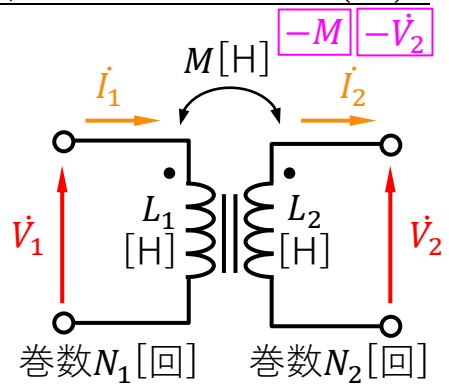
相互インダクタンス（11）



巻数比：$a = \dfrac{N_1}{N_2}$

$$\begin{cases} \dot{V}_1 = j\omega L_1 \dot{I}_1 - j\omega M \dot{I}_2 \\ \dot{V}_2 = -j\omega L_2 \dot{I}_2 + j\omega M \dot{I}_1 \end{cases}$$

【理想変成器の条件】
・漏れ磁束ゼロ（結合係数$k = 1$）
・エネルギー損失なし
→巻線抵抗ゼロ
→鉄心の透磁率∞ → （巻数比は保つ）$L_1, L_2 = \infty$

《理想変成器》

磁気抵抗：R_m[A/Wb]

$$L_1 = \frac{{N_1}^2}{R_m} \quad L_2 = \frac{{N_2}^2}{R_m} \quad M = k\sqrt{L_1 L_2} = \sqrt{\frac{{N_1}^2}{R_m} \cdot \frac{{N_2}^2}{R_m}} = \frac{N_1 N_2}{R_m} \quad \therefore R_m = \frac{N_1 N_2}{M}$$

$$L_1 = \frac{{N_1}^2}{R_m} = \frac{{N_1}^2}{\frac{N_1 N_2}{M}} = \frac{N_1 M}{N_2} = aM \quad L_2 = \frac{{N_2}^2}{R_m} = \frac{{N_2}^2}{\frac{N_1 N_2}{M}} = \frac{N_2 M}{N_1} = \frac{M}{a} \quad \therefore \begin{cases} L_1 = aM \\ L_2 = \dfrac{M}{a} \end{cases}$$

$$\frac{\dot{V}_1}{\dot{V}_2} = \frac{j\omega L_1 \dot{I}_1 - j\omega M \dot{I}_2}{-j\omega L_2 \dot{I}_2 + j\omega M \dot{I}_1} = \frac{L_1 \dot{I}_1 - M \dot{I}_2}{-L_2 \dot{I}_2 + M \dot{I}_1} = \frac{aM\dot{I}_1 - M\dot{I}_2}{-\frac{M}{a}\dot{I}_2 + M\dot{I}_1} = \frac{a\left(M\dot{I}_1 - \frac{M}{a}\dot{I}_2\right)}{M\dot{I}_1 - \frac{M}{a}\dot{I}_2} = a = \frac{N_1}{N_2}$$

$$\dot{I}_1 = \frac{\dot{V}_1 + j\omega M \dot{I}_2}{j\omega L_1} = \frac{\dot{V}_1}{j\omega L_1} + \frac{M\dot{I}_2}{aM} = \frac{\dot{V}_1}{j\omega L_1} + \frac{M\dot{I}_2}{L_1} = \frac{\dot{V}_1}{j\omega L_1} + \frac{\dot{I}_2}{a}$$

$L_1 \to \infty$ より、 $\dot{I}_1 = 0 + \dfrac{\dot{I}_2}{a} = \dfrac{\dot{I}_2}{a}$ $\quad \dfrac{\dot{I}_1}{\dot{I}_2} = \dfrac{1}{a} = \dfrac{N_2}{N_1}$

$$\frac{|\dot{V}_1| \cdot |\dot{I}_1|}{|\dot{V}_2| \cdot |\dot{I}_2|} = a \cdot \frac{1}{a} = 1$$

$\dot{V}_1 : \dot{V}_2 = N_1 : N_2$
$\dot{I}_1 : \dot{I}_2 = N_2 : N_1$

理想変成器は完全な電力変換器