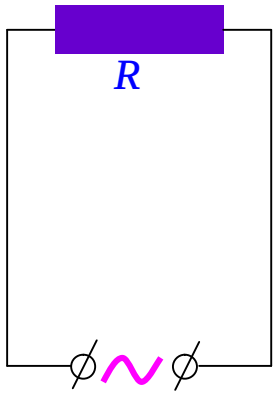
Agar $R_1=R_2$
$U_{AC}=U_{AB}+U_{BC}$

Umumiy holda kuchlanishning oniy qiymati $u=u_1+u_2$

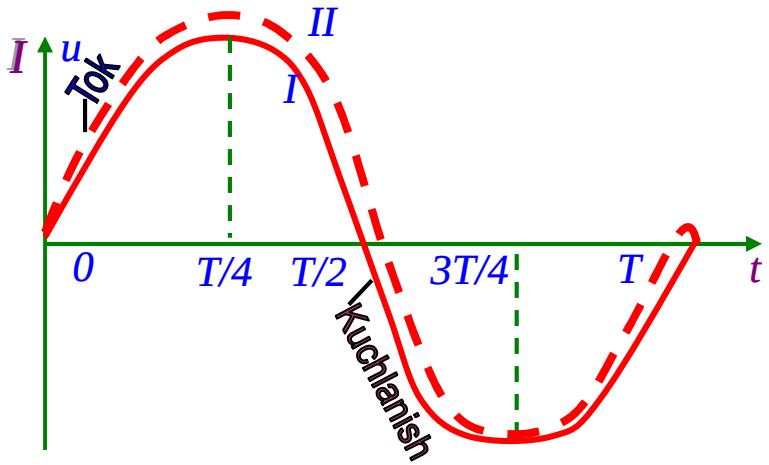
Agarda R_1 *va* R_2 *larning tabiatlari ha xhil bo'lsa,*
$U_{AC}<U_{AB}+U_{BC}$

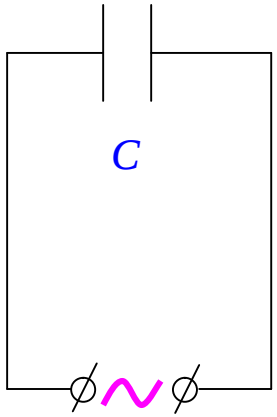
O'zgaruvchan tok zanjiriga qarshiliklarni ketma-ket ulanganda ularning kuchlanishi qo'shiladi ya'ni $R_{AB}+R_{BC}$ *lekin* $R_{BC}=R_L$ *induktiv g`altakning qarshiligi*
V_1 *voltmetr zanjirning AB qismidagi kuchlanish tushushini o'lchaydi*
V_2 *voltmetr zanjirning BC qismidagi kuchlanish tushushini o'lchaydi*
V_3 *voltmetr zanjirning AC qismidagi kuchlanish tushushini o'lchaydi*

O`zgaruvchan tok zanjiriga qarshilik va sig`imni ulanganda tok bilan kuchlanish orasida fazalar farqi

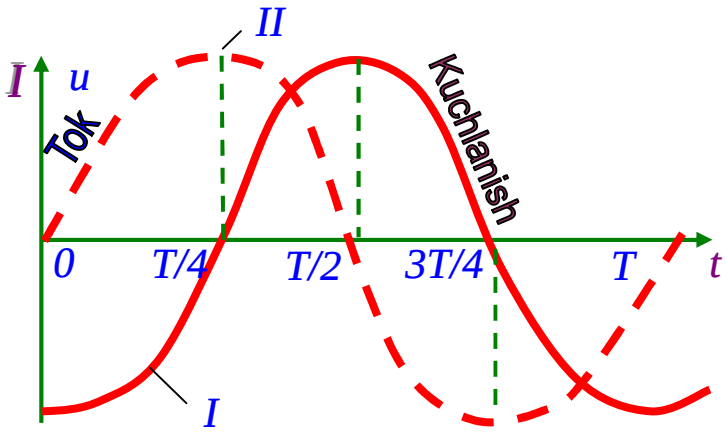


$$e = I\,R$$



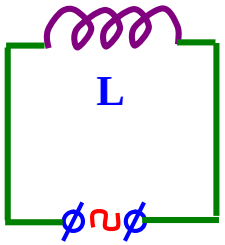


$$e = \frac{I}{\nu\, c} = I \cdot R_c$$

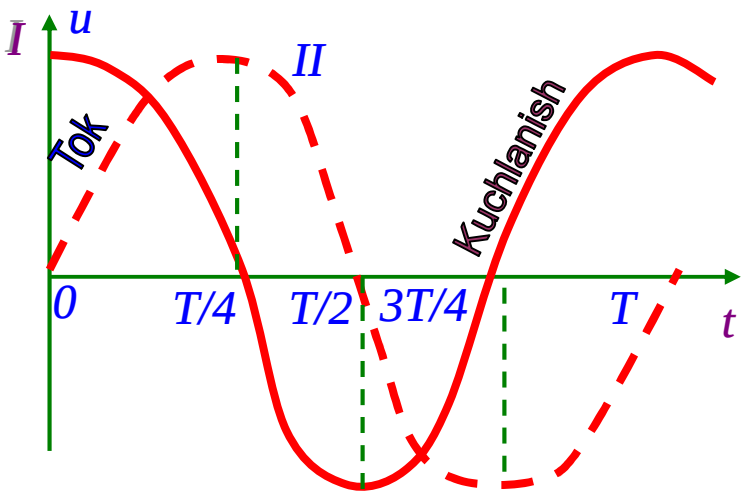


e- o`zgaruvchan elektr yurutuvchi kuch, w-o`zgaruvchan tokning chastotasi, c-kondensator sig`imi

O`zgaruvchan tok zanjiriga g`altak ulanganda tok bilan kuchlanish orasida fazalar farqi



$$e=I\ w\ L=I\ R_L$$



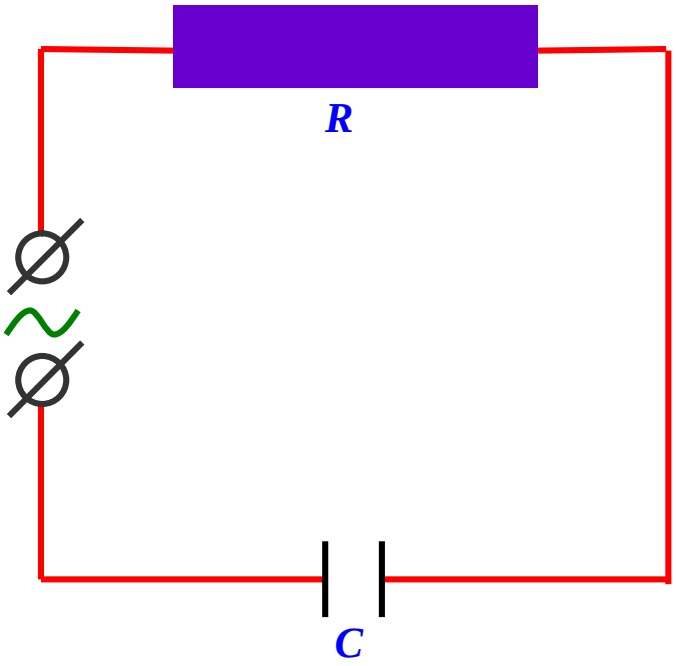
Tok va kuchlanish orasidagi fazalar farqi φ quyidagi ifoda yordamida aniqlanadi

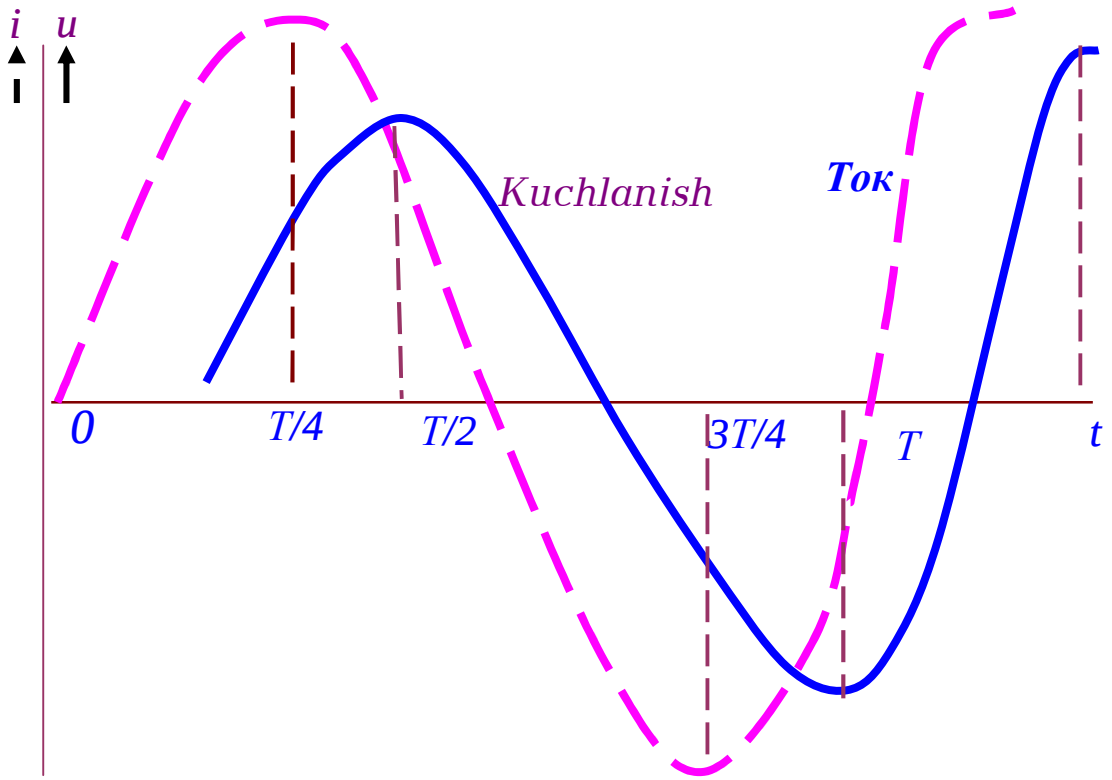
$$tgj = \frac{R_L}{R_{om}} = \frac{L \cdot w}{R_{om}}$$

L-g`altakning induktivligi, ω-o`zgaruvchan tok chastotasi, R_{om}-o`tkazgich qarshiligi.
Zanjirga sig`im ulanganda φ faza siljishi quyidagi ifoda bilan aniqlanadi

$$tgj = \frac{R_c}{R_{om}} = \frac{1}{R \cdot wC}$$

Qarshilik va sig`im ulangan o'zgaruvchan tok zanjiri



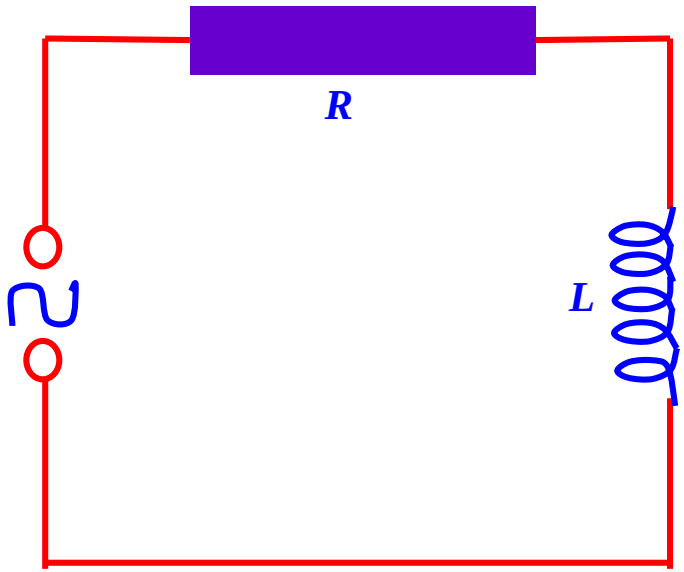


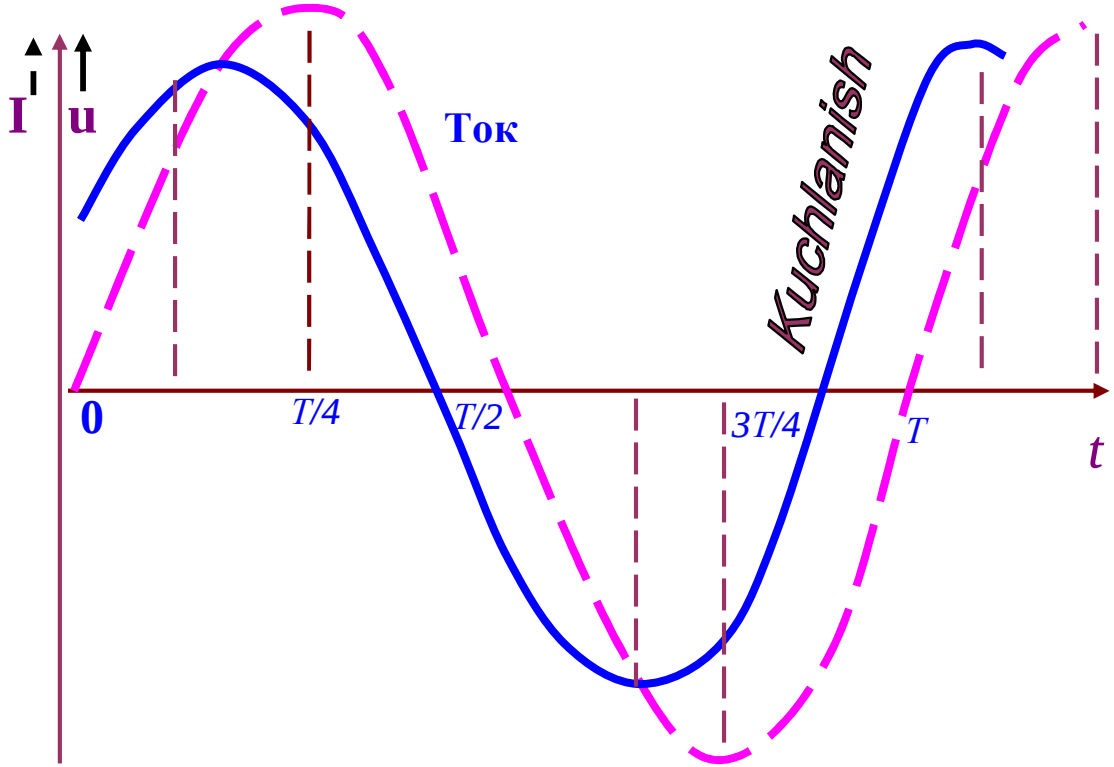
O`zgaruvchan tok zanjiriga R – qarshilik va C – kondensator ulanganda tok va kuchlanish tushish orasida j faza farqi vujudga keladi. Uning kattaligini quyidagi formula yordamida aniqlanadi:

$$tg\,j = \frac{R_c}{R_{om}} = \frac{1}{R \bullet wC}$$

R – aktiv qarshilik, $\frac{1}{wC}$ *- sig`im qarshiligi bo`lib, reaktiv qarshilik deyiladi.*

Qarshilik va g`altak ulangan o'zgaruvchan elektr tok zanjiri



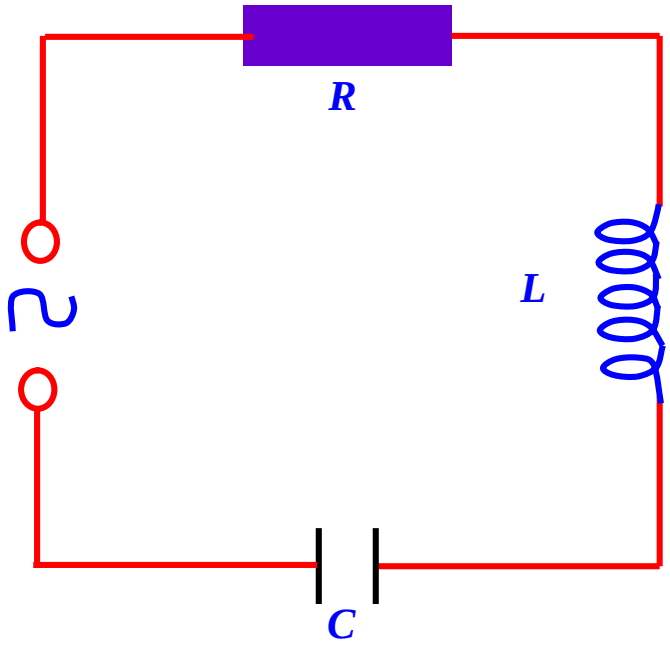


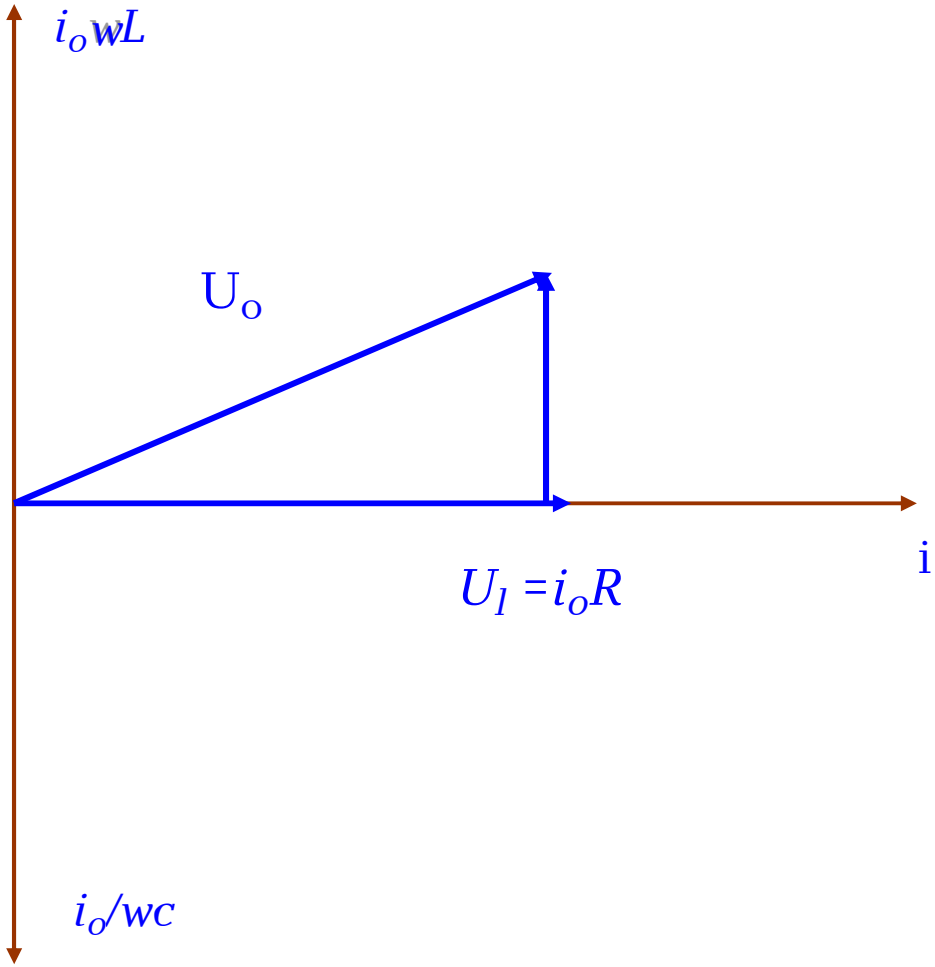
O`zgaruvchan tok zanjiriga R – qarshilik va L –g`altak ulanganda tok va kuchlanish tushish orasida j faza farqi vujudga keladi. Uning kattaligini quyidagi formula yordamida aniqlanadi:

$$tg\,j = \frac{R_L}{R_{om}} = \frac{L \cdot w}{R_{om}}$$

R – aktiv qarshilik, $L \cdot w$ - g`altak qarshiligi bo`lib, reaktiv qarshilik deyiladi.

RLC – o'zgaruvchan tok zanjiriga ketma – ket ulangan





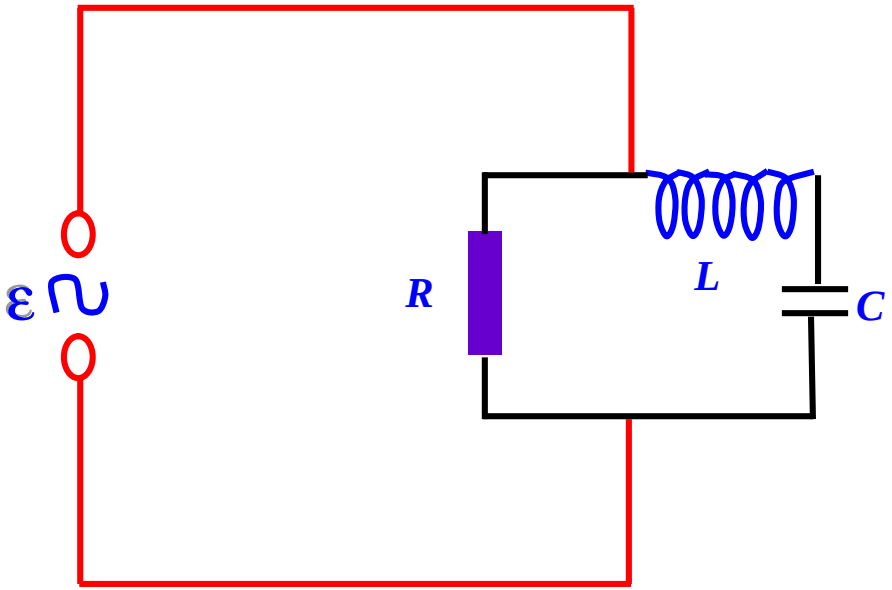
R–qarshilik C–sigim L–galtak

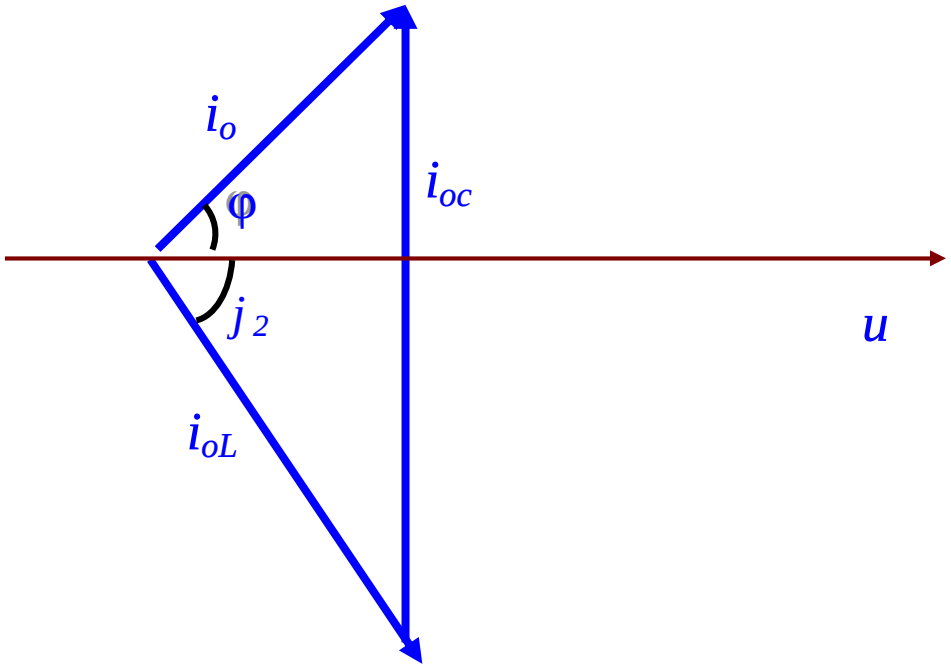
$$u = \frac{i}{\sqrt{R^2 + (w \cdot L - 1/w \cdot C)^2}}$$

$$\mathrm{tg}\varphi = (\omega L - 1/\omega C)/R$$

RLC–zanjirning kuchlanish vektor diagrammasi;
U_a–kuchlanishning aktiv tashkil etuvchisi;
U_z– kuchlanishning reaktiv tashkil etuvchisi.

RLC – o'zgaruvchan tok zanjiriga parallel ulangan

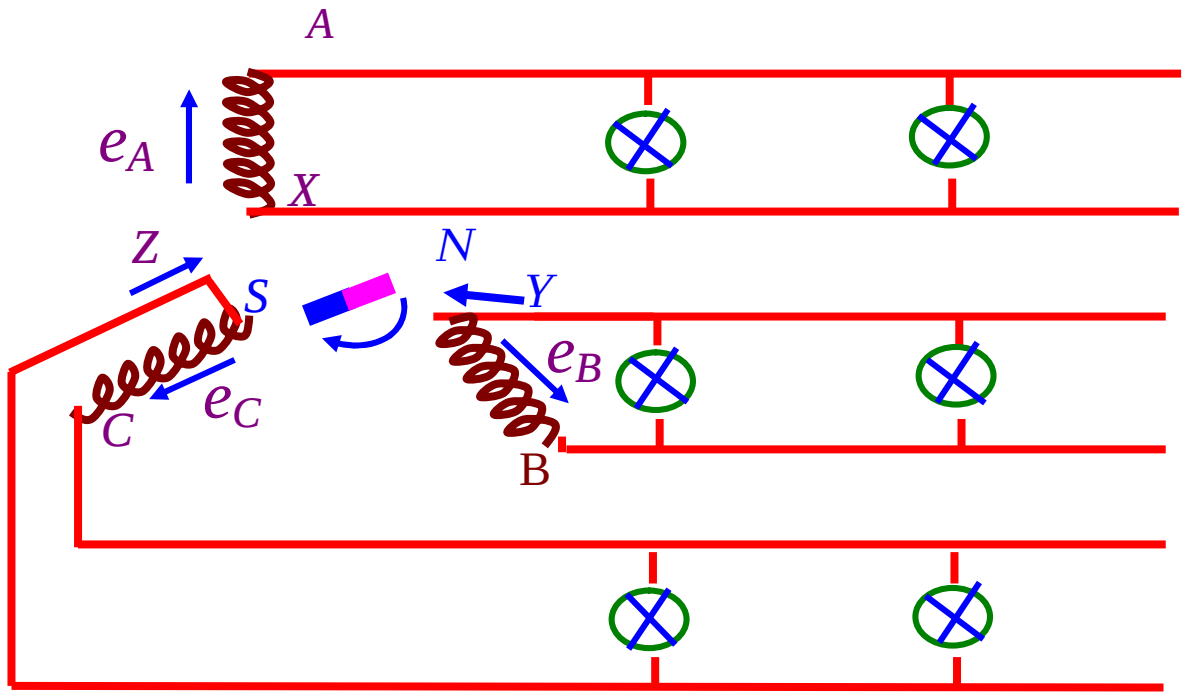




R–qarshilik, L–g'altak, C–sig'im, e-*o`zgaruvchan elektr manbayi*

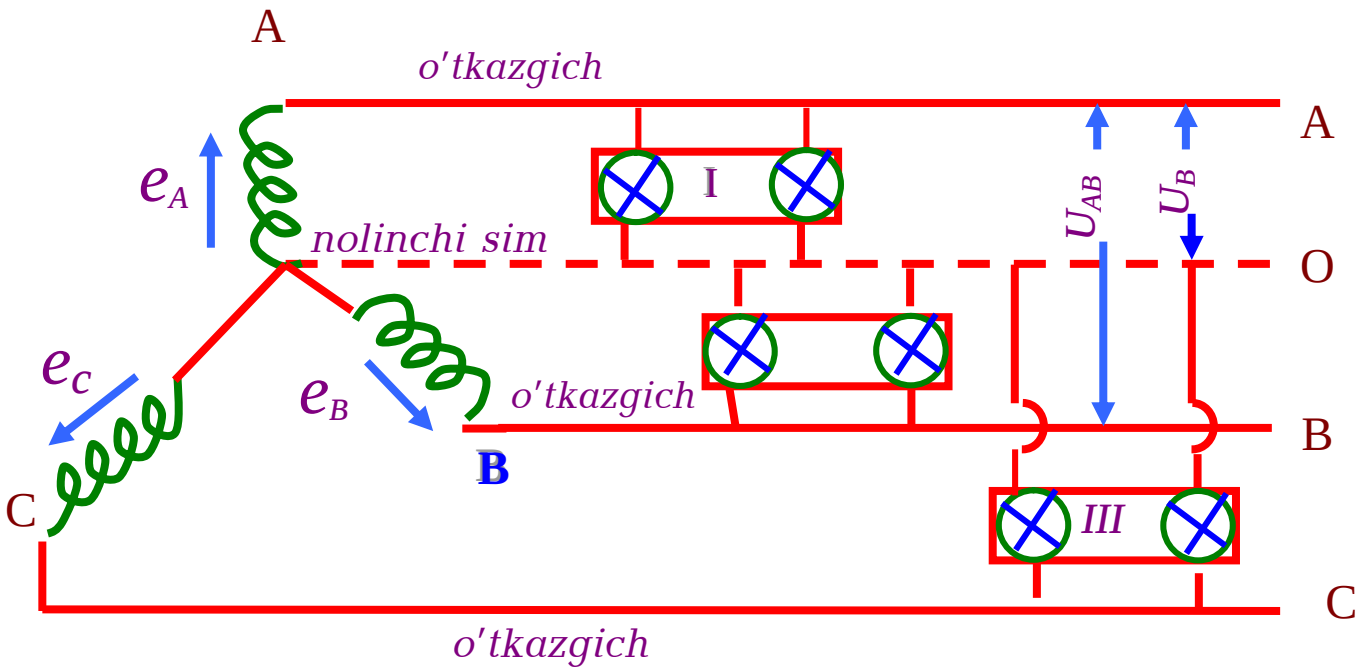
RLC–zanjirni parallel ulashda tok vektor diagrammasi

Uch fazali tok



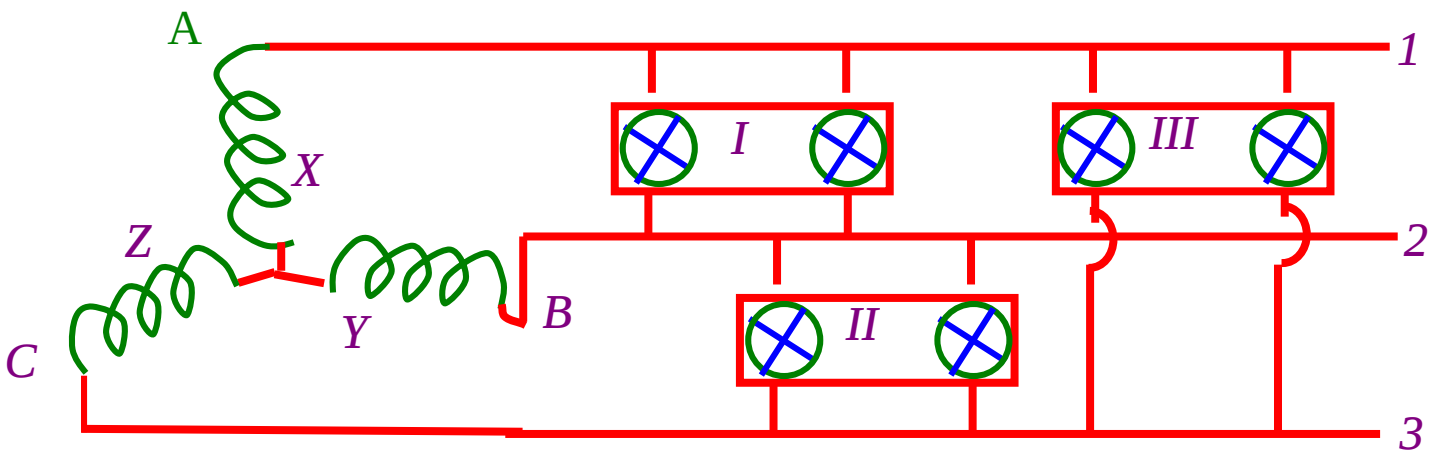
NS- doimiy magnitik, e_A, e_B, e_C – yakrda hosil bo`luvchi o`zgaruvchan elektr yurutuvchi kuchlar, ▬ - yakr uchlaruga ulangan o`tkazgichlar, ⊗ - yorutuvchi lampalar. Chizmada uch fazali o`zgaruvchan tok generatorining yakrlariga tashqi manbalarni ulash sxemasi keltirilgan.

Uch fazali generatorni tashqi zanjirga yulduz usulda ulash



Uch fazali generatorning uchlariga yulduzcha usulda ulangan simlar L–lampalar turkumini tok bilan ta'minlashdi uch fazani generator chulg'amlarini yulduzcha ulash to'rtta o'tkazgichdan foydalanishi.

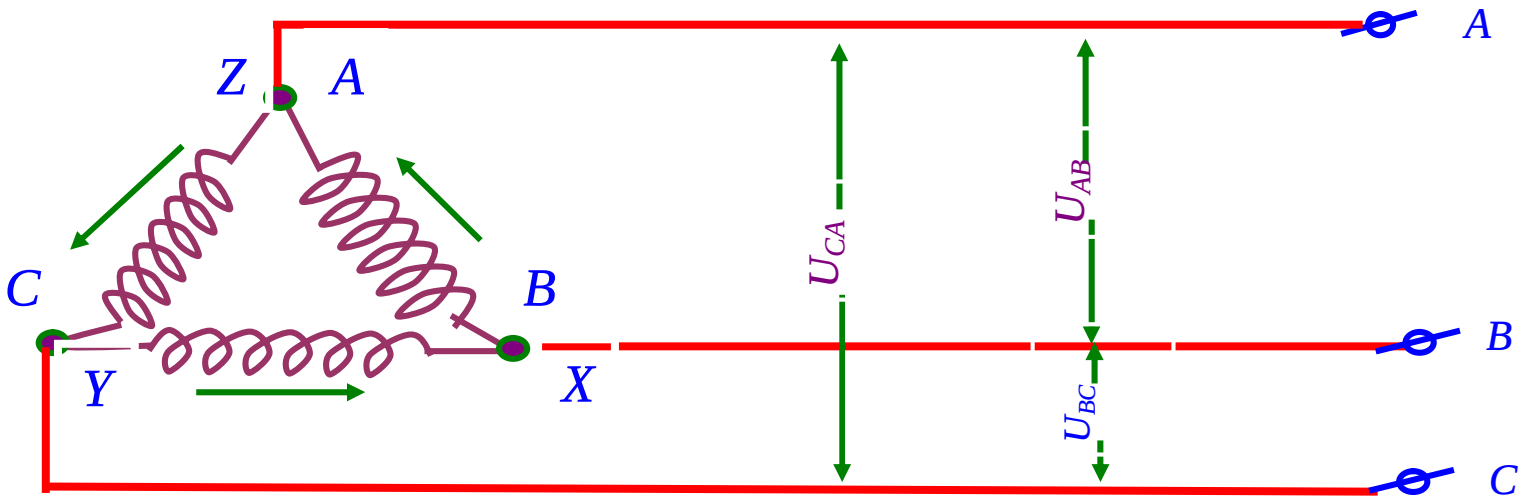
Uch fazali generator kuchlanishni foydalanishda yulduzcha usilda uchta o’tkazgichlarni qo`llash



Uch fazali generator cho`lg`amlarini tashqi zanjirga ulasdda uchta o`tkazgichdan foydalanish usulining sxemasi.

$U_{o`} = \sqrt{3} \cdot U_f \approx 1{,}73 \cdot U_f$ *$U_f$ - generator fazalarida hosil bo`luvchi kuchlanish. Agarda U_f =200 V bo`lsa $U_{o`}$ =380 V bo`ladi. Bu hisob generator cho`lg`amlarida hosil bo`luvchi toklarning kattaligi bir xil bo`lganda o`rinli.*

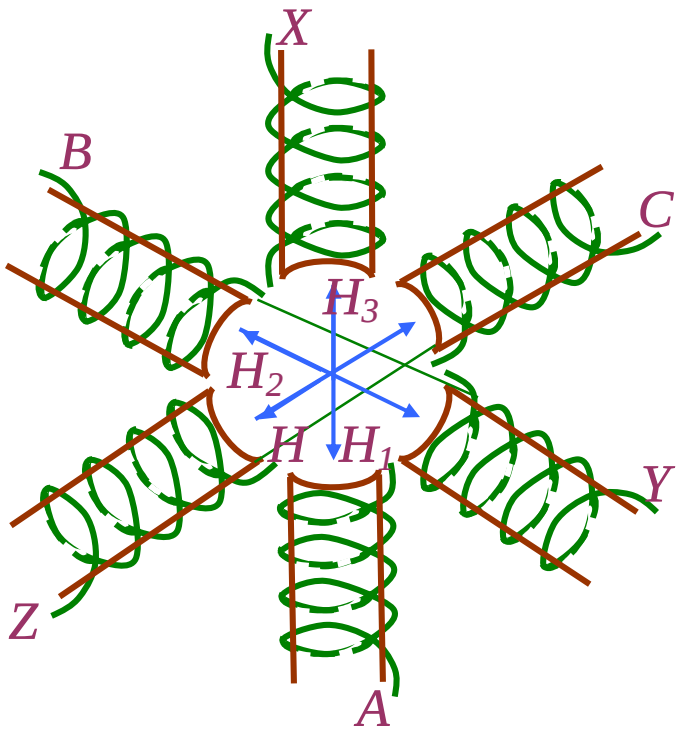
Uch fazali generatorni tashqi zanjirga ulashda uchburchak usuli

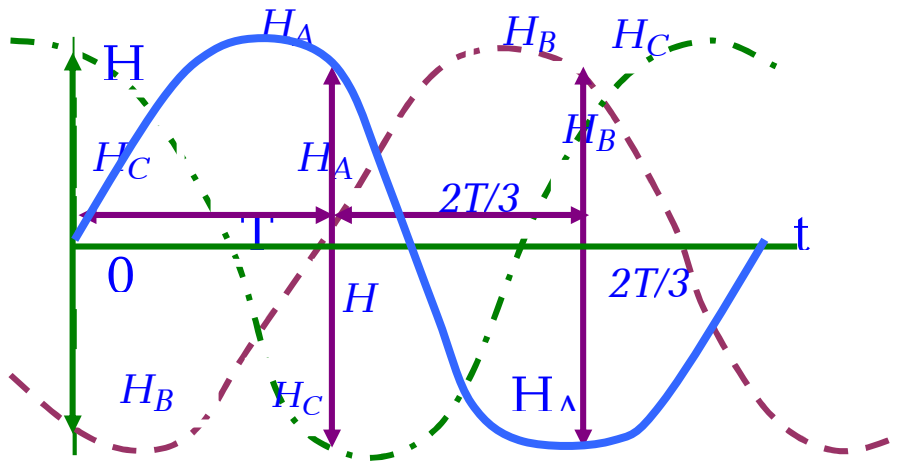


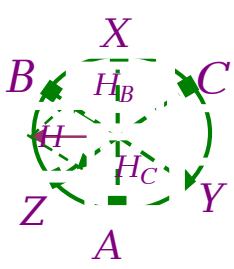
Uch fazali generator cho`lg`amlarini tashqi zanjirga ulashda uchburchak usulidan foydalanganda uchta o`tkazgichlar yetarli bo`ladi. O`tkazgichlar uchburchakning A,B va C cho`qqilariga ulanadi, uchburchak usulida ulanganda generatorning chiziqli kuchlanishi faza kuchlanishiga teng bo`ladi.

$U_o=U_f$. Shunday qilib, generator cho`lg`amlarini uchburchak usulida ulanganida o`tkazgichdagi kuchlanish tushish 1,73 marta kichik bo`ladi.

Uchta sinusoidal maydonlar qo`shilganda aylanuvchi magnit maydonni hosil qilish

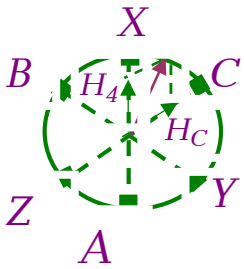






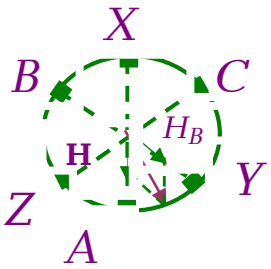
$t = B; H_A = 0$

$H \perp XA$



$t = \frac{T}{3}; H_B = 0$

$H \perp YB$

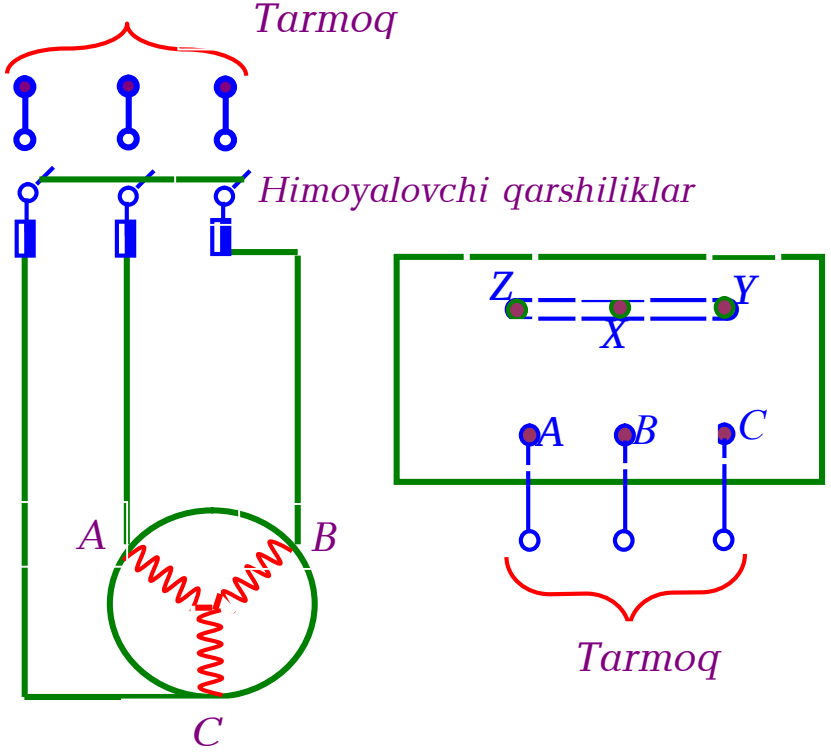


$t = \frac{2T}{3}; H_c = 0$

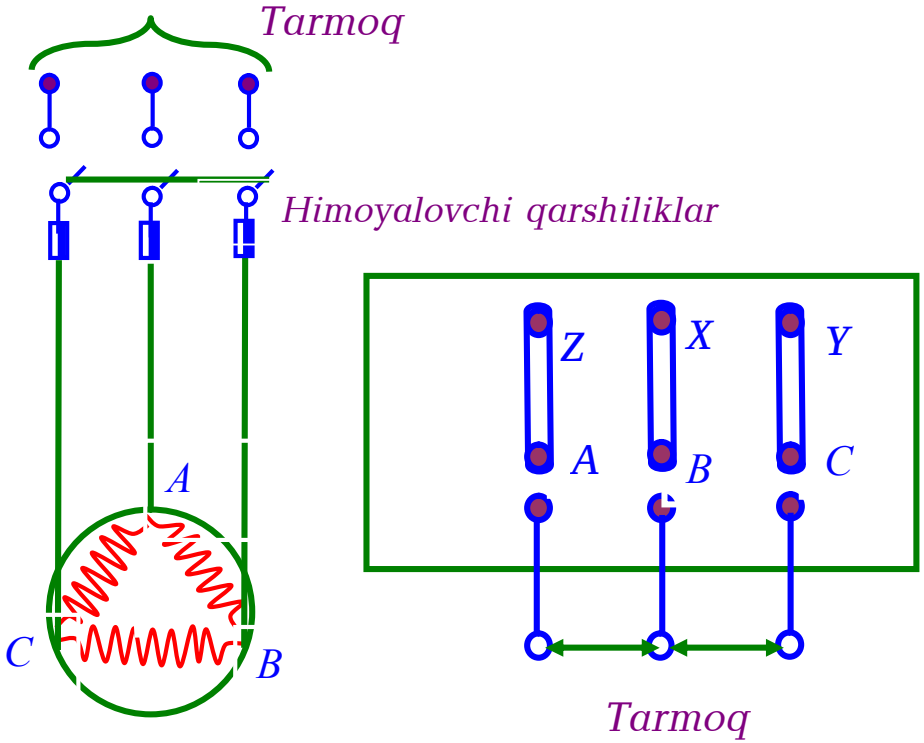
$H \perp ZC$

Bir–birini nisbatan 120^0 da yo'nalgan uchta sinusoidal maydon hosil qilish aylanuvchan magnit maydoni hosil qilish. XA,YB, ZC магнит maydonni hosil qiluvchi g'altaklardir.

Stator cho`lg`amlarini ulash usullari

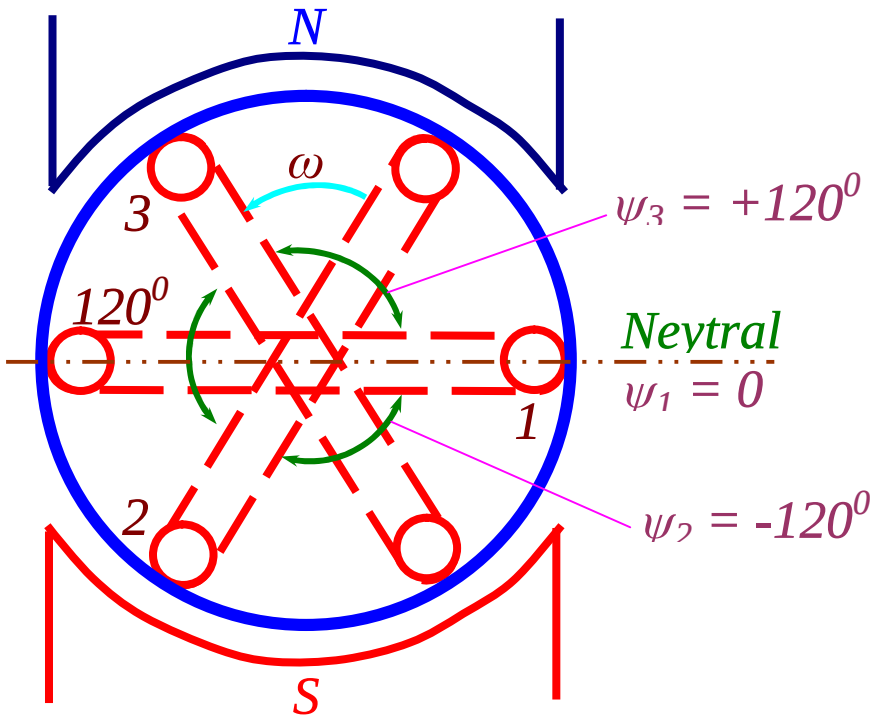


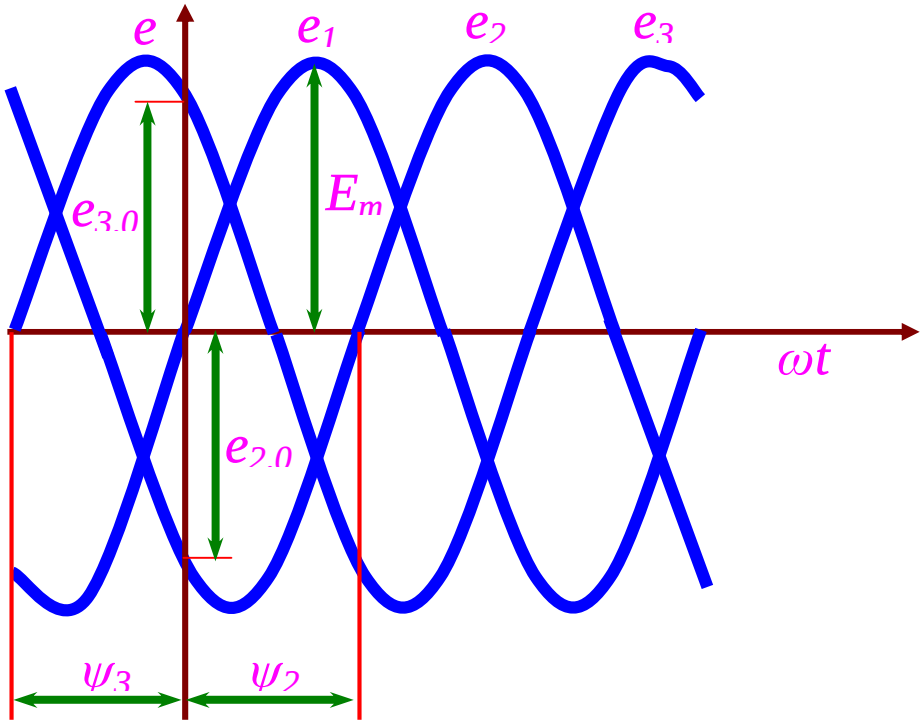
Stator cho`lg'amlatrini yulduzcha usulida ulash



Stator cho`lg'amlatrini uchburchak usulida ulash

Uch fazali elektr yurituvchi kuch





Magnit maydondagi rotor soat miliga qarama –qarshi aylanadi

$$e_A = E_m \sin \omega t;$$
$$e_B = E_m \sin (\omega t - 120^0);$$
$$e_c = E_m \sin (\omega t + 120^0)$$

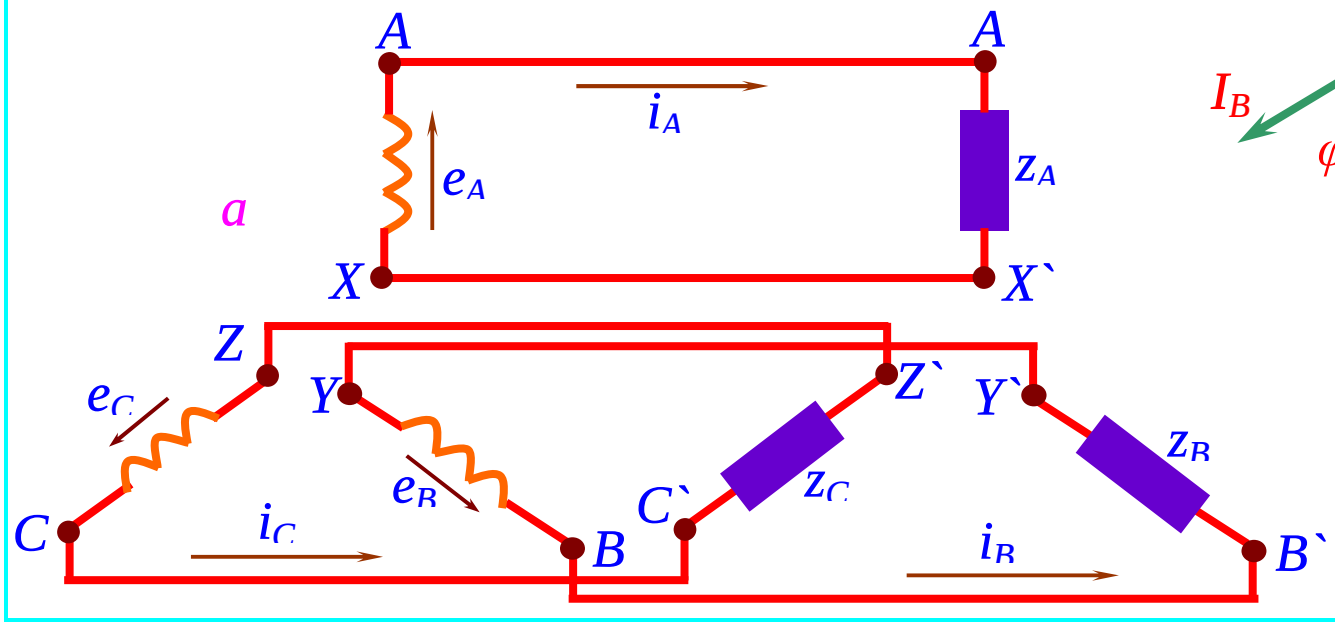
ψ_2, ψ_3 – *faza siljishlari*

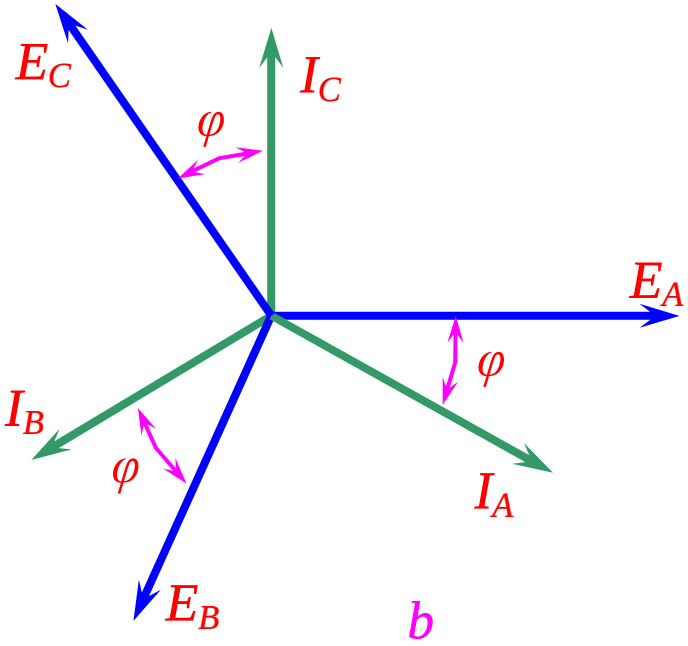
E_m – *maksimal amplituda*

$e_{2.0}, e_{3.0}$ – *amplitudalarning oniy qiymatlari*

Elektr yurituvchi kuchning uch fazali simmetrik sistemalari

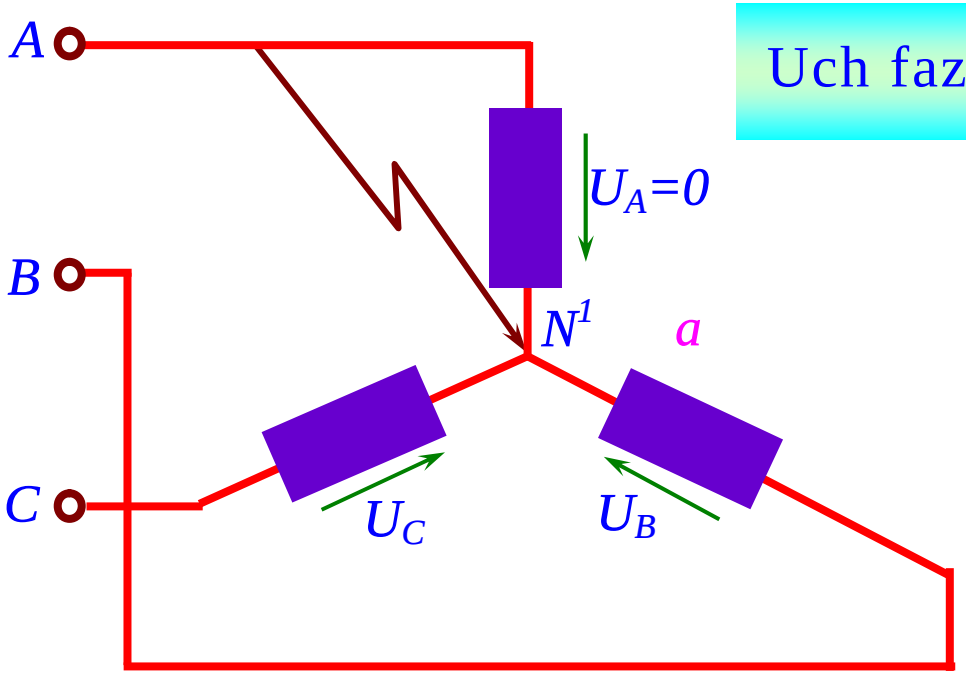
Uch fazali generatorning cho`lg`amlarida hosil bo`lgan elektr yurituvchi kuch (E.Yu.k.) X, Y, Z uchlaridan A, B, C boshlang`ich nuqtalarga tomon yo`nalishi musbat deb qabul qilingan. E.Yu.k. va toklarning tegishli vektor diagrammasi b - rasmda ko`rsatilgan. Manbaning har bir cho`lg`amini alohida iste'molchi bilan ulash va uchta mustaqil zanjir hosil qilish mumkin, ulardan har birining alohida toki i_A, i_B, i_C bo`ladi.





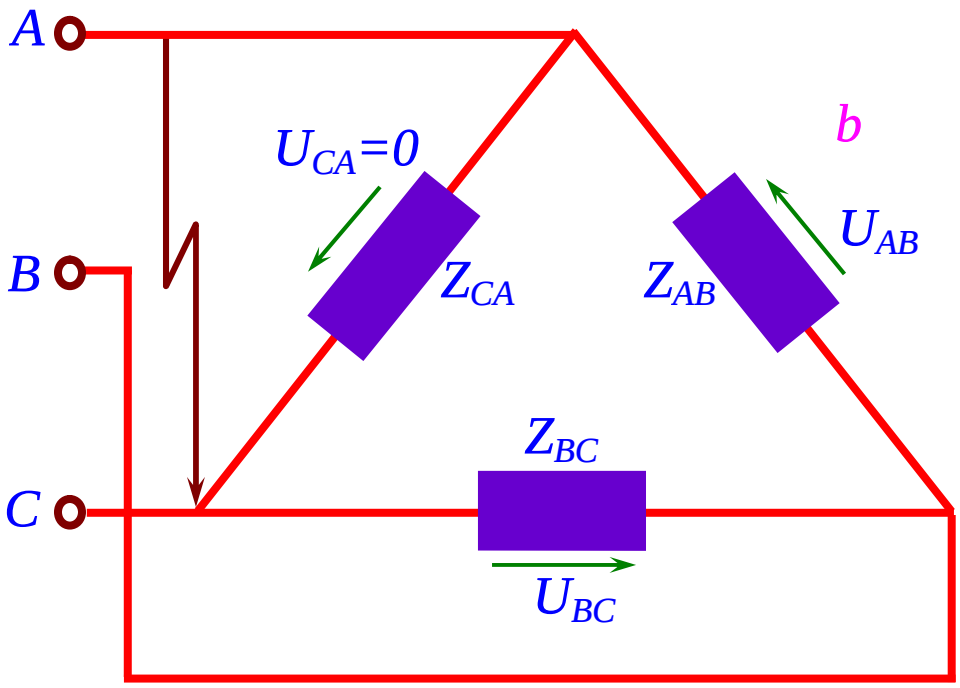
φ – tok kuchi va e.yu.k. orasidagi faza

Uch fazali zanjirlarda avariya rejimlari

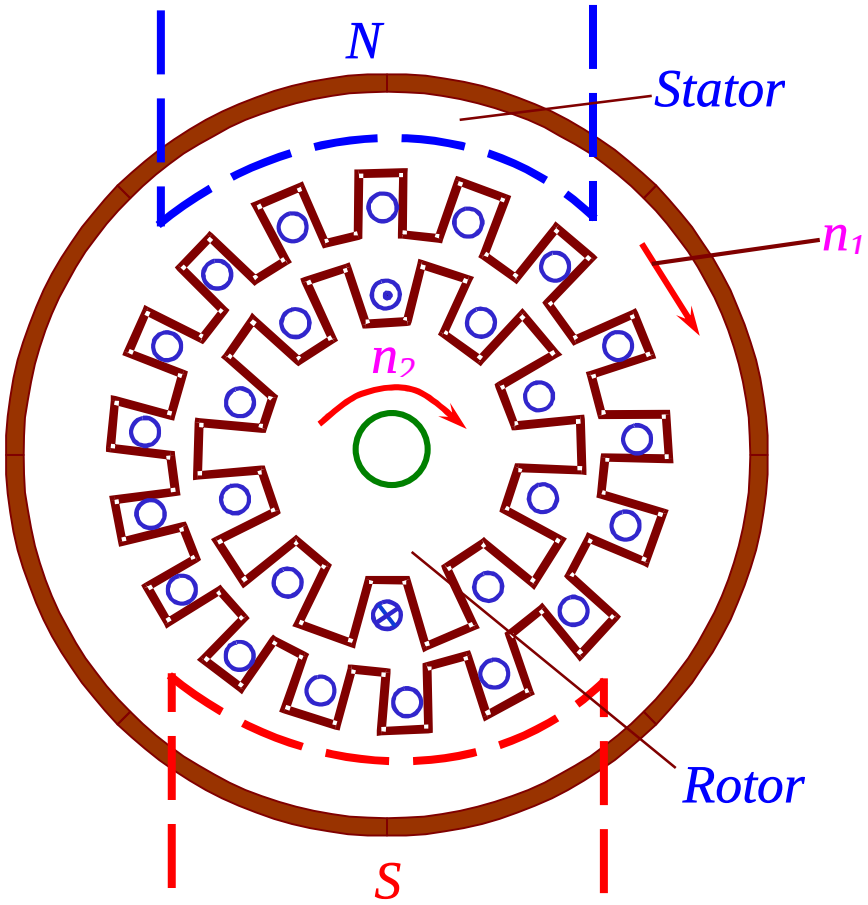


Iste'molchi uchburchak usulida ulanganda A fazada (b – rasm) liniya simining uzulishi sxemani ikkita Z_{AB}, Z_{CA} fazalar liniya kuchlanishi U_{BC} ga ketma – ket ulangan bo`lib qoladi. Uchinchi faza $Z_{BC}$ normal kuchlanish ostida bo`ladi.

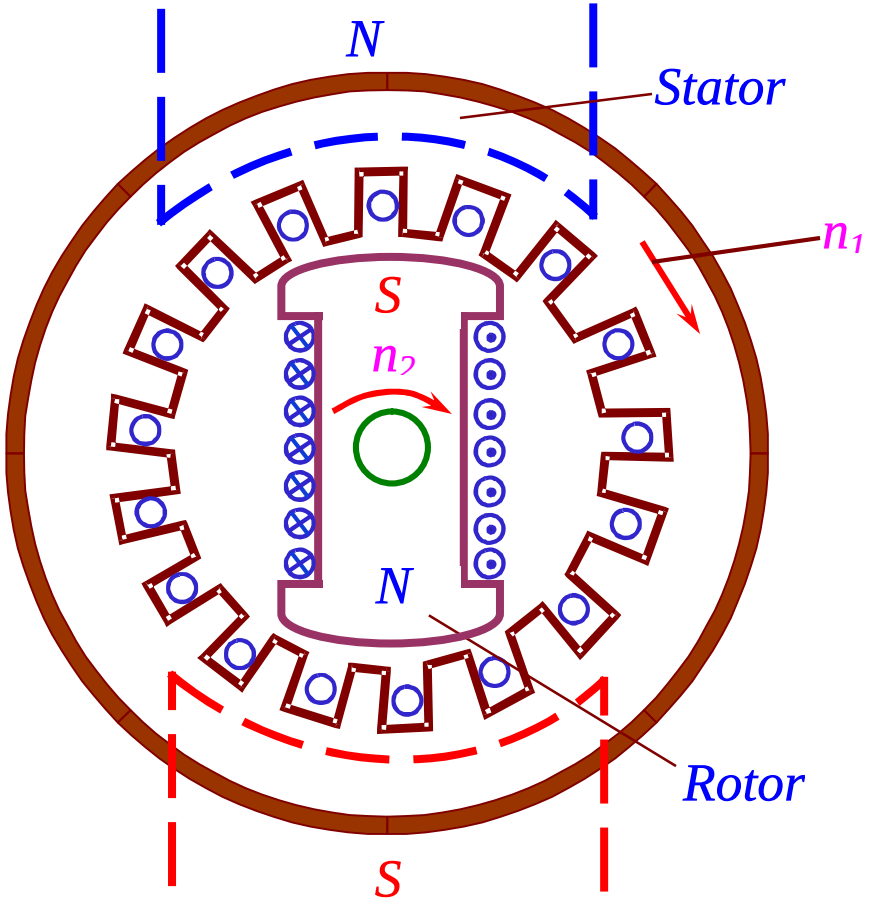
Uch simli sxemada iste'molchi yulduz usulida ulanganda bitta fazada simning uzulishi shu fazada kuchlanish va tokning mutlaqo bo`lmasligiga olib keladi. Iste'molchining boshqa ikkita fazasi liniya kuchlanishiga ketma – ket ulangan bo`lib qoladi. A fazada sim uzilganda (a – rasm) B va C ketma – ket ulangan.



O`zgaruvchan tok mashinalarining konstruktiv sxemalari

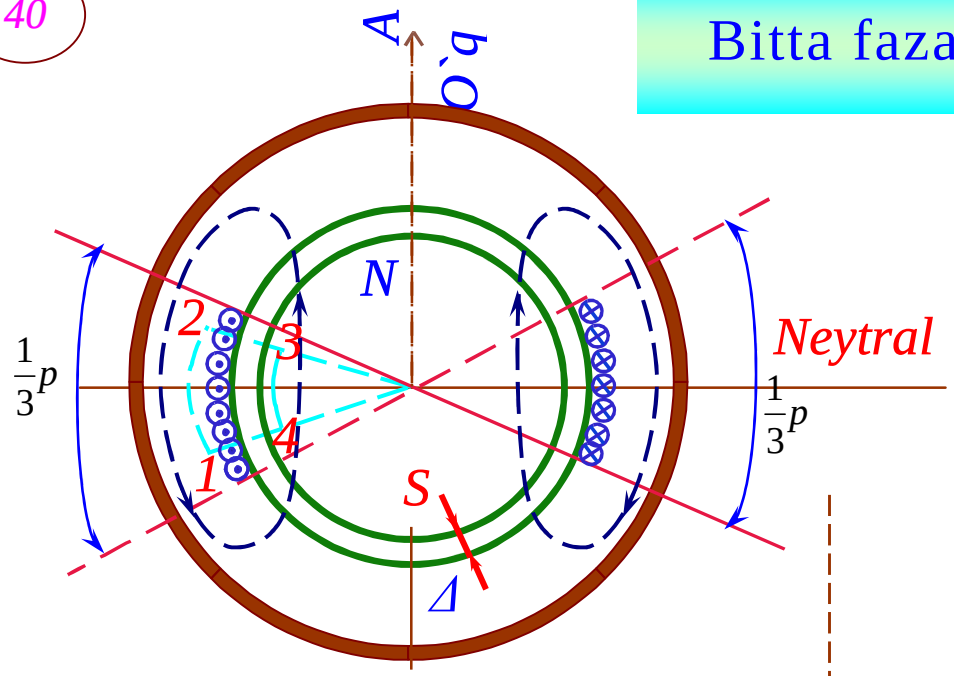


Asinxron mashinaning konstruktiv sxemasi

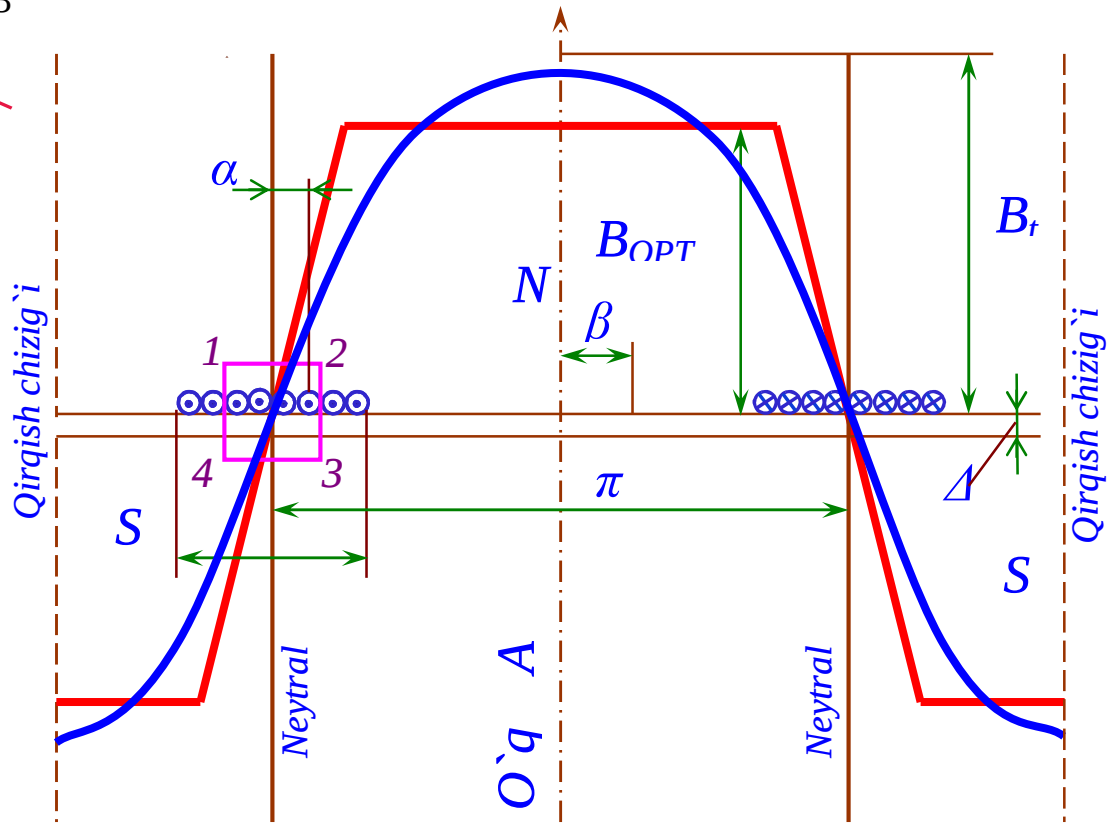


Sinxron mashinaning konstruktiv sxemasi

Bitta faza cho`lg`amining magnit maydoni

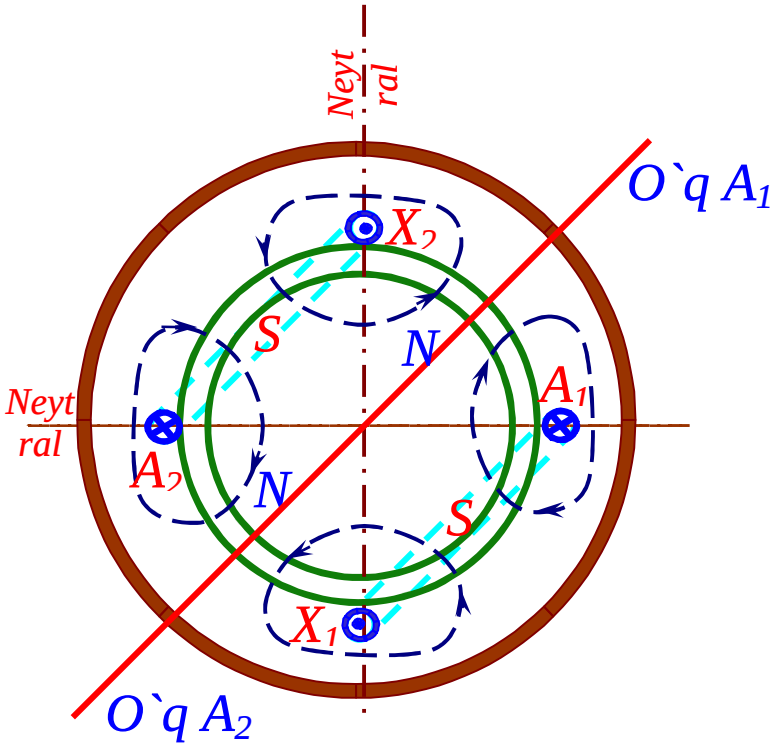


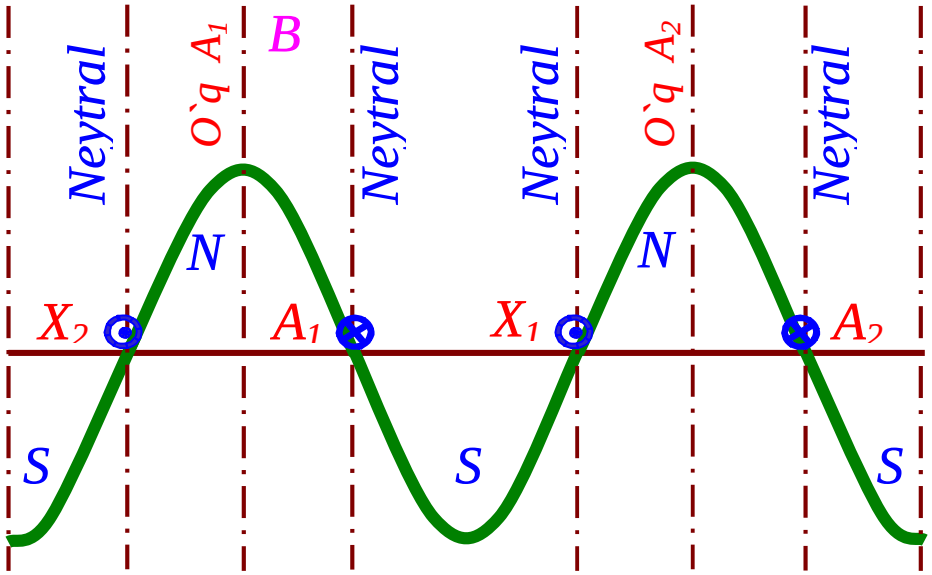
Statorning yoyilgan holati keltirilgan



Uch fazali cho`lg`amning bitta fazasi, uning o`tkazgichlari stator ichki yuzasining 1/3 qismiga bir tekis taqsimlangan. Magnit oqimining o`qiga perpendikulyar, stator bilan rotorni ikki qismga ajratadigan tekislik neytral deyiladi

Uch fazali chulg`mning aylanuvchi magnit maydoni



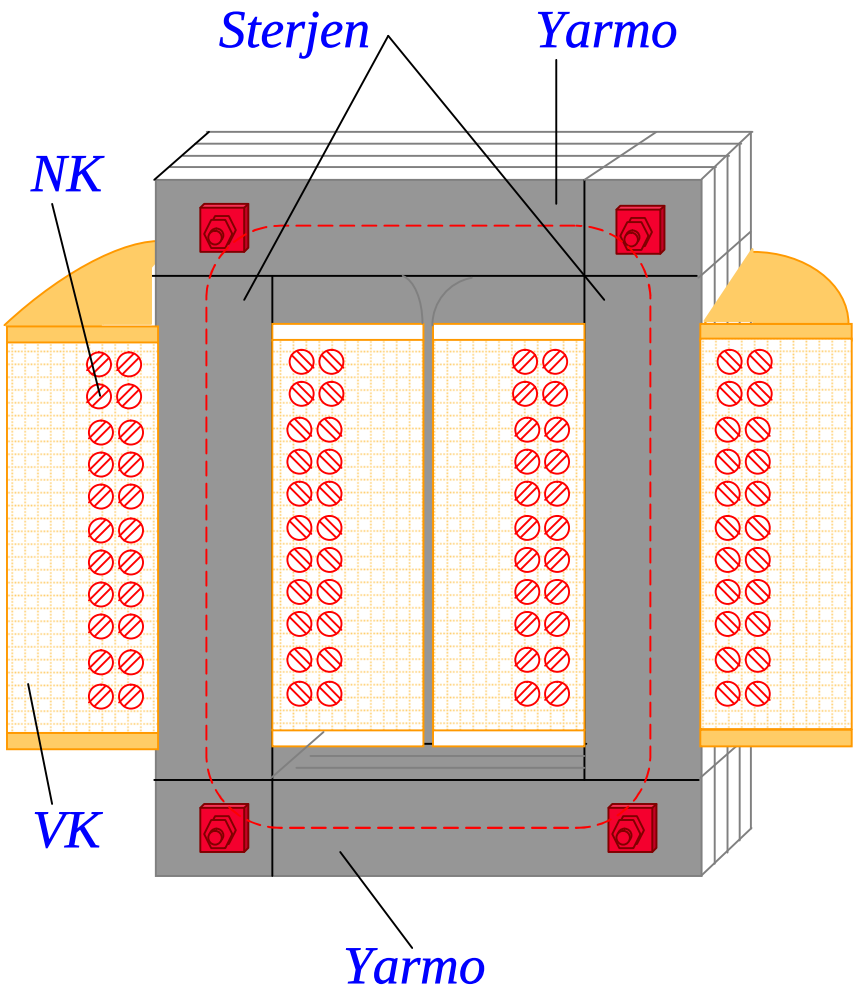


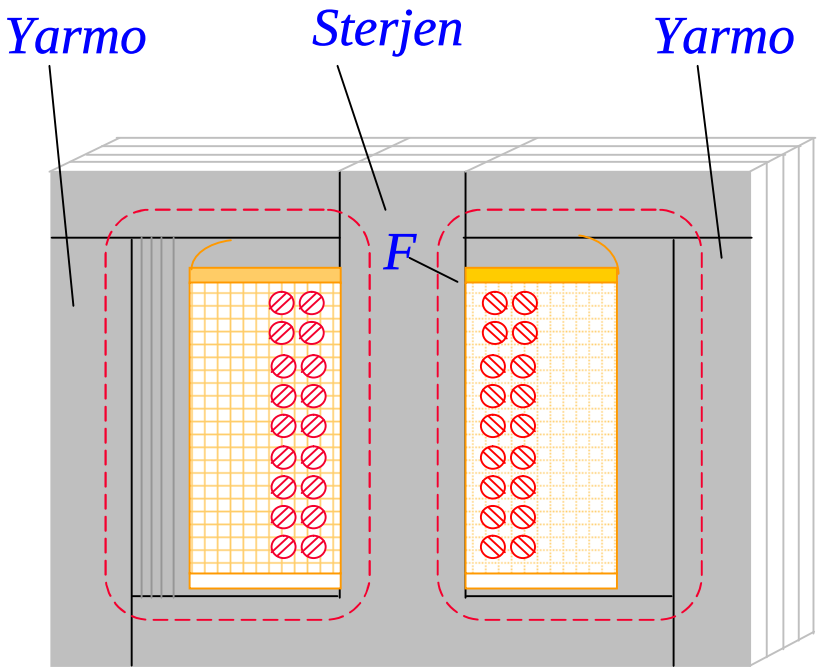
Har qaysi fazaning chulg`amini aktiv tomonlari orasidagi masofa stator aylanasining ¼ qismiga teng keladigan ikkita g`altakdan iborat qilib tayyorlanadi. Bu holda to`liq aylanasida bitta qutblar jufti bo`ladigan xol uchun aytilgan barcha mulohazalarni stator aylanasi uzunligining yarmiga bitta qutblar jufti to`g`ri keladigan holiga ham taaluqlidir.

p=2 magnit maydonining aylanish chastotasi n_1=60 f/2 ayl/min umumiy holda esa qutb juftlari soni istalgancha bo`lganda

$$n_1 = 60\frac{f}{p}$$

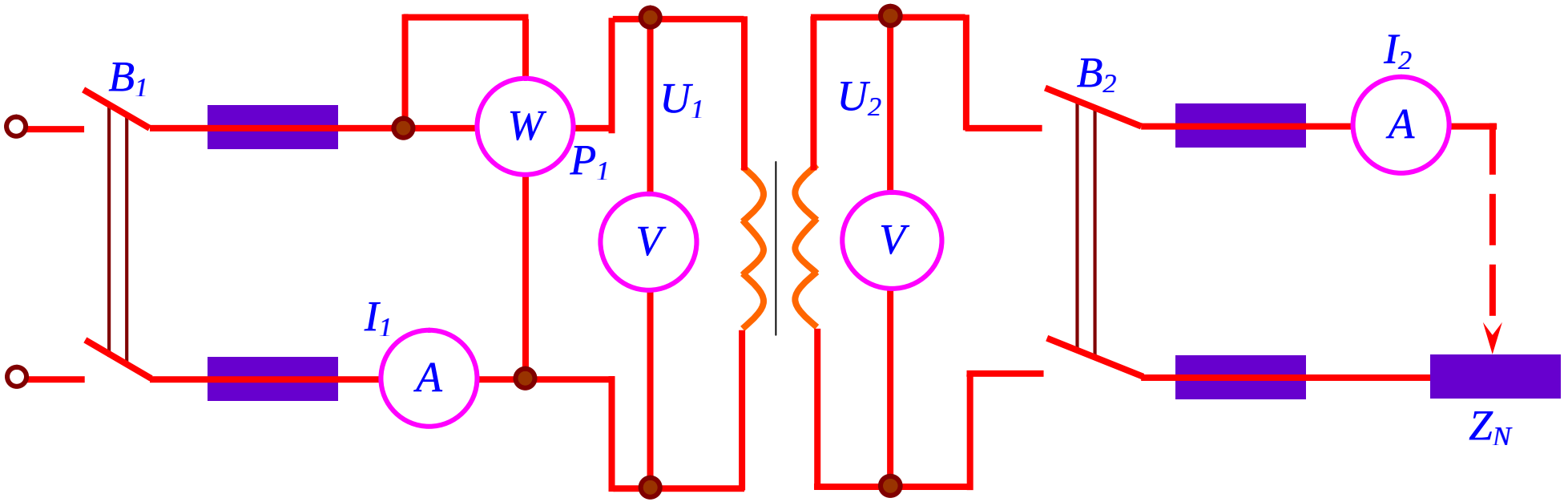
Transformatorning tuzilishi





Transformatorlarning magnit o`tkazgichlari sterjenlar bilan yarmodan tarkib topgan. Sterjenlarda cho`lg`amlar joylashadi, yarmo esa sterjenlarni birlashtiradi va magnit o`tkazgichning yopiq bo`lishini ta'minlaydi.

Transformatorning salt ishlash rejimi

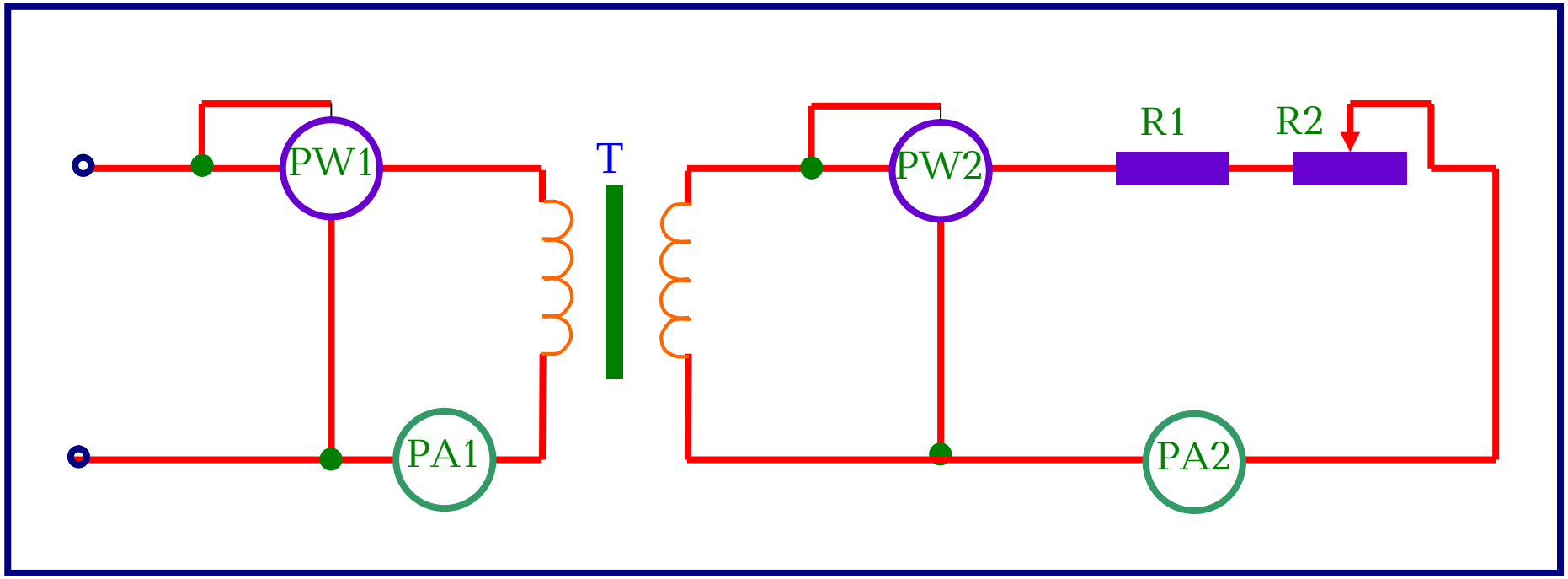


Transformatorning salt ishlash rejimida birlamchi cho`lg`ami tarmoqqa nominal kuchlanish U_1 ostida ulangan (uzgich B_1 yopiq), ikkinchi cho`lg`am esa uzgich B_2 bilan uzilgan ($I_2 = 0$) bo`ladi.

Ikkilamchi cho`lg`am qismlarida kuchlanish nominal kuchlanishga teng $U_2 = U_{2nom}$.

Transformator cho`lg`amlarida nominal nagruzkada kuchlanishning pasayishi nominal kuchlanishning 5 – 10 % ini tashkil etadi.

Transformatorning foydalanish koeffitsiyentini aniqlash sxemasi

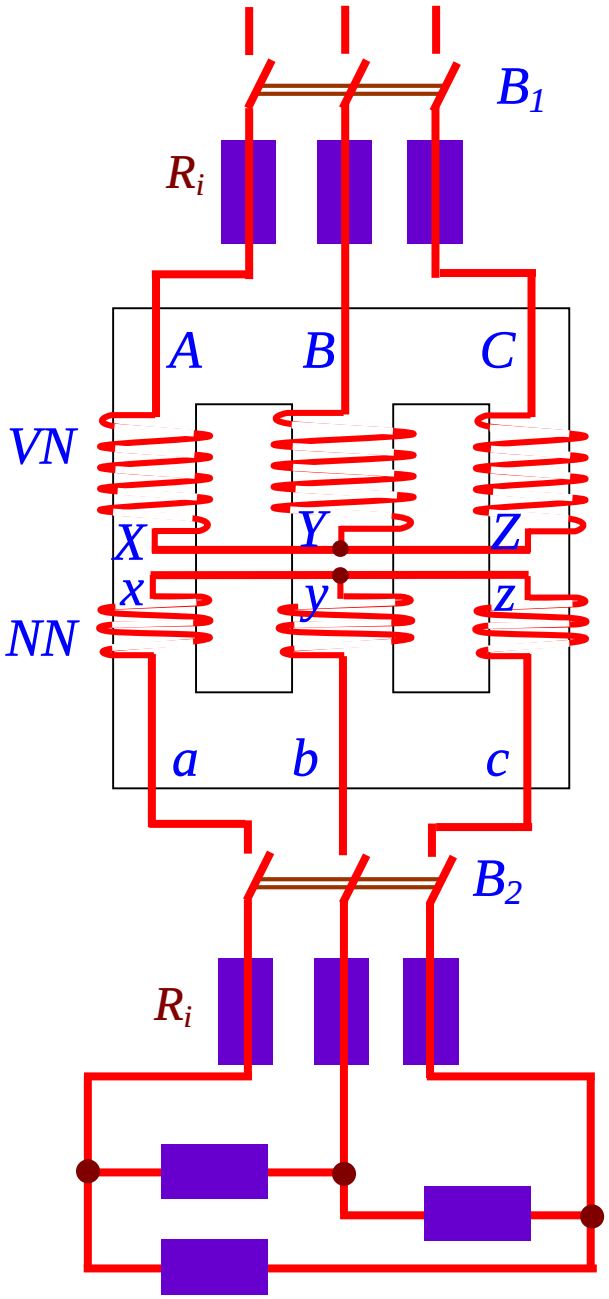


Transformatorning foydali ish koeffitsiyentini aniqlashda uning ikkilamchi zanjiriga har xil kuchlanishli elektr asboblar ulanadi. Bu kuchlanishni o`zgartirishga imkon beradi.Tajribada ikkilamchi zanjirda kuchlanishning oshishi birlamchi zanjirning kuchlanishining oshishi mos kelishi kuzatiladi. Transformatorning ikkilamchi zanjiriga ulangan voltmetr ko`rsatgichlariga qarab uning foydali ish koeffitsiyenti aniqlanadi.

ANIMATSIYA

CTRL tugmasini bosib, sichqonchaning chap tugmasini bosing

Uch fazali transformator



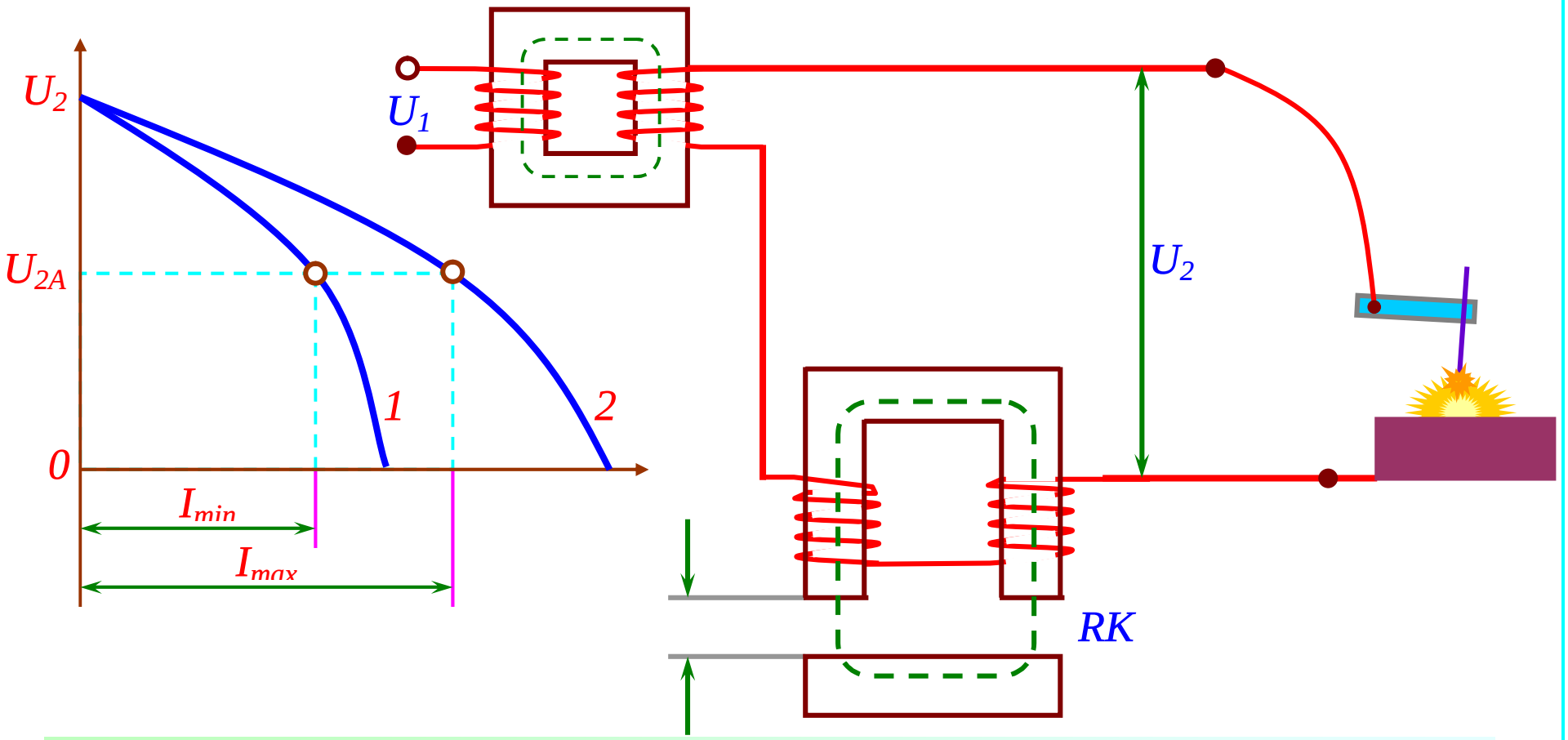
Uch fazali transformatorning tuzilish sxemasi. Uchta o`zak sterjenlarining har birida bitta fazaning ikkita cho`lg`ami (VN va NN) joylashgan. Transformatorlarni ulanish guruhlari bo`yicha ajratishga liniya kuchlanishlari – birlamchi va ikkilamchi kuchlanishlar orasidagi fazalarning siljish burchagi asos qilib olingan.

Transformatorlarning turlari va konstruksiyalarining nihoyatda xilma – xilligi ularning vazifasi, shuningdek quvvati va kuchlanishi turlicha ekanligi sababdir.

R_i – himoyalovchi qarshiliklar

B_1, B_2 – elektr tarmog`iga ulovchi dastalar

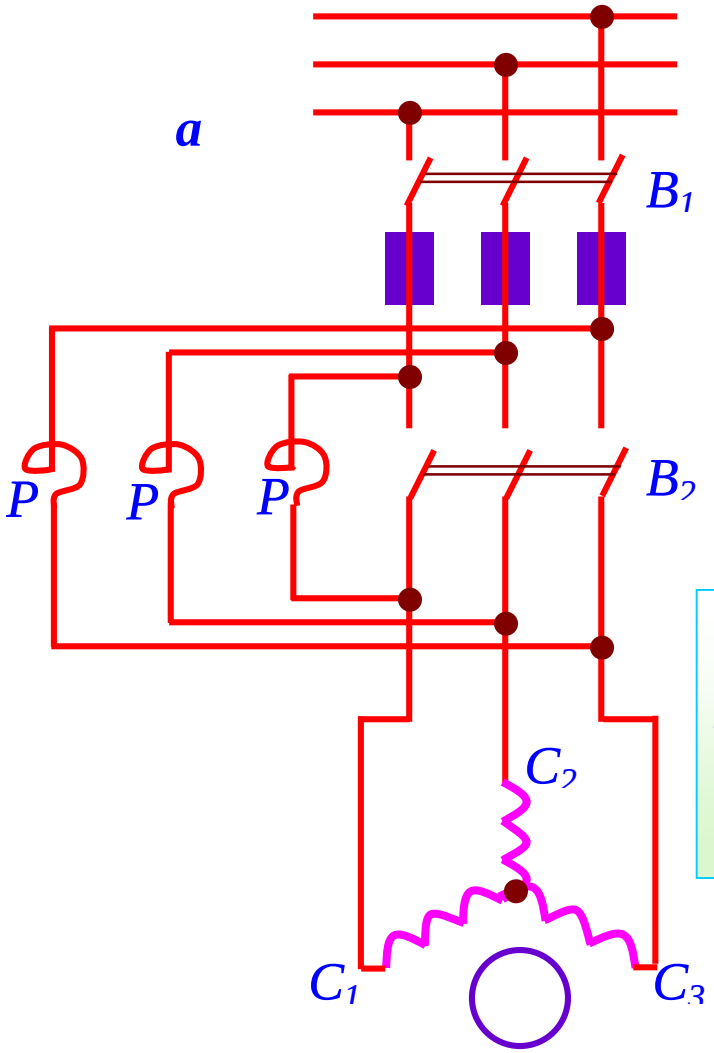
Payvandlash transformatori



Yoyli payvandlash uchun transformator 220 yoki 380 V li tarmoqqa ulash uchun mo'ljallangan bo'lib, ikkilamchi tarmoqda elektr yoyi hosil qilish uchun salt ishlash kuchlanishi yetarli darajada 60-70 V bo'ladi.

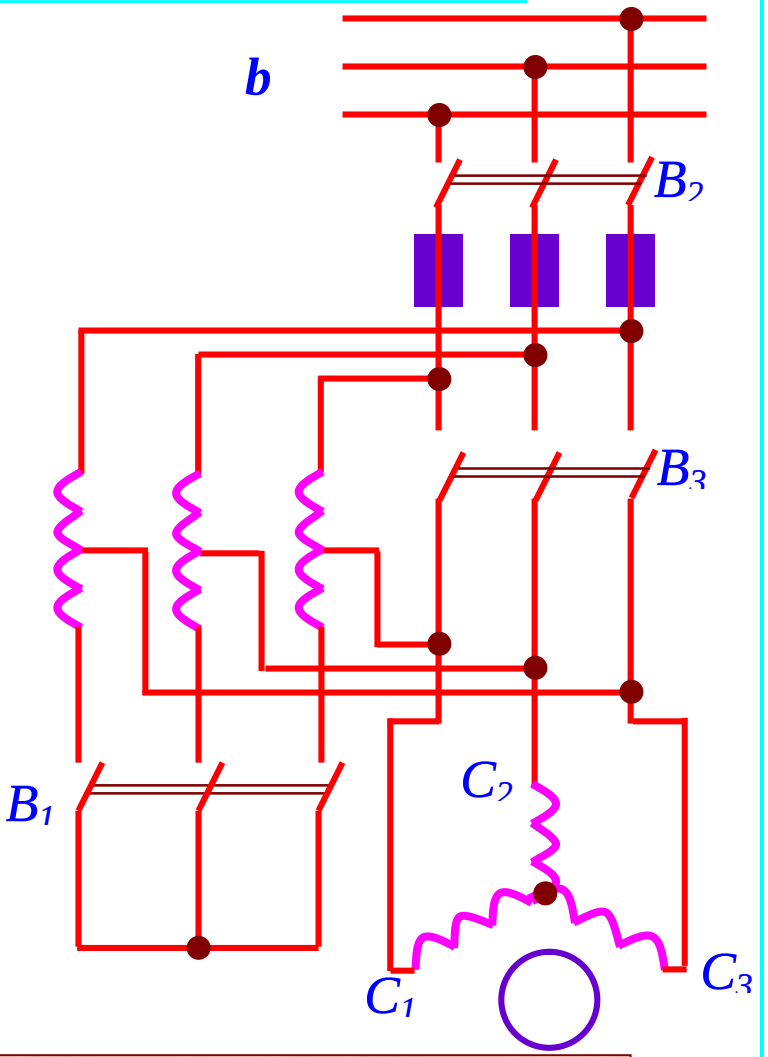
Tashqi xarakteristikasi keskin pasayadi va shu bilan bog'liq holda nagruzka salt ishlashdan qisqa tutashuvga qadar keskin va tez o'zgarganida tok qisman o'zgaradi

Qisqa tutashuvli rotorli dvigatellarni ishga tushirish



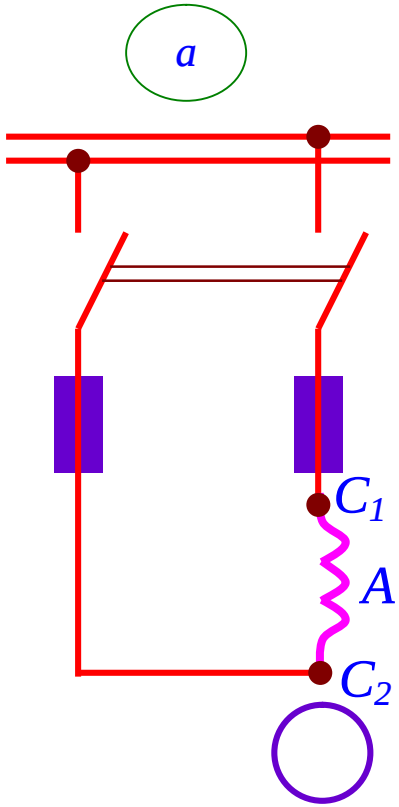
Ishga tushirishning boshlanashida kuchlanishni pasaytirish uchun stator cho`lg`amlarini yulduzdan uchburchakka o`zgartirib ulash (a-rasm).

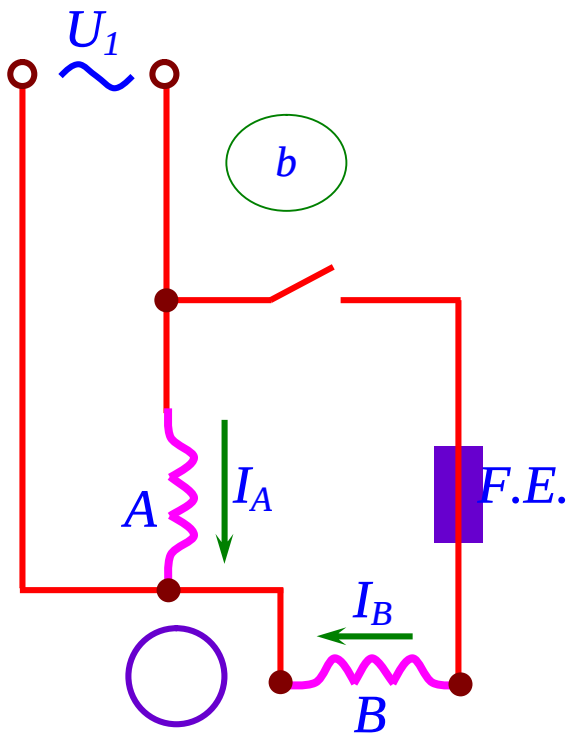
Ishga tushirish oldidan statorning cho`lg`amlari yulduz usulida ulanadi, so`ngra B_2 dasta yordamida dvigatel tarmoqqa ulanadi (b-rasm).

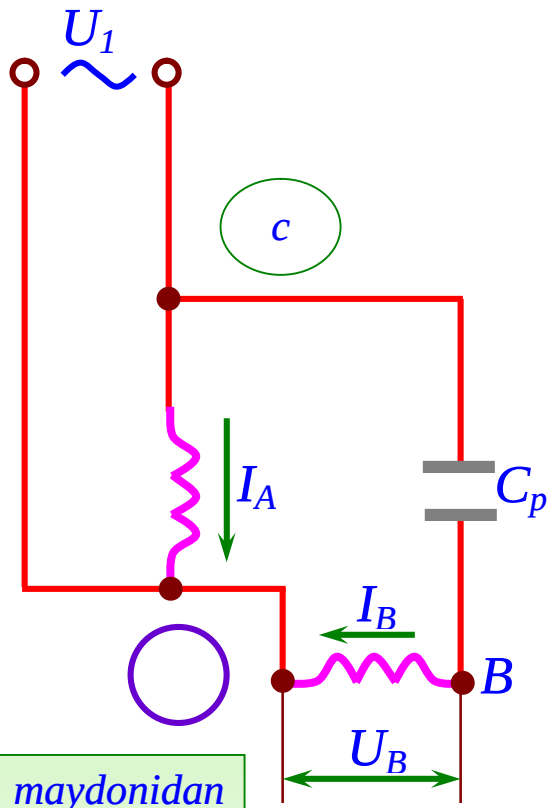


Bu usul ishga tushirishning boshlang`ich davrida faza kuchlanishni $\sqrt{3}$ marta, ishga tushirish liniya tokini 3 marta kamaytirishga imkon beradi.

Bir va iiki fazali asinxron dvigatellar

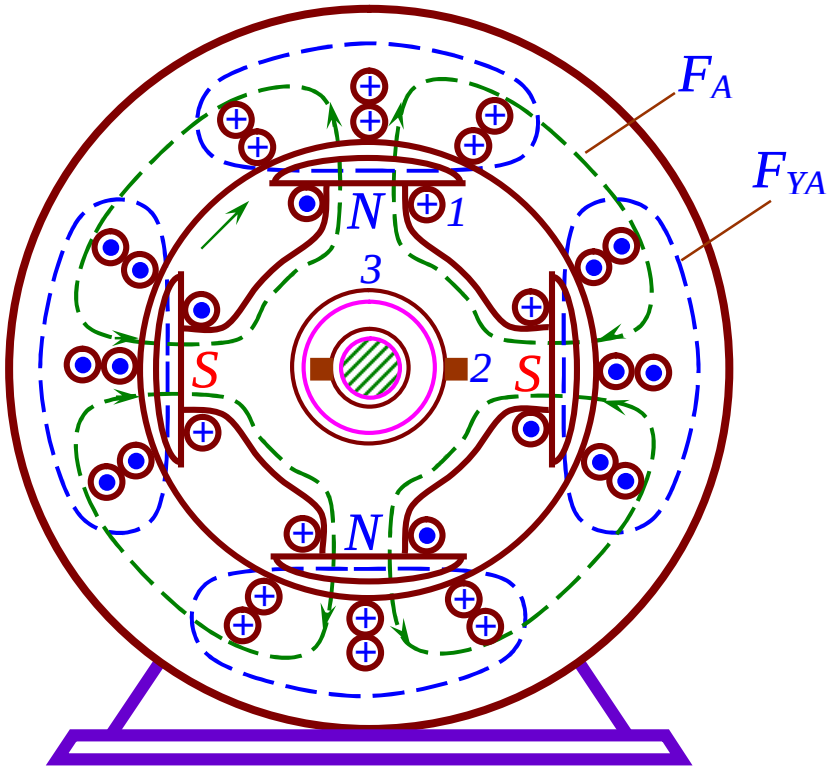


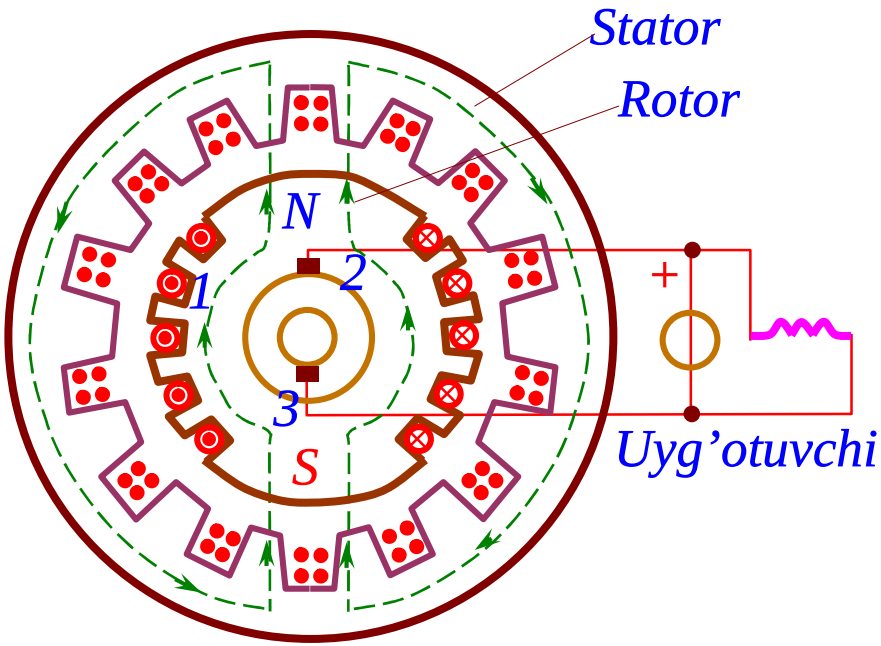




Bir fazali elektrodvigatellarning ishlash prinsipi aylanuvchan magnit maydonidan foydalanishga asoslangan (a-rasm).
Bir fazali dvigatelni ishga tushirish uchun zaruriy aylantiruvchi moment statordagi qo`shimcha chulg`am B vositasida hosil bo`ladi, bu chulg`am asosiy chulg`amdan bo`sh qolgan o`yiqlarga joylashtiriladi (b-rasm).
Chu`lg`amlardan biri tarmoqqa bevosita, ikkinchisi kondensator orqali ulanadi (c-rasm).

Sinxron mashinaning tuzilishi

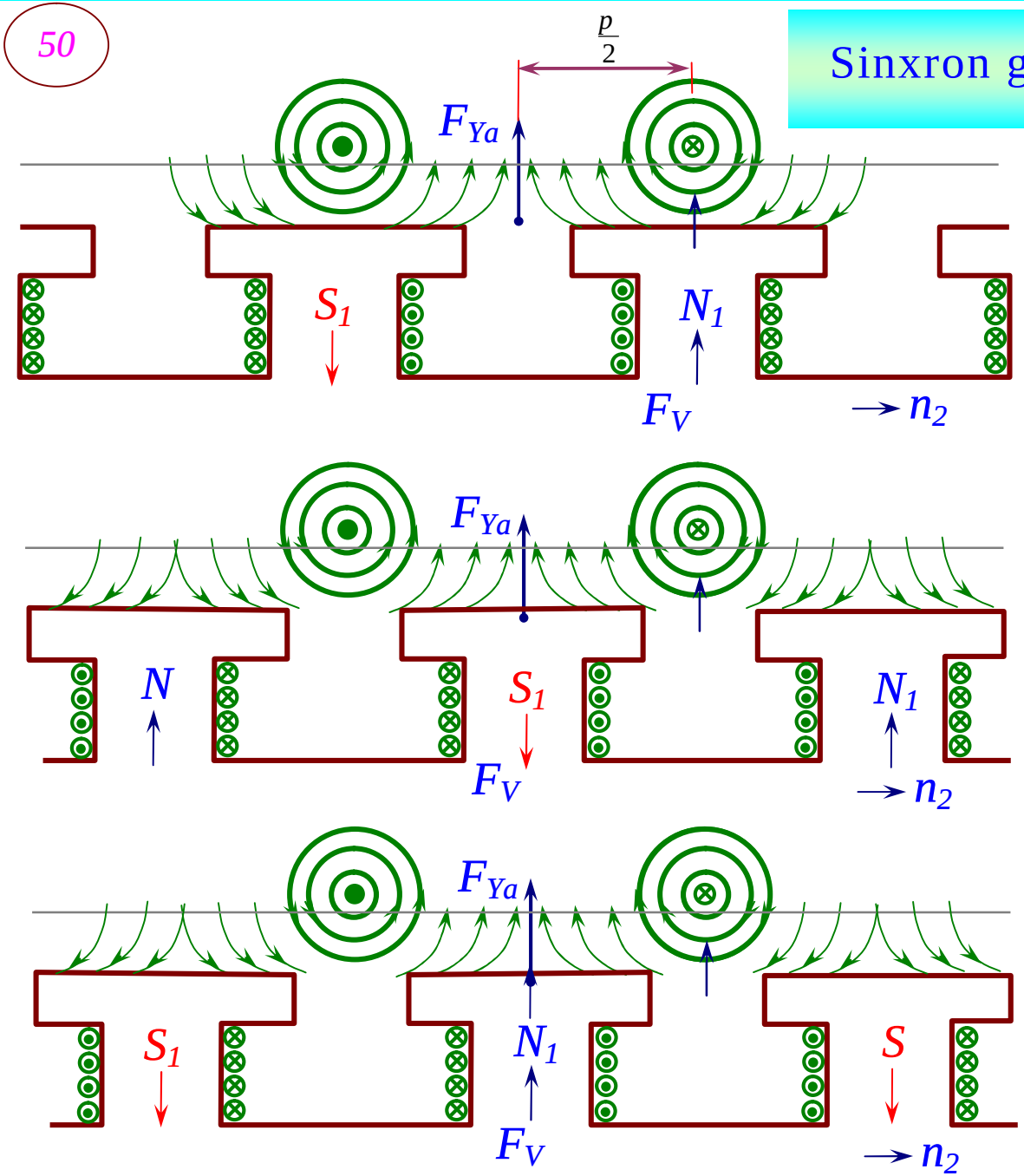


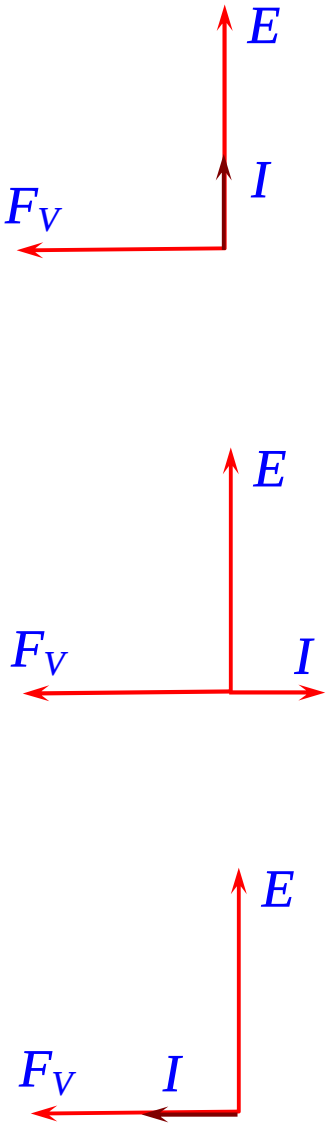


Ayon qutbli rotorning silindirsimon po'lat o'zagi bo'lib, unga uyg'otish cho'lg'amining g'altaklari bilan 1 – magnit qutblari -3 mahkamlangan 2-qo'zg'almas cho'tkalar.

N va S shimoliy va janubiy magnit qutblari, F-magnit maydon oqimlari.

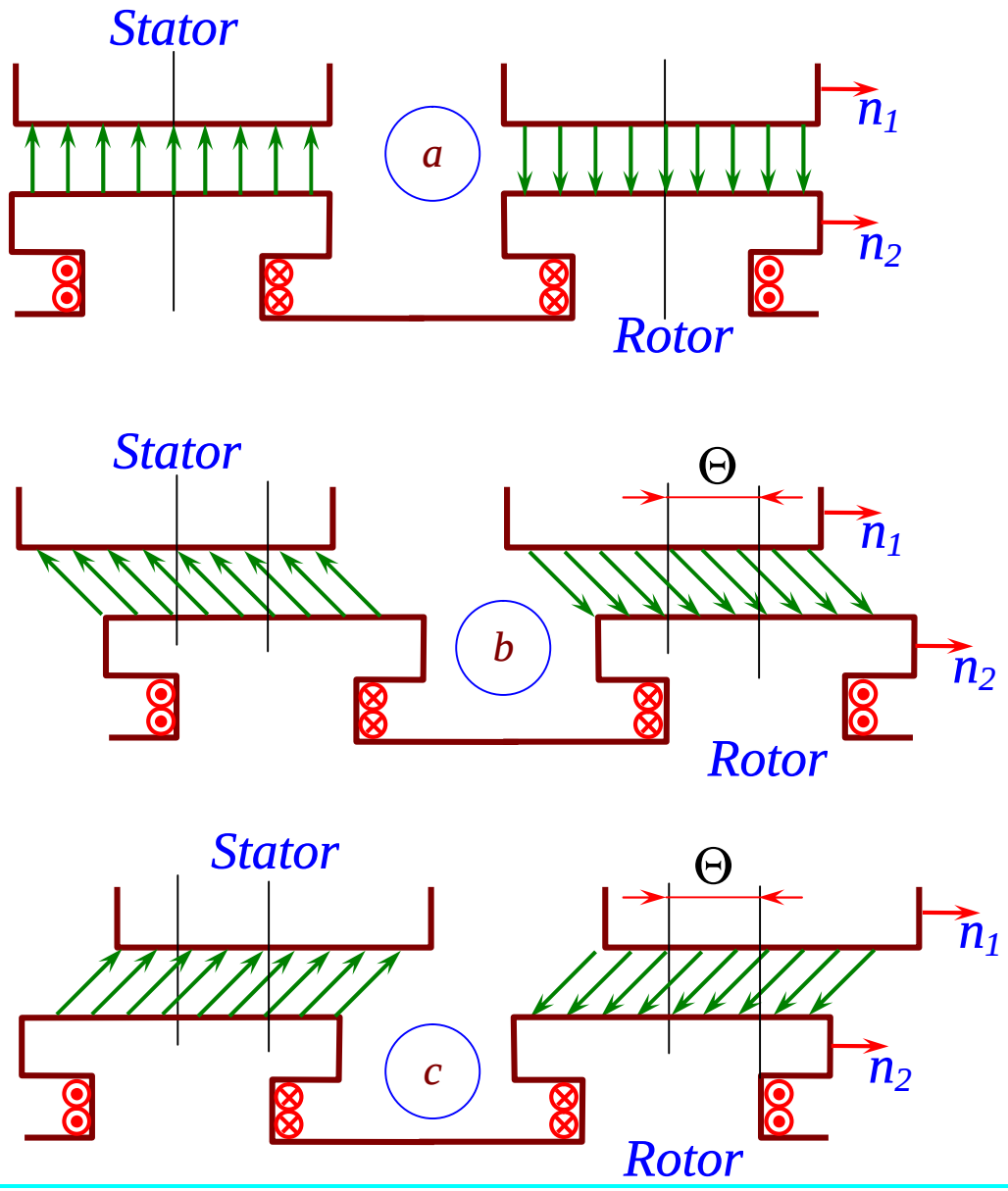
Sinxron generatorning ishlash jarayoni





Yakor chulg`amining magnit oqimi yo`nalishi chizmada keltirilgan

Sinxron mashinaning elektr tarmog`i bilan parallel ishlashi

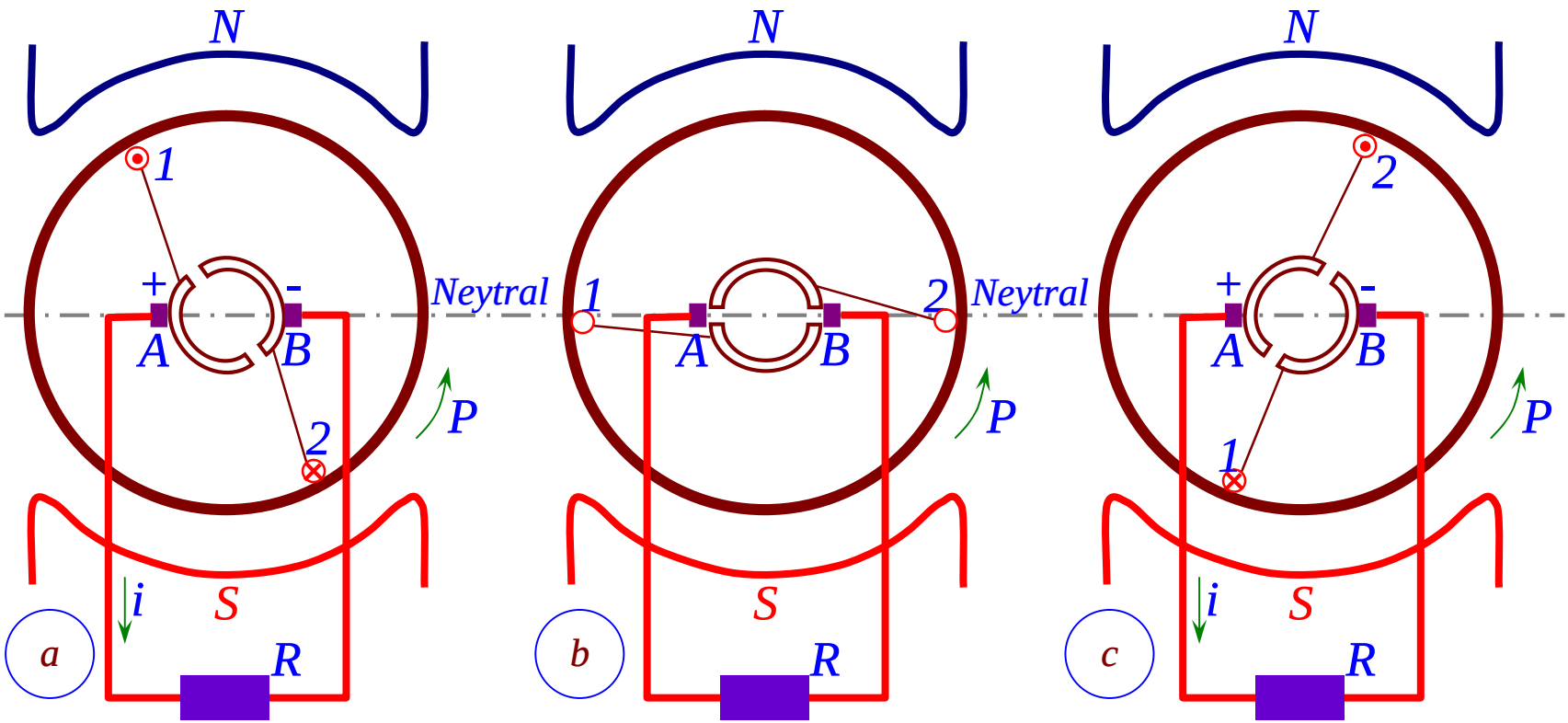


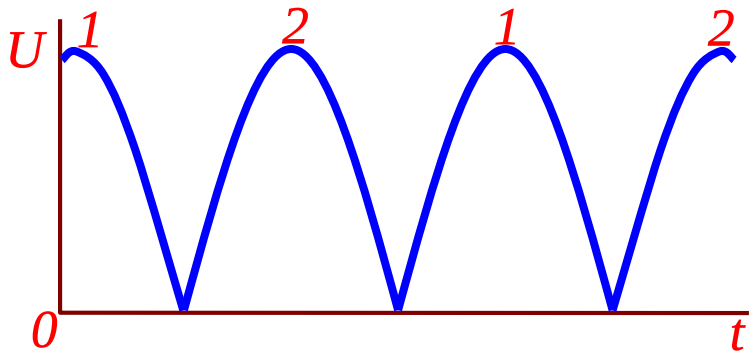
$\Theta = 0, \Phi = \Phi_y$ *bo`lganda salt ishlashda rotorning shimoliy qutbi ro`parasida statorning janubiy qutbi bo`ladi, ikkala qutbning o`qlari esa fazoda ustma – ust tushadi (a-rasm).*

Generator rejimida rotor bilan stator qutblarning o`qlari fazoda Θ burchakka siljigan bo`ladi, bunda aylanish yo`nalishi bo`yicha rotor oldinda bo`ladi, chunki u yetaklovchi zveno hisoblanadi (b-rasm).

Dvigatel rejimida statorning magnit maydoni yetakchi zveno bo`ladi va rotorni o`zining ketidan ergashtiradi (c-rasm).

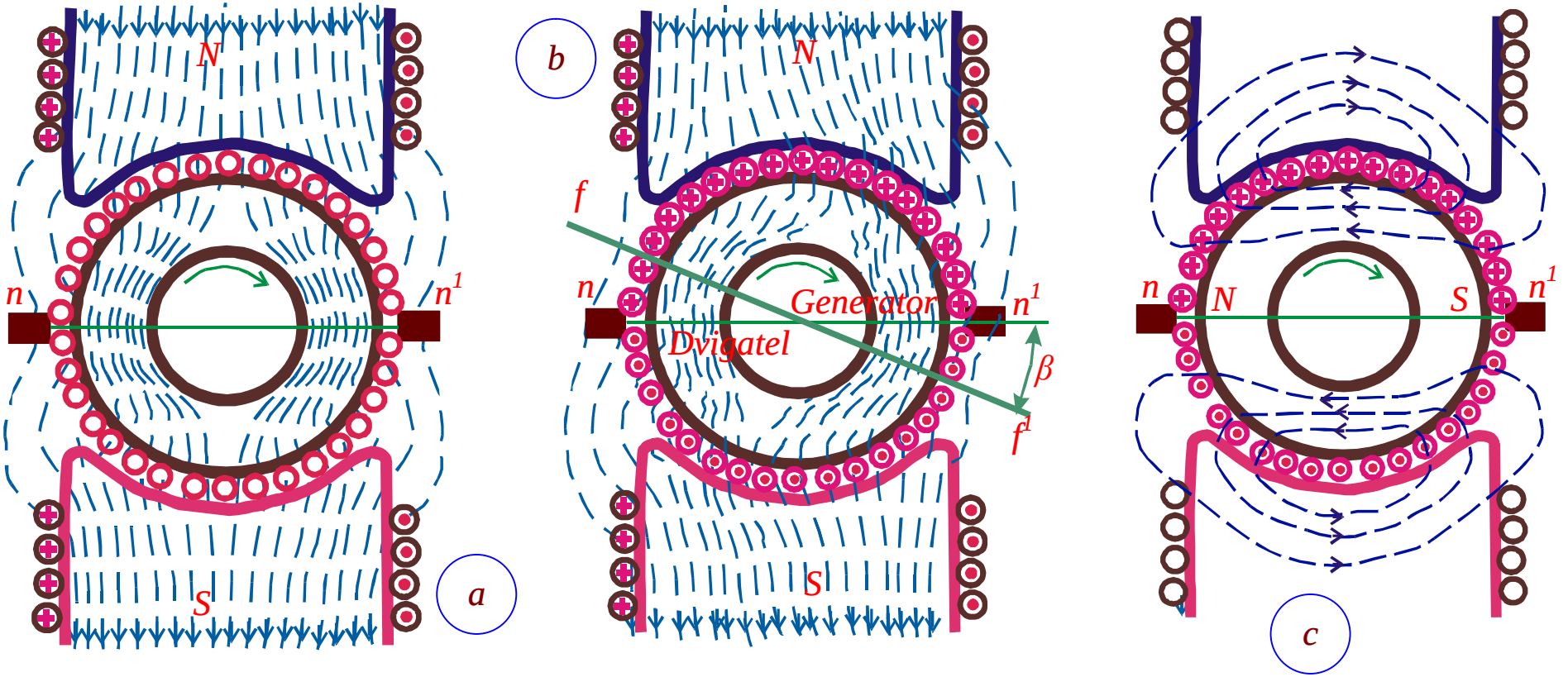
Kollektor





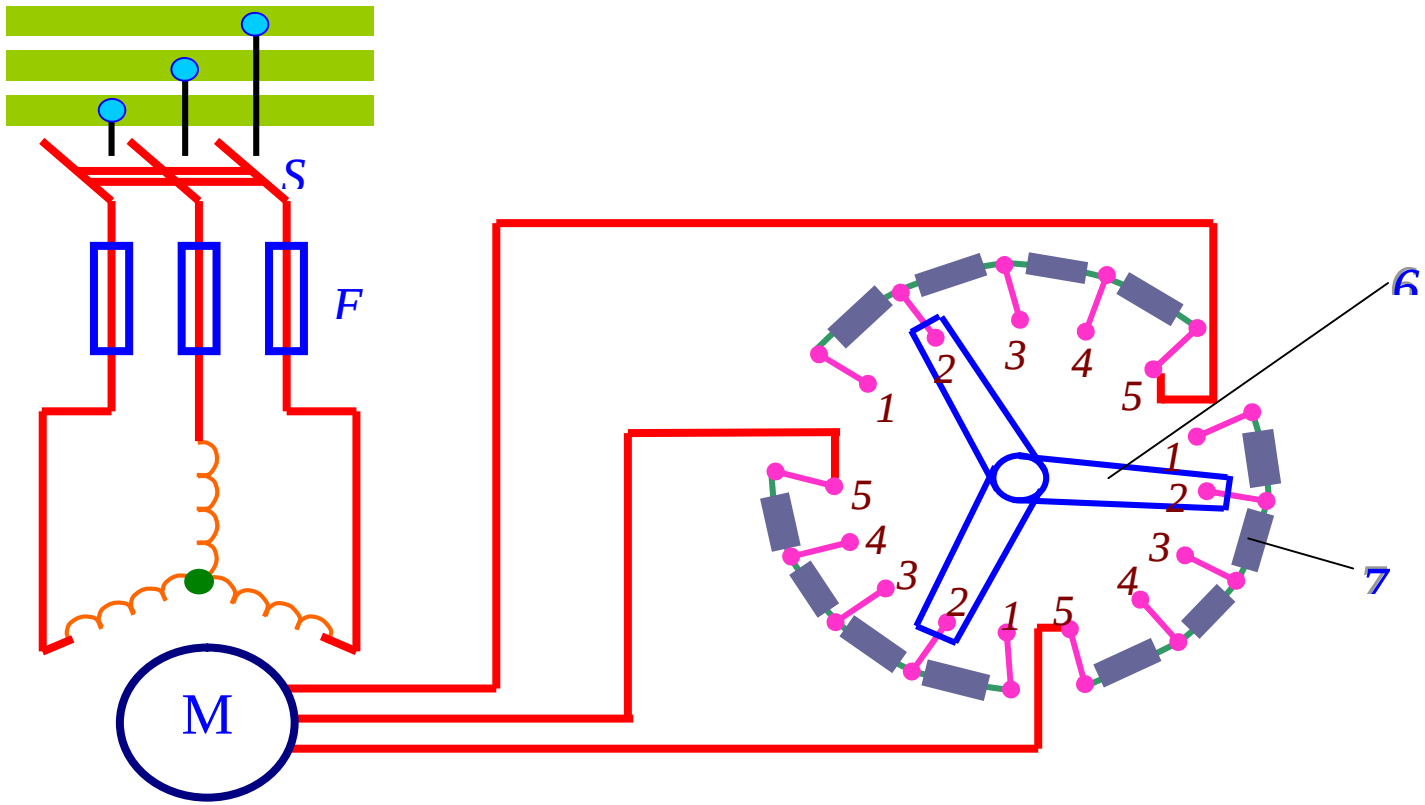
Rotor aylanganida seksiyaning o`tkazgichlari qutblar ostida joyini almashtirganida bir vaqtning o`zida cho`tkalar ostidagi kollektor plastinalari ham almashinadi (a,c-rasmlar). Seksiya o`tkazgichlarning neytral orqali o`tish momenti, cho`tkalar ostidagi plastinalarning almashinishi b-rasmda ko`rsatilgan.

O`zgarmas tok mashinasining ishlash jarayoni



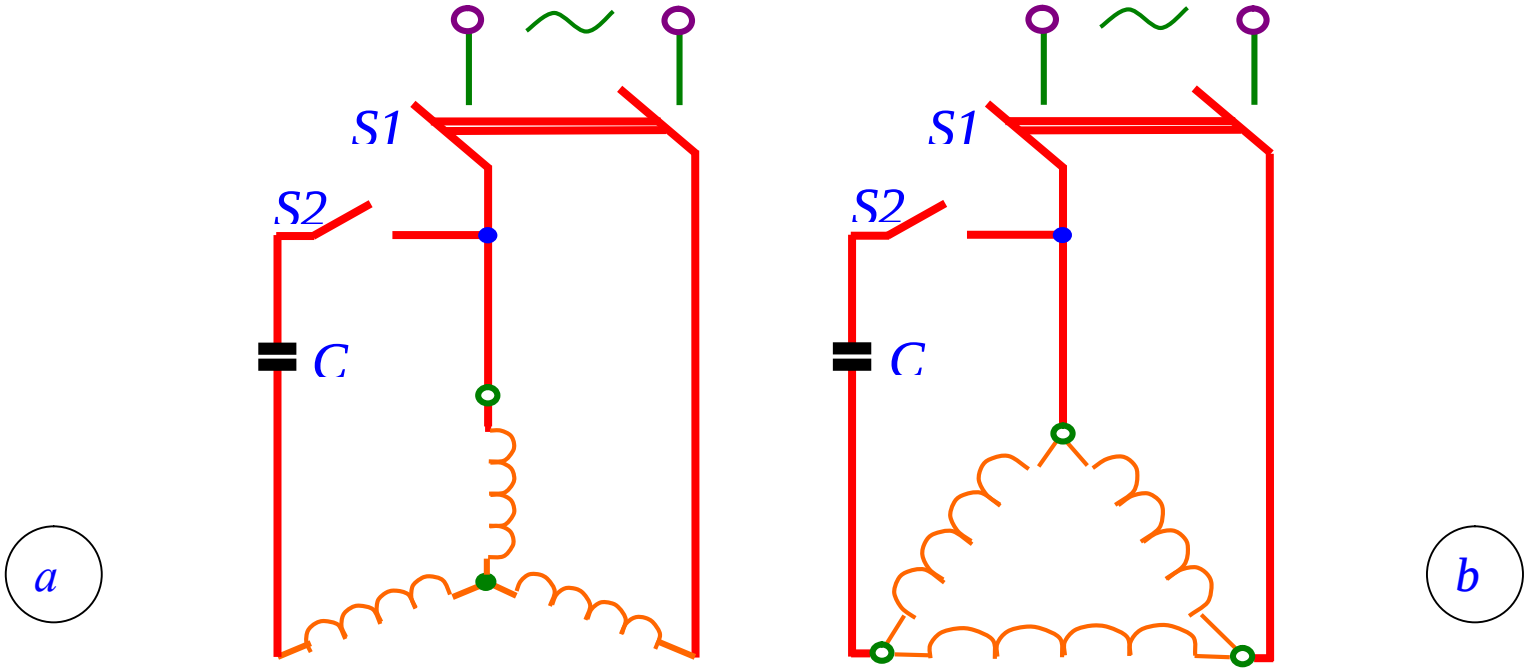
O`zgarmas tok mashinasining ishlash jarayonida yakor reaksiyasi. Salt ishlashda mashinaning magnit maydoni qutblariga simmetrik bo`ladi, fizik neytral, geometrik neytral n – n' bilan ustma – ust tushadi (a-rasm). Nagruzkali mashinada yakor chulg`ami magnitlovchi kuchning ikkinchi manbayi bo`lib, qutblar o`qiga ko`ndalang yo`nalgan ikkilamchi magnit maydon hosil qiladi (b-rasm). Ikkilamchi maydon qo`shilishi natijasida natijaviy nosimmetrik magnit maydoni hosil bo`ladi (c-rasm).

Uch fazali asinxron dvigatel sxemasi



S	-	*elektr tarmog`iga ulovchi dasta (rubilnik);*
F	-	*himoyalovchi qarshiliklar;*
M	-	*elektromotor*
1-5	–	*qisqichlar (kontaktlar);*
6	–	*qisqichlarni ulovchi moslama (pereklyuchatel);*
7	–	*qarshiliklar (rezistorlar).*

Uch fazali asinxron dvigatelni bir fazali zanjirga ulash sxemasi

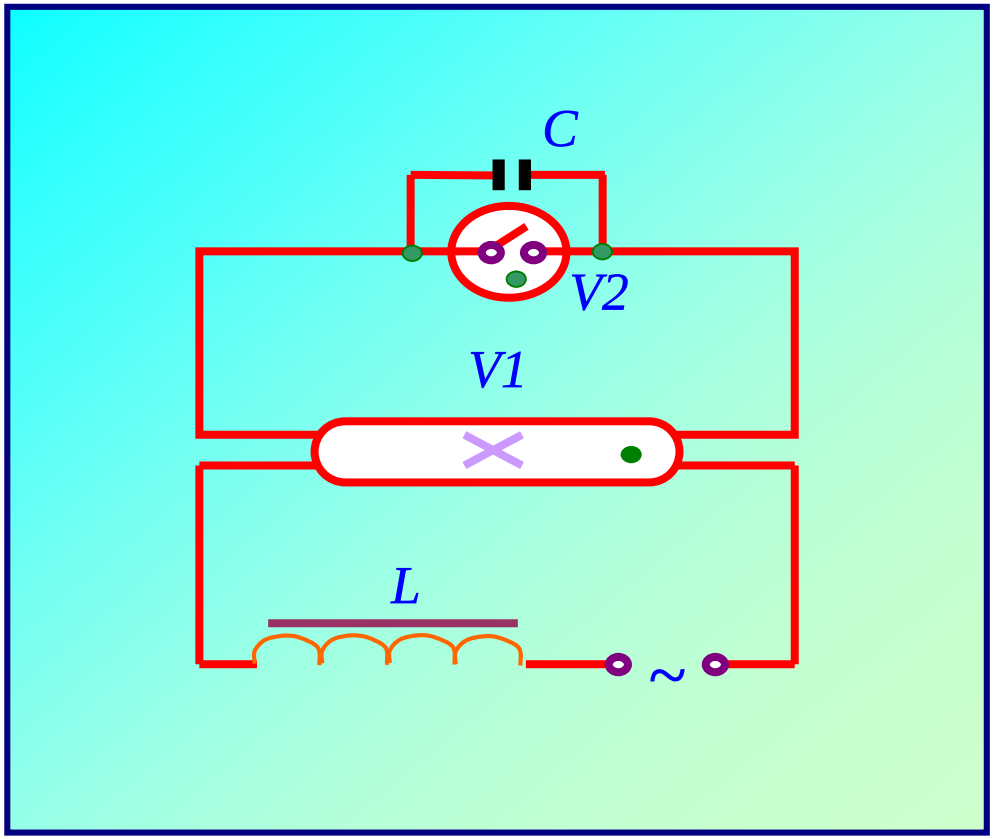


a — *stator chulg`am fazasi yulduzcha shaklida ulangan;*
b — *stator chulg`am fazasining uchburchak shaklida ulangan;*
c — *kondensator;*
S1 — *asinxron dvigatelni elektr tarmog`iga ulovchi dasta;*
S2 — *kalit.*

Lyuminessent lampani ulash sxemasi

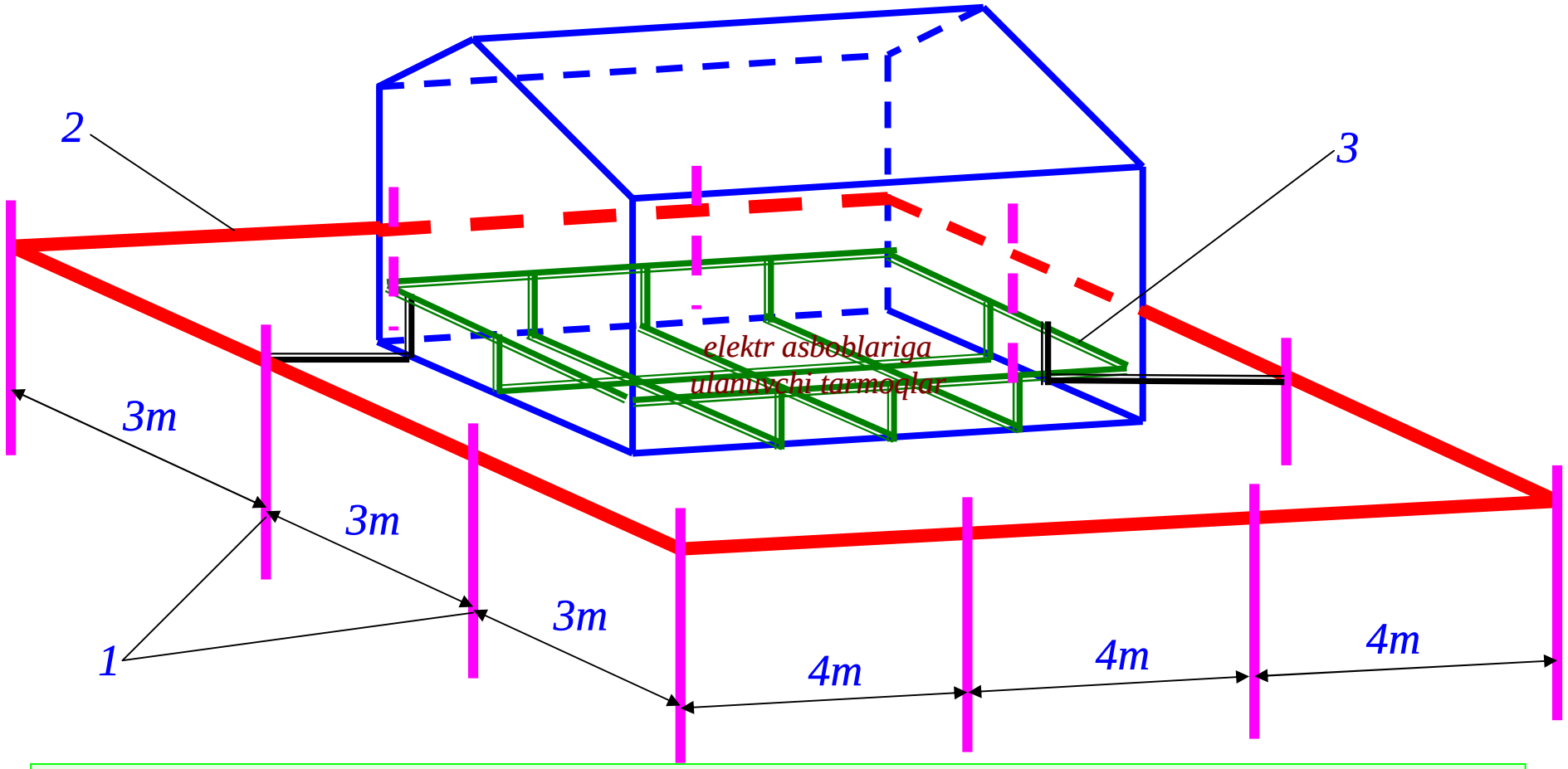
ANIMATSIYA

CTRL tugmasini bosib, sichqonchaning chap tugmasini bosing



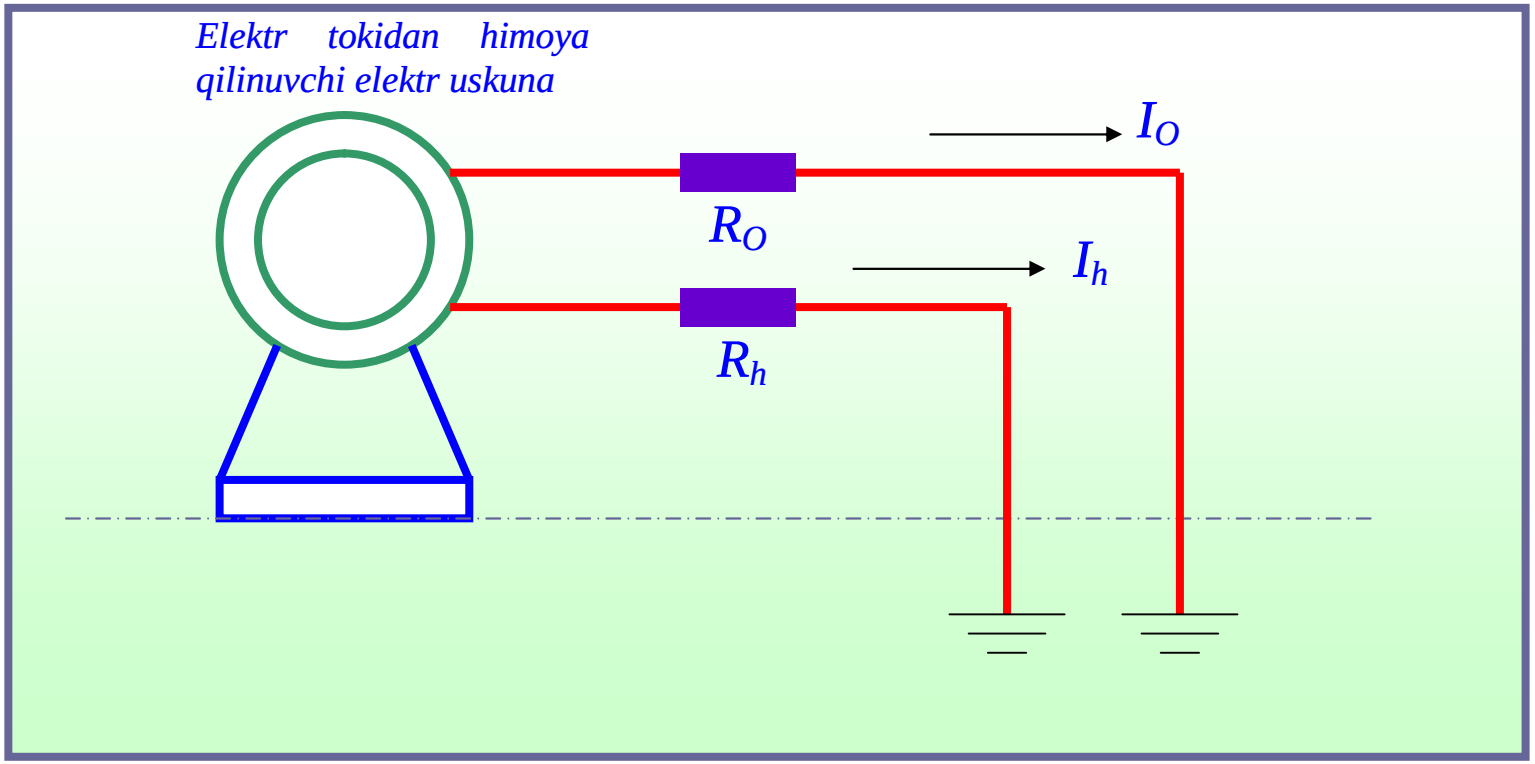
C	–	*kondesator;*
V2	–	*startyor, gazorazryadli lampa;*
V1	–	*lyuminessent lampa;*
L	–	*g`altak.*

Elektr tokidan himoya qiluvchi uskuna (zazemleniye) sxemasi



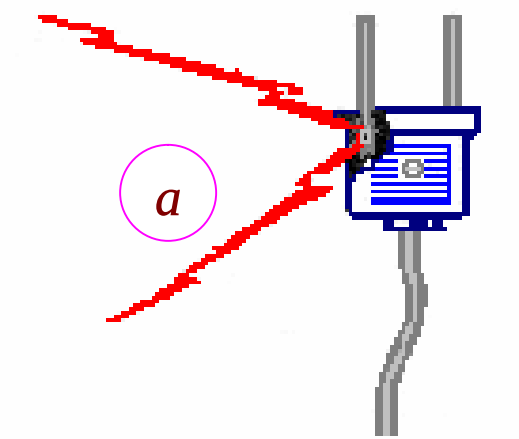
1 - vertikal elektr himoyalovchi (zazemleniye);
2 - gorizontal elektr himoyalovchi;
3 - elektr himoyalovchi o`tkazgichlar.

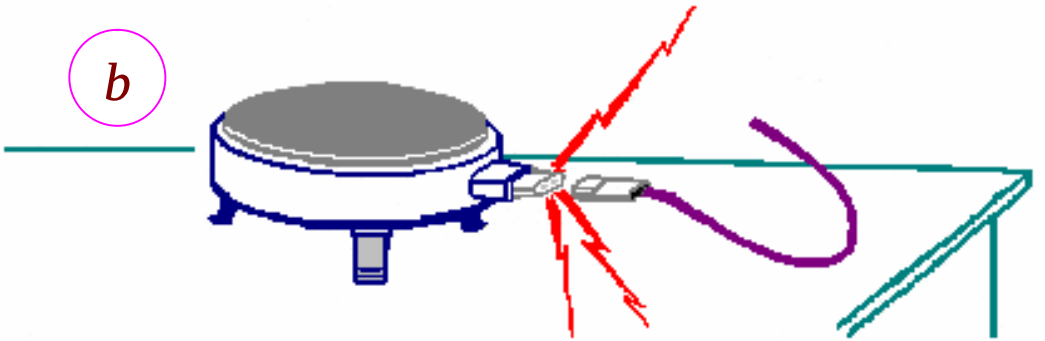
Uskunani elektr tokidan himoya qilish ahamiyatini tushuntiruvchi sxema

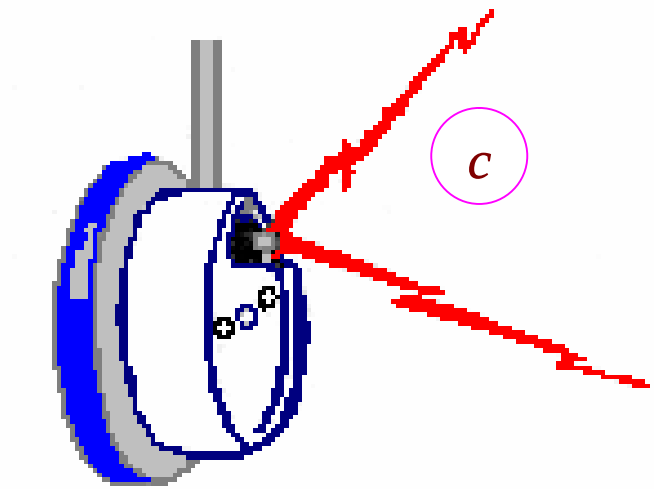


R_O - *odamning elektr qarshiligi;*
R_h - *himoya qiluvchi o`tkazgichlar qarshiligi,*
$R_h \leq 4$ *Om,* $R_h << R_O$, *shu sababdan* $I_O << I_h$.

Elektr jarohatini oldini olish



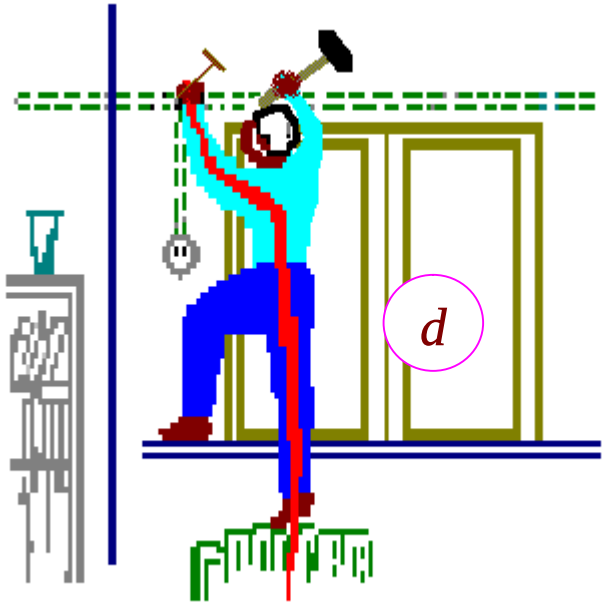


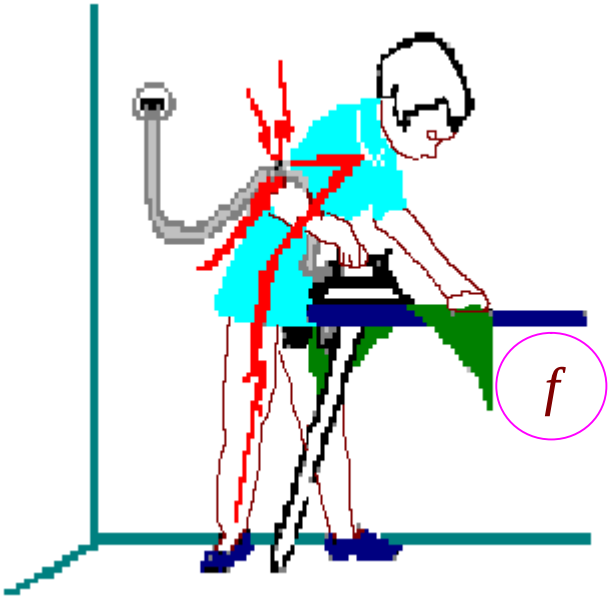


a - elektr vilkasining nosozligidan qisqa tutashuv kuzatiladi;

b - elektroplitani tokka ulash qismida nosozlikdan qisqa tutashuv kuzatiladi;

c - devordagi shtepsel qisqichlarning boshashib qolganligi tufayli qisqa tutashuv kuzatiladi.





ANIMATSIYA-1
ANIMATSIYA-2

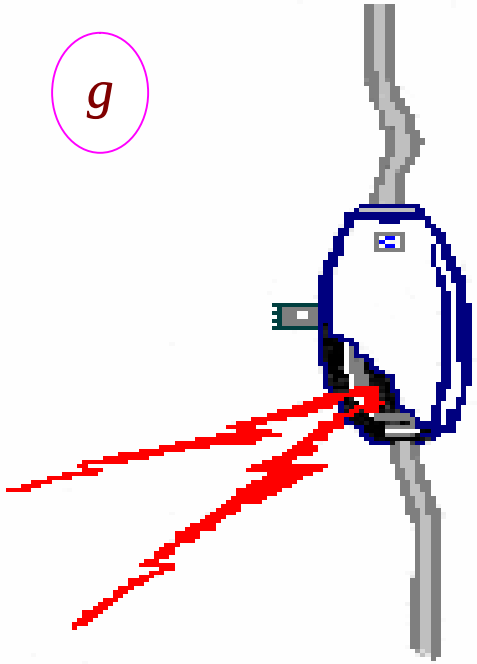
CTRL tugmasini bosib, sichqonchaning chap tugmasini bosing

d - devor ichkarisidan o`tkazilgan simlarni ta'mirlash jarayonida ehtiyotsizlikdan quruvchi qisqa tutashuv xodisasiga duch keladi;

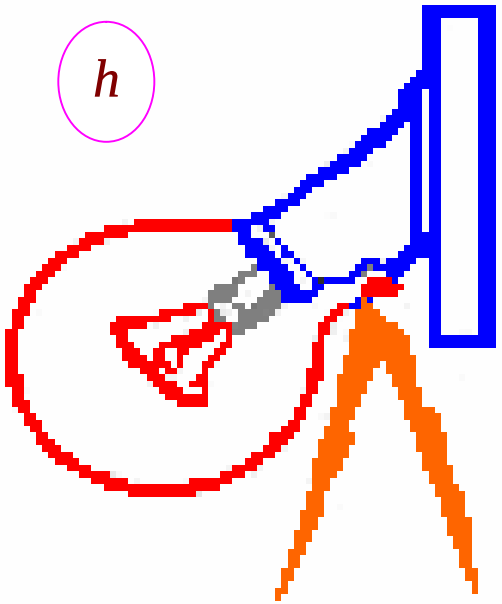
e - elektr o`tkazuvchi simlarga ho`l narsalarni osish havfli;

f - nosoz elektr dazmoli bilan ishlash ham havfli;

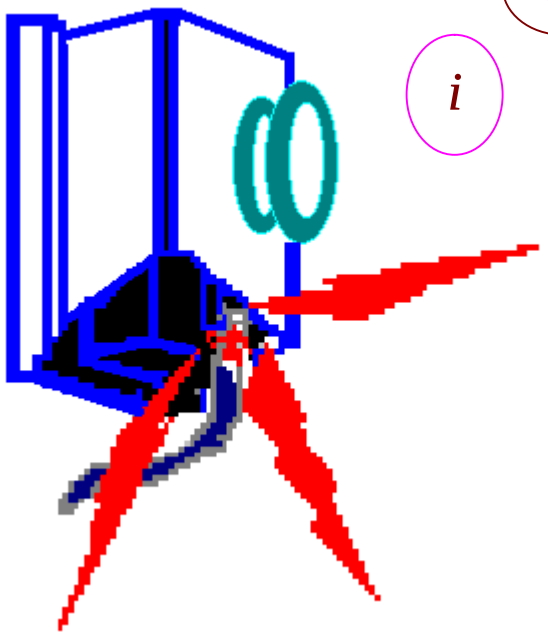
g



h



i



ANIMATSIYA

CTRL tugmasini bosib, sichqonchaning chap tugmasini bosing

g, h, i - rasmlarda tokni uzuvchi (выключатель) elektr lampa patronining va elektr propkalarda qisqichlarning bo`shab qolgani tufayli va elektr lampasining qizish natijasida patron oralig`ida kontaktlar buzilib qisqa tutashuv xodisasi kuzatiladi.