EXAMPLE 2.5. *A dc supply of 100 V feeds an inductance of 10 H through a thyristor. Find the minimum width of the gate pulse so that the thyristor is triggered. The latching current of thyristor is 80 mA.*

SOLUTION : The circuit is shown in Fig. 2.9.

$$100 = L\frac{di}{dt}$$

or

$$i = \frac{100}{10}t = 10\,t$$

Thyristor will trigger when $i = 80$ mA.

$$t = \frac{80 \times 10^{-3}}{10} = 8 \times 10^{-3} \text{ s}$$

Therefore, width of pulse should be more than 8 milli-seconds.

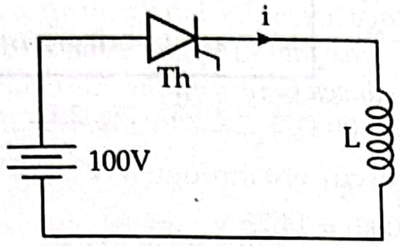

Fig. 2.9.

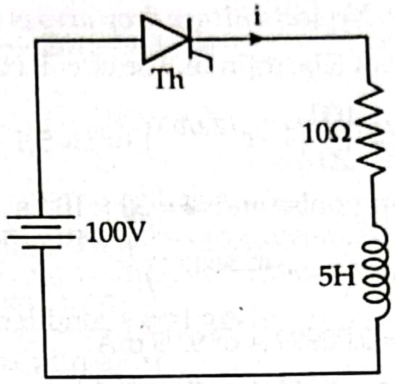

Fig. 2.10.

EXAMPLE 2.6. ***A dc supply of 100 V feeds a load having a resistance of 10 ohms and an inductance of 5 H through a thyristor. The latching current of thyristor is 50 mA. Find the minimum width of the gate pulse.***

SOLUTION : The circuit is shown in Fig. 2.10. The current at any time t is

$$i = \frac{100}{10}\left(1 - e^{-Rt/L}\right) = 10\left(1 - e^{-2t}\right)$$

Thyristor will trigger when $i = 50$ mA

$$50 \times 10^{-3} = 10\left(1 - e^{-2t}\right)$$

or $$e^{-2t} = 0.995$$

or $$t = 0.0025 \text{ seconds} = 2.5 \text{ milli-seconds}$$

Hence minimum width of gate pulse is 2.5 milli-seconds.

EXAMPLE 2.7. ***Figure 2.11 shows a thyristor circuit. Assume that switch S is open. The thyristor has a latching current of 40 mA and is fired by a pulse of width 40 μs. (a) Find if the thyristor will turn on (b) The switch is closed. Find the maximum value of R so that thyristor may turn on.***

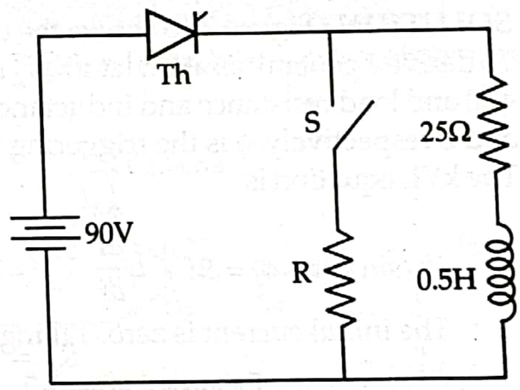

Fig. 2.11.

SOLUTION : *(a)* Switch is open. Resistance R is not in circuit. The circuit current is

$$i = \frac{90}{25}\left(1 - e^{-25t/0.5}\right) = \frac{90}{25}\left(1 - e^{-50t}\right)$$

At the end of gate pulse, *i.e.*, at $t = 40 \times 10^{-6}$ s

$$i = \frac{90}{25}\left(1 - e^{-50 \times 40 \times 10^{-6}}\right) = 0.0072 \text{ A}$$

Since the current is less than latching current, the thyristor will not turn on.

(b) $$R = \frac{90}{40 \times 10^{-3} - 0.0072} = 2744\ \Omega$$

R should be less than 2744 ohm.

10.08 W.

EXAMPLE 2.39. ***R, L and C in an SCR circuit meant for protecting against $\frac{dv}{dt}$ and $\frac{di}{dt}$ are 4 Ω, 6 μH and 6 μF respectively. If the supply voltage is 300 V, find maximum permissible values of $\frac{dv}{dt}$ and $\frac{di}{dt}$.***

SOLUTION :

$$\left(\frac{di}{dt}\right)_{max} = \frac{V}{L} = \frac{300}{6\times10^{6}} = 50\times10^{6}\ \text{A/s}$$

When the circuit is switched on the rate of change of voltage across capacitor is given by

$$\frac{dv_C}{dt} = R\frac{di}{dt} + \frac{I_{sc}}{C}$$

$$I_{sc} = \text{short-circuit current} = \frac{300}{4} = 75\ \text{A}$$

Therefore

$$\frac{dv_C}{dt} = 4\times50\times10^{6} + \frac{75}{6\times10^{-6}} = 212.5\times10^{6}\ \text{V/s}$$

Hence the maximum permissible value of $\frac{dv}{dt}$ is 212.5×10^6 V/s.

EXAMPLE 2.37. ***In an ac circuit using a thyristor having a dv/dt rating of 25 V/μs, the source inductance is 0.2 mH The rms value of supply voltage is 230 V. If the damping factor is 0.65, find the values of R and C of the snubber circuit.***

SOLUTION :

$$V_m = 230 \times \sqrt{2} = 325.27 \text{ V}$$

$$L = 0.2 \times 10^{-3} \text{ H}$$

$$\frac{dv}{dt} = 25 \text{ V}/\mu\text{s} = 25 \times 10^{6} \text{ V/s}$$

$$\varsigma = 0.65$$

Using Eqn. (2.54)

$$C = \frac{1}{2 \times 0.2 \times 10^{-3}} \left[\frac{0.564 \times 325.27}{25 \times 10^{6}} \right]^2 = 134.62 \times 10^{-9} \text{ F}$$

Using Eqn. (2.53)

$$R = 2 \times 0.65 \left[\frac{0.2 \times 10^{-3}}{134.62 \times 10^{-9}} \right]^{0.5} = 50.1\,\Omega\,.$$