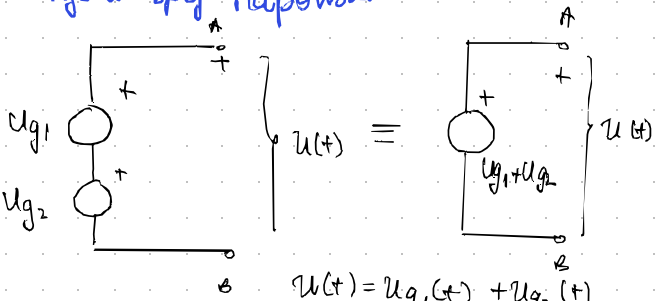
4.1. TRANSFORMACIJE IZVORA

• ono što zasad znamo: strujni u naponski i naponski u strujni

Serijski spoj naponskih izvora:

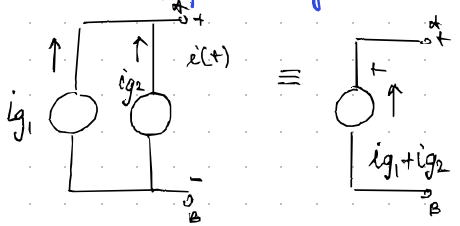


$$u(t) = u_{g_1}(t) + u_{g_2}(t)$$

Paralelno spojeni različiti $u_{g_1}(t)$ i $u_{g_2}(t)$ nije dopušteno!

(Ali ako se radi o identičnima nema veze jer $u_{g_1} = u_{g_2}$ svejedno)

Paralelni spoj 2 strujna izvora:

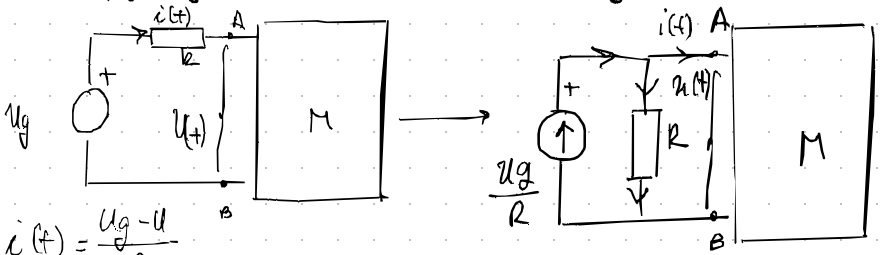


$$i(t) = i_{g_1}(t) + i_{g_2}(t)$$

Serijski spoj strujnih izvora $i_{g_1}(t)$ i $i_{g_2}(t)$ nije dopušten!

(osim u slučaju identičnih strujnih izvora jer su $i_{g_1} = i_{g_2}$ pa ridam samo maknemo)

Serijski spoj $u_{g_1}(t)$ i R $\longrightarrow$ Paralelni spoj $i_{g_1}(t)$ i R

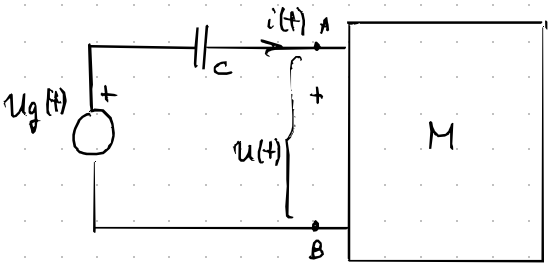


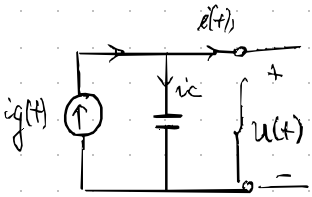
$$i(t) = \frac{u_g - u}{R}$$

$$i(t) = \frac{u_g}{R} - \frac{u}{R}$$

Transformacija $U_g \rightarrow i_g$ s nekim drugim pasivnim elementom osim R

Serijski spoj naponskog izvora i kapaciteta C





$$i_g(t) = i_c + i_g = C \cdot \frac{du(t)}{dt} + i(t)$$

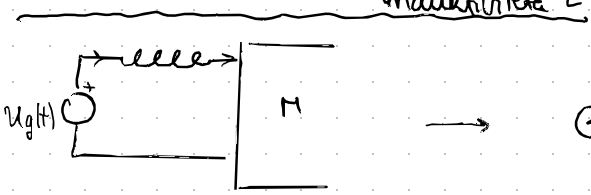
$$u_g(t) = \frac{1}{C}\int_{-\infty}^{t} i(\tau)\,d\tau + u(t)$$

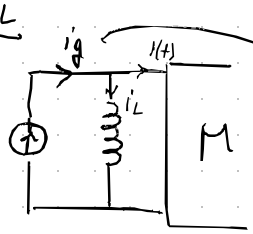
$$i(t) = C\,\frac{d(u_g - u)}{dt} = C\,\frac{du_g}{dt} - C\,\frac{du}{dt}$$

$i_g(t)$ mismo samo to tako pogledati

$$i(t) = i_g(t) - C\,\frac{du}{dt}$$

Serijski spoj naponskog izvora i induktiviteta L



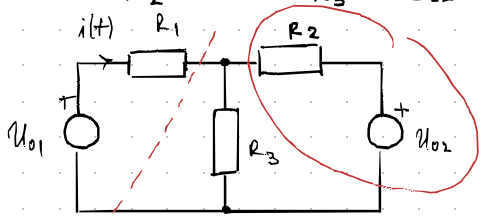


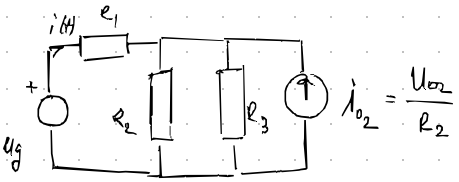
$$i_g(t) = \frac{1}{L}\int_{-\infty}^{t} u(\tau)\,d\tau$$

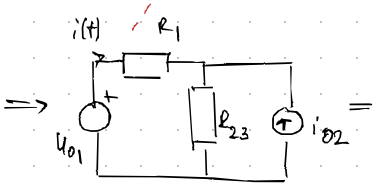
Zaključak: $U_g(t)$ i serijski spojen pasivni el. uvijek je moguće transformirati u paralelni spoj $i_g(t)$ i istog pasivnog el.

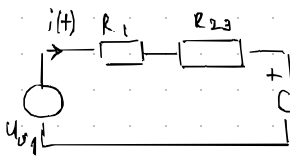
Primjer 1.) Odrediti $i(t)$ redukcijom kruga

$R_1 = 5k\Omega$ $R_2 = 30k\Omega$ $R_3 = 20k\Omega$ $U_{o1} = 5V$ $U_{o2} = 3V$









$U_{o2} \neq U_{o2}'$ → $U_{o2}' = i_{o2} \cdot R_{23}$

naponski

$$* \quad R_{23} = \left(\frac{1}{R_2} + \frac{1}{R_3}\right)^{-1}$$

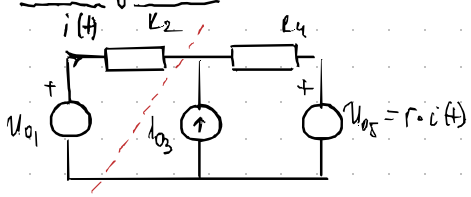
$R_{23} = 12k\Omega$

$i(t) = \text{konstanta} \longrightarrow i(t) = \dfrac{U_{o1} - U_{o2}'}{R_1 + R_{23}}$

$U_{o2}' = \dfrac{U_{o2}}{R_2} \cdot R_{23} = 1{,}2\,V$

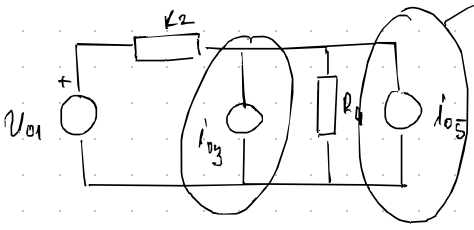
$i(t) = \dfrac{5 - 1{,}2}{(5+12)\times 10^3} = 0{,}224\,mA$

Primjer 2: $i(t) = ?$

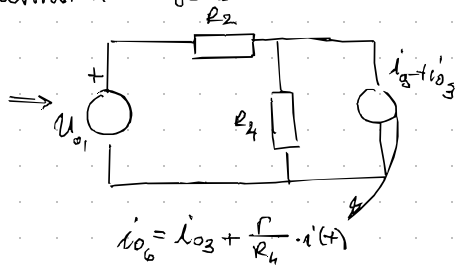


$R_2 = 3\,\Omega \quad r = 3\,\Omega \quad R_4 = 2\,\Omega$

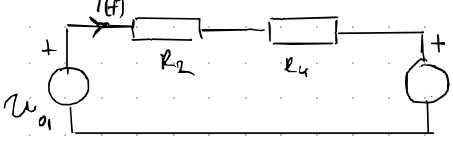
$U_{01} = 24\,V \quad i_{03} = 7\,A$



→ paralelno spojeni strujni izvori mogu se zamijeniti u jedan



→ vraćanje u naponski izvor



$U_{05}' = i_{06} \cdot R_4 = \underline{R_4 \cdot i_{03} + r \cdot i(t)}$

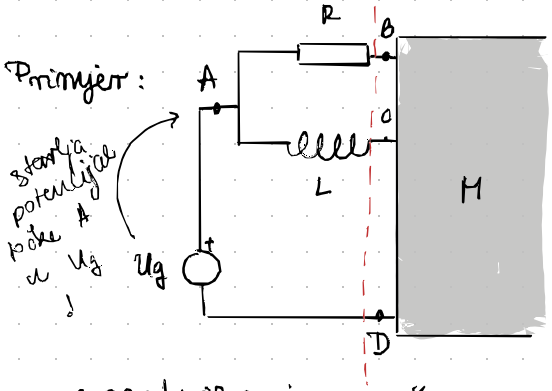
$i(t)(R_2 + R_4) = U_{01} - R_4 \cdot i_{03} - r \cdot i(t)$

$i(t)(R_2 + R_4 + r) = U_{01} - R_4 \cdot i_{03} = 24 - 14$

$i(t) = \frac{10}{5+3} \Rightarrow \boxed{i(t) = 1.25\,A}$

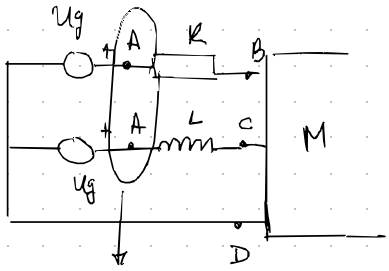
Pozmicanje naponskog izvora

Primjer:



→ naponski izvor je premješten kroz čvor

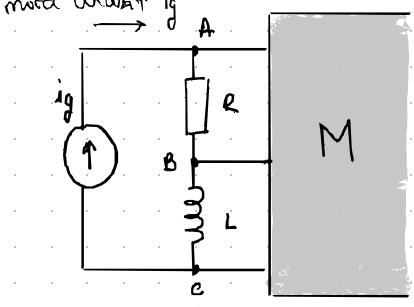
- ne možemo direktno transformirati u strujni izvor



u ogranke u čvorište A dolazi potencijal Ug

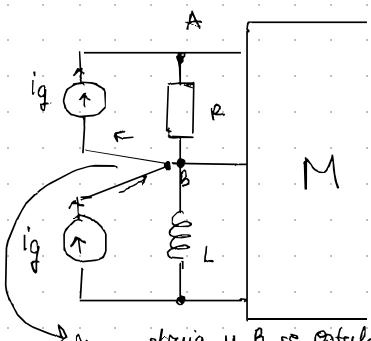
Pozmicanje strujnog izvora

mora ukrasit ig →



← mora izaći i_g

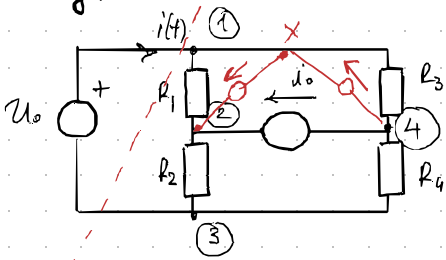
1 strujni je isto što i n strujnih spojenih ①

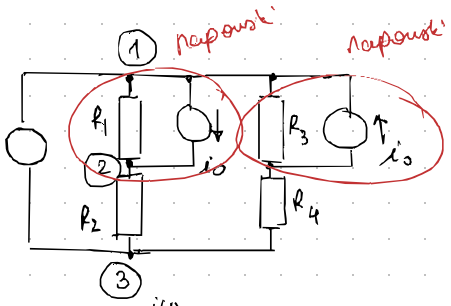


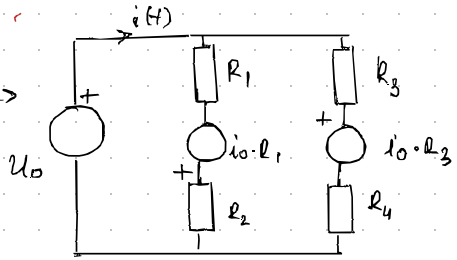
suma struja u B je ostala ista

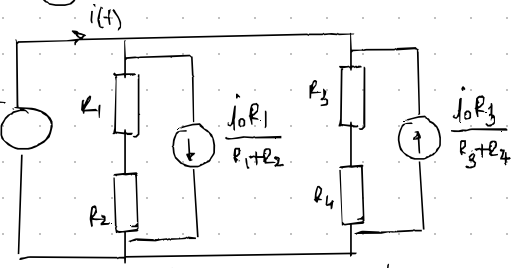
→ umjesto strujnog izvora između para čvorišta neke mreže možemo staviti identične strujne izvore na sve parove čvorišta u promatranoj konturi

Primjer 3 : $i(t) = ?$



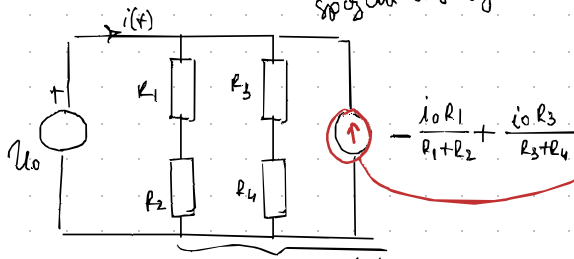






naponski izvori spojeni u seriji

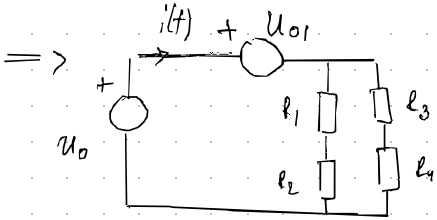
možemo zbrojiti



smjer određuje koji član od kojeg oduzimamo

$= i$

paralela → naponski!



$$U = \frac{i}{R_{12} \parallel R_{34}} \longrightarrow \left(\frac{1}{R_1+R_2} + \frac{1}{R_3+R_4}\right)^{-1}$$

$$= \left(\frac{R_3+R_4+R_1+R_2}{(R_1+R_2)(R_3+R_4)}\right)^{-1}$$

$$U_{01} = \frac{i_0 R_3 (R_1+R_2) - i_0 R_1 (R_3+R_4)}{(R_1+R_2)(R_3+R_4)} \cdot \frac{(R_1+R_2)(R_3+R_4)}{R_3+R_4+R_1+R_2} = \frac{i}{R_1+R_2+R_3+R_4}$$

$$\longrightarrow i(t) = \frac{U_0 - U_{01}}{R_{uk}} = \boxed{\frac{8}{5}\,mA}$$