FERRANTI

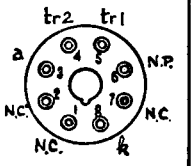
COLD CATHODE TETRODE

EN40

Type EN40 is a cold cathode tetrode gas discharge valve intended for use as a stroboscopic light source, particularly in applications employing photographic recording.

The light emitted is "whitish" in colour and of high actinic value.

Operation can be controlled by pulses of low energy.



Base Connections
Underside View of Base

PHYSICAL SPECIFICATION.

Base	International Octal.
Max. Seated Height	89 mm. ($3\frac{1}{2}$in.).
Max. Overall Length	103 mm. ($4\frac{1}{16}$in.).
Max. Diameter Base	32 mm. ($1\frac{1}{4}$in.).
Length of Arc	24 mm. ($\frac{15}{16}$in.).
Mounting Position	Any.*

PIN CONNECTIONS.

Pin 1—No connection.	Pin 5—Trigger No. 1.
Pin 2—No connection.	Pin 6—No Pin.
Pin 3—Anode.	Pin 7—No connection.
Pin 4—Trigger No. 2.	Pin 8—Cathode.

RATINGS.

Maximum Anode Voltage (Static)	440 volts.
Maximum Anode Voltage (working)	350 volts.
Minimum Anode Voltage (working)	250 volts.
Peak Inverse Anode Voltage ...	300 volts.
Maximum Mean Anode Current	100 mA.
Maximum Average Grid Current	10 mA.

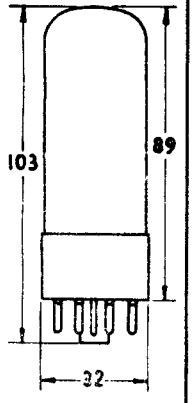
CHARACTERISTICS.

††Static Trigger Voltage (tr_2 to tr_1)	70–120 volts.
Maximum Flashing Frequency	150 per sec.
†Peak Anode Current	250 amps.
Minimum Trigger Current required :—	
V_a = 350	50 μA.
V_a = 250	300 μA.

TYPICAL OPERATION.

DC Supply Voltage	300–330 volts.
‡Trigger Electrode No. 2 Voltage (V_{tr_2})	50 volts.
§Trigger Pulse Amplitude (V_{tr_1})	150 volts.
Charging Resistor	3500 ohms.
Discharge Capacitor for operation	
at 6–35 c.p.s.	4 μF.
30–50 c.p.s.	3 μF.
45–80 c.p.s.	2 μF.
80–150 c.p.s.	1 μF.

For further information refer to "Notes on Operation" overleaf.



Dimensions shown are in millimetres (max.)

*Vertically base up or horizontally preferred.

†A minimum peak current of 5 amps. is recommended. This ensures the formation of an arc discharge with an anode-cathode volt drop of approx. 20 volts. If the peak current is less than 5 amps. a glow discharge is likely to form with a volt drop of 70 volts which may result in permanent damage to the valve.

††tr_1 negative with respect to tr_2. The limits quoted refer to operation with a trigger voltage having a low rate of change. For pulse operation a higher trigger voltage is generally necessary.

‡At instant of triggering.

§V_{tr_1} negative with respect to cathode.

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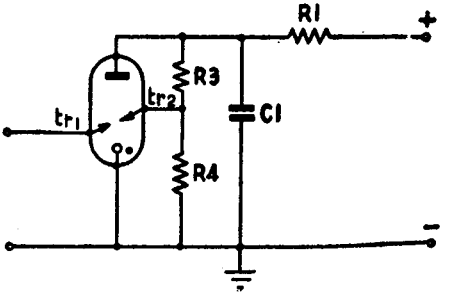
NOTES ON OPERATION.

The basic circuit for the operation of this valve is shown below. A capacitor C1 is connected across anode and cathode and charged through a series resistance R1. If a sufficient voltage is now applied between electrodes tr_1 and tr_2 to initiate a glow discharge, this will cause breakdown of the main anode to cathode gap. The capacitor C1 discharges within a few microseconds, and the valve emits a bright flash of light of similar duration.



The recommended triggering method is to apply a positive voltage from the potentiometer R3–R4 to tr_2, and a negative pulse to tr_1, the flashing frequency being controlled by the pulses on tr_1.

A suitable triggering pulse for tr_1 may be derived by differentiating a square pulse to give a pulse of 150 volts or higher, with a width of approximately 30–100 microseconds at half amplitude. Alternatively, square pulses of approximately 200 volts, with widths of 20–400 microseconds may be used.

The duration of the pulse must be limited to the time required for the anode discharge capacitor to recharge to about 80 volts as, during de-ionization time, pulses of greater length are liable to cause a glow discharge in the main gap with consequent serious deterioration of the cathode, or to initiate a second discharge when the anode reaches 80 volts. This discharge may in turn initiate a series of uncontrolled flashes quite independent of the trigger pulse and at a higher repetition rate.

(A glow discharge is characterised by a more diffused appearance and is of a less intense colour than the required arc discharge.)

For short pulses, higher values of initiating currents are required than those quoted in the specification.

For maximum light output, the time constant of the discharge capacitor and its charging resistance must be such as to ensure a nearly complete recharge between flashes. This requires that the time constant is not greater than about one third of the flash interval (for a 96% recharge). At higher frequencies it may not be possible to ensure such a complete recharge as, if the charging rate is faster than the valve recovery rate, a spurious discharge will occur as indicated above.

Suitable values of discharge capacitor and charging resistance are given under "Typical Operation" overleaf.

The mean anode current may be calculated as follows :—

$$I_a \text{ (mean)} = \frac{CVf}{1000} \text{ mA.}$$

where C = discharge capacitor in μF.

V = voltage on discharge capacitor at instant of triggering.

f = flash frequency per second.

In equipments which operate over a wide frequency band, the whole range of frequency is preferably covered in steps by switching different capacitor values in accordance with the recommendations regarding charging time.

The circuit resistance connected between cathode and tr_1 and cathode and tr_2 must have a value of at least 1000 ohms.