Triggering

Four types of triggering circuits have commonly been used as circuitry to trigger the flashlamp:

- Over-voltage
- External
- Series
- Parallel

The last three are used most often with solid-state lasers. The advantages and disadvantages of the triggering mechanisms will be discussed.

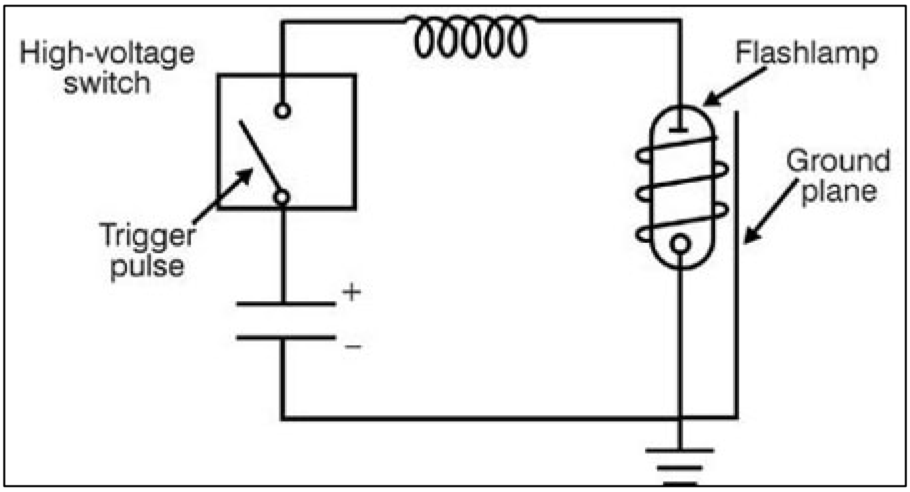

Fig. 1 Over voltage trigger circuit

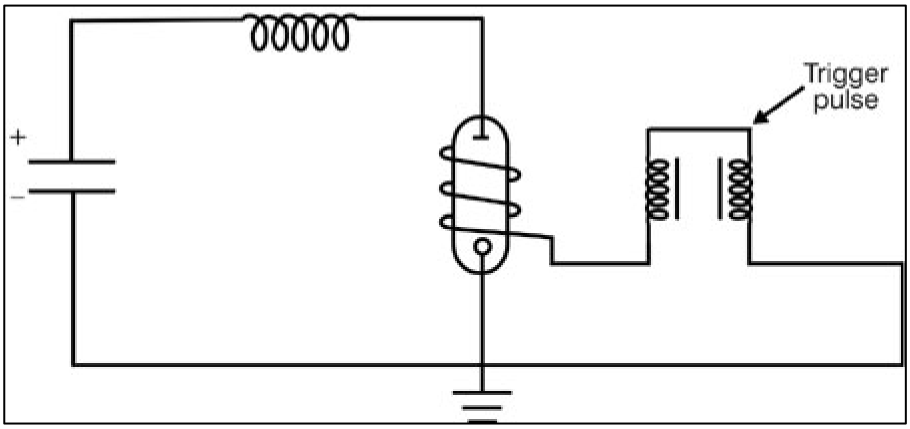

Fig. 2 External trigger circuit

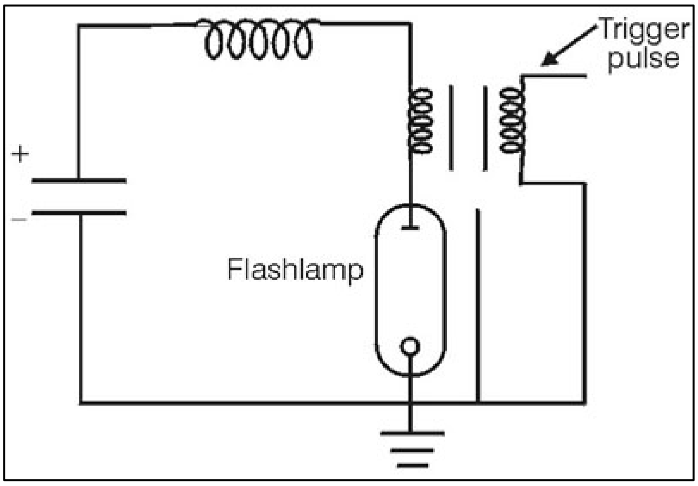

Fig. 3 Series trigger circuit

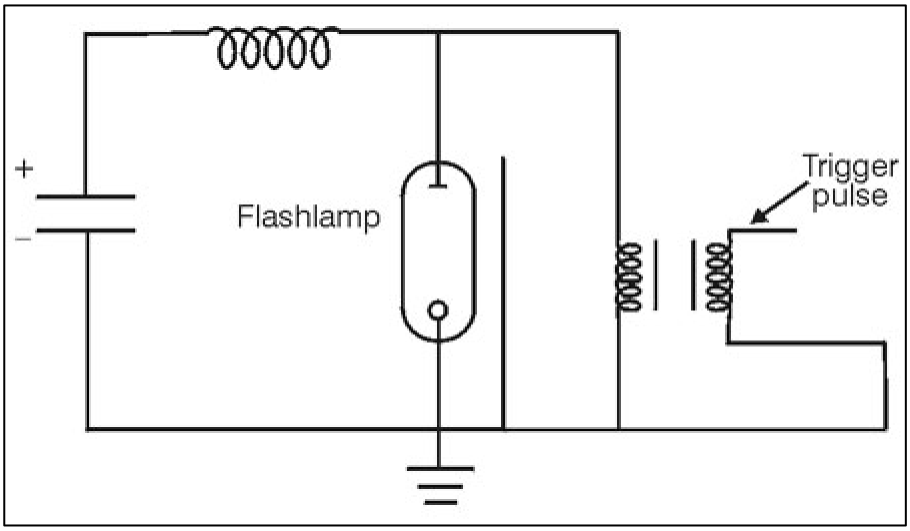

Fig. 4 Parallel trigger circuit

In addition, reliable triggering requires the use of a ground plane near the flashlamp. This is a factor independent of the method of triggering. Often, this stable voltage reference is a wire wrapped around the lamp. The entire arc length should be spanned to allow triggering to occur at the lowest values of voltage. The presence of the ground plane is indicated in the figures above.

H.W, given a two-inch arc length, how long should the trigger pulse be?

Control of Pulse Shape

The function of pulse forming network is to stores energy and deliver it to the lamp in desired pulse current shape. The pulse-shaping circuit shown in Figure 5 is an RLC discharge circuit. It consists of a single capacitor for energy storage, a single inductor for pulse shaping, and a resistive load in the form of the flashlamp.

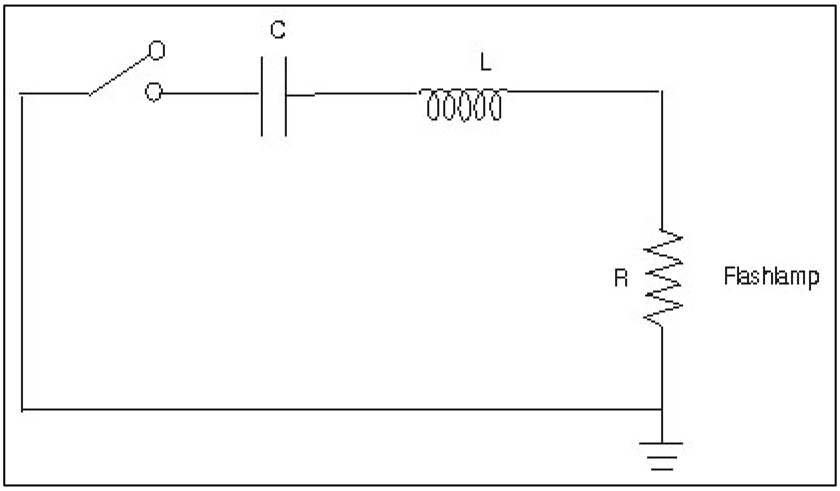

Fig. 5 RLC discharge circuit

The values of (RLC) may be obtained from the following equations:

$$C = (0.09 \text{ x } E_0 \text{ x } t_p^2/K_0^4)^{1/3} \qquad \ldots(1)$$

$$L = t_p^2/9C \qquad \ldots(2)$$

$$V = (2E_0/C)^{1/2} \qquad \ldots(3)$$

As an example, consider a flashlamp with a lamp-impedance parameter of 13 ohm-ampere$^{1/2}$. One desires to discharge 100 joules of energy through this lamp in a pulse of 500-microseconds duration. According to Equation 18 the capacitance should be $C = [0.09 \text{ x } 100 \text{ x } (500 \text{ x } 10^{-6})2/(13)4]^{1/3} = 0.199 \text{ x } 10^{-3}$ farads = 199 microfarads.

Then the inductance $L = (500 \text{ x } 10^{-6})2/(9 \text{ x } 0.199 \text{ x } 10^{-3}) = 1.40 \text{ x } 10^{-4}$ henry = 140 microhenrys.

Finally, the voltage $V = (2 \text{ x } 100/0.199 \text{ x } 10^{-3})^{1/2} = 1002$ volts.

The pulse circuit described above has a single inductor and a single capacitor and is referred to as a single-mesh network. In many cases, the circuit will contain two or more *LC* networks in series. This situation is called a multiple-mesh network. This is illustrated in Figure 6, for the case of three meshes.

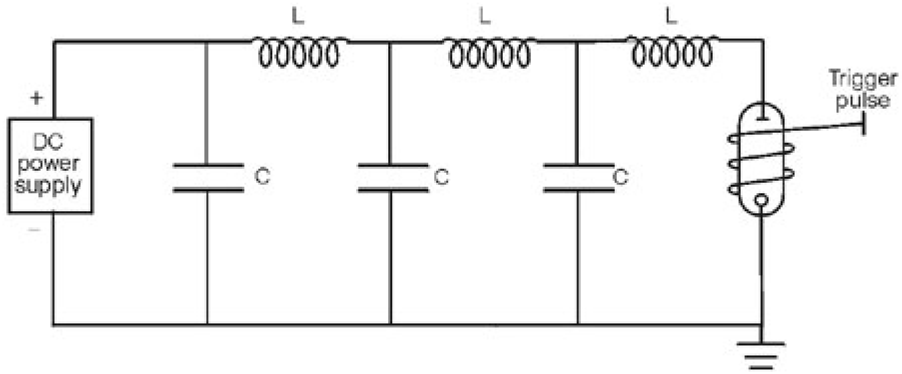

Fig. 6 Multiple-mesh discharge circuit

H.W: A 5ms- long current pulse is desired for two linear lamps connected in series and pumped at a total energy input of (1KJ). Each of lamps has an arc-length of (10cm) and a bore of (1cm). If we assume a peak current of (i_p=650A). Design a multiple mesh network including number of LC sections, inductance and capacitance per section and capacitor voltage.

Simmer Mode and Pseudosimmer Mode Circuits

Many pulsed solid-state laser systems incorporate driving circuits known as "simmer mode" or "pseudosimmer mode" circuits. These circuits maintain a steady-state partial ionization of the lamp during the time the lamp is not flashing. This is done by establishing and maintaining a low-current DC arc between the lamp electrodes. These circuits offer many operational advantages.

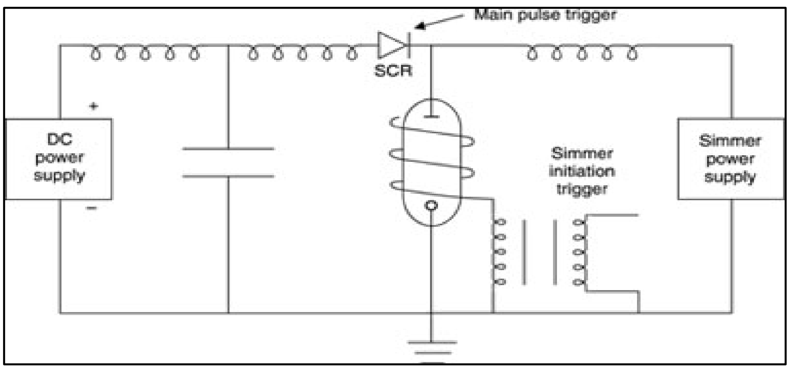

Fig. 7 Circuit for simmer mode operation

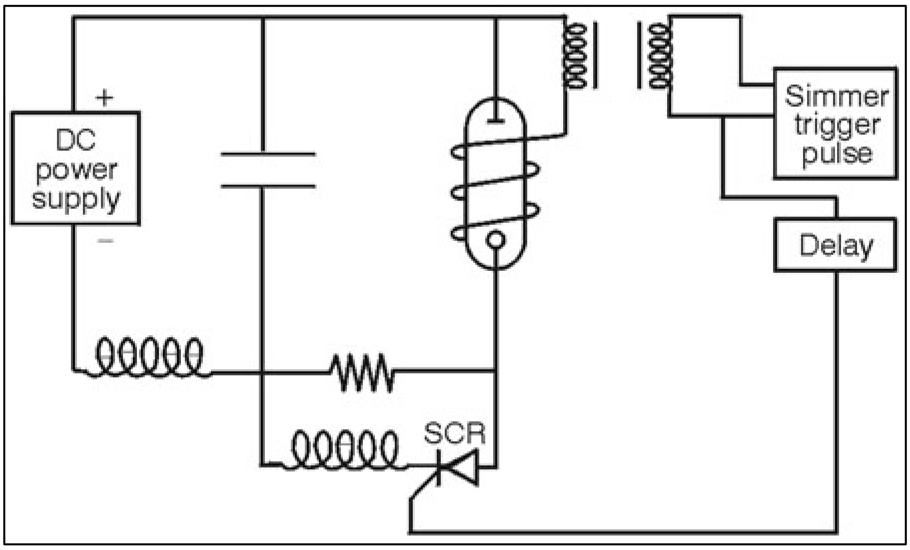

Fig. 8 Circuit for pseudosimmer mode operation