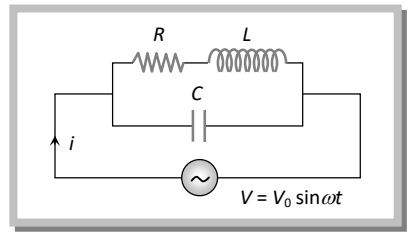
Parallel LC circuits

If inductor has resistance (R) and it is connected in parallel with capacitor as shown



(i) At resonance

(a) $Z_{\max} = \frac{1}{Y_{\min}} = \frac{L}{CR}$

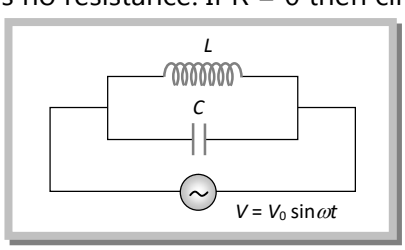
(b) Current through the circuit is minimum and $i_{\min} = \frac{V_0 CR}{L}$

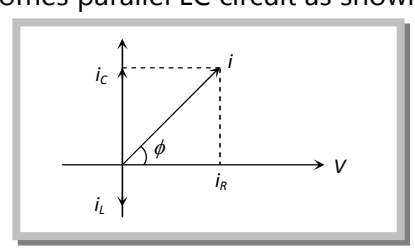
(c) $S_L = S_C \Rightarrow \frac{1}{X_L} = \frac{1}{X_C} \Rightarrow X = \infty$

(d) Resonant frequency $\omega_0 = \sqrt{\frac{1}{LC} - \frac{R^2}{L^2}} \frac{rad}{sec}$ or $\nu_0 = \frac{1}{2\pi}\sqrt{\frac{1}{LC} - \frac{R^2}{L^2}} Hz$ (Condition for parallel resonance is $R < \sqrt{\frac{L}{C}}$)

(e) Quality factor of the circuit $= \frac{1}{CR} \cdot \frac{1}{\sqrt{\frac{1}{LC} - \frac{R^2}{L^2}}}$. In the state of resonance the quality factor of the circuit is equivalent to the current amplification of the circuit.

(ii) If inductance has no resistance: If R = 0 then circuit becomes parallel LC circuit as shown





Condition of resonance: $i_C = i_L \Rightarrow \frac{V}{X_C} = \frac{V}{X_L} \Rightarrow X_C = X_L$. At resonance current i in the circuit is zero and impedance is infinite. Resonant frequency: $\nu_0 = \frac{1}{2\pi\sqrt{LC}} Hz$

Note: At resonant frequency due to the property of rejecting the current, parallel resonant circuit is also known as anti-resonant circuit or rejecter circuit.

Due to large impedance, parallel resonant circuits are used in radio.

Concepts

Series RLC circuit also known as acceptor circuit (or tuned circuits or filter circuit) as at resonance it most readily accepts that current out of many currents whose frequency is equal to its natural frequency.

The choke coil can be used only in ac circuits not in dc circuits, because for dc frequency $\nu = 0$ hence $X_L = 2\pi\nu L = 0$, only the resistance of the coil remains effective which too is almost zero.

Choke coil is based on the principle of wattless current.