4.1. Application of Magnetic Field

The objective is to create a magnetic field by driving a large current pulse through a rectangular solenoid coincident in time with the application of the strain field. Referring to Figure 4.2, the operation is as follows. A large electrolytic capacitor, C, is charged to a predetermined voltage, $\mathcal{E}_o$. At a predetermined time prior to application of the strain field the silicon control rectifier is triggered. Capacitor C then discharges via high voltage cables through the solenoid at a rate determined by the L, R, and C of the circuit. A current pulse of the form

$$I(t) = \frac{\mathcal{E}_o}{\omega L} e^{-\beta t} \sinh \omega t$$

is obtained where

$$\beta = \frac{R}{2L}$$

and

$$\omega = \left(\frac{R^2}{4L^2} - \frac{1}{LC} \right)^{1/2}.$$

Preadjustment of $\mathcal{E}_o$, R, and L allows a predetermined current I_{max} to be attained at a predetermined time τ_m governed by

$$\tanh \omega \tau_m = \frac{\omega}{\beta}.$$

This time is adjusted so that the shock wave passes through the specimen when $I = I_{max}$. The transit time is approximately 0.25 μs. The current is essentially steady during this time. The time variation in the neighborhood of τ_m is

$$\frac{\Delta I}{I} \simeq \frac{1}{2LC} (t - \tau_m)^2.$$

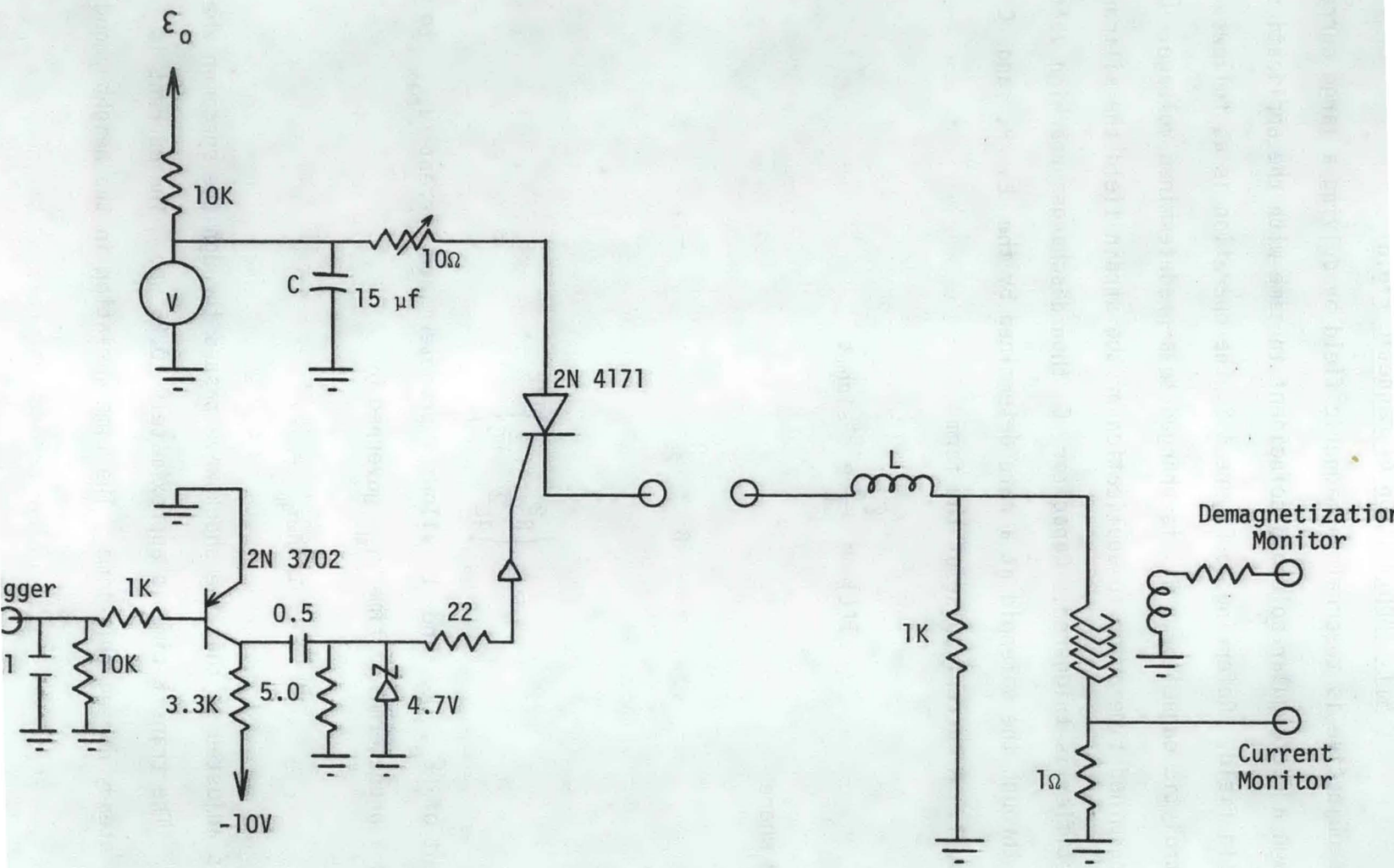

Fig. 4.2.--Current supply and target circuit.