JOINT SERVICE SPECIFICATION K1001

APPENDIX V

THE MEASUREMENT OF THERMIONIC EMISSION

1. GENERAL

1.1. The emission from the cathode, when specified, may be measured by one of the methods described in the following paragraphs.

1.2. In general, it is not possible to measure the emission by drawing the current continuously from the cathode, as the cathode temperature may be disturbed or the valve itself damaged through overheating the emission collecting electrodes. Therefore the collecting voltage will be applied periodically at such a rate and with a sufficiently brief duration of the actual application of voltage that appreciable temperature changes in the valve during measurement are avoided. Two alternative methods are outlined in this appendix and the particular method to be applied will be indicated in the individual valve specification.

1.3. The important circuit parameters in emission testing are the value of collecting voltage and the cathode temperature. The latter is governed largely by heater power which must therefore be adjusted with special care. Test values of heater voltage and collecting voltage will be specified in individual specifications.

2. METHOD I

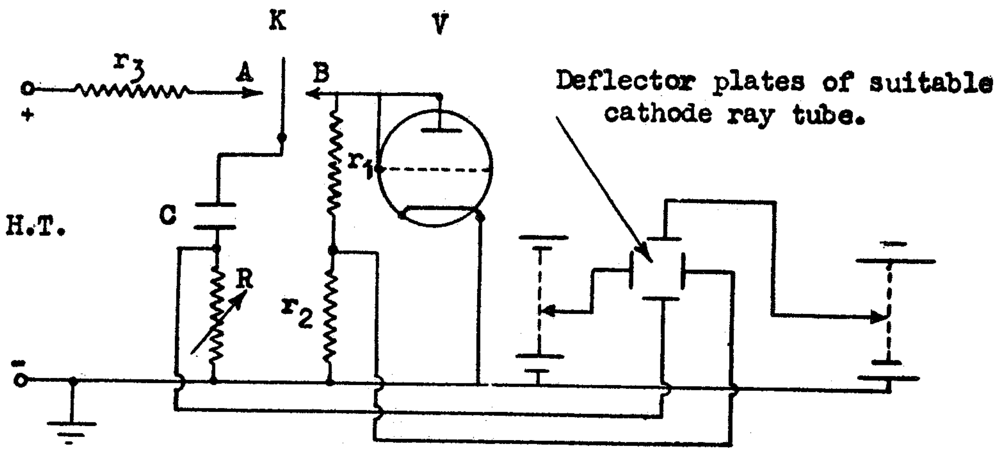

Fig. 1.

2.1. The circuit for this method of test is shown in Fig. 1. C is a capacitor of suitable value and capable of withstanding the voltages V_0 which are to be applied across the valve V under test. The cathode ray tube has its final anode at earth potential. "Shift" circuits may be used as shown to move the zero position of the spot to any desired position on the screen of the C.R.T. R is a non-inductive variable resistor of known value; r_1 r_2 is a non-inductive potentiometer of known resistance values. Resistor "r_3" is a current limiting resistor of suitable value.

2.2. Methods of operation

The capacitor C is charged to the potential V_0 of the H.T. supply by means of the key or contactor K connecting to terminal A. "C" is then discharged through valve V by moving K to position B. Voltages proportional to the collecting voltage V_a and the corresponding space current I_a appear simultaneously across the pairs of deflecting plates. As the capacitor progressively discharges, these voltages decrease and a characteristic curve of I_a versus V_a is traced on the C.R. Tube screen.

The deflecting voltages are

$$V_x = \frac{r_2}{r_1 + r_2} \times V_a; \quad V_y = I_a R$$

The ratio $\frac{r_2}{r_1 + r_2}$ and the resistance R are adjusted to obtain suitable scales for the X and Y deflection so that the form of the I_a, V_a curve gives a clear indication of the emission performance of the valve.

2.3. Calibration

By providing D.C. voltmeters across the shift voltages it is possible to calibrate the deflection directly in the following manner.

The shift voltages are adjusted so that the spot is returned to the arbitrary zero position from its position of maximum deflection during the test. The change in the shift voltages will then measure the maximum collecting voltage and current on arbitrary but easily determined scales dependent only on $r_1 r_2$ and R respectively.

In many cases, it may be sufficient to assume a linear relation between deflections and applied voltages and to provide scales on the tube face, or on a visor, calibrated in collector voltage and emission current.

3. METHOD II

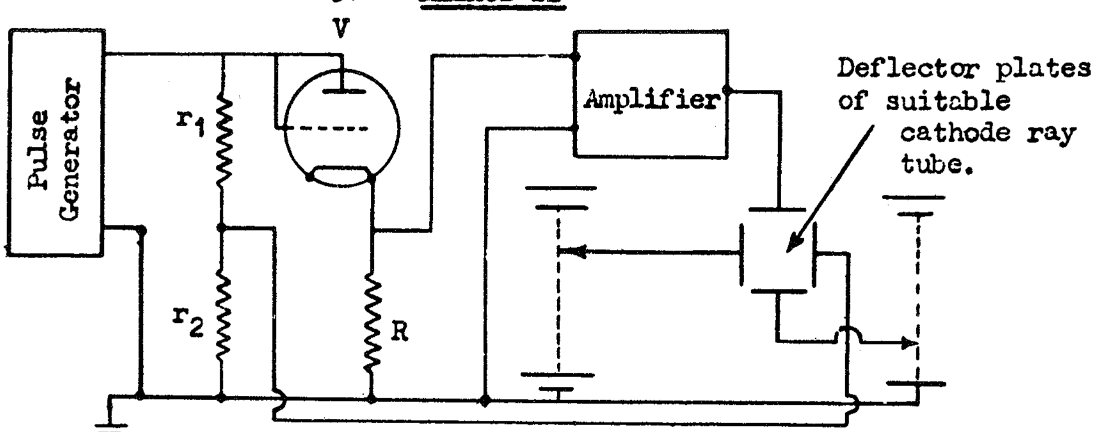

Fig.2.

4.3. Checking the apparatus

The following test should be carried out to ensure that the resistances and capacitances of the deflecting circuit components are not so excessive as to produce appreciable disturbances of the valve characteristics and to ensure that the calibrations are correct.

Substitute a non-inductive resistor of known value R_V chosen to give a curve of comparable size to that of the valve under test. With this resistor substituted, the trace on the screen should be a straight line free of appreciable looping and of slope $\frac{Ia}{Va} = \frac{1}{R_V}$ when the co-ordinates of the trace have been translated into the corresponding current I_a and Voltage V_a

3.1. The circuit for this method is indicated in Fig. 2. In principle the circuit conditions are identical with those of Method 1 but the contactor K of Fig. 1 is replaced by an impulse generator of suitable type, and an amplifier is interposed in the Y or current deflection circuit.

3.2. "Duty" Cycle

The duty cycle of the applied pulse, which is chosen to avoid damage to the valve or appreciable disturbance of the cathode temperature, shall be as detailed below.

3.3. Pulse Form.

The pulse shape shall be substantially half sine wave in character unless otherwise specified.

3.4. Pulse Length

The pulse length shall be approximately 2 μ secs. unless otherwise specified.

3.5. Repetition Frequency

A frequency of 500 pulses per second shall be used unless otherwise specified.

3.6. Limitation of Resistor R

The value of resistor R shall be limited so that the voltage appearing across R shall be not greater than 1% of the voltage across the potential divider resistors r_1, r_2.

4. Procedure of Testing to be applied to both methods of Test

4.1. Filament or Heater Voltage

The filament or heater voltage shall be the specified nominal value within the limits + 0%, -2%.

4.2. Application of "Collecting" Voltage

The full specified limiting voltage may be applied immediately to the valve or the applied voltage may be increased gradually and observations continued until either the specified current is obtained or the specified limiting voltage is reached.