Cold-cathode-tube test set

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Switching Development

In the panel and crossbar dial systems, many timed periods are required to permit certain circuit operations to be carried out, and to give an alarm if these operations are not completed by the end of the period. In the past, these time intervals have been provided by power-driven, cam-actuated interrupters. With the introduction of the No. 5 crossbar system, however, the power-driven interrupters were replaced by circuits employing cold-cathode tubes. Time delays are obtained by utilizing the time required to charge a capacitor in series with a high resistance. The potential on the capacitor is applied to the control anode of the tube, and when this potential builds up to a value sufficient to cause the tube to ionize, a relay in the tube circuit operates.

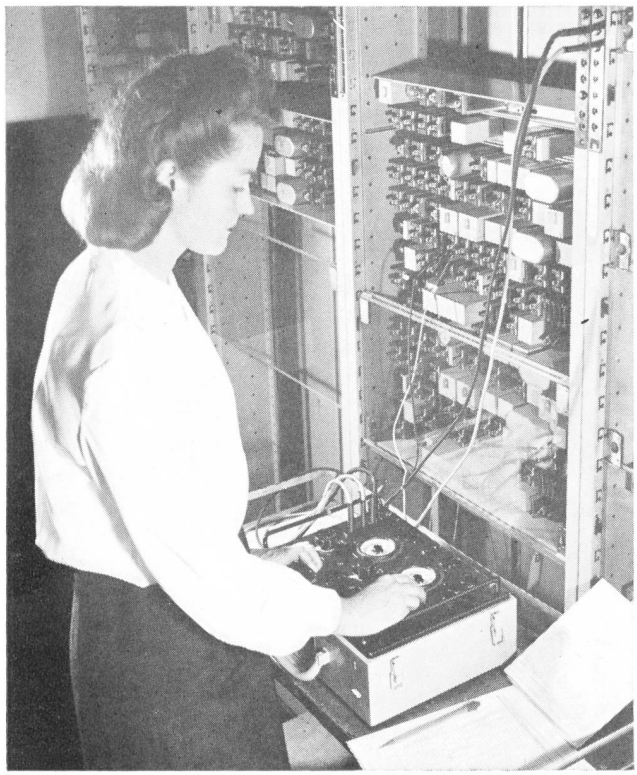

Fig. 1—Cold-cathode-tube test set in use in the Systems laboratory

The voltage at which individual cold-cathode tubes will ionize and conduct current varies considerably, resulting in corresponding variations in the time delay obtained with different tubes. To prevent excessive time variations that would result from the use of tubes with ionization voltages greater or less than the specified tolerances, a test set has been developed for checking these tubes. The principal equipment of the test set consists of a voltmeter, a milliammeter, potentiometers, keys, and sockets for mounting the various types of tubes to be tested, all of which are encased in a standard metal test set box as shown in Figures 1 and 5. Jacks provide access for testing wired-in tubes and for connecting to the necessary testing battery by patching to frame jacks furnishing the required −48 and +130-volt potentials. Binding posts are provided for making direct connections to tubes with lead-in wires.

Most of the testing connections are set up by operating either of two keys to one or the other of two positions. The SG key is used for testing the starter gap, and the AG key for the main anode gap. With triodes, tests may be made on the starter and anode gap successively, but for diodes only the AG key is used. Each of these keys has an ionization test position marked ION, and voltage drop test position marked DROP. Figure 2 shows the circuit established for testing the starter gap. The only change made by moving the SG key from the ION to the DROP position is to change the voltmeter connections so as to read the potential across the starter gap rather than that from the starter anode to ground.

With the SG key in the ION position, the SG-V potentiometer is turned until the tube starts to pass current, which will be indicated by a sudden increase in the reading of the milliammeter. The potential to ground on the starter anode may then be read on the voltmeter after the RLS key has been operated to extinguish the tube and

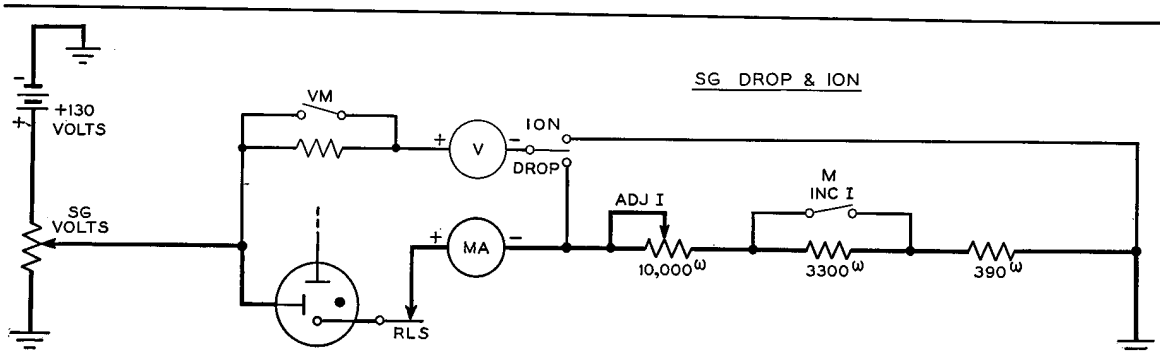

Fig. 2—Test circuit as established for testing the starter gap

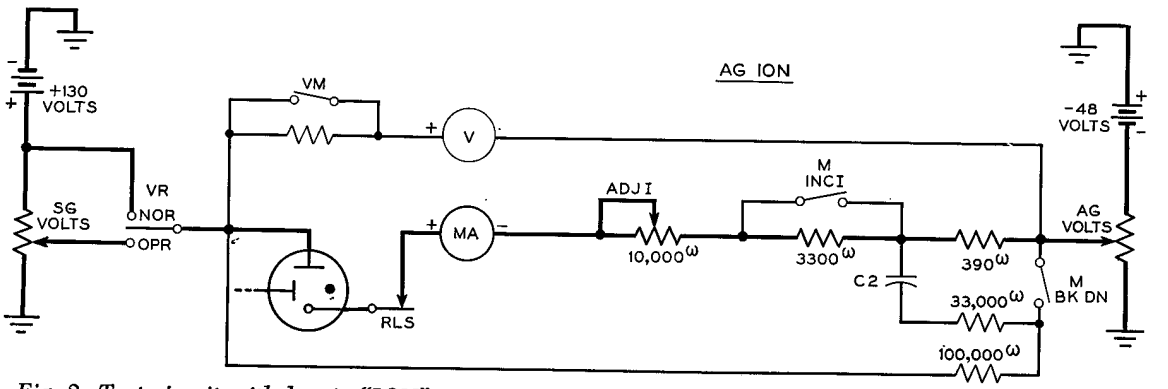

Fig. 3—Test circuit with key in "ION" position

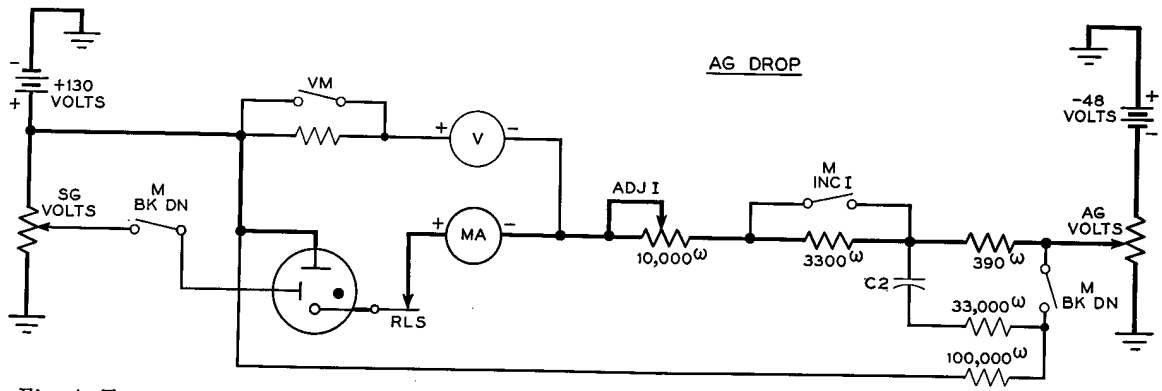

Fig. 4—Test circuit with key in "DROP" position

reduce the current to zero. To measure the drop across the starter gap, the SG key is moved to the DROP position so that the voltmeter is connected directly across the starter gap. In either position, the potential of the starter anode to ground may be adjusted to the desired value. The drop across the starter gap cannot be measured on tubes that are permanently wired in a circuit, since the anode is connected directly to positive battery, and the anode current would prevent such measurements.

Current through the tube for the starter and anode drop tests may be adjusted by the ADJ-I potentiometer. When more current is required than may be obtained with this potentiometer, the M key may be moved to the INC-I position, thus shorting out a 3,300-ohm resistor in the cathode circuit. There are thus two ranges over which the current may be adjusted, and over both ranges the ADJ-I potentiometer is used to obtain the

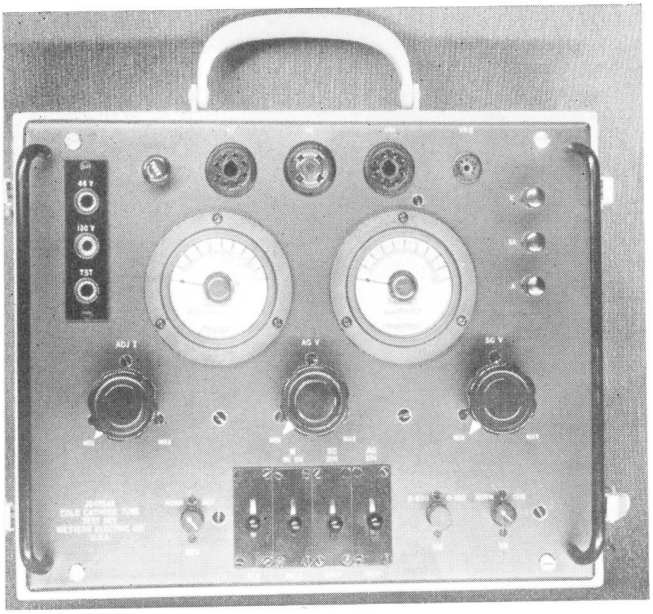

Fig. 5—Front view of cold-cathode-tube test set

exact current required. The voltmeter also has two ranges: 100 and 200 volts. Normally, the 200-volt range is connected in, but by operating the VM key, a resistor in series with the voltmeter is shorted out to give the 100-volt range.

When the AG key is operated to the ION position, the circuit is as shown in Figure 3. Normally, the anode is connected directly to the +130-volt battery, and the cathode —through the milliammeter and the cathode resistor—is carried by way of the AG-V potentiometer to the —48-volt battery. This latter potentiometer will be adjusted to the non-ionizing potential across the anode gap, and the tube should not ionize, since this is a non-operating test on the tube. For testing voltage-regulator tubes, the VR key may be operated, which changes the connection of the anode from the 130-volt battery to the SG-V potentiometer, and thus gives wide control over the anode potential. On these tubes, the potential should be adjusted to the point where the tube ionizes.

When the AG key is moved to the DROP position, the circuit is as shown in Figure 4. This is similar to Figure 3, except that the voltmeter is connected directly across the anode gap, and the anode is always connected directly to the +130-volt battery. Operation of the M key to the BK-DN position, however, will connect the SG-V potentiometer directly to the starter anode, and thus ionize the tube when the potential across the anode gap is not sufficient.

This M key closes a second contact in the BK-DN position that gives a transient voltage to start ionization. This key is used only on VR two-element tubes to insure a potential across the anode gap high enough to ionize the tube. The arrangement is shown in both Figures 3 and 4. With the M key normal, the C2 capacitor is charged to +130 volts through a large resistor. When the M key is moved to the BK-DN position, this capacitor is suddenly discharged and thus momentarily increases the voltage across the anode and cathode gaps and causes the tube to ionize. When the key is restored to normal, the capacitor will slowly recharge through the 100,000-ohm resistor.

These various keys and controls are evident in Figure 5, which shows the front of the test set. Across the top are four receptacles for various types of tubes, while at the upper right are binding posts for connecting to tubes with lead-in wires. At the upper left are jacks for battery connections and also a test jack for connection to wired-in tubes.

In a line directly beneath the two indicating meters are the three potentiometers already referred to. Beneath the central potentiometer are four keys: the AG, SG, M, and RLS keys, reading from right to left. The latter key opens the cathode circuit and thus de-ionizes the tube preparatory to making a new test and also permits reading ionizing voltages. The VR and VM keys are at the right of this group, while at the left is a reverse key that reverses the connections to the cathode and starter anode for testing bi-directional three-element tubes.

As used in the new No. 5 crossbar offices, the set may be kept at some convenient location and tubes carried to it for testing, or the set may be carried to the frames where the tubes are located when tests are to be made on tubes that are permanently wired into the circuit. Figure 1, on page 481, shows a test of this latter type being made in the No. 5 crossbar laboratory. Complete with cords, the set weighs only twelve pounds and thus is readily carried about a central office as needed.