Notes

BRIEF contributions in any field of instrumentation or technique within the scope of the Journal can be accorded earlier publication if submitted for this section. Contributions should in general not exceed 500 words.

Series Triggering of Xenon Flash Lamps

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XENON flashtubes require initial ionization to provide a low resistance path for the conduction of a high power energizing current. This may be achieved by applying a high voltage trigger pulse to ionize the gas contained within the flashlamp. Different trigger methods are used: an external trigger control electrode, a radiation source, self breakdown or ignitron switching, a shunt or series trigger pulse.[1,2] The purpose of this note is to describe a very simple and reliable trigger circuit which eliminates the need for a third external trigger electrode with conventional flashlamps by providing simultaneously a short duration high voltage trigger pulse across the lamp terminals superimposed on the main high current dc power source. This can be of considerable use in a number of applications requiring single or repetitive flashes. Particularly it simplifies the design of pulsed laser devices employing liquid cooling and selective filtering[3] of the optical pump source. Furthermore, series triggering can be advantageous when one considers compact pump configurations using one or several xenon flashlamps.

The circuit of the series trigger arrangement is shown in Fig. 1. Direct application of a high voltage trigger pulse from the pulse transformer in the absence of the spark gap results in pulse leakage through the low impedance main dc energizing circuit. A convenient remedy to achieve both breakdown and discharge conditions in the xenon flash tube becomes possible by generating a high frequency pulse train. Such transient oscillations may be produced by the negative resistance characteristics of a spark gap connected across the secondary of a high voltage transformer in conjunction with a suitable tuned series LC circuit, once the voltage across the gap is high enough to start a spark discharge. The L of the circuit serves also to block the high frequency trigger pulse from the energy storage capacitors while C isolates the trigger transformer from the lamp terminal voltage. Figure 2(a) shows typical high voltage damped oscillations that are generated between point A and ground (see Fig. 1) in the absence of the flashlamp. The voltage and power necessary to effect triggering will depend upon the particular lamp type employed. With a xenon lamp in the circuit the lamp impedance changes rapidly from a high initial value to less than an ohm for high discharge currents upon ionization. The nature of the initial trigger pulse is now modified and lamp ionization appears to occur within the first cycle of the pulse train as shown in Fig. 2(b). The frequency of the oscillations is determined by the electrical constants of the circuit. With typical values of $L=200$ μH, $C=500$ pF, and an EG & G FX45 lamp, the observed frequency of the pulse train at the lamp terminal with a 6.35-mm air spark gap is 400 kc. Encapsulated spark gaps are available for which temperature, humidity, and pressure conditions do not affect the electrical circuit characteristics.

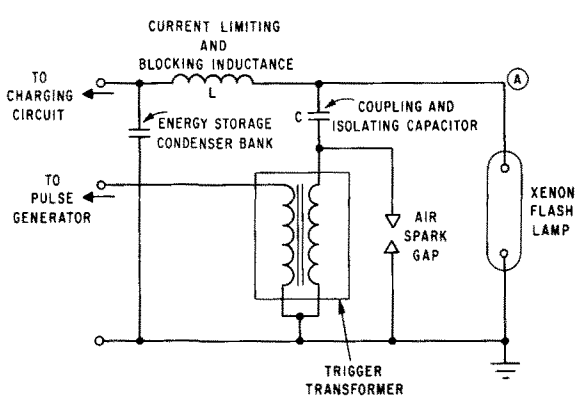

Fig. 1. Diagram of a spark gap series trigger circuit for flashtubes.

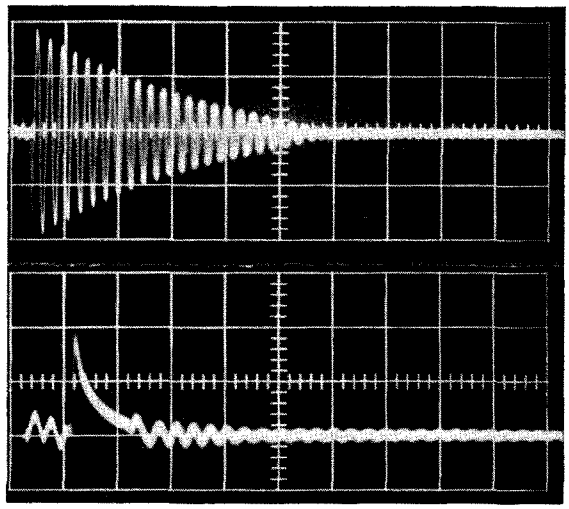

Fig. 2. Oscilloscope traces of spark gap generated trigger pulse across lamp terminals: (a) lamp disconnected, sweep speed 10 μsec/div, sensitivity 5 kV/div; (b) lamp connected, sweep speed 5 μsec/div, sensitivity 1 kV/div.

[1] K. J. Germeshausen, U. S. Patent Letter 2,722,629 (1955).
[2] W. R. Mallory and K. F. Tittel, Proc. Symp. on Optical Masers, Brooklyn, New York, 301 (1963).
[3] K. F. Tittel, Rev. Sci. Instr. **35**, 522 (1964).