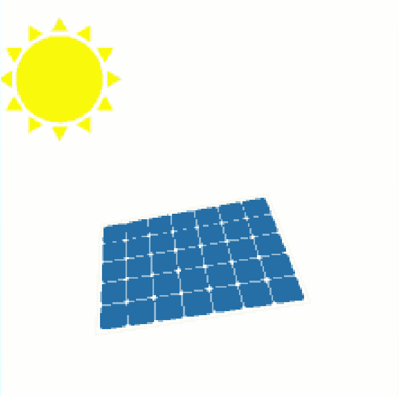
Coupled Circuits



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Connection of Two Coils to Form a Coupled Coil :

Two coils can be connected in four different way to form a coupled coil. They are : -

(i) Series aiding connection

(ii) Series opposing connection

(iii) Parallel aiding connection

(iv) Parallel opposing connection

5.10 SERIES AIDING CONNECTION :

In fig. 5.16, the current is entering both the coils at the dotted both the coils at the dotted terminal. So, it is called series aiding combination.

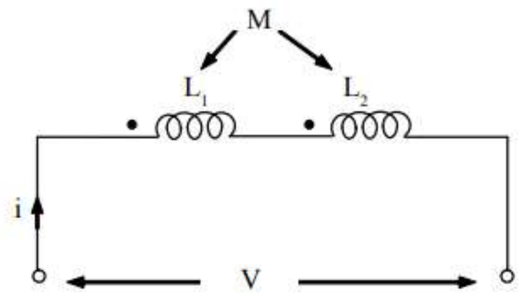

Fig. 5.16 Series Aiding

Applying KVL, we get, $L_1\frac{di_1}{dt}+M\frac{di}{dt}+L_2\frac{di}{dt}+M\frac{di}{dt}=V$

(or) $(L_1+L_2+2M)\,\frac{di}{dt}=V$ ----------(33)

Let L be equivalent inductance of the combination, them

$$V=L\frac{di}{dt} \quad \text{----------(34)}$$

Equating eq. (33) and (34), the equivalent inductance of series aiding connection is,

$$L=L_1+L_2+2M$$

5.11 SERIES OPPOSING CONNECTION [BUCKING]

In fig. 5.17, the current is entering first coil at dotted terminal and leaving the other coil at dotted terminal. so, the mesh equation for this circuit is

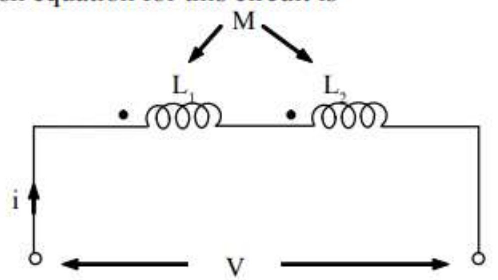

Fig. 5.17 Series Opposing

$$L_1\frac{di}{dt} - M\frac{di}{dt} + L_2\frac{di}{dt} - M\frac{di}{dt} = V$$

(or) $$(L_1 + L_2 - 2M)\frac{di}{dt} = V \qquad \text{--------------(35)}$$

we know that, $$V = L\frac{di}{dt} \qquad \text{--------------(36)}$$

Equating eq. (35) and (36), the equivalent inductance of series opposing connection is $L = L_1 + L_2 - 2M$.

Equivalent inductance in the series aiding combination is more than that in series opposing combination by an amount = 4M.

5.12 PARALLEL AIDING CONNECTION :

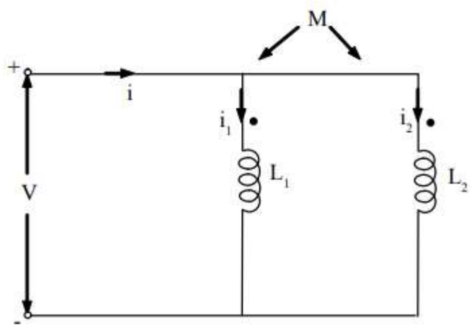

Fig. 5.18 Parallel aiding

In fig. 5.18, both currents i_1 and i_2 enter the coils at the dotted terminals. Applying KVL to both loops, we get

$$L_1 \frac{di_1}{dt} + M \frac{di_2}{dt} = V$$

$$\& \qquad M \frac{di_1}{dt} + L_2 \frac{di_2}{dt} = V$$

Assume that the excitations are sinusoidal for convenience. Then the above equations can be written as,

$$j\omega L_1 I_1 + j\omega M I_2 = V$$

$$\& \qquad j\omega M I_1 + j\omega L_2 I_2 = V$$

$$L = \frac{L_1 L_2 - M^2}{L_1 + L_2 - 2M}$$

5.13 PARALLEL OPPOSING CONNECTION

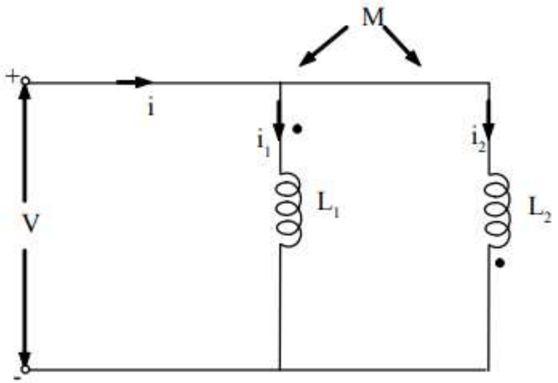

Fig. 5.19 Parallel opposing

In fig. 5.19, one current enters and other leaves the coil through the dotted end of the coil. Hence, mutual inductance is negative. Applying KVL to both loops, we get

$$L_1\frac{di_1}{dt} - M\frac{di_2}{dt} = V$$

& $$-M\frac{di_1}{dt} + L_2\frac{di_2}{dt} = V$$

$$L = \frac{L_1L_2 - M^2}{L_1 + L_2 + 2M}$$

Thank You