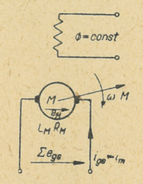
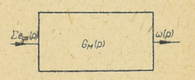
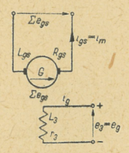
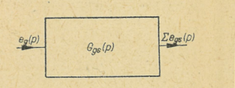
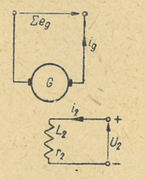
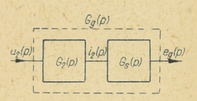
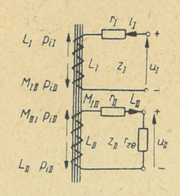
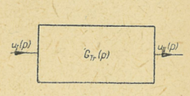
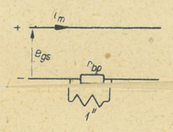
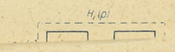
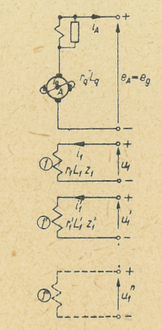
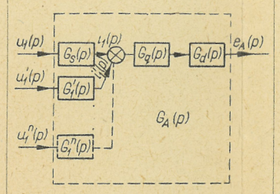
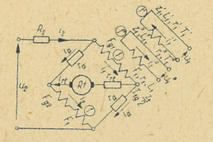
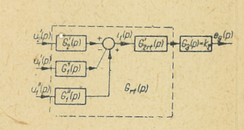
Lp.	Nazwa elementu	Schemat elektryczny elementu	Schemat blokowy elementu	Funkcja przenoszenia $G(p)$	Warunki początkowe	Funkcja przenoszenia uogólniona $G_u(p)$	Oznaczenia	Uwagi
1	Silnik obcowzbudny prądu stałego, wzbudzenie stałe			$G_M(p) = \frac{\omega(p)}{e_{gs}(p)} = \frac{1}{k_e} \cdot \frac{1}{1+pT_{em}(1+pT_m)}$	$M_{st}(p)$; $i_{m0}L_m$; $J\omega_0$	$G_{Mu}(p) = \frac{\omega(p)}{\Sigma e_{gs}(p)} = G_M(p)\left\{1 + \frac{\omega_0 k_e T_{em}(1+pT_m) + \Sigma e_{gs}(p) + i_{m0} r_m T_m - M_{st}(p)\frac{k_e T_{em}}{J}(1+pT_m)}{\Sigma e_{gs}(p)}\right\}$	$r_m = r_M + r_{gs}$ [Ω] $L_m = L_M + L_{gs}$ [H] $T_m = \frac{L_m}{r_m}$ [s] $T_{em} = \frac{Jr_m}{k_e k_m}$ [s] $k_e = c\Phi = \frac{e_M}{\omega}$ [Vs] $k_m = \frac{M}{i_m}\left[\frac{\text{kGm}}{\text{A}}\right]$	Przy pominięciu indukcyjności twornika ($L_m = 0$) funkcja przenoszenia przyjmie postać $G_m(p) = \frac{1}{k_e} \cdot \frac{1}{1+pT_{em}}$
2	Prądnica sterująca prądu stałego obcowzbudna			$G_{gs}(p) = \frac{e_{gs}(p)}{e_g(p)} = \frac{k_3}{r_3} \cdot \frac{1}{1+pT_3}$	$i_{30} L_3$ $\mp \Delta e_{gs}(p)$	$G_{gsu}(p) = \frac{\Sigma e_{gs}(p)}{e_g(p)} = G_{gs}(p)\left\{1 + \frac{i_{30} r_3 T_3 \pm \frac{r_3}{k_3}(1+pT_3)\Delta e_{gsr}(p)}{e_g(p)}\right\}$	$k_3 = \frac{e_{gs}}{i_3}$ [Ω] $\Sigma e_{gs}(p) = e_{gs}(p) \pm \Delta e_{gsr}(p)$ r_3 — całkowity opór obwodu wzbudzenia (ew. wraz z oporem twornika wzbudnicy sterującej) Δe_{gsr} = *SEM* magnetyzmu szczątkowego	
3	Wzbudnica sterująca obcowzbudna			$G_g(p) = G_2(p) \cdot G_3(p)$ $G_2(p) = \frac{i_2(p)}{U_2(p)} = \frac{1}{r_2} \cdot \frac{1}{1+pT_2}$ $G_3(p) = \frac{e_g(p)}{i_2(p)} = k_2$ $G_g(p) = \frac{k_2}{r_2} \cdot \frac{1}{1+pT_2}$	i_{20} $\pm \Delta e_{gr}(p)$	$G_{gu}(p) = \frac{\Sigma e_g(p)}{U_2(p)} = G_g(p)\left\{1 + \frac{i_{20} r_2 T_2 \pm \frac{r_2}{k_2}(\Delta c_{gr}(p)(1+pT_2))}{U_2(p)}\right\}$	$T_2 = \frac{L_2}{r_2}$ [s] Δe_{gr} = *SEM* magnetyzmu szczątkowego $k_2 = \frac{e_g(p)}{i_2(p)}$ [Ω]	Pomijamy indukcyjność twornika L_g; opór twornika włącza się do obwodu wzbudzenia prądnicy sterującej
4	Transformator przyspieszeniowy lub stabilizujący			$G_{Tr(p)} = \frac{U_{II(p)}}{U_{I(p)}} \cdot \frac{\frac{z_{II}}{z_I} \cdot \frac{r_{ze}}{r_{II}+r_{ze}} p T_I}{1 + p\left(T_I + \frac{r_{II}}{r_{II}+r_{ze}} T_{II}\right)}$	i_{II0} , i_{I0}	$G_{Tru}(p) = G_{Tr}(p)\left[1 + \frac{\Delta U_{\Sigma I0}}{pU_I(p)}\right]$	$\Delta U^{\Sigma I_0} = -r_I\left(i_{I_0} - \frac{z_{II}}{z_I} i_{II_0}\right)$, gdzie $\frac{z_{I_1}}{z_I} i_{II0}$ — prąd początkowy obwodu wtórnego przeliczony na obwód pierwotny, $\Delta U_{\Sigma I_0}$ — spadek napięcia początkowego spowodowany przez prądy i_{I0} oraz i_{II0} $T_I = \frac{L_I}{r_I}$ $T_{II} = \frac{L_{II}}{r_{II}}$	
5	Sprzężenie zwrotne prądowe (z obwodu			$H_i'(p) = \frac{i_m r_{bp}}{e_{gs}(p)} = k_i H_i(p) = k_i \frac{pT_{em}}{1+pT_{em}}$ $k_i = \frac{r_{bp}}{\ddot{p}T_{em}}$ $H_i''(p) = \frac{\ddot{p}T_{em}}{1+pT_{em}}$	$M_{st}(p)$, $J\omega_0$	$H_{iu}(p) = H_i'(p)\left[1 + \frac{k_e(M_{st}'(p) - J\omega_0)}{I_{n\,2}\ (m)}\right]$		Przy hamowaniu wartość funkcji przeniesienia $H_i(p)$ pozostaje taka "—"
6	Wzmacniacz maszynowy amplidyna			$G_1(p) = \frac{z_1}{r_1}$ $G_1'(p) = \frac{z_1'}{r_1'}$ $G_1''(p) = \frac{z_1''}{r_1''}$ $G_1^n(p) = \frac{z_1^n}{r_1^n}$ $G_q(p) = k_q \frac{1}{1+pT_{1\Sigma}}$ $G_d(p) = \frac{k_d}{r_q} \frac{1}{1+pT_q}$ $G_A(p) = G_1(p) \cdot G_q(p) \cdot G_d(p) = \frac{e_A(p)}{U_1(p)} =$ $= \frac{z_1}{r_1} \cdot \frac{k_q k_d}{r_q} \cdot \frac{1}{1+pT_{1\Sigma}} \cdot \frac{1}{1+pT_q}$ $G_a(p) = G_q(p) \cdot G_d(p)$	$i_{10} L_1$ $i_{10}' L_1'$ $i_{10}'' L_1''$ $i_{10}^n L_1^n$ $i_{q0} L_q$	$G_{Au}(p) = G_A(p)\left(1 + \frac{U_{10}}{U_1(p)}\right) + G_d(p)\frac{e_{A0}}{U_1(p)}$	$T_{1\Sigma} = T_1 + T_1' + T_1'' + \cdots + T_1^n$ [s] $k_q = \frac{e_{q1}(p)}{z_1' i_1(p)} = \frac{e_{q1}'(p)}{z_1' i_1'(p)} = \cdots$ [Ω] $k_d = \frac{e_A(p)}{i_q'(p)}$]Ω] $U_{10} = L_1 i_{10} + M_{11} i_{10} + \cdots + M_{11^n} i_{10}^n$ $U_{10}' = L_1 i_1' + M_{1'1} i_{10} + \cdots + M_{1'1^n} i_{10}^n$ ⋮ $U_{10}^n = L_1^n i_{10}^n + M_{1n_1} i_{10} + \cdots + M_1 n_1 n\text{-}1\, i_{10}^{n-1}$ $e_{AO} = k_d i_{qo}$ — początkowa *SEM* aplidyny, wzniecona przez prąd początkowy obwodu szczotek zwartych i_{q0}	W przypadku występowania przeciwsprzężeń znak przy odpowiednich $G_1(p)$ itd. będzie "—", tzn. że np. $G_1(p) = -\frac{z_1}{r_1}$ itp.
7	Wzmacniacz maszynowy rototrol w układzie mostkowym			$G_{2rl}(p) =$ $= \frac{1}{\{[r_{Fg}(1+pTg)+r_1(1+pT_1)]R_m + a\}(1+pT_{1\Sigma}) + z_1 k_1 b(1+pT_1)}$ $G_2'(p) = r_k(1+pT_{1\Sigma})$ $G_1'(p) = k_1 \frac{z_1'}{r_1'} b$ $G_I(p) = k_1 \frac{z_1''}{r_1''} b$ $G_{2rl}(p) = G_2'(p)\, G_{2rl}(p)\, k_2$ $G_{1rl}'(p) = G_2'(p)\, G_{2rl}'(p)\, k_2$ $G_3(p) = \frac{e_g(p)}{i_1(p)} + k_1$			$T_{1\Sigma} = T_1 + T_1 + T_1'' + \cdots + T_1^n$ [s] $_1k = \frac{e_{rl1}}{z_1 i_1} = \cdots$ [Ω] $k_2 = \frac{e_g}{i_1}$]Ω] $r_k = r_{rl} + r_a$ [Ω] $a = R_2(2r_{rl} + r_a)\ r_a r_{rl}$ [Ω] $b = 2(R_2 + r_a)$ [Ω] $R_m = R_2 + r_{rl} + 2r_a$ [Ω]	Jak wyżej