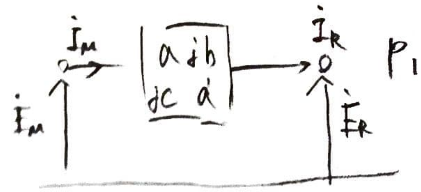
[S.61 迷2]　(V) E：線間電圧　$\dot{E}_M, \dot{E}_R, \dot{E}_S$ ⇒ 対地間電圧.

(1) 接続点電圧 E(kV) に保ったときの受電端の有効電力 P_1 (MW)



$$\begin{pmatrix} \dot{E}_M \\ \dot{I}_M \end{pmatrix} = \begin{pmatrix} a & jb \\ jc & a \end{pmatrix} \begin{pmatrix} \dot{E}_R \\ \dot{I}_R \end{pmatrix} \quad \text{より} \quad \dot{E}_M = a\dot{E}_R + jb\dot{I}_R \ (\text{kV}) \ —①$$

$$\dot{I}_R = \frac{\dot{E}_M - a\dot{E}_R}{jb} \ (\text{kA}) \ —②$$

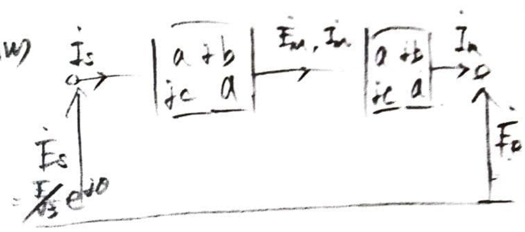
$\dot{E}_M = \frac{E}{\sqrt{3}} e^{j\theta}$　$\dot{E}_R = E/\sqrt{3}$ (kV)

$$\dot{I}_R = \frac{\frac{E}{\sqrt{3}}\{(\cos\theta + j\sin\theta) - a\}}{jb} = \frac{E}{\sqrt{3}}\left(\frac{1}{b}\sin\theta\right) - \frac{E}{\sqrt{3}b} j(\cos\theta - a) \ (\text{kA})$$

∴ 求める受電点の有効電力 P_1 (MW) は.

$$P_1 = \sqrt{3}\, E\, \mathrm{Re}[\dot{I}_R]_{\text{kA}} = \sqrt{3}\, E \times \frac{E}{\sqrt{3}} \frac{1}{b} \sin\theta = \frac{E^2}{b} \sin\theta \ [\text{MW}]$$ //

(2) 接続点の調相設備を離した時の受電端有効電力 P_2 (MW)



$$\begin{pmatrix} \dot{E}_S \\ \dot{I}_S \end{pmatrix} = \begin{pmatrix} a & jb \\ jc & a \end{pmatrix} \begin{pmatrix} a & jb \\ jc & a \end{pmatrix} \begin{pmatrix} \dot{E}_R \\ \dot{I}_R \end{pmatrix} = \begin{pmatrix} a^2 - bc & j2ab \\ j2ac & a^2 - bc \end{pmatrix} \begin{pmatrix} \dot{E}_R \\ \dot{I}_R \end{pmatrix}$$

$$\therefore \dot{E}_S = (a^2 - bc)\dot{E}_R + j2ab\dot{I}_R$$

$$\dot{I}_R = \frac{\dot{E}_S - (a^2 - bc)\dot{E}_R}{j2ab} = \frac{\frac{E}{\sqrt{3}}(\overset{\cos\theta + j\sin\theta}{e^{j\theta}} - (a^2 - bc))}{j2ab} = \frac{E}{2\sqrt{3}ab}\sin\theta - \frac{jE}{2\sqrt{3}ab}(\cos\theta - (a^2 - bc))$$

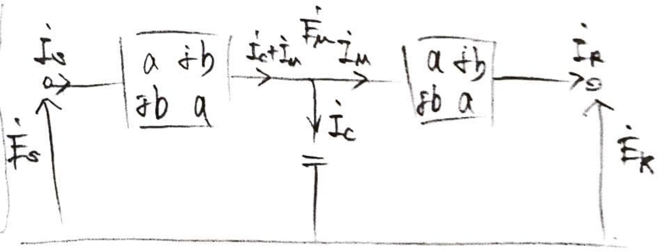
$$\therefore P_2 = \sqrt{3}\, E\, \mathrm{Re}[\dot{I}_R] = \sqrt{3}\, E \frac{E}{2\sqrt{3}ab} \sin\theta = \frac{E^2}{2ab} \sin\theta \ (\text{MW})$$ //

$$\frac{P_1}{P_2} = \frac{\frac{E^2}{b}\sin\theta}{\frac{E^2}{2ab}\sin\theta} = 2a \text{ 倍}$$ // ⇐ 調相設備ありで、接続点をEに保ったときに、受電端有効電力は2a倍になる

(3) 図より

$$\begin{bmatrix} \dot{E}_S \\ \dot{I}_S \end{bmatrix} = \begin{bmatrix} a & jb \\ jb & a \end{bmatrix} \begin{pmatrix} \dot{E}_M \\ \dot{I}_M + j\dot{I}_C \end{pmatrix}$$

$\dot{E}_S$ と $\dot{E}_M$ の位相差も θ である. $\dot{E}_M$ を基準として
$\dot{E}_S = \frac{E}{\sqrt{3}} e^{j\theta}$, $\dot{E}_R = \frac{E}{\sqrt{3}} e^{-j\theta}$
$\dot{E}_M = E/\sqrt{3}$ とする.



$$\dot{E}_S = a\dot{E}_M + jb(\dot{I}_M + j\dot{I}_C)$$

$$= aE/\sqrt{3} + jb\dot{I}_M - bI_C \ —③$$

② より

$\dot{I}_M = jc\dot{E}_R + a\dot{I}_R$ と表わされ

$$\dot{I}_M = jc\frac{E}{\sqrt{3}}e^{-j\theta} + a\frac{\dot{E}_M - a\dot{E}_R}{jb} = jc\frac{E}{\sqrt{3}}e^{-j\theta} + a\frac{E/\sqrt{3} - aE/\sqrt{3}\,e^{-j\theta}}{jb}$$

$$= \frac{-bcEe^{-j\theta} + aE - a^2Ee^{-j\theta}}{j\sqrt{3}b}$$

を ③ に代入

$$\frac{E}{\sqrt{3}}e^{j\theta} \leftarrow \dot{E}_s = a\frac{E}{\sqrt{3}} - bI_c + jbI_\mu$$

$$\boxed{\begin{pmatrix} a & jb \\ jc & a \end{pmatrix}^{-1} = a^2 + bc = 1}$$

$$\begin{pmatrix} A & B \\ C & D \end{pmatrix} \quad AD - BC = 1$$

$$= a\frac{E}{\sqrt{3}} - b\dot{I}_c + jb\frac{-bcEe^{-j\theta} + aE - a^2Ee^{-j\theta}}{j\sqrt{3}b}$$

$$= a\frac{E}{\sqrt{3}} - b\dot{I}_c - \frac{(bc+a^2)}{\sqrt{3}}Ee^{-j\theta} + \frac{aE}{\sqrt{3}}$$

$$= 2a\frac{E}{\sqrt{3}} - b\dot{I}_c - (bc+a^2)\frac{E}{\sqrt{3}}e^{-j\theta}$$ この式の右辺と左辺の実部が等しいので

$$\frac{E}{\sqrt{3}}\cos\theta = 2a\frac{E}{\sqrt{3}} - b\dot{I}_c - \frac{E}{\sqrt{3}}\cos\theta$$

$$\frac{2E}{\sqrt{3}}\cos\theta = 2a\frac{E}{\sqrt{3}} - b\dot{I}_c \qquad b\dot{I}_c = \frac{2E}{\sqrt{3}}(a-\cos\theta)$$

$$\dot{I}_c = \frac{2E}{\sqrt{3}}\frac{a-\cos\theta}{b}$$

∴ 接続点の調相設備の容量 $Q_{c(MVA)}$は

$$Q_c = \sqrt{3}E|\dot{I}_d| = \sqrt{3}E\frac{2E}{\sqrt{3}}\frac{a-\cos\theta}{b} = \frac{2E^2}{b}(a-\cos\theta)\ \mathrm{MVA}$$ //

虚部

$$+\frac{E}{\sqrt{3}}\sin\theta = \frac{E}{\sqrt{3}}\sin\theta$$

$$-\frac{E}{\sqrt{3}}(\cos(-\theta) + j\sin(-\theta))$$
$$= -\frac{E}{\sqrt{3}}(\cos\theta - j\sin\theta)$$